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SECOND GENERATION INNOVATION AND ACADEMIC RESEARCH PRODUCTIVITY IN SOUTH AFRICAN UNIVERSITIES

BY
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A Master's dissertation submitted to the Faculty of Commerce, Law and Management, University of Witwatersrand, Johannesburg in fulfilment of the requirements of the degree of Masters in Management

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ABSTRACT

It has been suggested that a global 'Second Generation' of innovation (SGI) is required in order to address the deficiencies of contemporary innovation practice. In the commercial context, contemporary innovation practice is often constrained by market forces and the profit mechanism, effectively resulting in stagnation in the innovation pipeline. As a consequence, many potentially profitable and beneficial innovations are not pursued. SGI is a proposed new paradigm that makes use of open innovation, open source and crowdsourcing in order to extricate the full potential of distributed knowledge systems to ultimately ameliorate the free flow of knowledge and innovation. Much of SGI theory relates to pharmaceutical research but there exists a paucity of literature that applies SGI theory in the academic research context, where similar problems exist. It has been purported that academic research is inherently non-innovative and the occurrence of 'academic failure', or the inability of academia to produce innovative research output is a serious concern. In order to examine the relationship between SGI and academic research, a mixed methodology approach, which incorporated both quantitative and qualitative research methodologies has been used. First, a model of relationships between important theoretical concepts was derived from the literature. Next, a questionnaire survey was distributed to a sample of 529 academic researchers across South African universities and research institutions in order to gauge potential 'SGI Propensity' in relation to academic research output (or productivity) along with all other relevant variables in the literature-derived model. It is argued that the relationship between SGI Propensity and academic research productivity can provide a clear indication of the potential of SGI in the South African academic context. Aggregated data collected from this sample was then tested using a variety of statistical tests, including correlation analysis, hierarchical multiple regression, as well as tests of moderation and mediation. Additionally, a sample of 30 high-ranking South African academic researchers was also sampled for a parallel qualitative study, which occurred through a one-on-one interview process. Results from both studies were recorded, analysed and contrasted. Thereafter, conclusions were drawn and recommendations made.

DECLARATION

I hereby declare this research report is my own, unaided work. It is being submitted in fulfillment of the requirements for the degree of Masters in Management at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree of examination in any other university.

_____

ASAF RUBIN

Signed on this the _____ day of _____, 2016

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LIST OF ACRONYMS

ARP Academic Research Productivity. ARP is a measure of research output for academic researchers.

HCI Human Capital Investments. HCI refers to intangible individual-level investments (such as education, training and experience).

NEO-FFI Neuroticism-Extraversion-Openness Five Factor Inventory. A 5-point Likert scale used to measure personality, based on the 'big five' theory of personality (Costa & McCrae, 1989). A shortened version of the NEO-FFI is used in this research.

NRF National Research Foundation. A South African ratings and funding agency that provides ratings for South African academic researchers

SGI Second Generation Innovation. SGI is a proposed new paradigm of knowledge, finance and innovation management, first suggested by Callaghan (2014a)

WEIMS Work Extrinsic-Intrinsic Motivation Scale. A 5-point Likert scale used to measure work level motivation, based on Self-Determination theory and developed by Tremblay, Blanchard, Taylor and Pelletier (2009).

ALPHA INDEX TABLE

Academic Research Productivity
A measure of performance or productivity of academic researchers, measured by aggregate totals of both locally accredited and internationally accredited journal article publications and used in this study as an indication of individual-level output.

Human Capital Investment (HCI)
A measurement of individual level intangible investments in the form education, training and experience, proposed by Becker (1962) and which should result in a return on investment, over time.

Motivation
A psychological measure which is determined in this study through the use of the WEIMS scale, developed by Tremblay, Blanchard, Taylor and Pelletier (2009). The WEIMS scale is based on self-determination theory (Ryan & Deci, 2000), which is an important component of motivation in psychology.

The NRF
A South African ratings and funding intermediary agency (NRF, 2015). The NRF also provides ratings for South African academic researchers based on productivity, or research output.

Personality
A psychological measure which is determined in this study through the use of a personality assessment in the form of a reduced version of the NEO-FFI scale, developed by Costa and McCrae (1989). Personality considers individual-level differences in traits such agreeableness, extraversion, neuroticism, conscientiousness and openness to experience.

Second Generation Innovation (SGI)
Second Generation (SGI) is a proposed new paradigm of innovation, finance and knowledge management (Callaghan, 2014a). In contrast to contemporary, or 'First Generation' Innovation, SGI makes use of a probabilistic mechanism in order to exploit distributed knowledge systems to allow for exponential knowledge creation and innovation. Callaghan (2014a) suggests the use of crowdsourcing – or, generating input from a widely distributed network of potential labourers in the form of an open call (Howe, 2006) – as a means of activating this probabilistic mechanism.

SGI Propensity
The proclivity of an individual to engage in processes commonly associated with SGI such as crowdsourcing, crowdfunding and open source production in order to improve their productivity or performance. SGI propensity also measures beliefs pertaining to 'First Generation' (or, contemporary) systems and processes.

South African Universities
Defined as any university or institution of higher learning located within the boarders of the Republic of South Africa and that employs academic researchers.

CHAPTER 1

INTRODUCTION

1.1. Introduction

The following chapter provides an overview of the structure of this study. A brief background pertaining to the theoretical tenets that form the foundation of this study are introduced and discussed. Thereafter, the significance of this study in the context of academic research is explored, as are the aims and objectives. Research questions and hypotheses are introduced, as is the theoretical model containing the variable relationships under study. A brief outline of all subsequent chapters is also provided.

1.2. Background to the Study

"The virtual environment has expanded the reach of science to include interested parties of all skills and knowledge levels. No longer is science the domain of experts. It is increasingly recognised that harnessing large virtual networks of human intelligence and manpower can facilitate science, from funding through to execution" (Torr-Brown, 2013: 13).

Despite the primary function of academic research being the production of knowledge and innovation, the term 'academic failure' has been used to describe the market failure of academia to innovate and create new knowledge (Dewald, Thursby & Anderson 1986; Camparino, 2009; Welsh, 2013).

This 'failure of innovation' cannot be attributed to academia alone. It has been purported that the global innovation pipeline has become stagnant (Callaghan, 2014a, McKenna, 2014). The origin of this failure of innovation has been identified as a market failure, or the failure of profit-seeking models of innovation to provide innovation that is socially beneficial (Martin & Scott, 2000).

As such, there exists a stalemate effect in the interaction between innovation, knowledge and business, or profit-seeking incentives in the global economy (Rubin, 2014). This introduces a fundamental tension; despite recent radical advancement in communication technology (Aadir & Vohra, 2003; Metz, 2015), which should allow for exponential increases in innovation, innovation is instead often constrained by profitability models (McKenna, 2014; Callaghan, 2014a).

In the global context, "knowledge has replaced the traditional assets of land capital, labour and entrepreneurship," as a vital component of competitive advantage (Huang, 2009: 1). Thus, in a commercial sense, knowledge can be viewed as a business product – one that can be invested for a high-value return (Powell & Snellman, 2014). Becker (1962) introduces the notion of 'human capital investments' as individual-level intangible investments such as experience, education, or training to reflect the view of knowledge as an asset, which expects a return on investment (de la Fuente, 2011). Drucker's (1994) knowledge economy predicts a business environment in which knowledge is a third factor of production, in addition to capital and labour. The existence of organisations can be attributed to their efficiency in integrating knowledge (Grant, 1996) and the successful application of scientifc management to the knowledge economy results in innovation (Soumitra, 2012). Schumpeter (1942) refers to innovation as the catalyst for business growth and knowledge as the business input that drives innovation.

The implications for innovation and hence, for business are clear. Now more than ever, the digital industry has resulted in a knowledge-based society (Drucker, 1994; Metz, 2015), feeding into a high-technology global economy that has drastically improved the efficiency and effectiveness of both the manufacturing and service sectors, through focus on personal needs and significant decreases in resource costs (Humbert, 2007). However, despite the exponential global growth of knowledge and its availability, innovation failure still occurs (Callaghan, 2014a; McKenna, 2014).

A thorough examination of the literature pertaining to knowledge management reveals the reasons as to why innovation failure has occurred. Knowledge is decentralised by nature (Hayek, 1945), it is 'sticky', that is, difficult to transfer from where it originated (von Hippel, 1994) and it is tacit (Nonaka, 1994). It is difficult to separate tacit knowledge from the individual (Polanyi, 1963). These constraints form a threshold to knowledge creation, knowledge transfer and ultimately innovation (Callaghan, 2014a).

In order to solve this dilemma, Callaghan (2014a) suggests a 'Second Generation' of innovation, R&D and problem solving to overcome the deficiencies of contemporary (or 'First Generation) innovation and R&D, which is constrained by its very nature. This proposed new paradigm of problem solving is referred to in this paper by the umbrella term 'Second Generation Innovation' (SGI) and is contrasted to contemporary R&D and innovation practice, termed First Generation Innovation (FGI). At its core, SGI builds on the notion of Chesbrough's (2003a) Open Innovation paradigm and also incorporates the use of open source methodologies, "the wisdom of the crowd" (Surowiecki, 2004:1) or 'crowdsourcing' and distributed knowledge systems, in order to overcome the threshold constraints inherent to FGI. SGI has potential applications in a vast array of scientific, academic and commercial fields, particularly in pharmaceutical research (Callaghan, 2014a). Academia has long been perceived as "breeding ground for innovation" (Debackere, 2000: 323); the aggregation and interaction of diverse knowledge inputs is considered a prerequisite for the innovation (Wang, 2013). As such, this research will investigate the potential of SGI in the sphere of academic research in South African universities.

The work of von Hippel (1976) identifies users as an important source of innovation, not only in idea generation but also in subsequent development (Smith, 2010). More recently, von Hippel (2005) has referred to the 'democratisation of innovation' as user involvement in development has increased, particularly in the fields of software development (Lakhani & Panetta, 2007). The success of Linux and other similar open source software development has demonstrated the effectiveness of such methods (Brabham, 2008). Linux has been described as "as good as, if not better than its for-sale counterparts" (Wheeler, 2005: 176)

SGI theory predicts that the implementation of SGI practices and processes in pharmaceutical R&D may result in an expedited rate of innovation by overcoming the threshold constraints of FGI. Callaghan's (2014a) proposed SGI paradigm is conceived through the lens of knowledge and innovation management. This dissertation aims to extrapolate SGI theory in order to gauge its potentiality in the academic research context, by assessing SGI's ability to attain Accelerated Radical Innovation (ARI) (Dismukes, 2004) in different fields of study.

From a sociological perspective, the emergence of the 'Open Culture' Movement, which has become most prevalent in the current decade (Reed, Storrud-Barnes and, Jessup, 2012, Boynton, 2004), has precipitated an environment in which the Internet has become the primary transmission mechanism for the flow of knowledge, ideas, data and information (Smith, 2010). Popular websites such as Google, Wikipedia, Facebook, Twitter and YouTube have been built on the premise of openness, allowing users to dictate content and to contribute in a free and open manner (Swan, 2012). This can be seen as an extension of von Hippel's (1976) theory pertaining to users as an important source of innovation, which has contribution to the dissolution of societal and geographical boundaries (Chesbrough, 2007). The free flow of knowledge, ideas and information, which can permeate through organisational boundaries allows for a potentially infinite range of innovation potential (Hagel & Brown, 2011; Callaghan, 2014a). Problems once considered insoluble can now be solved in real time (Callaghan, 2014a).

The focus of this dissertation is the output of academic researchers in relation to an SGI Propensity, or a willingness to engage in open or crowd-based research methodologies. In the context of academic research, Kuhn (1970) suggests that 'best practice' may cause resistance to the incorporation of innovative practices. Kuhn's (1970) suggestion has been consistently echoed by others over the course of the history of academia. More recently, Changizi (2012) and Welsh (2013) have made reference to the "inhospitable nature [of academia] to big discoveries" (Changizi, 2012:1). As a result, academic research may be inherently non-innovative (Camparino, 2009). It is possible that this 'non-innovativeness' is still a prevalent feature of modern-day academia. However, in considering the individual-level absorptive capacity of academic researchers, a tension emerges. Absorptive capacity is defined as the ability to integrate and make use of new knowledge as a function of previous existing knowledge (Cohen & Levinthal, 1990). By this definition, experienced academic researchers should be more inclined to engage in SGI practices and thus have a higher SGI propensity, which should theoretically result in a higher level of research productivity, as per the assertions of Becker (1962). This research aims to delineate the extent of this proposed relationship.

Becker (1962) suggests that the primary driver of performance, or productivity is human capital investments (HCI). HCI can be defined as intangible individual-level investments such as education, training and experience that subsequently result in a 'return on investment', in the form of improved performance or productivity. This theory bears important consequences for academic researchers, since as per Becker's (1962) assertion, researchers' performance or productivity will be significantly associated with levels of experience, training and education, which are all factors of human capital investment. In the university environment, academic researchers become conditioned over time through repeated experience, or learning (Redding, 1996). However, if academic research is inherently non-innovative (Camparino, 2009), it may be possible that the experience of an academic researcher in a university may also be non-innovative, as this effect becomes transposed onto the individual (de la Fuente, 2011). Over time, academic researchers' level of innovativeness may be decreasing as a result of academic and innovation failure. As a result, academic researchers' SGI Propensity may actually be decreasing over time.

Consideration of the implications low levels of SGI Propensity, or low levels of innovativeness in the academic research context must be considered (Rubin, 2014). In an academic environment in which innovation is constrained, the risk of inferior problem solutions is imminent, as is the resource cost of such (Callaghan, 2014c). Close ties exist between academic research and the private sector (Wang & Wang, 2012) and the state of private R&D innovation is often mirrored in its academic counterpart (Perkmann & Walsh, 2007). It is suggested that both commercial and academic innovation pipelines exist parallel to each other and are constrained by similar factors.

Convergence theory (Kuhn, 1970) predicts that over time, practices and values will converge, or more specifically – will become the same across different contexts (Kerr, Harbison, Dunlop and Myers 1960). This has seemed to be the case in innovation. Globalisation and the 'McDonaldisation' of the world (Ritzer, 1993) have resulted in a homogenisation of global cultures (Pieterse, 2009). Despite an abundance of 'free-for-all' knowledge available, global uniformity has resulted in an emphasis on organisational profitability through convergence, or sticking to the 'tried and tested' (Callaghan, 2014a; Martin & Scott, 2000). It has been suggested that the innovation pipelines have become congested with product, service and process innovations that do not address pressing social concerns such as hunger, poverty and disease (McKenna, 2014). Rather, the innovation pipeline has become shaped to contribute to the sales of non-essential commodities (Callaghan, 2014a). It is also possible that radical innovations that may provide for greater organisational profitability in the long run (Henderson & Clark, 1990), are not pursued because they are too high risk (Martin & Scott, 2000). Similar challenges face academic research (Perkmann & Walsh, 2007). In academia, the importance of paradigmatic constancy (Kuhn, 1970) is inherently antithetical to the requirements of innovation and SGI (Callaghan, 2014b). It is argued that this model is not sustainable and hence the SGI paradigm may be an important future aspect of academic research. It is argued that it is important to consider the existing potentialities in the academic context and the possibility of improving academic research productivity with the use of SGI techniques.

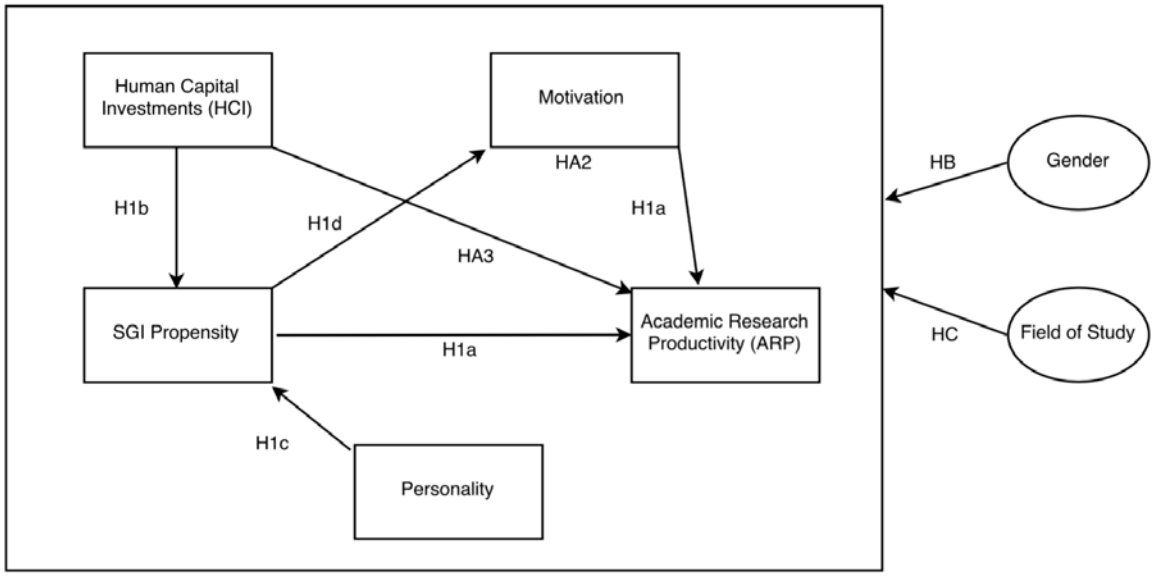
It is also important to note that the focus of this study will be the application of SGI and SGI-based processes in the academic research context in South Africa. It is suggested in this study that the logic that governs SGI-theory can be extended to the academic context. Historically, academia has been referred to as non-innovative (Kuhn, 1970; Lindquist, 1975). Often academic innovation may be stifled due to reliance on paradigms (Kuhn, 1970) and sticking to the 'tried and tested (Callaghan, 2014a; Camparino, 2009). More recently, it has been argued that academia is inherently non innovative and resistant to discovery (Welsh, 2013; Changzidi, 2012). It is suggested that the implementation of SGI-based practices (such as the use of crowdsourcing and open source production) to help conduct academic research, may potentially counteract this stagnation of academic innovation (Callaghan, 2014a). However, if academia is inherently resistant to change (Lindquist, 1975; Camparino, 2009), it follows that academics may be resistant to incorporating these new and untested techniques, due to the effects of transposed non-innovativeness (Becker, 1962). In this study, 'innovation' refers to new, novel, inventive and ground-breaking output, or academic research that challenges standards and norms (Smith, 2010;

Callaghan, 2014a) and that could potentially provide solutions to some of society's most pressing problems (Callaghan, 2014a).

1.3. Theoretical Model

The relationships between the variables under study are now presented below in diagrammatic form in the theoretical model of the study.

Figure 1: Theoretical model depicting relationships between variables



1.4. Rationale for Inclusion of Variables

The inclusion of the variables SGI Propensity and Academic Research Productivity (or, ARP) have been justified in the above discussion. It is acknowledged that this research is aimed at unveiling individual-level behavioural patterns. More specifically, this research seeks to uncover the behaviours associated with academic researchers in South African universities within the context of their research output and SGI propensity. Since this pertains to an individual-level analysis, it was deemed appropriate that individual-level behavioural measurements are included in the analysis.

SGI theory builds on the theory of open innovation (Chesbrough, 2003a), which relates to the organisational level. It is suggested that at the individual level, 'openness', as an individual trait can be seen a precursor to an open orientation that could potentially drive SGI propensity. Openness as a characteristic of personality is included in Costa and McCrae's (1989) Five Factor Model (FFM) of personality. Measuring openness alone however, may not provide a holistic measure of the individual-level relationship between SGI propensity and ARP, since the other factors in the FFM may introduce confounding effects. Furthermore, personality can be considered a measurement that is proximal to the individual (Langston & Sykes, 1997). For these reasons, personality is included in the model as an individual-level measurement.

Motivation, also considered as a measurement that is proximal to the individual (Langston & Sykes, 1997), is imperative in the measurement of ARP. Intrinsic motivation in particular has been found to associate significantly with high levels of performance, or productivity (Grant, 2008; Erez & Judge, 2001). It is predicted that high levels of intrinsic motivation amongst academic researchers will associate with higher levels of ARP.

The variable Human Capital Investments (HCI), as defined by Becker (1962) is included as the exogenous variable in the theoretical model in order to measure intangible individual-level investments, particularly experience in the academic context. It is argued that HCI is a variable that is proximal to the individual and that university context shapes individuals' innovativeness and SGI propensity over time. Hence, by measurement of 'years of experience', as an intangible individual-level investment, HCI can be used to further conceptualise the relationship between SGI propensity and academic research productivity.

The results of the qualitative and quantitative research undertaken in this study indicate that personality, motivation and human capital investments is supported in the study of the relationship between SGI propensity and academic research productivity. Additionally, the variables 'gender' and 'field of study' are included in this study as variables that may have a moderating impact on the main relationships under study. It is well established that optimal innovation occurs at a diverse combination of males and females (Boyd, 2013). However, the interaction effect of gender on the relationship between SGI Propensity and research productivity is poorly understood. This research aims to create an understanding of these interactions. Field of study is also used as a moderating variable in this study and its interactive effect on the relationship between SGI propensity and research productivity is tested. SGI theory predicts that levels of SGI propensity will differ in different fields of expertise (Callaghan, 2014b). This research aims to examine these interaction effects as well.

Both the literature and the results of both the qualitative and quantitative research have provided justification for the inclusion of the seven key variables under study. These variables include: Human Capital Investments (HCI), SGI propensity, ARP, Personality, Motivation, Gender and Field of Study.

1.5. Aims and Objectives

The primary aim, or practical outcome of this study is to examine the relationship between academic researcher's propensity to engage in SGI-based practices and their research productivity (or output). The objective of this study is to test theory that predicts relationships between academic research productivity and the propensity of academic researchers to engage in SGI-based practices in the innovation process. The research problem, research questions and subsequent derived hypotheses are now introduced.

1.6. Research Problem, Research Questions and Derived Hypotheses

The research problem of this study relates to the lack of knowledge of the effectiveness and potential of implementing SGI and the resultant impacts on research

productivity in the South African academic context. Thus, the purpose of the study is to delineate and examine this relationship.

This research aims to answer the primary research question: *what is the relationship between SGI propensity and academic research productivity (ARP)?*

With the inclusion of other variables in the theoretical model, the overarching research question of this study is: *what is the relationship between SGI propensity and, personality, motivation and academic research performance (ARP)?* From this core research question, the subordinate research questions and hypotheses of this research are as follows:

Research Question A1: What is the relationship between SGI Propensity, HCI, Motivation, Personality and ARP?

- **Hypothesis A1a**: SGI Propensity is significantly associated with ARP
- **Hypothesis A1b**: Human Capital Investments (HCI) are significantly associated with SGI Propensity
- **Hypothesis A1c**: Personality is significantly associated with SGI Propensity
- **Hypothesis A1d**: Motivation is significantly associated with SGI Propensity

Research Question A2: What is the interactive effect of motivation on the relationship between SGI Propensity and ARP?

- **Hypothesis A2a:** Amotivation mediates the relationship between SGI Propensity and ARP
- **Hypothesis A2b:** External Regulation mediates the relationship between SGI Propensity and ARP
- **Hypothesis A2c:** Introjected Regulation mediates the relationship between SGI Propensity and ARP
- **Hypothesis A2d:** Identified Regulation mediates the relationship between SGI Propensity and ARP
- **Hypothesis A2e:** Integrated Regulation mediates the relationship between SGI Propensity and ARP
- **Hypothesis A2f**: Intrinsic Motivation mediates the relationship between SGI Propensity and ARP

Research Question A3: What is the relationship between HCI and ARP?

Hypothesis A3: HCI are significantly associated with ARP

Research Question B: What is the interactive effect of Gender on the relationship between SGI Propensity and ARP?

- **Hypothesis B1**: Gender moderates the relationship between SGI Propensity and ARP
- **Hypothesis B2**: Gender moderates the relationship between HCI and SGI Propensity
- **Hypothesis B3**: Gender moderates the relationship between Personality and SGI Propensity

- **Hypothesis B4**: Gender moderates the relationship between Motivation and SGI Propensity
- **Hypothesis B5**: Gender moderates the relationship between HCI and ARP

Research Question C: What is the interactive effect of Field of Study on the relationship between SGI Propensity and ARP?

- **Hypothesis C1**: Field of Study moderates the relationship between SGI Propensity and ARP
- **Hypothesis C2**: Field of Study moderates the relationship between HCI and SGI Propensity
- **Hypothesis C3**: Field of Study moderates the relationship between Personality and SGI Propensity
- **Hypothesis C4**: Field of Study moderates the relationship between Motivation and SGI Propensity
- **Hypothesis C5**: Field of Study moderates the relationship between HCI and ARP

It is important to note, that these research questions and hypotheses are formally derived from the literature review section. The measurement of these variables also forms the basis of the research hypothesis.

1.7. Background to the Methodological Approach

The purpose of this study is to evaluate the potential of SGI practices that may accelerate the rate at which innovation in the academic research context may occur. A model designed specifically to delineate the relationship between two constructs – SGI Propensity and ARP was used as a baseline to test the potential of and interest in SGI in South African universities. Hence, it was deemed appropriate to employ a mixed methods approach, using both qualitative and quantitative research methods (Creswell, Plano & Clark, 2003).

First, a model of the most important theoretical constructs uncovered in the literature was developed (Figure 1) in order to compose a theoretical framework of relationships between variables. Thereafter, in order to investigate the relationships in the theoretical model, both qualitative and quantitative data was collected and analysed. Quantitative data was collected via the means of a questionnaire, which was administered to approximately 600 active academic researchers from universities across South Africa. Qualitative data was collected with the use of an interview (either face to face or telephonic), which was administered to 30 respondents from universities across South Africa, as per precedent. Both the quantitative and qualitative processes of data collection occurred simultaneously.

Finally, the collected quantitative and qualitative data was used to test the theoretical model derived from the literature. The results of these two studies were used to draw conclusions and make recommendations.

1.8. Chapter Sequence

Each of the subsequent chapters in this study are now briefly described.

1.8.1. Chapter 1: Introduction

Chapter one provides a brief introduction to the key concepts under study in this research. The notion of Second Generation Innovation, as defined by Callaghan (2014a) is discussed, as are the interlinking concepts of 'innovation failure (McKenna, 2014) and 'academic failure' (Dewald, et al., 1986). The significance and the aims and objectives of the study are examined next. Thereafter, the variables included in the theoretical model are justified and a discussion of the research questions and derived hypotheses follows. A diagram of the relationships between the variables under study is provided.

1.8.2. Chapter 2: Literature Review

Chapter two provides a broad review of the pertinent literature relating to the variables under study. In order to provide context to the concept of SGI, an examination of seminal innovation and knowledge management theory is provided. Thereafter, the notion of open innovation is discussed as a precursor to SGI. SGI is discussed in full, with reference to the work of Callaghan (2014a, 2014b, 2014c, 2015a, 2015b).

The concept of the 'probabilistic mechanism' that underlies SGI theory is discussed in terms of processes such as crowdsourcing, crowdfunding and open source production. Next, the characteristics of innovation failure in the context of academia (termed, 'academic failure') are discussed. SGI is then proposed as a potential solution to academic failure.

Thereafter, individual-level variables that are proximal to the individuals under study are examined. This includes a full consideration of personality in terms of the Five Factor Model (Costa & McCrae, 1989) as well as consideration of motivation in terms of self-determination theory related to extrinsic and intrinsic motivational factors (Ryan & Deci, 2000). Additionally, the concept of Human Capital Investments is explored, particularly the importance of education, training and experience in academia. Finally the issue of gender in academia and in innovation is discussed and a conclusion is provided.

1.8.3. Chapter 3: Methodology

Chapter three is concerned with the methodological approach undertaken in this study. A brief overview of the methodology chapter is provided. Thereafter, a discussion pertaining to the paradigmatic location of the research is given. Next, justification for the use of a mixed methodology is stipulated, highlighting the pluralistic nature of the research at hand and the benefits associated with such an approach.

The minutiae of the qualitative research are discussed next. This includes the process of verification, the process of coding and analysis undertaken in this research, and specification of the qualitative sampling process, which made use of the maximum heterogeneity sampling technique. Following this, the details pertaining to the quantitative portion of this research are discussed. This includes the research design and scope of the study as well as details of the population and sample, the confidence

levels used for statistical testing and examination of reliability and validity. A brief explanation of the pilot study follows this.

Subsequently, the methodology chapter provides a detailed description of the instruments used in this research, both the interview schedule and questionnaire. The measures used in the questionnaire are explained. This includes the reduced NEO-FFI scale, which measures personality (Costa & McCrae, 1989) the WEIMS (Work-Intrinsic-Extrinsic Motivation Scale), used to measure work motivation (Tremblay, Blanchard, Taylor & Pelletier, 2009) and the SGI-Propensity scale, which was derived from the literature. The full procedure of data collection and analysis is then discussed.

An explanation of the data analysis in terms of the derived hypotheses is also provided. The univariate, bivariate and multivariate statistical analyses are described in detail, as is the qualitative data analysis process. Ethical considerations and limitations of the research are also included in this chapter.

1.8.4. Chapter 4: Quantitative Results

Chapter four provides discussion of the results of the empirical study and the specific results of the tested hypotheses.

The results of the quantitative portion of the research are presented, without discussion. The results of the univariate descriptive statistics are presented. Thereafter, the results of the bivariate statistics are presented. The results of all statistical tests pertaining to factor analyses, regressions, mediation and moderation are provided. Each hypothesis is discussed, in relation to the results of the statistical analyses.

1.8.5. Chapter 5: Qualitative Results

Chapter four provides discussion of the results of the qualitative study and the specific results of the tested hypotheses.

The results of the qualitative research are examined. Tables that summarise the emergent themes from the qualitative research are provided and discussed at length, in relation to the literature.

1.8.6. Chapter 5: Discussion

Chapter five presents the analysis of research findings, both quantitative and qualitative

Discussion of the quantitative results is presented in conjugation with each of the research questions and hypotheses. The results of the statistical analyses are discussed in relation to the predictions of the literature.

Next, qualitative results are discussed, in relation to each question presented to respondents in the qualitative interviews. These are then linked to the variables under study, firstly to the primary relationship: SGI Propensity and ARP. Thereafter, the results of the qualitative research are related to the other variables under study:

personality, motivation, human capital investments, gender and field of study, respectively.

1.8.7. Chapter 6: Conclusion

Chapter six concludes the research process with a summary of the empirical research results. Potential areas of further study are identified and considered. Conclusions relating to the literature and both the qualitative and quantitative research are provided and a final summation of the research concludes the chapter.

1.9. Conclusion

In this chapter, an introductory summary of this dissertation was provided. The background to the study, theoretical framework, research problem and research questions were presented. A description of the three-pronged dilemma encountered in the current academic research innovation landscape was provided. An introduction of the research problem, the aim of the research, the research objective and the research questions was provided. Hypotheses were formulated and the research process applied in the research was explained. The theoretical model of the interactions between the variables under study was presented and discussed in full. Thereafter, a brief overview of the existing chapters in this study was provided. A thorough review of the literature now follows.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction and Structure of the Literature Review

In this section, literature that relates to Second Generation Innovation (SGI) and its link to performance (in this case, academic researcher productivity or ARP) is reviewed.

The following pertains to an extensive examination of the history and theory that structures the SGI paradigm and the context in which it can be studied, understood and ultimately implemented. This study aims to address the gap in knowledge on SGI practices in the context of academic research. The elements upon which the theoretical model is built are discussed below. A description of knowledge management and innovation management as the theoretical foundation upon which SGI theory is built, is discussed. It is important to bear in mind that this research will relate to the productivity of academic researchers in a university setting. As such, the 'organisation', as presented in the following literature review, is taken to be the university as an institution that generates knowledge. 'Employees' are taken to be academic researchers and innovative output is taken to be academic research output (or knowledge) generated by the 'firm' and its 'employees'. Thereafter, literature related to open innovation is presented, as are the fundamental tenets of SGI theory, as proposed by Callaghan (2014a, 2014b, 2014c, 2015a, 2015b). The SGI mechanisms of crowdsourcing, crowdfunding and open source production are discussed in relation to SGI theory; as are important theoretical concepts including collective intelligence, swarm intelligence and stigmergy.

Following the full examination of theory pertaining to SGI, additional model constructs are discussed. These include the theory pertaining to personality, motivation, human capital investments, gender and field of study, each of which relates to a particular research question posed in this research.

2.2. Antecedent Theory: Innovation and Knowledge Management in the Context of Academia

Management as a scientific discipline has the unique ability to act as an interface between other disciplines. The principles of classic scientific management theory still hold as the adhesive mechanism that contains within it the inherent ability to organise, plan and control processes through precise and rigourous scientific measurement processes (Smith, 2010). In short, management helps to deal with change. The advent of the Information Age and the wave of technological change that followed can be seen as an example of such change. In this case, the management of knowledge and innovation becomes imperative. It is important to bear in mind that the phenomena under study in this research will be considered through the lens of knowledge and innovation management. A brief discussion pertaining to relevant innovation theory, and the differentiation between radical and incremental innovation follows.

2.2.1. Innovation Management Theory in the Context of Academia

The focus of this study is innovation in academic research. Hence, it is important to note that the purpose of the following theoretical discussion is to draw associations between seminal innovation theory and academia. More specifically, to understand how academia functions, in terms of innovation theory. For the purposes of this study,

the academic research paradigm is seen to be a 'technology' that is subject to the scientific principles of innovation theory.

Henderson & Clark's (1990) seminal typology of innovation makes the distinction between incremental and radical innovation, polarised and best interpreted as being opposite extremes.

Radical innovation is defined as the result of a major technological breakthrough, or the application of new technology (Smith, 2010). "Radical innovation establishes a new dominant design, and hence, a new set of core design concepts embodied in components that are linked together, in a new architecture (Henderson & Clark, 1990:17). Radical innovations are generally associated with a high degree of risk and uncertainty (Smith, 2010) but are also relatively rare in occurrence. It is estimated that radical innovations only account for 10 per cent of innovation (Rothwell & Gardiner, 1989a). Because of its close association with technological change, radical innovation is linked closely to the notion of 'disruptive technologies' (Christensen, 1997), which are those technologies associated with significant changes in markets and industries, often resulting in high levels of uncertainty and far-reaching consequences (Smith, 2010).

Radical innovation however, goes hand in hand with incremental innovation, which involves only modest changes to existing designs. More specifically, Christensen (1997) defines incremental innovation as "a change that builds on a firm's expertise in component technology within an established architecture." Incremental innovation makes use of existing technology and knowledge, and the expertise associated with it, favouring those with established knowledge and expertise. Hence, it can be deduced that academic research, may be a fertile breeding ground for incremental innovation, rather than radical innovation.

Both radical and incremental innovations are instrumental in technological change, not only embedded in artifacts such as equipment and machinery, but also in people and organisations (Forbes & Wield, 2002). The cumulative knowledge that takes form in the place of technology, is proprietary and tacit – it resides within the individual and is difficult to move (von Hippel, 1976). Once more, the relation to academic research is clear.

There are several important theoretical notions related to the cyclical nature of innovation that are important precursors to understanding innovation in the context of academic research.

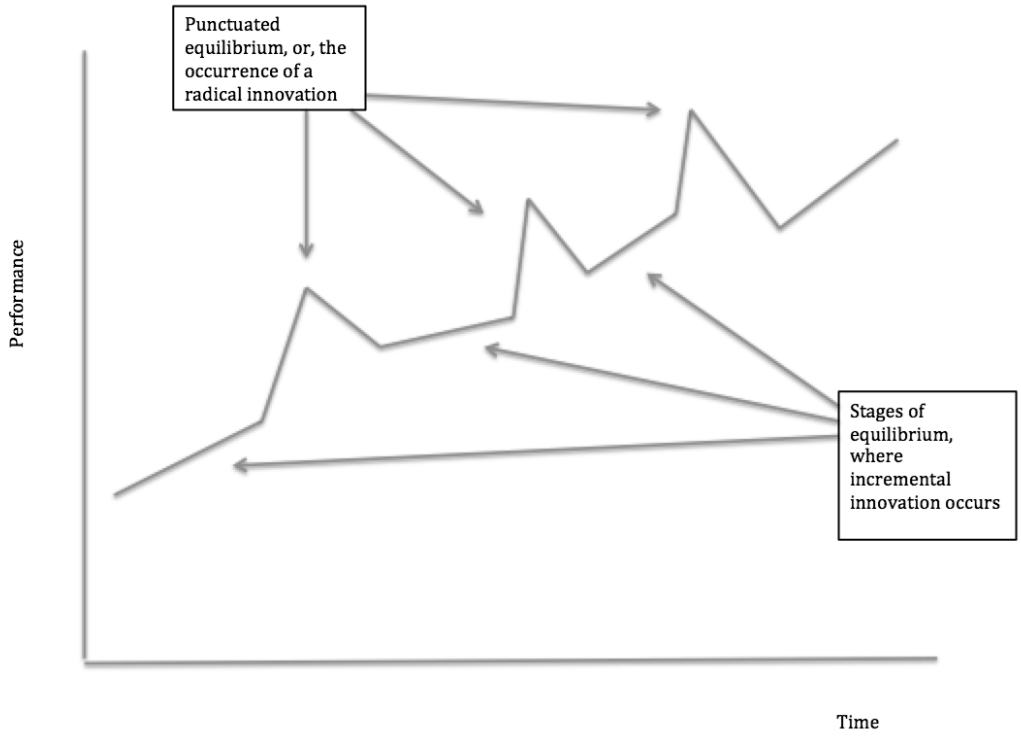
Firstly, Kondratiev (1925) puts forth the notion of the technological long wave cycle, a measure of cyclical technological change representing the application of a new group of technologies over a course of time (Smith, 2010). Each wave of technological change has a profound economic impact. The Industrial Revolution can be seen as an example of a 'Kondratiev Long-Cycle Wave'. At present, Kondratiev's theory points to a fifth technological wave, which involves technology associated with computers, telecommunications and the Internet (commonly referred to as 'The Information Revolution'), one which emerged circa 1980 and is currently in its peak phase of technological convergence (Smith, 2010).

Academia, in particular has felt the full effect of the Information Revolution. Conventional academic practice has long subscribed to orthodox methodologies and methods of experimentation, to the extent that paradigm shifts in academia are often greeted with suspicion and take long periods of time to be integrated. That is not to say that academia's emphasis on orthodoxy is a drawback (academia requires paradigmatic constraints to function effectively). Rather, that academia, by its very nature, must be cautious in the face of change and hence, can be considered in some cases to be non-innovative.

Secondly, the term 'dominant design' is used to describe a configuration that comprises "the one that wins the allegiance of the marketplace" (Nordstrom & Bistrom, 2002: 713). In other words, a dominant design can be seen to be the result of the introduction of a radical innovation. The notion of dominant design can be seen to be analogous to the evolutionary development of science and technology (Teece, 1986). Dosi (1982) puts forth a perspective of technological evolution in the form of a cycle, which is characterised by a series of phases (Anderson & Tushman, 1990). At first, a new technology ushers in an era of 'flux', in which several forms of the technology exist, and configurations are fluid. Thereafter, through a process of variation, selection and retention (Basalla, 1988), a single design form of the technology will emerge as the dominant design that becomes the 'industry standard' (Teece, 1986). This process does indeed occur in academia, as new paradigms of research emerge, although this does occur at a very slow rate and faces a host of challenges. The acceptance of qualitative forms of academic research, which was initially frowned upon can be seen as a prime example. The theory of dominant design demonstrates the importance of the user (i.e. the academic) - who adopts a dominant design for its' usability (Campbell-Kelly, 2004: 253).

Thirdly, Foster (1986) introduces the notion of the technology S-Curve, which posits that over time, the capability of a technology to deliver improved performance will vary until the technology invariably reaches a natural limit. Abernathy and Unterback (1978) describe the process of 'punctuated equilibrium' to describe the manner in which a dominant design (or the introduction of a radical innovation in the form of a major technological breakthrough) essentially 'punctuates' an existing technological equilibrium, collapsing existing stability in order to make room for the new technologies. These punctuations can be seen as discontinuities, which will require new skills, new abilities and new knowledge (Smith, 2010). In essence, they are 'competence destroying' and hence, considered very disruptive (Loch & Huberman, 1999). It is clear that the advent of a technological discontinuity would be disruptive to academia, since the foundation of academia is built on existing knowledge. For this reason, academics may be prone to prefer incremental innovations, rather than radical innovations. Academia's strong emphasis on tradition, as well as the existence of internal political constraints and commitment to outmoded technologies may also hamper the responsiveness of academics to radical innovations (Smith, 2010).

Figure 2: Punctuated Equilibrium (Adapted from Smith, 2010: 77)



These theoretical concepts presented together help to delineate the applicability of innovation theory in academia. Academia however, is built on a foundation of knowledge. A full discussion of relevant knowledge management theory follows.

2.2.2. Knowledge Management Theory in the Context of Academia

Drucker (1987) introduces the notion of a "knowledge based business" and organisations comprised "largely of specialists who direct and discipline their own performance through organised feedback" best seen as "information-based organisations." As previously mentioned, evidence of a shift from classic business practices to one heavily influenced by rapidly changing information technology became apparent at the dawn of The Information Age. Drucker (1987) successfully predicts the advancement of technology necessitating analysis and diagnosis of data, generated before it becomes too large to handle – an issue, which is abundantly evident in the seemingly utopian modern environment of free-for-all information and data quite literally at our fingertips.

The dawn of the Information Age has been mirrored by a parallel shift in economics and business – one in which the productivity of knowledge has become a crucial factor in organisational success (Drucker, 1988). Indeed, this has been seen to be particularly true over the course of the current decade in the global explosion of technological breakthroughs and significant shifts in information communication technology (ICT), which have had a profound impact on business practice worldwide, becoming global platforms for accelerating the flow of information and knowledge (Zelenika & Pearce, 2013). It has been proposed that the modern business environment is built on a foundation of knowledge, commonly referred to as the 'knowledge economy' (Drucker, 1994). As a result, an intensely competitive

environment has materialised; one in which knowledge and innovation has become a prerequisite for organisational survival (Colombelli, Kraft & Quataro, 2014).

The Information Age does not relate strictly to technological innovations such as those mentioned above but also to a changing global cultural perception of the importance of fluid and free information and knowledge for all (Chan, Kirsop and Arunchalam, 2011). This perceptual shift is often referred to as the 'Open Culture Movement' (Boynton, 2004) and has become particularly pertinent in an increasingly globalised world. In essence, open culture can be seen as a result of globalisation, characterised by rapid social change and free-flowing movement of capital, people, knowledge ideas, technology and information across political borders and cultural boundaries (Thompson & McHugh, 2009).

Even prior to the surfacing of open culture, Drucker's (1988) 'New Organisation' predicted the increasing importance of knowledge and specialised 'knowledge workers' in an information-based organisation (Drucker, 1988). At the core of Drucker's prediction lay the claim that "converting data into information requires knowledge and knowledge – by definition – is specialised," (Drucker, 1988: 93). Hence, the 'knowledge worker' – a specialist that directs and disciplines his/her own performance – is introduced. Building on the premise of knowledge as the "fuel for innovation" (Nonaka, 1994), the knowledge worker entity is the human component of organisational capital that holds the potential to provide impetus as "agents for change" – in a word – innovation (Nonaka, 1991)

It is well established that the aggregation and interaction of knowledge, stemming from the human component of the organisation results in continuous and sustainable innovation (Wang & Wang, 2012). However, the existence of impediments to knowledge creation and aggregation can be attributed to three distinct theoretical assertions. Firstly, knowledge is proprietary (firm-specific) (Forbes & Wield, 2002) and is unevenly distributed at the macro level (Hayek, 1945). As such, knowledge can be said to be inherently decentralised. Secondly, knowledge is 'sticky'. It resides within individuals, rather than within the boundaries of the organisations and is very difficult and costly to move from where it originated (von Hippel, 1976). Thirdly and finally, the differentiation between explicit and tacit knowledge is important to consider (Nonaka, 1994). It is very difficult and costly to separate tacit knowledge from the individual (Polanyi, 1963).

The combination of these impediments results in a closed system, in which the rate at which innovation occurs is stifled due to this lack of knowledge (that which exists outside of the organisation) and is very difficult to access (Lakhani & Panetta, 2007). Knowledge, as a resource is decentralised but it is also sometimes contradictory and asymmetric, that is, it is possessed by different people across organisational and geographical boundaries. This presents a severe impediment to problem solving which requires a combination of different specialised knowledge to solve. This is defined as the problem of knowledge aggregation.

Logically, it follows that constraints to knowledge creation and knowledge aggregation will inadvertently lead to constraints in innovation. In response, Chesbrough (2007) introduces the notion of 'open innovation'.

2.3. Fundamentals of Open Innovation

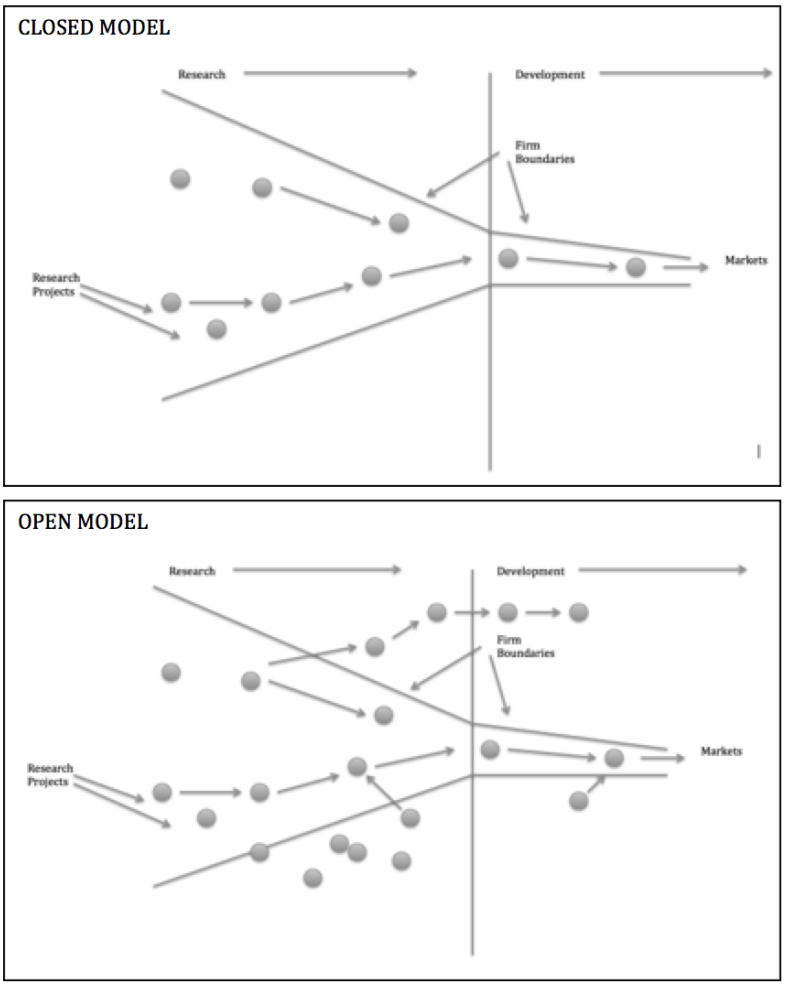
Open innovation, as defined by Chesbrough (2006: 2) is "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation, respectively." Open innovation assumes that a firm can and should use external ideas, as well as internal ideas and internal and external paths to market as they look to advance their technology (Chesbrough, 2003a). Most importantly, the open innovation paradigm assumes that *useful* knowledge is widely distributed and thus, employing an open system of R&D will help to identify, connect to and leverage external sources of knowledge as a core process of innovation (Chesbrough, 2006).

Through this definition, the boundaries between a firm and environment have become more permeable – in a world of widely distributed knowledge, organisations can now look outward for innovation (Chesbrough, 2003a). In the face of potential 'information-overload', the ideals of Open Innovation are more relevant now than before, as Drucker's (1988) prediction becomes a reality, which must be carefully managed.

The seminal work of von Hippel (1976) on user innovation is an important area of discussion with regard to open innovation. Users' significant role in generating innovations reflects the problem of the stickiness of knowledge (Lakhani & Panetta, 2007). Von Hippel (1976) argues that users play a critical role not only in generating ideas for innovations, but also in their subsequent development. More recently, von Hippel (2005) describes the 'democratising of innovation – the involvement of users as a source of innovation in certain industry sectors. Software development, such as that of Linux, has most recently become a hotbed of user innovation (Hertel, Niedner & Hermann, 2003). The prominence of user-generated innovation has been attributed to improvements in communication and computing, greater levels of education amongst 'users' as well as the growth of the open innovation phenomenon. Coupled with more flexible technology and lower costs, the democratising of innovation has become an important consideration in the field of open innovation.

The theory of open innovation predicts a current state of 'closed' innovation (see Figure 3) in which firms control and complete the innovation and R&D processes entirely from idea generation through to marketing and distribution in a funnel approach (Tidd, Pavit and Bessant 2001). That is not to say that flexibility and adaptability are entirely disregarded in the closed model; the importance of inter-company networking in innovation and R&D is well established and a widely spread practice (Rothwell, 1992). However, in the closed model of innovation, there exists a high level of idea project termination due to the nature of the closed model boundaries (Chesbrough, 2006). Whilst the closed model has indeed produced an unprecedented number of innovations, in the past, environmental changes have begun to necessitate a paradigm shift.

Figure. 3: Closed vs. Open Innovation Process (Adapted from: Chesbrough, 2003a)



Firms increasingly draw on external sources for knowledge and ultimately, innovation (Chesbrough, 2003). Modern innovation processes require firms to master highly specific knowledge about different users, technologies and markets. Those firms that are too internally focused may miss important opportunities. A lack of openness may result in technological myopia, which spells only doom for the firm in question (Smith, 2010). As the landscape of competitive high technology industry environments become more hostile for the modern firm, an emphasis on external knowledge search, rather than continually increasing investments in internal R&D has become more commonplace (Laursen & Salter, 2006). The increasing mobility of knowledge workers makes it difficult for firms to appropriate and control R&D investments.

Historically, R&D as an organisational function operated on improving production activities internally, through traditional vertical integration strategies (Chesbrough, 2003a). However, a substantial value loss stemming from knowledge spillovers (Teece, 1980) has remained a major area of concern for most firms.

Ultimately, the openness and interaction in innovation through the network of relationships between firm and environment is expected to result in improved performance (Rosenkapf & Nerkar, 2001). Whereas traditional approaches to R&D and innovation face issues with value wastage, open innovation treats spill overs as an opportunity to expand the organisational business model or spin off the technology to a new business model outside of the firm from which it originated, rather than as a cost of business (Chesbrough, 2003a). For example, firms generally acquire intellectual property (IP) for internal R&D purposes but patents are for the most part worth very little and often never used. Instead, the open innovation paradigm views patents as a new class of asset – one that can generate revenue and point to new business. It proposes that firms should be active buyers and sellers of intellectual property (Chesbrough, 2006). Open innovation requires a firm to integrate external sources along with innovation process and competitive strategy. Proctor & Gamble's shift in R&D strategy with their 'connect and develop' model – can be seen as an example of an open innovation strategy that satisfies the criteria of Chesbrough's definition (Sakkab, 2002). Additionally, global high-tech companies such as Google and IBM have experimented with open innovation strategies. Google created parent company Alphabet, in order to allow for more flexibility in developing spin-off technologies (Greenberg, 2015). IBM has also tapped into open innovation, investing large sums into developing open source software (Greenberg, 2015).

For Chesbrough (2007), a growing division of labour has promulgated the need for openness in innovation. The importance of a wide and diverse range of competencies that may exist outside of organisational boundaries has become broadly established in the modern economic environment. The deployment of open business models allows for synergistic relationships with other firms and individuals to be exploited through combining diverse assets, resources and markets, resulting in improved value and ultimately, competitive advantage.

Chesbrough (2007) refers to the fact that firms generally only use between 5-25% of their patents, while the rest remain 'on the shelf'. Callaghan (2015) suggests that this problem of dormancy has serious implications for social innovation and is particularly severe in the case of pharmaceutical R&D.

Callaghan (2015a: 9) comments on the phenomenon of open innovation, relating that "*the scale of these interventions needs to be ramped up, to the point that a nexus between social and proprietary innovation incentives is created, and the rate of problem solving can be increased, perhaps exponentially. In other words, a new paradigm in innovation can potentially exist, beyond the innovation threshold."*

2.4. Second Generation Innovation (SGI)

The seminal theory on SGI (Callaghan 2014a, 2014b 2014c, 2015a, 2015b) relates primarily to the use SGI-based technologies and methodologies to address 'catastrophic events' (such as 'bio-events'), which are defined as global-scale outbreaks of disease or the advent of antibiotic resistance. A discussion of SGI theory in the context of such 'bio-events' follows.

In a world increasingly connected by airline travel (Maher, 2013), the risk of an outbreak of a large-scale life-threatening disease is imminent. Renown Microsoft

founder Bill Gates recently predicted that "the chance of a widespread epidemic, far worse than Ebola, in my lifetime, as well over 50%." (D'onfro, 2015: 1)

To date, the advent of 'bio-events' or large-scale outbreaks of disease that have caused significant loss of human life have been plentiful in the history of humanity. Such bio-events are seemingly becoming more common, as the effects of globalisation take root. One of the most well known examples of a large scale 'bio-event' is that of the Black Death, which saw the loss of over 50 million lives during the 14th century (Twigg, 1984). The 1918 Spanish Flu pandemic infected 500 million people across the world and resulted in the deaths of 3-5% of the world's population at the time (Johnson & Muller, 2002). More recently, large scale outbreaks of Severe Acute Respiratory Syndrome (SARS) in 2003 (World Health Organisation, 2003), Middle East Respiratory Syndrome (MERS) in 2012 (CDC, 2013), the re-emergence of the deadly Ebola virus in 2014 (Lakoff, 2015) and most recently, the Zika virus in 2016 (Peterson, 2016) have all caused widespread global concern and a significant number of human causalities. In addition, the advent of microbial antibiotic resistance and the resultant emergence of 'superbugs' (Halifax, 2013) has been cited as one of the most dangerous problems facing humanity, at present. Global pharmaceutical industry representatives recently declared the urgent need for government-industry funding models to "fight the problem of antimicrobial resistance," at the World Economic Forum in Davos in 2016 (Kirkham, 2016). It has been suggested that too little R&D is spent on combatting these issues, due to the profitability models of commercial pharmaceutical companies (Halifax, 2013).

A fundamental tension in the literature emerges at this point. Whilst the past few decades has seen an explosion and exponential growth in information and knowledge made available through improved telecommunications technology and the Internet (Adair & Vohra, 2003), solutions to problems such as 'superbugs', antibiotic resistance and other potential catastrophic events are still tethered to the market mechanism, and as a result, still pose major threats to humanity (Callaghan, 2014a).

In order to solve this dilemma, a new management model of R&D addressing the problems associated with a potential global pandemic is required (Callaghan, 2014a). This model would need to be able to effectively reduce the time dimension of an R&D project (it would 'crash' the project, almost entirely) (Doloi, 2011). Callaghan (2015a) argues that a 'second generation', or a new paradigm of R&D management systems, that uses a probabilistic perspective of knowledge management is required to address potential catastrophic events.

2.4.1. An Overview of the Fundamentals of Second Generation Innovation (SGI): The Failure of 'First Generation' Innovation and The Probabilistic Mechanism

Building on open innovation theory, Callaghan (2014a) introduces the notion of Second Generation Innovation (SGI) as a probabilistic paradigm of innovation, knowledge, innovation and R&D management and value creation. At its core, SGI relates to the use of distributed knowledge systems, using methodologies known as i) open source production and ii) crowd sourcing and crowdfunding mechanisms (Callaghan, 2014a). SGI is used in this dissertation to describe an overarching umbrella term for distributed knowledge management through a system of open innovation practices, open source production, crowdfunding and crowd-sourced

knowledge used in order to gain solutions to problems previously thought 'unsolvable' (Callaghan, 2014a).

The core tenet of SGI theory, as proposed by Callaghan (2014c: 165) is that; *"the stickiness of knowledge poses a constraint to innovation that cannot be breached without the use of probabilistic mechanisms that reconfigure the 'knowledge space' so as to change the location of information, the cost structure of its generation and its transfer across nodes of creation, and that improve the efficiencies with which it can be used in new locations… at the nexus of proprietary and social 'probabilistic R&D, there exists the alignment of economic incentives with social goals, a 'space' in which problem solving can be accelerated significantly."*

The term probabilistic mechanism can be described as the manner in which knowledge and information harness probabilistic forces through the exposure of knowledge to large numbers of people or 'nodes of creation' in order to find solutions to problems (Callaghan, 2014c). Increasing the number of problem solvers exponentially would thus exponentially increase problem solutions (Callaghan, 2014c). This is known as the 'The Law of Reductability', in that "the solution to any problem that is ultimately solvable is a function of the quality and quantity of problem solving inputs it receives" (Callaghan, 2014c: 168).

This proposed probabilistic mechanism for problem solving is offered as a new paradigm of problem solving and is termed 'Second Generation Innovation (SGI). In order to further delineate the concept of SGI, Callaghan (2014a) makes reference to 'First Generation Innovation' (FGI) to represent the innovation paradigm that does not make use of the probabilistic mechanism, as described above.

"In a global context of resource scarcity few incentives exist for firms to pursue innovations that provide social externalities if these are not inherently profitable" (Callaghan, 2015a: 8).

Callaghan (2014a) suggests that contemporary innovation practices (referred to as 'First-Generation Innovation or 'FGI') are fundamentally flawed in that they are "coupled to the dictates of the market mechanism which disproportionally allocates resources to other ends than those required to address global catastrophes" (Callaghan, 2014a: 2070). Investments in innovation are characteristically linked to profit-driven incentives, which have over time contributed to the development of a closed system and have resulted in the stagnation of the innovation 'pipeline' (McKenna, 2014). Hence, innovation that is not inherently profitable is not pursued because financial incentives are tethered to the need to generate profitable returns (Martin & Scott, 2000; Callaghan, 2014). Consequently, research and innovation concerned with societal problem solving has suffered severe obstacles. Closed models of innovation that do not use distributed R&D systems are fundamentally adverse to the requirements of R&D management in the case where a disaster or catastrophic event has already happened (Callaghan, 2014a). It has been purported that the innovation 'pipeline', or supply of knowledge that contributes to the development of new pharmaceutical products is inherently flawed and 'nearly broken' (McKenna, 2014).

Callaghan (2015a) argues that as per Henderson and Clark's (1990) typology of innovation, systems and processes associated with closed models of innovation have

reached their natural limit. This means that the 'S-Curve' associated with the contemporary closed model of innovation ('or, 'First Generation' Innovation) has reached a natural saturation point. If this is true, then this saturation point may represent a constraint threshold, which may reflect the inability of the system to innovative further. Essentially, stagnation occurs. Furtehrmore, it is argued that the only way in which to breach this threshold is through the adoption of a new technology, namely, a probabilistic mechanism of innovation, or knowledge creation (Callaghan, 2015a).

However, it is important to note that so-called First Generation Innovation (FGI) is not considered to be antithetical to SGI, rather that innovation exists on a continuum and the point of optimal innovation exists somewhere along that continuum. Essentially, SGI theory is only suggested as a mechanism that can be used to improve contemporary innovation practice, not to replace it (Callaghan, 2015a).

SGI draws on evolutionary theory and the field of microbiology to explain the mechanics of the probabilistic mechanism. To solve newly encountered problems, bacteria assess the problem via collective sensing, recall stored information of past experience, and then execute distributed information processing of the or bacteria in the colony- transforming itself into a "super-brain" (Eshel, 2009: 78). In the case of disease outbreaks, microorganisms that cause bio-events spread by using a probabilistic mechanism. One infected person will infect two more, those two will each infect another two, and those, another two and so on, increasing the infection rate exponentially. This is a form of distributed learning, or adaptive behaviour and is considered a probabilistic mechanism by harnessing the effects of large numbers (Eshel, 2009). This evolution of microorganisms runs in parallel to the development of new drugs in pharmaceutical R&D in a 'race for survival' (Callaghan, 2015a). The potentially catastrophic effects of microorganisms learning to outstrip pharmaceutical R&D is evident. Callaghan (2015a) suggests that the use of a *human* probabilistic mechanism in the form of second generation R&D, which could potentially be a catalyst for exponential human learning, provides a means to prevent this from happening.

"Due to overuse of antibiotics, we're breeding super-resilient, drug resistant bacteria that can survive the strongest weapons humanity has against infection. When an infection occurs, antibiotics are used to suppress or kill the bacteria that cause the infection. But if there's a big population of organisms, there may be a few that are resistant to the antibiotic and these multiply while the others die out – it's survival of the fittest" (Stockton, 2015).

Callaghan (2014a: 2073) defines 'Second Generation R&D as "R&D that uses large-scale economies of scale in obtaining knowledge inputs at any stage of the innovation process and which can offer a new paradigm in problem solving, particularly with regard to societal problems that are outside the ambit of market incentives". Callaghan (2014a) argues that R&D failure is an inherent aspect of FGI – a paradigm that does not make efficient use of economies of scale, while in contrast; SGI makes use of multiple large-scale inputs to provide for more robust solutions to problems. Essentially, this theory draws similarities to Chesbrough's (2003a) closed and open models of innovation.

Private R&D, classically associated with the pharmaceutical industry faces the challenge of stagnation due to the need to generate a financial return. As previously mentioned, the result of this is that the innovation pipeline or flow of knowledge creation and innovation in pharmaceutical R&D has encountered a production bottleneck. This is referred to as the 'chronification' of health solutions (Callaghan, 2014c), as pharmaceutical R&D gears itself to function as a supply of medications and drugs that need to be administered over periods of time, rather than simple cures. Callaghan (2014c) refers to this chronification of health solutions as the 'Golden Goose' model. Patients receiving continuous treatments for disease will invariably generate greater revenue for pharmaceutical firms than patients requiring once-off treatments. Providing once-off cures to patients could be considered anecdotally as 'killing the golden goose'. Hence, it remains in the pharmaceutical industry's best interests to maintain a steady flow of revenue by shaping the industry to its financial needs. Such a model is clearly associated with the FGI paradigm of problem solving and innovation.

Callaghan (2015a: 22) suggests that SGI offers the potential to transcend these profitability constraints and to "move to a curvative paradigm in health-related social innovation, because of the different economic structure that underlies SGI." In order to transcend the constraint to knowledge creation however, a transmission mechanism that can transmit the steady exponential increase in volumes of information and knowledge over time (Adair & Vohra, 2003) toward innovative problem solutions is required. Callaghan (2014a) proposes 'crowdsourcing' as this probabilistic mechanism.

2.4.2. The Crowd

The virtual environment has expanded the reach of science to include interested parties of all skill and knowledge levels. No longer is science the domain of experts. It is increasingly recognised that harnessing large virtual networks of human intelligence and manpower can facilitate science, from funding through to execution. Crowdsourcing is an idea whose time has come. (Torr-Brown, 2013:1)

The above quote encapsulates the fundamental principles on which the theory of SGI is built. SGI, as proposed by Callaghan (2014a) extends open innovation by leveraging external knowledge sources not only from users (von Hippel, 1976) or from other firms (Chesbrough, 2003a), but also from the potentially infinite 'crowd' as well (Callaghan, 2014a).

2.4.2.1. Crowdsourcing

Crowdsourcing – a portmanteau of the words 'crowd' and 'outsourcing' is defined as a distributed problem-solving and production model (Brabham, 2008) and "represents the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call (Howe, 2006). This can take the form of peer-production (when the job is performed collaboratively), but is also often undertaken by sole individuals. The crucial prerequisite is the use of the open call format and the large network of potential labourers" (Howe, 2006). Most importantly, it is the leveraging of collective intelligence (Buecheler, Sieg, Fuchslin & Pfeifer, 2010). Crowdsourcing has become enabled by the advent of recent advances in communication technology, namely, the

Internet, social media and smartphones. These advances provide the opportunity for significant resource cost reduction in knowledge search and knowledge management. Crowdsourcing has provided the impetus for a shift in knowledge economics. "Distributed labour networks are using the Internet to exploit the spare processing power of millions of human brains" (Howe, 2006).

Crowdsourcing has been successfully applied by a significant variety of organisations spanning a wide range of industries that provide web-based platforms to an open pool of potential labourers or problem solvers in order to accurately pinpoint ideal solutions to previously unsolvable problems for extremely low costs (Brabham, 2008). One of the key benefits that crowdsourcing can generate for a firm is the dramatic decrease in costs involved in knowledge search and subsequent knowledge management – the issue of resource constraints essentially becomes void (Kittur, Chi & Suh, 2008).

Crowdsourcing in the form of 'idea competitions', inviting crowds to solve problems in exchange for rewards, have been used often in the past (Stieger Matsler, and Chatterjee, 2012). Some examples include the Longitude Prize in 1714 and the Alkali Prize in 1783 (Brown, 2012). More recent successes have been enabled by the technological changes associated with today's postmodern society (Goneos-Malka, Grobler & Strasheim, 2013) such as Web 2.0 technologies and their social network capabilities (Stieger et al., 2012).

A growing number of organisations rely almost entirely on crowdsourcing to operate (Brabham, 2010). Some better-known examples include InnoCentive (Vukovic, 2009) and Amazon's Mechanical Turk (Callison-Burch & Dredze, 2010) – both online platforms that provide a marketplace for solution seekers and problem solvers to interact (Brabham, 2008). Through 'commission-based research and development', InnoCentive allows organisations to pose problems in fields ranging from engineering to life sciences to business. These are framed as 'challenge problems' for anyone to solve. Cash prizes are awarded to the best solutions (Lakhani & Panetta, 2007). InnoCentive's open model has proven to be considerably successful, "problem-solving success was found to be associated with the ability to attract specialised solvers with a range of diverse scientific interests. Furthermore, successful solvers solved problems at the boundary or outside of their fields of expertise, indicating a transfer of knowledge from one field to others" (Lakhani, et al 2007).

Crowdsourced R&D already exists in medical research for the purposes of data collection, analysis and clinical trails. Crowdfunded biomedical research has also become more popularised. Examples include crowdsourcing in the field of proteomics, AIDS and cancer research as well as research in protein folding and drug development (Anderson & Anderson, 1998).

Previously, the term Citizen Science has been used to describe "a methodology that enlists the public and an inclusive set of stakeholders in gathering scientific information" (Irwin, 1995). Similarly, Callaghan (2014b: 1505) refers to crowdsourced R&D as "a methodology, or a set of methods used to generate knowledge or source large data inputs that addresses the problem of knowledge aggregation." Crowdsourcing makes use of large-scale data sourcing, each individual

in the crowd as a potential knowledge input. Expert input, in particular forms an important component of such knowledge aggregation (Callaghan, 2014b).

Crowdsourcing has become increasingly embraced in health research (Swan, 2012). "Active participation of individuals in their health care particularly using web 2.0 technologies" (Swan, 2012: 46). The emergence of the 'Fit Bit', The Apple Watch and other wearable health tracking technologies has further developed this trend (Wright & Keitch, 2014), along with increasing Internet and social network usage. Social networks have proven to provide 'early-warning systems' for disease or bio-surveillance (Collier, Son & Nguyen, 2011). Twitter and Google Trends, for example, have been used to track outbreaks of disease in real time (Collier, et al., 2011).

Further proof of crowdsourced R&D is widespread in the literature. Examples include Google's search engine, which optimizes search results based on crowd input (Afuah & Tucci, 2012). The garment industry has recently taken up the use of crowdsourcing in designing new items of clothing (Brabham, 2008)

Medical research has also been known to make use of a process known as gamification – the use of game thinking and game mechanics in non game contexts in order to find innovative solutions to problems (Huotari & Hamari, 2012), which is then sourced to the crowd. A University of Washington experiment called FoldIt asked users to try 'solve the puzzle' of folding various protein structures (relating to AIDS research) using video-game tools and mechanics. In contrast to scientific researchers that had been working on similar problems for extended periods of time, solutions sourced from the crowd (players) were reached in just three weeks (Torr-Brown, 2013). The University of Exeter's Project Nightjar – aimed at understanding animal camouflage and survival strategies in the wild – was concealed in the form of a 'citizen science game' in order to expedite the rate at which information and solutions were obtained (Ho, 2014). Blizzard Entertainment's popular World of Warcraft – a Massive Multiplayer Online Role Playing Game (MMORPG) has been closely monitored by sociologists in order to monitor social interactions amongst online virtual communities (Williams, Ducheneaut, Xiong, Zang, Yee, and Nickell, 2006). Epidemiologists and even anti-terrorist specialists studied World of Warcraft's 'Corrupted Blood Incident' – an in-game glitch which produced an outbreak of a virtual epidemic, for its implications of how human populations could react to a real-world epidemic (Balicer, 2007). Similarities were drawn to the Severe Acute Respiratory Syndrome (SARS) and avian influenza outbreaks of the 2000s (Balicer, 2007). Waze, a popular crowdsourced geo-navigational system uses game mechanics to help users avoid traffic jams (Jain, Raj, Mishra & Bevja, 2015). Even Fast Moving Consumer Goods (FMGC) are moving towards crowdsourced R&D in developing and designing products, such as face wash (Sciaca, 2016) in order to meet exact consumer demand.

Other interesting examples worth mentioning vary from McDonald's crowdsourcing ideas for their latest burger (Wong, 2014) to the search for the missing Malaysian Airlines Flight MH370 being extended to the crowd via the use of space imaging through a smartphone application. This allowed volunteers to scour over areas of the Indian Ocean to try find debris (Sharma, 2014). reCAPTCHA, an extension of the Completely Automated Computer Turing Test to tell Computers and Humans Apart (CAPTCHA) security system restricts bots from accessing restricted areas online (von

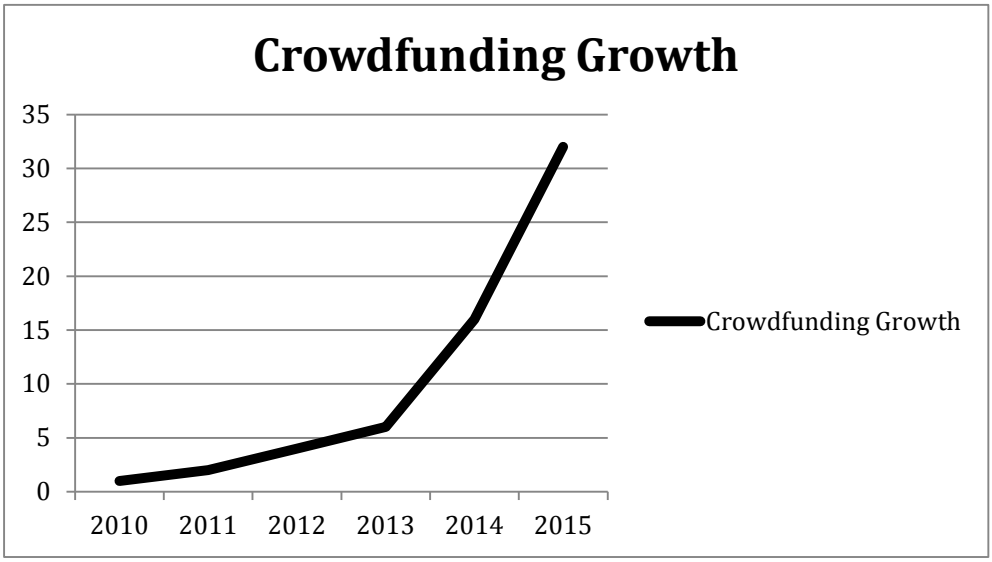
Ahn, Maurer, McMillen, Abraham and Blum, 2008). This has an additional function of digitising old textbooks or confirming numbers of houses on open-source mapping systems such as Google Street View (Devaux & Paparoditis, 2010). By asking users to "enter the code seen on screen, to prove you're a human and not a machine" (von Ahn, et al, 2008), reCAPTCHA serves the dual purpose of security and what is known as 'implicit crowdsourcing' (Brabham, 2008). These examples show the scope of crowdsourcing potential.

2.4.2.2. Crowdfunding

The term crowdfunding is defined as "an Internet-based mechanism through which individuals solicit small amounts from many donors instead of a single large sum from an institution" (Averett, 2013: 908) or a mechanism of external financing (Torr-Brown, 2013). The popularity of crowdfunding to raise funds for research has been steadily increasing. One of the best-known crowdfunding platforms is 'KickStarter', which provides a web-based platform for users to pose project ideas – ranging from food to films to journalism to video games – and allows other users to fund these projects. Each contributes small amounts until a total monetary objective is attained and the project is fully funded. 'Backers' (those who fund projects) are offered rewards in exchange for their donations and contributions (Walker, 2011). By 2012, KickStarter had raised $230 million (Wasik, 2012), by 2014, that figure increased to over $1 billion and is expected to grow (Scholz, 2015). However, KickStarter only accounts for a small percentage of the total crowdfunding industry, which has been growing exponentially over the past few years. In 2013, the crowdfunding industry as a whole raised a total of $6.1 billion dollars. It expanded by 167% in 2014 to $16.2 billion and then more than double to $34.4 billion in 2015 (Salman, 2016). The World Bank estimates that crowdfunding will reach $90 billion by 2020, but if the trend of doubling every year holds, this figure will most likely be reached by 2017 (Barnett, 2015).

In comparison, the venture capital (VC) industry presently invests an average of $30 billion a year (Barnett, 2015), whereas angel capital averages roughly $20 billion a year (Barnett, 2015). The potential growth and impact of crowdfunding could be staggering.

Figure 4: Crowdfunding Growth (2010-2015) in $5 billion increments



The increasing popularity of crowdfunding is expected to contribute significantly to economic growth, innovation and job creation (Thompson, 2014). Crowdfunding has been cited as a promising advancement in developing countries, where "85% of people have mobile phones, with a growing share of 'smart phones' that can enable crowdfunding in its different forms" (Thompson, 2014: 407).

Crowdfunding has also been suggested as a feasible solution to the issue of funding in medical research (Torr-Brown, 2013), which is often heavily constrained by regulations that encumber the rate at which medical innovations occur. Crowd-based problem solving and funding systems hold vast potential in the field of medicine and medical research (Torr-Brown, 2013), particularly with regard to cancer research, drug R&D and genomics.

It is important to note however, that not all crowdfunding campaigns are successful. Between 2011 and 2013, it was reported that 1 in 5 UK crowdunding initiatives failed often due to a lack of interest from potential 'backers' (Salman, 2016). However poor management and insufficient support also contributed to these failures (Salman, 2016). Despite the inherent riskiness and potential instability associated with crowdfunding, the same UK study that investigated crowdfunding failure also found that 80% of failed ventures were "willing to try again" and "would recommend equity based crowdfunding to others" (Salman, 2016: 1).

2.4.3. Collective Intelligence

The abovementioned examples all make use of distributed labour networks in order to tap into the collective intelligence of millions. As the world becomes more connected, the potential of humanity's collective intelligence grows. Collective intelligence is a characteristic of groups of people, which is over and above the individual intelligence of its members (Surowiecki, 2004). Crowdsourcing offers a way to harness collective intelligence.

The probabilistic mechanism makes use of the 'wisdom of crowds' (Surowiecki, 2004), or the emergent properties of problem solving, which could potentially take form as a function of scale in the use of crowdsourcing for R&D. This proposed model may prove to be more robust way of dealing with the limitations associated with decentralisation and non-transferability of information and knowledge (Hayek, 1945, von Hippel, 1994).

"Non-probabilistic systems of innovation are less likely to transcend the endogenous limitations of constraints to innovation than are probabilistic systems" (Callaghan, 2015).

For Surowiecki (2004:xv11): *"If you put together a big enough and diverse enough group of people and ask them to "make decisions affecting matters of general interest, that group's decisions will, over time, be intellectually [superior] to the isolated individual, no matter how smart or well-informed he is."*

The effectiveness of group making decisions is widely debated in the literature. Groups have under some circumstances, shown to have poor judgment; examples include riots or stock market bubbles (Surowiecki, 2004). In these cases, the negative consequences of collectivism and 'groupthink' are clear – the aggregation of group intelligence eventually contributes to entirely irrational and bad decisions. However, Surowiecki (2004) is careful to point out the prerequisites for good group decision-making.

For a crowd to be wise, certain conditions must be met, namely the need for the crowd to be diverse, to have independence, and to be decentralised (Surowiecki, 2004: xix). These conditions link directly to the theoretical foundation that holds SGI together (Callaghan, 2015a).

If individuals in the crowd are diverse, they are more likely to think and act independently. Surowiecki (2004) makes reference to the mechanisms that underlie market prices and voting systems as examples of aggregated or collective judgments. (Surowiecki, 2004)

2.4.4. Open Source Production

The notion of open source production can best be understood from the perspective of open source software, perhaps the most popular and well-known variation thereof. However, examples date as far back as the early 1800s in the case of the Oxford English Dictionary, which used an open call to source English words, their definitions and usages in order to compile a more comprehensive edition (Brabham, 2008). The success of open source software, such as Linux is proof of the success of distributed knowledge systems.

Open Source Software (OSS), is defined simply as computer software with its source code made available to users to be developed in a collaborative and open manner (St. Laurent, 2008). One of the better-known examples of OSS is Linux – a popular free and open source software that allows users to contribute to and continuously improve on the software available to them – an iterative process with users continuously working to change and improve the source code to better suit their needs (Lin, Hwang

and Baker, 2012). The popularity of open source software has increased significantly; tech-giant Microsoft has recently announced a potential move to an open-source version of its operating software Windows (Metz, 2015).

It is interesting to note that open source contributors have been found to primarily be motivated by intrinsic motivation, particularly in terms of enjoyment, creativity, user need, intellectual stimulation and learning (Lakhani & Wolf, 2003). Information providers are willing to perform these tasks without remuneration (Lakhani & von Hippel, 2003), while crowdfunding initiatives have been found to have altruistic motivations (Lakhani, 2008). This tends to support the belief that the probabilistic mechanism underlying SGI may be more robust to cost pressures than financial systems that fall under the FGI paradigm (Callaghan, 2015a).

In the use of open source production, essential elements of a certain product (such as source code for software) are made freely available to anyone to collaboratively improve the existing product. The key element to open source production is continued transparency and free distribution (Brabham, 2008).

OSS communities are able to download source code and then develop it for their own needs with the modified source code typically returned to the Internet for others to develop further. Discussion forums and collaborative work also arise from this process (Lakhani & Panetta, 2007). Lakhani and Panetta (2007:100) quote Linus Torvalds, the founder of Linux, expressing the nature of this system as follows:

"Free availability and… crosspollination… through sharing of 'source code', although biologists call it DNA…. a rather unforgiving user environment, that happily replaces bad versions of us with better working versions and thus culls the herd (biologists often call this 'survival of the fittest') – massive undirected parallel development ('trial and error')... Too strong a vision can kill you- you'll walk right over the edge firm in the knowledge of the path in front of you...I'd much rather have 'Brownian motion', where a lot of microscopic directed improvements end up pushing the system slowly in a direction that none of the individual developers really had the vision to see on their own...And I'm a strong believer that in order for this to work well, you have to have a development group that is fairly strange and random. "

The analogies are clear. References to the random, or probabilistic process of knowledge creation, and the biological metaphor of the evolution of DNA. It is argued that in the face of threats from certain catastrophic events such as microorganisms that literally represent the evolution of DNA, a probabilistic mechanism of problem solving might be uniquely suited to addressing these threats.

Table 1: Overview of SGI Theory

Overview of Innovation and SGI Theory			
		Theory	**Key Author/Theorist**
1	**Antecedent Theory**	Knowledge is proprietary and unevenly distributed	Hayek, 1945
		Knowledge is 'sticky'	Von Hippel. 1976
		The knowledge economy and knowledge worker	Drucker, 1988
		Knowledge fuels innovation	Nonaka, 1991;

Overview of Innovation and SGI Theory			
			Nonaka, 1994
2	**Openness**	Open Innovation	Chesbrough, 2003
		Open Culture Movement (Sociology)	Boynton, 2004
		Emergence of Web 2.0	Swan, 2012
3	**The Crowd**	Crowdsourcing	Howe, 2006
		Crowd funding (rose to prominence in the 2010's)	
4	**Second Generation Innovation (SGI)**	SGI theory is first proposed	Callaghan, 2014

The uptake of open source production has seen an explosion in the past decade. "Companies are becoming more comfortable in open sourcing their software because they're sitting on large amounts of proprietary data that nobody else has access to. So they open source the algorithms used to manage and analyse the data, which are very complex and are constantly evolving at a rapid pace" (Metz, 2015: 1). The trend of global companies moving to open source development platforms has allowed for acceleration of the progress of technology (Metz, 2015).

2.4.5. Swarm Intelligence and Stigmergy

Callaghan (2015b) makes reference to Adam Smith's 'invisible hand' hypothesis and its relation to efficient markets in order to explain how the crowd engages in brokerage or trade of knowledge to solve price problems in the market. The notion of crowdsourced R&D, presents similar conditions to the mechanisms of a market in that crowds work in systems in order to solve problems. The theoretical foundation of SGI is underpinned by collective intelligence. Systems that exhibit chaotic dynamics at the individual level, have been found to sometimes have stable conditions at the collective level. Essentially, collective intelligence relates to the potential economy of scale advantages of crowdsourced R&D. Collective intelligence can be viewed as analogous to the qualities of other complex systems, such as the human brain, complex ecological systems and financial markets (Teece, 1986). Studies in swarm intelligence have described the phenomenon known as stigmergy, which may help to describe the underlying 'invisible hand' hypothesised by Smith (1776).

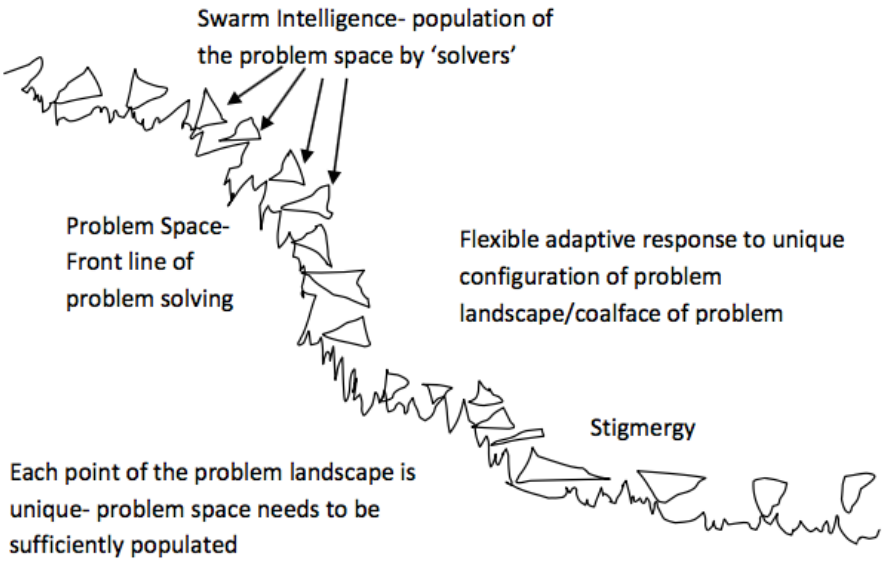
Stigmergy is defined as the achievement of complex coordination without a central decision making capacity, occurring commonly in natural systems such as flocks of birds and ant colonies. Through stigmergy, task decomposition is possible. Task decomposition may be highly suited to humans who are highly specialised at performing certain tasks or have certain specialised knowledge. The use of 'flash teams' is another potential application. The systems discussed above show how the emergent properties of crowd behaviour might be useful in problem solving, R&D and ultimately, innovation.

Research into the phenomenon known as 'stigmergy' provides anecdotal evidence of methods through which this concern is addressed, due to the inherent nature of crowd behaviour (Callaghan, 2015b). Crowds behave like social insects (Garnier, Gautrais & Theraluz, 2007). The example of ant colonies is used here. Contextual triggers push each individual in the crowd to respond with an individual specialised input, effectively providing a space in which problems can be solved in 'real-time' (as they occur). Callaghan's (2014a) proposed paradigm of large-scale, real-time, problem solving potential provides the theoretical foundation that encapsulates this concept.

The mechanisms of the crowd can be compared with the example of ant colonies, which can solve difficult problems to obtain food or build nests through self-organised cooperation. Using pheromones to communicate, changes by one insect in the swarm can trigger changes in the other insects in order to achieve perfect cooperation of synchronisation. This process is known as stigmergy (Garnier, et al., 2007).

Workers (members of the crowd) shift between roles based on a flexible and adaptable crowd-work algorithm based on stigmergy. In this way, the crowd solves the problem 'piece-meal' through unique cues to each individual at certain times and in certain places. Essentially, individual crowd-members (workers) populate the problem space, filling it with their own specialised knowledge until the problem is solved (Callaghan, 2015b).

Figure 5: Erosion of problem space driven by swarm intelligence configurations (Adapted from: Callaghan, 2015b).



It is interesting to note that crowd-level problem solving is not structured. It has been purported that complex adaptive systems may explain Adam Smith's 'Invisible Hand' hypothesis (Kochugivonda & Vriend, 1998). Workers in the crowd do not need full information on the problem, rather only to maximise their own utility, using their own specialised skills and knowledge (Callaghan, 2015). A 'market' of problem solutions takes shape around the problem space – one in which an open exchange of knowledge, ideas and problem solving inputs takes place until the entire problem is eroded.

Studies in group behaviour have uncovered a certain set of dynamics that when applied, create order from chaos (Derenyi & Vicsek, 1995). Seemingly complex behaviour often has simple foundations, based on 'if-then rules', which, when applied, can apply to the way swarms of insects and flocks of birds form and how cancer cells

spread. Swarm theory has been mentioned as an important dynamic underlying the future of self-driving cars (Yong, 2013).

Essentially, a swarm is a 'hive mind (Yong, 2013) and functions similarly to the motion of neurons in the human brain, which fire in favour of different options (e.g. go right or go left), ultimately culminating in a decision. The same has been found to occur in the formation of tumorous cancer cells (Yong, 2013).

It is argued that the emergence of the Internet has unlocked the inherent potential of humanity to act as a highly efficient and effective swarm, rather than as individual components or teams.

The central principles of evolutionary theory are useful in understanding the power of crowdsourcing and SGI. Mitchel (1996: 7) describes evolution as " a method for searching among an enormous number of possibilities for 'solutions'", or "a method for designing innovative solutions to complex problems… The search space is the collection of all possible [solutions] – an infinite set of possibilities."

For Torr-Brown (2013:2), "scientific progress is likely to occur through networks of human intelligence that can frame and solve difficult problems but are also supported by supercomputing capabilities". Constraints associated with medical research can be mitigated through the use of crowdsourcing, or "the act of outsourcing tasks through an open call for participation to experts, skilled enthusiasts, or the general public to donate time, money, insights, or computing power to a particular framed problem" (Torr-Brown, 2013:2). Crowdsourced R&D offers the potential for multi-disciplinary problem solving, through the use of distributed knowledge systems. This could potentially solve the problem of knowledge aggregation by making specialised skills and knowledge readily available.

2.4.6. Potential Benefits Associated SGI

The benefits of incorporating SGI practices, such as open source and crowdsourcing are evident. Transparency in the scientific process is not common, constraining problem solving to a "few scientists who work in secret and fail to leverage the entire accumulation of scientific knowledge available" (Lakhani, Jeppeson, Lohse & Panetta, 2007: 2). Instead of the traditional solitary researcher spending months or years trying to solve a certain problem (Sapartio, 2013), solutions can now be obtained from a potentially infinite source of information and knowledge. Chesbrough (2003a) cites the importance of the centrality of the business model, seeking people and information external to the firm, rather than securing "the best and brightest", in order to provide fuel to the business model.

In the field of cloud computing, a network of processing capacity from computers, mobile devices and servers distributed all over the world, is harnessed in order to provide a significantly more powerful processing capacity for extremely complex problems or storage that exceeds the capability of the single computer or small network (Mell & Grance, 2011).

Here, Callaghan's (2014a) proposition is raised once more; that R&D is fundamentally constrained by dyadic linkages between the knowledge provider and

the knowledge seeker due to the need to keep information and knowledge proprietary. Hence, in 'collapsing' this dyadic link by feeding knowledge and information back into the crowd, a three-dimensional space of knowledge creation could become enabled, which may significantly improve the rate at which innovation occurs (Callaghan, 2014c). This is the key benefit and significance of the implementation of SGI.

Crowdsourcing has the potential to solve problems that were until now considered to be unsolvable (Brabham, 2008).

For Callaghan (2015: 3), "A crowdsourced R&D 'problem space' might share certain of the characteristics of complex systems, certain of which might be uniquely suited to effective problem solving… crowdsourced R&D can benefit significantly from these ideas, as they provide a way to differentiate between solutions provided by the crowd. Essentially, using the crowd to provide very large numbers of potential solutions to societal problems like Ebola, HIV or antibiotic resistance, might replicate the mechanisms of evolutionary selection, in this case the selection of ideas."

"The crowd solves the problems that stump corporate scientific researchers. The crowd outperforms in-house geophysicists at mining companies. The crowd designs a handful of original t-shirts every week which always sell out of stock. The crowd produces memorable commercials and fresh stock photography on a par with professional firms. And the crowd outperforms industry faster and cheaper than even the top minds in the fields" (Brabham, 2008: 79)

2.4.7. Potential Challenges Associated with SGI

Crowdsourced R&D does pose certain challenges. Many have expressed concerns relating to the accuracy of data, which is analysed or collected by non-experts. It has been proposed that the implementation of verification systems may be able to contest this issue. Such verification systems could be developed and applied by the crowd itself, as a control mechanism or oversight criteria which would help in the support and coordination of crowdsourced R&D. Wikipedia, the online open-sourced encyclopedia has faced challenges relating to contributors that are "less inclined to publish information that contradicts [accepted knowledge]" (Torr-Brown, 2013:5). "The bias afforded by the crowd leads to an effective closing off to new interpretations, which tends to ensure that common wisdom outweighs "expert" views" (Torr- Brown, 2013:5). Callaghan (2014a: 2074) is careful to note that "crowdsourcing as a second-generation of R&D might not be suited to basic research that requires idiosyncratic approaches". Along with problems related to verification and bias, ethical issues may also arise. "The questions of ownership of data and information feedback to respondents are examples of these issues (Torr-Brown, 2013:6). Despite these challenges however, the demand for more open source data seems to be driven by patients themselves (Torr-Brown, 2013).

The issues of validity and quality management also pose potential problems in the sourcing of information and solutions from the crowd (Wang, Ipeirotis & Provost, 2011). It is recommended that standardised protocols are included in crowdsourcing activities in order to make sure the information supplied is as useful and accurate as possible (Ho, 2014). It has been proposed these issues could be counteracted by the

use of ‘gold’ data, which acts as a failsafe device that blocks poor quality input (Wang et al., 2011). In the case of the crowd answering questions or providing information, this is typically accomplished by inserting a small percentage of questions for which the answers are already known into crowdsourcing tasks, and then re-measuring the performance of crowdsourced workers (Wang, et al., 2011). Other possible quality control mechanisms that could be put in place to improve crowdsourced input quality to near-professional levels also exist (Zaidan & Callison-Burch, 2011). Rating systems of crowdsourced input have been shown to motivate improved crowd performance (Zaidan & Callison Burch, 2001). Recently, quality assurance software has been developed to validate crowd input (Ipeirotis, 2013). Crowdsourcing platform incentives and compensation policies have been shown to significantly associate with level of quality, as have task design, worker profiles, contributor evaluations, majority consensus and real time support (Dustdar, 2013).

In the case of obtaining solutions from large numbers of people (the crowd), concerns over having “too many cooks” have arisen (Yu & Nickerson, 2011). It has been argued that smaller, specialised teams are more adept at solving problems efficiently and effectively, rather than a mass of uncoordinated input from a potentially infinite amount of sources (Brabham, 2013). Concerns over quality control and the inherent difficulties thereof, as well as the difficulty associated with sifting through large amounts of data to find pertinent solutions, raises the issue of potentially “spoiling the broth” (Yu & Nickerson, 2011).

2.5. Accelerated Radical Innovation (ARI)

The ultimate objective of implementing an open model of innovation would be to accelerate the rate at which innovation occurs.

As previously discussed, the process of technological evolution (Teece, 1986) and the emergence of dominant designs through punctuated equilibrium are important considerations in regard to ARI. The attainment of ARI would rely on an acceleration of technological evolution – an increase in the frequency of ‘creative destruction’, which may be attainable through the implementation of a Second Generation of Innovation.

Schumpeter (1942, pg. 84) makes reference to ‘creative destruction’ as the "process of industrial mutation that incessantly revolutionises the economic structure from within, incessantly destroying the old one, incessantly creating a new one." The advent of a radical innovation is the proverbial spark that ignites the flame of creative destruction (Smith, 2010). While such innovations are often unfavoured by organisations because of their ‘competence destroying’ nature (organisations require new skills, knowledge and competencies in order to survive) (Smith, 2010), it is clear that the introduction of radical innovations ultimately contribute to the betterment of humanity (Bers, Dismukes, Miller & Dubrovensky, 2009). Radical innovations are arguably responsible for some of humanity’s greatest advances (Bers, et al. 2009). Some well known examples include The Manhattan Project (Bers, et al. 2009), the advent of the Internet and the personal computer, mobile and smartphone revolutions that followed (Hillbert & Lopez, 2011) and the launch of Sputnik and the resultant ‘space race’ that followed (Bers, et al, 2009). However, it is also clear that these radical innovations occur infrequently. The introduction of the concept of Accelerated Radical Innovation

– the reduction of time that lapses between radical innovations may be able to change this (Bers, et al. 2009). A prime example is in the case of Apple; radical, game-changing innovations such as the iPod, iPhone and iPad were introduced systematically over consistently shortening periods of time – 2001, 2007 and 2010 respectively (Bers, Dismukes, Mehersele and Rowe, 2014). This can be seen as an example of ARI.

Reference to exponential knowledge expansion was first made in 1945 in the form of Rider's Law of Library Expansion, which predicted library capacity to double every 16 years (Laursen & Salter, 2006).

More recently, Moore's Law, an observation relating to the increasing number of transistors in an integrated circuit over time (Moore, 1965) mirrors the theory underlying ARI. At its heart, Moore's Law relates to exponential improvement, growth and change (Keyes, 2006), and has applications not only in computer hardware but also in any area of technology that may experience creative destruction through radical innovations (Disco & Barend, 1998). If the innovation and change can be anticipated, predicted and managed correctly, its wild nature could be tamed and ultimately harnessed by organisations to guide long-term planning in addition to setting targets for research and development (Disco & Barend, 1998). This may overcome the problems associated with creative destruction and result in an environment in which radical innovation is embraced rather than avoided. A system of open innovation may provide the conduit through which this could become a reality.

The Information Age has precipitated an extremely competitive environment. It is important for organisations to attain ARI – or an improved level of innovative output – in order to maintain a competitive advantage (Bers, et al. 2009). It must be noted however that a global company such as Apple is not impeded by resource constraints in attaining ARI. Organisations without the same degree of freedom and access to resources may not be able to accomplish ARI in the same fashion. Instead, it is suggested that an open model of innovation be implemented in order to overcome the high costs of achieving ARI.

2.6. SGI In Academia

"Academia is still largely a medieval guild... Peer review is just another popularity contest, inducing familiar political games; savvy players criticise outsiders, praise insiders, follow the fashions insiders indicate, and avoid subjects between or outside the familiar subjects" (Hanson, 1990:np)

It is important to note the linkage between the fundamental tenets of SGI theory and the innovation associated with conventional academic research. In order to further delineate the conceptual theory underlying SGI, this study aims to test SGI's applicability amongst academic researchers – those who are very close to the heart of the aforementioned problems relating to innovation. This association is now discussed.

The majority of theory pertaining to SGI (Callaghan, 2014a, 2014b, 2014c, 2015a, 2015b) emphasises the importance of SGI's potential to provide solutions to societal problems, particularly in the field of pharmaceutical R&D and medical research.

However, it is suggested that the philosophy governing SGI can be extended beyond these parameters into academic research practices, as is the focus of this dissertation. It is argued that the innovation of academic research is inherently constrained by a reliance on closed models of innovation and resistance to radical innovation and as a result, the academic 'innovation pipeline', has become constrained. The implementation of SGI processes may allow for the leveraging of external knowledge sources that hold the potential to improve levels of academic research innovation and in turn, improve research performance.

Resistant human value systems that reject best practice, such as collectivism and 'groupthink' can often impede innovation, or more specifically, the diffusion of innovation (Smith, 2010).

"*Academic innovation faces a threshold limitation that is inherently related to the academic nature of the R&D process*" (Callaghan, 2015: 13)

Resistance to innovation has long been a feature of academia. A well-known example is that of Ignaz Semelweiss' antiseptic procedures (Codel, Carter & Barbara, 2005), during the 1840's, which was at first rejected by the 'conventional wisdom' of the time, which favoured primitive methods such as 'bloodletting' (Codel, Carter & Barbara, 2005). Some of the highest cited papers and most influential books in academia were also first rejected by journal reviewers and editors, including work that eventually was awarded the Nobel Prize in the fields of Physics, Chemistry, Physiology and Medicine (Camparino, 2009).

Kuhn (1970) argues that convergence theory dictates the generation of inherently non-innovative performance (in the context of academic research) due to the constraints of "paradigms" (Kuhn, 1970: 2).

The assumptions of SGI as defined by Callaghan (2014), echo the assertions of Kuhn. The theory underlying SGI states that first-generation innovation is fundamentally flawed due to the constraints of a standardised and converged paradigm that is resistant to change and hence, causes a stagnation of innovation (Callaghan, 2014). The same logic holds when applied in the context of academic research (Kuhn, 1970). Therefore, in conjunction with the predictions of both Callaghan (2014) and Kuhn (1970), it is argued that academic research is inherently non-innovative. However, this is not to say that academic research is devoid of innovation, rather that the paradigmatic constraints to academic research may create a barrier to radical innovation in academia.

Rubin (2014) discovers academic researchers' low levels of interest in SGI (low SGI propensity), which might be attributable to Kuhn's (1970) theory that academic research is inherently non-innovative. Researchers with higher levels of research productivity were shown to correlate highly with years of experience as a researcher, indicating a greater level of productivity with experience. This has implications relating to Kuhn's (1970) assertions. The convergence of best practice may have resulted in a paradigm that is fundamentally fixed and very difficult to change. In essence, this relates closely to Joy's Law on tacit knowledge (Lakhani & Panetta, 2007). The knowledge that exists in academic research can be seen to be tacit and very difficult to move. The same can be said of academic research paradigms. The

more experienced the academic researcher, the less willing they may be to incorporate crowd-based SGI processes into their research (Rubin, 2014). Hence, SGI may represent a new iteration of Schumpeterian creative destruction in the academic research context, and it is to be expected that resistance may be present (Smith, 2010). Once this equilibrium is punctuated, it is expected that a much faster and more open adoption of SGI practices will occur (Teece, 1998).

Rubin (2014: 97) goes on to state that "as per the fundamentals of Moore's Law, it is recommended that innovation and change in the academic context be anticipated, predicted and managed correctly and ultimately harnessed by organisations to guide long-term planning and set targets for research and development."

Historically, academic research has often been considered non-innovative. Others have echoed the assertions of Kuhn (1970) as mentioned above.

"As research methods become more sophisticated, they have also become increasingly less useful for solving… practical problems" (Susman & Evered, 1978: 582). Essentially a "closed loop" prevails, one in which, "a wide gap between research and practice" exists (Rynes, Bartunek & Daft, 2001: 240).

Lindquist (1975: 327) puts forth a summation of the "barriers to smooth flow from new idea to implemented reform" faced by academic researchers, including: i) major academic changes threatening secured positions, ii) colleges and universities vivisected into diverse and isolated subgroups, iii) academic power dispersed amongst pluralistic interest groups, iv) prevalent academic values oppose much current innovation, v) measuring the relative advantage and future context for academic innovations in extremely difficult, vi) most faculties are isolated from teaching-learning, research, theory and practice conducted elsewhere, vii) there are few adaptive mechanisms to fight organisational inertia.

It is argued that the abovementioned factors still hold true today (Changzidi, 2012). It is purported that the modern academic research environment may actually slow innovation, rather than accelerate it (Welsh, 2013, Changizi, 2012). A lack of funding, bloated publication processes and "too many academics" are considered just some of the key factors in the slow rate of academic innovation (Welsh, 2013: 1). Another term used to describe this phenomenon is 'academic failure'.

The term 'academic failure' is used to define the 'market failure' of academia to innovate and create knowledge (Dewald, et al., 1986). The 'Death Valley' phenomenon (Koyayashi, Nakamori & Wierzbicki, 2007), relating to the divide between academic research and actual implementation by practitioners, can be seen to be synonymous with academic failure. The associated difficulties of knowledge transfer from academia to industry fall within this categorisation as well.

Another important aspect of academic failure is the peer-review process, which has been described as a constraint to innovation (Bornmann, 2010). Concerns related to the "adequacy and fairness of modern peer-review practices in publication and funding and surrounding "reliability, accountability, reviewer bias, and competence" has been raised several times (Peters & Ceci, 1982). Several experiments have been conducted in order to test the consistency of journal publication. Mahoney (1977)

conducted separate experiments by submitting different articles to journal publications. It was found that many were strongly biased against results that did not conform to their theoretical perspectives. Mahoney (1977: 161) concluded that confirmatory bias (or "the tendency to… confirm their beliefs") was commonly present in journal publications. For Callaghan (2015a), the literature indicates that there are also serious issues related to the resistance of academics themselves to scientific discovery.

Camparino (2009:550) discusses the "resistance to scientific discovery," in regard to innovative articles that are not published because they do not conform to the orthodox viewpoints of reviewers nor do not they fit within accepted paradigms, an issue that "raises important questions about current policies which govern the dissemination of new information" (Camparino, 2009: 558).

The overview of the literature pertaining to paradigmatic constraints and resultant academic failure above, serve as a precursor to understanding the severe problems associated with innovation failure. These problems occur simultaneously and cumulatively, ultimately resulting in a 'threshold constraint', or a barrier to radical innovation in academia. It is proposed, that Callaghan's (2014) 'probabilistic innovation' could potentially be used to combat the stagnation of the innovation pipeline in academia.

2.7. Theoretical Model and Development of Hypotheses

Following discussion of the relevant theoretical concepts pertaining to SGI theory, a discussion of the theoretical components that make up the model of this research is now presented. The combination of these components introduces research questions, from which hypotheses are derived. The components include: Academic Research Productivity (ARP), SGI propensity (as a function of absorptive capacity) personality, motivation, human capital investments, gender and field of study. The overarching research question under study is: *what is the relationship between SGI Propensity, Academic Research Productivity (ARP), Human Capita Investments (HCI), Personality, Motivation, Gender and Field of Study?*

2.7.1. Academic Research Productivity (ARP)

For Altbach (2015: 1): "for research-intensive universities and the academics working in them, the measurement of academic productivity is neither straightforward nor easy." Most commonly, the use of a number of publications per researcher is used as the standard measurement protocol in discerning research productivity (Abramo, 2014). South Africa has been found to have one of the highest research productivities on the continent, accounting for almost one third of total research productivity in Africa (Uthman & Uthman, 2007). For the purposes of this research, measures of academic research productivity falls under two broad terms, namely supervisory productivity and publication productivity.

Supervisory productivity refers to the administrative tasks associated with supervising Masters and PhD (postgraduate) students. It is predicted that postgraduate supervision is positively associated with ARP.

Publication productivity refers to the number of times an academic researcher's work has been published in the form of a journal article. In the case of this research, an aggregated total of articles that have been published locally, in South African Department of Higher Education and Training (DOHET) (South African but not ISI/IBSS) accredited journal article publications as well as ISI/IBSS indexed (or, internationally accredited) journal article publications was used as a measure of ARP.

Additionally, in the context of South African academic researchers, academic research productivity may be measured as a function of NRF rating. The NRF (National Research Foundation) is "an independent statutory body…[which] funds research, the development of high-end human capacity and critical research infrastructure to promote knowledge production across all disciplinary fields" (NRF, 2015: 1). The NRF assigns leading South African researchers with a rating, as per a measure of research output.

An official NRF rating serves as proof of a high level of research productivity. The NRF rating system is defined, by the NRF (2015) as follows:

"The NRF Rating system is…. a tool for benchmarking the quality of… researchers. NRF ratings are allocated based on a researcher's recent research outputs and impact as perceived by international peer reviewers. The rating of individuals is based on the quality and impact of their research outputs over the past eight years, taking into consideration the evaluation made by local and international peers. It identifies researchers who count among the leaders in their fields of expertise and gives recognition to those who constantly produced high quality research outputs." (NRF, 2015:1).

The NRF-Rating system is as follows (NRS, 2015: 1)

A-Rating: Leading International Researchers
B-Rating: Internationally Acclaimed Researchers
C-Rating: Established Researchers
P – Prestigious Awards
Y – Promising Young Researchers

It is noted here that (ARP) academic research productivity may provide an indication of respondents' level of innovativeness and thus provides salience to the theoretical model under study. As previously noted, academia may be inherently non-innovative, or resistant to innovative change. Academic researchers that are innovative may therefore be at the mercy of 'gatekeepers' to innovative academia, as innovative research may be rejected (Camparino, 2009). This is particularly the case for journal articles, which must go through overly stringent reviewing processes (Welsh, 2013) but applies in general to innovative thinking (Kuhn, 1970). This concept links very closely to that of Human Capital Investments, which is discussed later in this chapter. Over time and repeated exposure to a system of innovative 'gatekeeping', innovative researchers may produce increasingly less innovative output as time progresses. Hence the measure of ARP is not only an indication of productivity, but of repeated exposure to the innovation gatekeepers.

In investigating ARP, it is important to consider Lakota's Law (Egghe, 2005), which states that the number of academic researchers making x contributions in a given period if a fraction of the number making a single contribution. In other words, academic researchers with high levels of output may only represent a small percentage of all academic researchers and as a result, the majority of academic research output may only be attributable to a small percentage of the total academic researcher population. If this assertion holds true, then it is expected that academic researchers with high levels of research output may account for a large percentage of the total academic research output produced (Egghe, 2005).

2.7.2. SGI Propensity (Absorptive Capacity)

Rubin (2014) argues that the degree to which innovation does exist in academia can act as a predictor of the degree of willingness to engage in SGI processes. In simpler terms, an academic researcher that is innovative and readily engages in radical innovation will be more likely to understand and be willing to participate in SGI-based research (such as the use of crowdsourcing).

The concept of Absorptive Capacity, or "the ability… to recognise the value of new information, assimilate it and apply it to commercial ends" as a function of prior related knowledge, forms an important precursor to the development of SGI theory in the context of academic research. The ability to exploit external knowledge is critical to innovative capacity (Cohen & Levinthal, 1990).

Thus, in order to further conceptualise the potential applicability of a proposed SGI at the level of academic research, one must take into consideration not only the organisation (university) itself, but the individuals and employees that form its human base – the knowledge workers that contain within them the tacit knowledge resource and the inherent innovation that can be extracted therefrom. It is suggested that a potential predictor of the propensity to make use of SGI at the individual level is absorptive capacity. Furthermore, if absorptive capacity is "a function of prior related knowledge" (Cohen & Levinthal, 1990: 128) then academic researchers (being in the business of knowledge creation) should have a strong foundation upon which an SGI propensity can be developed (Rubin, 2014).

Here, Research Question A1a is introduced: *what is the relationship between SGI Propensity and ARP?*

2.7.3. Human Capital Investments (HCI)

Human Capital Investments (HCI) refers to the investment of resources that contribute to the development (or appreciation) of an individual, or alternatively, the depreciation of an individual (Bosma, van Praag, Thurik & De Wit, 2004).

While traditional, neoclassical models of investment focused primarily on physical capital, the work of Becker's (1962, 1964, 1994) attribute importance to the individual-level accumulation of 'productive knowledge' (de la Fuente, 2011).

The seminal theory of Becker (1962) on human capital investment (HCI) describes the expenditures on training, education, medical care and lifestyle choices as a form of individual level self-invested capital, directly associated with productivity (de la

Fuente, 2011). The term 'human capital' is used in describing intangible assets such as knowledge, expertise, skills and values that cannot be separated from the individual (Blundel, Dearden, Meghir and Sianesi, 1999). Becker (1994: 11) offers a succinct definition of human capital as "activities that influence future real income through the embedding of resources in people." Assets such as education and training are considered vital elements of human capital. Research has shown direct associations with the level of education and training and personal income, or 'return on investment' (Blundel, et al., 1999). Becker (1962) argues that investment in human capital has an important effect on earnings (or productivity).

The chief principle of human capital theory relates to the factors other than physical resources (intangible assets), which contribute to income growth (Becker, 1962). Becker (1962) lists i) on the job training, ii) schooling, iii) other knowledge (or 'information about the economic, political or social system, such as individual's knowledge of salaries in a related job), iv) productive wage increases (improvement in emotional and physical health) as different types of investment in human capital. Becker (1962) offers a broad description of the human capital investment components, which is beyond the scope of this paper.

It is important to note however, that measurement of human capital investment is generally considered problematic (Blundel, et al., 1999; Becker, 1962), since "investment in human capital usually extends over a long and variable period, so the amount invested cannot be determined from a known investment period" (Becker, 1962: 30).

The relationship between human capital investments (HCI) and work productivity has been investigated (Black, 1994; Black & Lynch, 2001). Organisational training and education has been found to correlate most highly with work performance and productivity (Black & Lynch, 2001). Additional human capital investments such as age, experience, education levels of parents and familial situations have been shown to impact productivity levels as well (Black & Lynch, 1995). It is also recognised that individual differences such as personality and motivation may impact the relationship between HCI and productivity (Bosma, et al, 2004). Redding (1996) discovers the positive relationship between R&D performance and human capital investments.

It is important here to note the linkage between human capital investments and academic research productivity. As previously noted, academic innovation may exist at the mercy of innovation 'gatekeepers', or mechanisms that prevent the free-flow of innovation. Parallels can be drawn between this notion and that of the stagnation of the innovation pipeline (McKenna, 2014, Callaghan, 2014a). If human capital investments can be attributed to experience and learning, then the innovative academic researcher's innate innovativeness may be dulled with prolonged exposure to a system of innovation gatekeepers. In other words, as an academic researcher gains more experience and publishes more research, their level of innovativeness may decrease (Kuhn, 1970).

Here, Research Question A1b is introduced: *What is the relationship between Human Capital Investments and SGI Propensity?*

Research Question A3 is also introduced here: *What is the relationship between Human Capital Investments and ARP?*

2.7.4. Personality

In the interest of identifying the proclivity to engage in SGI practices in order to improve productivity, individual personality can be considered a feature that is proximal to the individual (Langston & Sykes, 1997) and hence, a reliable measurement.

Personality is defined in terms of "the physical, mental, moral and social qualities of the individual" (McKenna, 2000: 11) and can be understood as a complexity of characteristic feature describing particular dimensions through which personalities are categorised (Thompson & McHugh, 2009). Others have defined personality as "the set of psychological traits and mechanisms within the individual that are organised and relatively enduring and that influence his or her interactions with, and adaptations to, the intra-psychic, physical and social environments (Larsen & Buss, 2010: 4). These 'psychological traits' are often defined as a bundle of personality attributes, commonly referred to as the Five Factor Model (or FFM) of personality (Costa & McRae, 1995). Empirical research has shown that the 'Big Five' model is able to account for different personality traits, without overlapping (Boyle, 2008). The model is considered 'trans-theoretical in nature (Costa & McCrae, 1990). The five broad categories of personality include Neuroticism (N), Agreeableness (A) Continuousness (C), Openness to Experience (O) and Extraversion (E) (Costa &McRae, 1995; Goldberg, 1981; McCrae & John, 1992).

Costa and McCrae (1989) refer to the Five Factor Model of personality as a hierarchical organisation of personality traits, applicable across observers and cultures. All five factors have been shown to have convergent and discriminant validity (Costa & McCrae, 1990). The FFM provides a "common language for psychologists from different traditions, a basic phenomenon for personality theorists to explain, a natural framework for organising research, and a guide to the comprehensive assessment of individuals that should be of value to education, industrial/organisational and clinical psychologists" (Costa & McCrae, 1989: 177).

Table 2: Examples of Adjectives, Q-Sort Items, and Questionnaire Scales Defining the Five Factors (Adapted from Costa & McCrae, 1990: 178).

Factor (Personality Trait)	Adjectives (a)	Q-Sort Items (b)	Scales (c)
Extraversion (E)	Active, Assertive, Enthusiastic, Energetic, Outgoing, Talkataive	Talkative, Skilled in Play, Humour, Rapid personal tempo, facially, gesturally expressive, behaves assertively, gregarious	Warmth, gregariousness, assertiveness, activity, excitement seeking, postivie emotions
Agreeableness (A)	Appreciative, Forgiving, Generous, Kind, Sympathetic, Trusting	Not critical or skeptical, behaves in a giving way, sympathetic, considerate, arouses liking, warm, compassionate, basically trustful	Trust, straightforwardness, altruism, compliance, modesty, tender-mindedness,

Factor (Personality Trait)	Adjectives (a)	Q-Sort Items (b)	Scales (c)
Conscientiousness (C)	Efficient, Organised, Planful, Reliable, Responsible, Thorough	Dependable, responsible, productive, able to delay gratification, not self-indulgent, behaves ethically, has high aspiration level	Competence, order, dutifulness, achievement striving, self-discipline, deliberation
Neuroticism (N)	Anxious, Self-Pitying, Tense, Touchy, Unstable, Worrying	Thin skinned, brittle ego defense, self-defeating, basically anxious, concerned with adequacy, fluctuating moods	Anxiety, hostility, Depression, self-consciensness, impulsiveness, vulnerability
Openness (O)	Artistic, Curious, Imaginative, Insightful, Original, Wide Interests	Wide range of interests, introspective, unusual thought process, values intellectual matters, judges in unconventional terms, aesthetically reactive	Fantasy, Aesthetics, Feelings, Actions, ideas, values

(a) Adjective checklist items defining the factor in a study of 280 men and women rated psychologists serving as observers during an assessment weekend at the Institute of Personality Assessment and Research (John, 1989a)

(b) California Q-Set items from self-sorts by 403 men and women in the Baltimore Longitudinal Study of Aging (McCrae, Costa & Busch, 1986)

(c) Revised NEO Personality Inventory facet scales from self reports by 1539adult men and women (Costa, McCrae & Dye, 1991)

It must be noted that the Five Factor Model of personality is not universally accepted (Boyle, 2008). The model has been described as overly simplistic (McAdams, 1992). Saucier and Goldberg (2001:1) argue that "it is not yet clear that this is the optimal model" for measuring individual-level personality, due to the fact that the FFM may not be cross-culturally generalisable (Boyle, 2008). Boyle (2008:296) also makes reference to the "procrustean factor-analytic techniques" that were used to determine the scale, which may perhaps provide for a "static account of personality" (Boyle, 2008: 297).

Despite its detractors, the FFM has received general wide acceptance (O'Connor, 2002). The factors Extraversion (E) and Neutoricism (N) "appear to be universally accepted" (Boyle, 2008: 300). For the purposes of this study, the FFM model was selected based on its widespread use in the psychological and human resources literature (Zuckerman, 2001; Quirk, 2003; Schouwenburg & Lay, 1995). It is however acknowledged that alternate measures of personality may have been implemented in this study.

Each of the five personality traits listed below contain two separate but correlated aspects reflecting a level of personality below the broad domains but above the many facet scales that are also a part of the model (DeYoung, Quilty & Petersen, 2007). These are included in parentheses alongside the title of each broad personality dimension, below.

2.7.4.1. Neuroticism (N) (Volatility and Withdrawal)

Neuroticism (or ‘N’) “represents individual differences in the tendency to experience distress [and generally unpleasant emotions], and in the cognitive and behavioural styles that follow from this tendency” (Costa & McCrae, 1989: 195). Neuroticism is also commonly referred to as ‘emotional instability’ and is linked closely to low tolerance for stress or aversive stimuli (Eysenck, 1967). Respondents with a high N score (those with sensitive or nervous personality characteristics) are prone to recurrent nervousness, frustration, guilt, depression, sensitivity, self-consciousness and vulnerability (Atkinson, 2014, Costa & McCrae, 1989). These attributes often associate closely to low self esteem, irrational decision-making, and poor control or coping skills (McCrae & Costa, 1987), which often results in a pessimistic approach to work and personal relationships On the other hand, respondents with low N scores (those with secure or confident personality characteristics) are generally associated with calmness, and being less emotionally reactive (McCrae & Costa, 1987), although this can also indicate lack of inspiration or unconcern.

2.7.4.2. Extraversion (E) (Enthusiasm and Assertiveness)

Extraversion describes individuals that are outgoing, energetic, sociable and assertive (Atkinson, 2014) related to energy creation from external means (Atkinson, 2014). Watson and Clark (1984) identify seven components of Extraversion (or ‘E’) including venturesomeness, affiliation, positive affectivity, energy, ascendance and ambition. Like the other 4 factors, Extraversion exists on a scale with one extreme being individuals who are outgoing, assertive or energetic and the other being individuals who are solitary or reserved (Costa & McCrae, 1989). Extraverted individuals tend to seek stimulation in the company of others and are generally talkative and action-oriented. However high extraversion can also equate to attention-seeking and domineering individuals (Costa & McCrae, 1990). Individuals with low Extraversion scores are reserved, reflective, aloof and self-absorbed (Costa & McCrae, 1989). These individuals are referred to as ‘introverts’, who require less stimulation and social interaction than extraverts (Costa & McCrae, 1989).

2.7.4.3. Agreeableness (A) (Compassion and Politeness)

The tendency to be compassionate and cooperative, rather than suspicious and antagonistic towards others is labeled Agreeableness (or ‘A) (Costa & McCrae, 1990). Agreeableness is related to “more humane aspects of humanity… characteristics such as altruism, nurturing, caring and emotional support at one end… hostility, indifference to others, self-centeredness, spitefulness and jealousy at the other” (Digman, 1990: 422). Those with a high degree of agreeableness tend to be friendly, kind, compassionate, cooperative, trusting and trustworthy. Such individuals are generally optimistic about social harmony and are willing to compromise (Costa & McCrae, 1992). However, extremely high agreeableness is sometimes associated with naivety or submissiveness (Costa & McCrae, 1989). Disagreeable individuals however are generally associated with character traits such as suspicion and skepticism. They are argumentative, competitive and less likely to be cooperative (Costa & McCrae, 1989).

Agreeableness has been shown to correlate positively with the quality of relationships with other team or group members (Barrick, Stewart, Neubert & Mount, 1998), an important indicator of ability to work in a team.

2.7.4.4. Conscientiousness (C) (Industriousness and Orderliness)

Costa and McCrae (1990: 197) describe Conscientiousness (or 'C') as a combination of "a dimension that holds impulsive behaviour in check" and also "a dimension that organises and directs behaviour." Conscientiousness is associated with the manner in which people control, regulate and direct their impulses (Costa & McCrae, 1992)

A conscientious individual is expected to be efficient, organised, dependable, self-disciplined and planned. Conscientiousness can be seen to link closely to performance (Costa & McCrae, 1992) (or, in the case of this study – productivity). Conscientiousness points to individuals who aim to achieve, are dutiful and are inclined to prefer planned, rather than spontaneous behaviour (Costa & McCrae, 1989). High levels of conscientiousness can result in individuals being viewed as stubborn or obsessive, while low conscientiousness indicates flexibility and spontaneity, which can sometimes be perceived as unreliability (Costa & McCrae, 1992).

2.7.4.5. Openness to Experience (O) (Intellect and Openness)

For Costa & McCrae (1990: 198), Openness to Experience (or 'O') "includes the aspect of 'Intellect', but is considerably broader in scope."

Openness to experience is comprised of personality traits such as inventiveness and curiosity and is said to reflect the degree of individual-level intellectual curiosity, creativity, independence, imaginativeness and a preference for variety and novelty (Atkinson, et al, 2014). Fundamentally, SGI and Open Innovation theory relates directly to openness (Callaghan, 2013; Chesbrough, 2003). Thus, it is to be expected that individuals with high levels of Openness to Experience should also have high levels of SGI propensity.

Broad in nature, Openness to Experience can be described as an appreciation for experience, related to those who are intellectually curious, open to emotion and sensitive to beauty and the pursuit of self-actualisation although these items are not mutually exclusive (Costa & McCrae, 1990). These traits can often be perceived as unpredictable or lacking in focus. Open individuals have also been noted to have a propensity to use symbols and abstractions in thinking processes, while individuals that score lower on the openness scale tend to have more concrete, conventional thinking facilities and may be resistant to change (Barrick, et al., 1998).

Cross-cultural research has uncovered differences in male and female responses to the NEO-FFI scale (McCrae, 2001). Female respondents are generally associated with higher scores in Neuroticism, Agreeableness and Openness while male respondents generally associate highly with Extraversion and Openness (McCrae, 2001).

Ozer and Benet-Martinez (2006) suggests that the Five Factor Model of personality may act as an accurate predictor of performance outcomes (in the case of this research, academic research productivity or ARP). However this view has been met with criticism. For Murphy, (2007: 685): "The problem with personality tests is … that the validity of personality measures as predictors of job performance is often

disappointingly low. The argument for using personality tests to predict performance does not strike me as convincing in the first place."

The FFM model has been found to maintain consistency across a wide range of participants, of different ages and cultures in the literature (McCrae, 2001). Despite this, the model has been subject to considerable critical scrutiny (Jakobwitz & Egan, 2006). Some have suggested that the model is limited in its capacity as an explanatory or predictive mechanism (Thomas, 1995) and that the 5 traits associated with the FFM model do not account for the 'abnormal personality trait sphere' (Thomas, 1995).

Despite the critiques of the Five Factor Model, these five dimensions of personality aptly describe the broad categorisations of individual personality for the purposes of this research and most importantly, link closely to individual-level absorptive capacity and SGI propensity. Measurement of individual personality may then provide for an accurate indication of the ability and willingness to adopt an SGI mindset, or make commercial use of external knowledge sources (Cohen & Levinthal, 1990), ultimately improving levels of productivity.

Here, Research Question A1c is introduced*: What is the relationship between Personality and SGI Propensity?*

2.7.5. Motivation

For Dawson (1986: 7) motivation is "the mainspring of behaviour; it explains why individuals choose to expend a degree of effort towards achieving particular goals." In organisational theory, one of the principal concerns is "to increase motivation in the search for greater productivity" (Thompson & McHugh, 2009: 307).

In the context of this research, the term motivation is the theoretical constrict used to explain the behaviour of academic researchers in their work environment.

2.7.5.1. Intrinsic and Extrinsic Motivation

The two most prevalent theories of motivation in the context of academic research include theories relating to intrinsic and extrinsic motivation, or 'Incentive Theory' (Clark & Wilson, 1961). Incentive theory relates to behaviourist principles of reinforcement, or "the incentive or motive to do something" (Clark & Wilson, 1961: 133).

Ryan and Deci (2000) define intrinsic motivation as the self-desire to seek out challenges, analyse one's capacity and to observe and gain new knowledge. Intrinsic motivation is driven internally, by the individual's interest in certain tasks or enjoyment in the task itself. Most importantly, intrinsic motivation occurs independently of external pressures, such as rewards (Guay, Vallerand & Blanchard, 2000). Furthermore, individuals who are intrinsically motivated are more likely to engage willingly in tasks that are likely to improve skills and capabilities (Wigfield & Guthrie, 2013).

An individual's intrinsic (or internal) motivation can be ascribed to 3 distinct contributing factors (Wigfield, Guthrie, Tonks & Perencevich, 2004). Firstly, individuals are likely to be intrinsically motivated if they attribute their achievement

to factors under their own control. This element of motivational theory is termed 'locus of control', related closely to autonomy (Wigfield, et al., 2004). Secondly, individuals are more likely to be intrinsically motivated if they believe that the skills they possess are indeed effective agents in reaching their desired goals. This is termed 'self-efficacy' beliefs (Wigfield, et al., 2004). Thirdly, individuals are more likely to be intrinsically motivated if they are interested in the task at hand; if the attainment of objectives is only a secondary motivational factor (Wigfield, et al., 2004).

Research in the field of gamification has shown the importance of intrinsic motivation in individuals achieving objectives (Radoff, 2011). Gamification techniques leverage an individual's natural desire for socialisation, learning, mastery, competition, achievement, status, self-expression, altruism or closure (Radoff, 2011), all of which can be seen to be intrinsic (or internal) motivation factors. This bears significance for SGI theory. Individuals motivated by intrinsic factors should be more likely to partake in, or make use of SGI practices.

Fostering intrinsic motivation can be laborious and often requires extensive repetition in order to generate behavioural change (Ryan & Deci, 2000). Despite this, once established, intrinsic motivation is both long lasting and self-sustaining (Ryan & Deci, 2000).

By contrast, extrinsic motivation can be considered the opposite of intrinsic motivation (Ryan & Deci, 2000). An individual that is extrinsically motivated performs tasks in order to achieve desired outcomes; motivation is driven by external factors (Gillet, Vallerand & Lafreniere, 2012). Commonly, extrinsic motivation is driven by a system of rewards and punishment (Deci, Koestner & Ryan, 1999) or by competition (Besley & Ghatak, 2003). Competition, for example, is considered an extrinsic motivational factor as the rewards (outperforming others) is independent of the intrinsic rewards (Ryan & Deci, 2000). Extrinsic rewards however may lead to a reduction in the desirability of an activity (Ryan & Deci, 2000). Removing extrinsic constraints, such as the threat of punishment or the consequences of a loss, have been found to increase an individual's levels of intrinsic interest in said task (Ryan & Deci, 2000).

2.7.5.2. Self-Determination Theory and The WEIMS (Work Extrinsic and Intrinsic Motivation Scale)

Tremblay, Blanchard, Taylor and Pelletier (2009) introduce The Work Extrinsic and Intrinsic Motivation Scale (WEIMS), an 18-item measure of work motivation, which is theoretically grounded in Deci and Ryan's (2000) self-determination theory (SDT). SDT is defined as the "nature" of motivation", or the "why of behaviour" (Deci & Ryan, 2000). Essentially, SDT theory relates to the degree to which an individual's behaviour is self-motivated and self-determined, rather than extrinsically motivated. For this reason, SDT is considered an apt fit for this research.

In SDT, the term 'internalisation' is used to describe the degree to which a motivation is internalised; the "active attempt to transform an extrinsic motive into a personally endorsed value and thus assimilate behavioural regulations that were originally external." (Ryan & Deci, 2000: 70). Deci and Ryan (2000) proposed three psychological needs to motivate the self to initiate behaviour; these needs are said to

be universal, innate and psychological and form the basis for self-motivation and personality integration to allow for optimal function and growth. They form a link between people's basic needs and their motivations (Ryan & Deci, 2000).

These three needs include i) competence, ii) relatedness and iii) autonomy, each of which is now discussed.

Competence refers to seeking to control the outcome and experience mastery of a certain task (Ryan & Deci, 2000). For example, an individual receiving positive feedback upon task completion will fulfill the individual's need for competence, thus increasing levels of intrinsic motivation (Deci, 1971). Negative feedback however, was found to have the opposite effect (Vallerand & Reid, 1984).

Relatedness refers to the desire to socialise, whether by interacting, being connected or experiencing care for other (Ryan & Deci, 2000).

Autonomy is defined as the urge to be a causal agent of one's own life and to act in harmony with one's integrated self (Ryan & Deci, 2000). Deci (1971) suggests that extrinsic rewards for behaviour may actually be detrimental to motivation, as this may undermine individual autonomy. Hence, individuals with higher levels of autonomy are more likely to be intrinsically motivated.

SDT presents a 'Continuum of Self-Determination Theory', upon which the different types of motivation exist (Ryan & Connell, 1989) and representing the degree to which goals and values have been internalised (Ryan & Deci, 2002)

Table 3: The Self-Determination Continuum (Adapted from Deci & Ryan, 2000: 237)

Behaviour	Nonself determined	Self determined				
Type of Motivation	Amotivation	Extrinsic Motivation				Intrinsic Motivation
Type of Regulation	Non-Regulation	External Regulation	Introjected Regulation	Identified Regulation	Integrated Regulation	Intrinsic Regulation
Locus of Causality	Impersonal	External	Somewhat External	Somewhat Internal	Internal	Internal

The continuum can be divided into three distinct components, each representing the different forms of motivation in SDT. These include i) Amotivation, ii) Extrinsic Motivation and iii) Intrinsic motivation.

Amotivation exists at the low-end of the continuum, and represents individuals that either "lack the intention to act or act passively" (Tremblay, et al., 2009: 214). The second component of the continuum is the External Motivation component, which itself consists of four separate sub-sections, including external regulation (ER), introjected regulation (INTRO), identified regulation (IDEN) and integrated regulation (INTEG). External regulation (ER) refers to "doing an activity only to obtain a reward" Tremblay, et al., 2009: 214). This component represents pure external motivation. Introjected Regulation (INTRO) is defined as the regulation of

behaviour through self-worth contingencies, such as self-esteem or guilt (Tremblay, et al., 2009). Identified Regulation (IDEN) refers to an individual that partake in an activity that has value or meaning to the individual (Tremblay, et al., 2009). The final component of extrinsic motivation is integrated regulation (INTEG) which Tremblay, et al. (2009: 214) define as "identifying with the value of an activity to the point that it becomes part of the individual's sense of self. This is the form of extrinsic motivation that is most fully internalised and hence, is said to be autonomous." The final component on the SDT continuum is intrinsic motivation, which refers to pure intrinsic motivation.

The WEIMS (Work Extrinsic-Intrinsic Motivation Scale), which makes use of the SDT-continuum, has been identified as a useful measure of intrinsic and extrinsic motivation in work-related situations. A series of studies conducted by Tremblay, et al. (2009), evaluated the scale in different working environments. Results show the adequacy of both construct validity and internal consistency of the scale. The usefulness of the scale is directly related to its foundation in SDT (Deci & Ryan, 2000). Tremblay, et al. (2009) cite SDT's usefulness in distinguishing between intrinsic and extrinsic motivation. Intrinsic motivation related to "doing an activity for its own sake because one finds the activity inherently interesting and satisfying" and extrinsic motivation related to "doing the activity for an instrumental reason" (Tremblay, et al., 2009:214).

Most importantly for the purpose of this research, the WEIMS scale measures *work motivation*, defined as "a set of energetic forces that originates both within as well as beyond an individual's being, to initiate work-related behaviour, and to determine its form, direction, intensity and duration" (Pinder, 1998: 11). The WEIMS scale in particular is used to measure the implicit/explicit motivation measure of work motivation (Tremblay, et al. 2009).

As previously noted, research has indicated that contributors to open source software as well as volunteers performing micro-work on Amazon's Mechanical Turk, have been found to be motivated intrinsically, independent of rewards (Lakhani & Wolf, 2003; Lakhani & von Hippel, 2003). However, very little research pertaining to the individual-level of motivation to be innovative in the academic context exists.

Here, Research Questions A1d is introduced: *what is the relationship between SGI Propensity and Motivation?*

Research Question A2 is also introduced here: *What is the interactive effect of Motivation on the relationship between SGI Propensity and ARP?*

2.7.6. Gender

It is necesary in the context of this research to discuss gender from the perspective of ascription theory. For Marwell (1975: 445) "'in every culture women and men are assigned disparate functions and patterns of behaviour well beyond those dictated by clear psychological differences."

The classical sociological view on social stratification and ascription imputes gender inequality to conflict theory (Reskin, 1986), where dominant groups (here referring to

the male gender) exercise control over resources in order to maintain privilege and exemplify the motive-based explanations. Essentially, gender inequality occurs due to individuals pursuing their own interests (Reskin, 1986), which may in turn lead to gender discrimination.

Gender may be seen to act as a proxy for the interaction between cultural standards and societal norms, which may significantly impact productivity. This is particularly relevant in the case of academia and academic research productivity.

Optimal innovation occurs at a diverse combination of males and females (Boyd, 2013). Gender diversity in R&D teams has been shown to be positviely related to generation of radical innovation (Marvel & Lee, 2011). However, research has shown perceived gender roles within the context of an organisation to have an impact on innovative behaviour – men are often perceived to be more innovative than women. (Boyd, 2013). Therefore, "gender roles… may inhibit (in the case of women) or facilitate (in the case of men) the likelihood of innovative behaviour" (Millward & Freeman, 2002: 96). Percpetions on gender roles also extend to acceptable levels of risk. Females are often expected to be more risk-averse than males (Millward & Freeman, 2002). It is well established however, that innovation stems from diversity (Smith, 2010). Combinations of input from both men and women generally result in higher levels of innovation (Boyd, 2013).

Research has indicated a gender gap in science, technology, engineering and mathematics (STEM) professions as well as in the usage of ICT exists (Samson, 2006). Bure (2007) refers to the 'glass ceiling' as well as issues relating to the instability of the professional pipeline, as precursors to the innovation gender gap. High impact factors such as i) individual encouragement and support, ii) networking opportunities and social capital, iii) geographic mobility, iv) workplace structures and flexibility and v) the proportion of men and women in teams have been shown to contribute to the 'masculinisation' of innovation in thecontext of the workplace (Bure, 2007). These factors may also contribute to the existence of a gap in spinoffs of university-based technologies into entrepreneurial start-up companies (Rosa & Dawson, 2006) and the difficulty in launching such enterprises (McAdam & Marlow, 2008).

Lower levels of technical training have been shown to have a profound impact on innovative technology uptake (Samson, 2006). However, including women in design, development and introduction of innovative products has shown higher adoption rates amongst women (Samson, 2006).

For Danilda (2011: 13), "the case for gender diversity in technology is stronger than ever." Research on the status of gender equality in innovation and technology has identifed enhanced emplyee recruitment and retention from a wider pool of skilled workers (Pugliesi, 1995), improved coprporate image and reputation (Jackall, 1988) and greater innovation and enhanced marketing opportunities (Chaves, 1996). These represent potential business advantages of employing gender-equality policy. Danilda (2011: 28) encourages "gender analysis" in order to "reveal unexploited innovative opportunities."

Discussion on women's involvement in innovation, and economic participation in general, has become increasingly important. In 2015, McKinsey Global Institue published findings proclaiming that the advancement of female equality could contribute $28 trillion of additional annual GDP by 2025 (McKinsey, 2015).

Interestingly, research on the association between gender and innovation has revealed that male and female innovation tends to differ in nature. Females tend to angle towards innovations that are largely inspired by local needs to achieve wider social ends (Blake & Hanson, 2005).

In relation to the variables in the theoretical models, consideration of gender differences in research productivity, motivation and personality are considered. Leahy (2006) notes as a general trend, females are slightly less research productive than males, in the academic context, as a result of the spillover effect stemming from 'family life', commonly associated with duties relating to maternity leave and raising children. Additionally, females tend to specialise less than males, in academic research, which may be another contributing factor to lower levels of research output in females (Leahy, 2006).

In conideration of self-determination theory, it has been suggested that the difference between males and females in levels of motivation are essentially "near-zero, thus representing negligable differences between men and women" (Fortier, 2012). In consideration of personality, based on the 'big five' NEO-FFI (Costa & McCrae, 1989) personality measurement, females were found to be more susciptible to score highly on traits such as agreeableness and neuroticism, while males were found to score more highly on traits such as extraversion and openness and differences conscientiousness were generally evenly spread (Chapman, 2007).

Here, Research Question B is introduced: *What is the interactive effect of Gender on the relationships in the theoretical model?*

2.7.7. Field of Study

The philosophy of open innovation practice has spread much further than only high technology industries (Chesbrough & Crowther, 2006). In the search for growth in revenues and for new products drives the desire for firms to adopt open innovation practices. Often the increased focus on open R&D does not occur independently, it is accompanied by an increase in internal R&D expenditure. Open innovation has spread beyond high technology industries such as IT and pharmaceuticals and many 'early adopters' in low technology industries such as consumer packaged goods and even hardware and home-improvement industries have been identified as proponents of open practice (Chesbrough & Crowther, 2006).

It is proposed that a similar precedent can be set for the SGI paradigm. Indeed, if the SGI paradigm is built on the foundations of open innovation, it can be argued that both low and high technology firms already do make use of SGI and as such, both high and low technology level fields of study, in the academic research context may display similar outcomes.

Although innovation may be more common in industries with higher dynamism (high technology), innovative firms are likely to enjoy revenue growth irrespective of the industry in which they operate (Thornhill, 2005). For high-technology firms, a highly skilled workforce contributes most significantly to innovation while low technology industry firms benefit most from investments in training (Thornhill, 2005). In the context of academic research, field of study (grouped by 'faculty') can also be considered either high or low technology, as in the commercial business sense. For the purposes of this study, respondents' primary research areas are used to categorise respondents into various groups, or 'fields of study'. Four fields of study have been defined, in accordance with the theory discussed above.

SGI theory pertains primarily to the field of health sciences, particularly virology, pharmaceuticals production and cancer and AIDS-related research (Callaghan, 2014a, 2014b, 2014c) as well as the study of biological systems, such as swarm theory, evolution and the collective mechanism (Callaghan, 2015). As such, fields of academic study that relate to these areas of inquiry are combined into a single 'field' for the purpose of the research at hand. The first field is termed Medicine and Biology and is considered a 'high technology' field, as research in these areas often rely on highly technological research methodologies and procesess.

Research in the areas of mathematics, physics, chemistry, engineering and other closely related disciplines are categorised as a second field of study, Maths and Science, relating to high-technology areas of research that investigate natural and abstract occuring phenomena through the use of complex mathematical methods and processes.

For this research, low technology fields of study are defined as those that are not as reliant on new technologies or highly mathematical processes and procedures as Medicine and Biology and Maths and Science (refered to as Field 1 and Field 2, respectively).

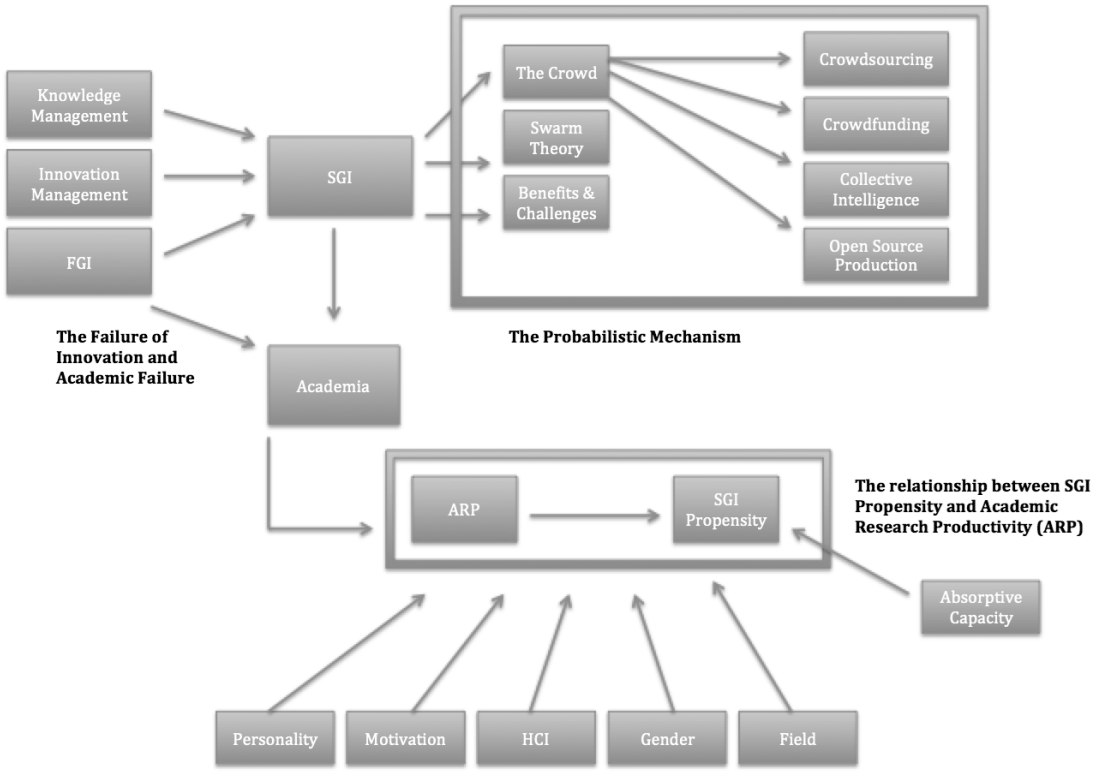
Thus, Field 3 comprimses of areas of study related most closly to law, commerce and economoic and management sciences, while field 4 comprises of areas of study related to the study of people, such as psychology, history, sociology and and languages.

Here, Research Question C is introduced: *What is the interactive effect of Field of Study on the relationships in the theoretical model?*

2.8. Diagrammatic Representation of the Literature Review

In order to clearly conceptualise a model of the theory underlying this research, Figure 6 shows the relationships between all of the important concepts and theories provided in the literature review, the manner with which they interact with one another and as a precursor to the analyses that follow.

Figure 6: Diagrammatic Representation of the Literature Review



2.9. Conclusion

In this section, theory relating to SGI theory was extensively covered. Discussion of classic innovation management and knowledge management theory was discussed as a precursor to understanding SGI theory. Open innovation, as defined by Chesbrough (2003a) was also discussed. Following this, the seminal theory of Callaghan (2014a, 2014b, 2014c, 2015a, 2015b) was discussed in relation to the probabilistic mechanism underlying SGI theory and full descriptions of the proposed SGI mechanisms, including crowdsourcing, crowdfunding and open source production. Following this, key literature pertaining to the theoretical constructs of the proposed research model was covered extensively. A comprehensive discussion of personality and motivation as psychological constructs was presented. Discussion on the theory of human capital investments and gender in the context of innovation theory was also presented. Five research questions were introduced over the course of this literature review. The methodology of this research is now presented.

CHAPTER 3

METHODOLOGY

3.1. Introduction

The details of this study's methodology are now explained in detail. The exact research methodology is described, including appropriateness of research design, location of the research in a paradigmatic sense and a description of both the qualitative and quantitative methods of research that were incorporated in the study. The population, the sample and sampling techniques, the research instruments, the data collection processes, the elements of reliability and validity will all be discussed. In addition, the minutiae of the various statistical analyses will be outlined as a means of supporting the hypotheses formulated from a review of the literature. Limitations and ethical considerations are also discussed.

3.2. Brief Overview

The purpose of this study is to evaluate the potential of SGI practices that may accelerate the rate at which innovation in the academic research context may occur. A model designed specifically to delineate the relationship between two constructs – SGI Propensity and ARP is used as a baseline to test the potential of and interest in SGI. In view of this, it was deemed appropriate to employ both qualitative and quantitative (mixed) methods (Cresswell, Plano & Clark, 2003). A purely quantitative approach was taken into consideration but rejected in favour of a mixed method due to the specific nature of the research question and the complexity of SGI theory.

The objectives of both the qualitative and quantitative studies undertaken in this research were to test theory pertaining to SGI in the context of academic research, to uncover expected associations between high performance academic research and the propensity to engage in SGI-based research. In other words, it is expected that academic researchers that are innovative are more likely to be willing to engage with SGI processes, such as crowdsourcing. The process of data collection occurred in two separate phases. First, quantitative data collection occurred, through the online distribution of a questionnaire. The findings of the empirical study were subsequently contrasted to the theoretical model derived from the SGI literature, in order to draw conclusions and make recommendations. Thereafter, the qualitative portion of the research was undertaken through a process of face-to-face and telephonic interviews, in order to further validate the findings of the empirical study.

To this end, the key research question underpinning this research is phrased as: "*what is the association between SGI propensity and academic research productivity?*"

In order to answer the proposed research question and sub-questions, five basic hypotheses have been built. These hypotheses are tested in order to provide answers to the research questions in terms of establishing the existence or non-existence of significant tested associations between the variables under study. A discussion on the paradigmatic location of the research follows.

3.3 Paradigmatic Location of the Research

Certain assumptions underpin this research. These assumptions relate to epistemology or, (the foundation of knowledge) and ontology (or, the assumptions about the nature of the phenomena to be explored) (Burrell & Morgan, 1979). According to the

classification of Burrell and Morgan (1979), this research is located at the nexus of two paradigms – interpretivism and critical realism.

In the first phase of study (quantitative research), the research paradigm rests within the parameters of post-positivism, influenced by the ideals of critical realism (Trochim, 2002). Ontologically, post-positivism is associated with critical realism, which recognises potential observation errors (Wagner, et al., 2012). Epistemologically, reality cannot be known with certainty but an attempt to reach objectivity can be achieved through using multiple methods (Trochim, 2002), as in the case of this study. Thereafter, proceeding into the second phase of the study (qualitative research), the research paradigm shifts into the interpretivist paradigm. Interpretivism is related to concepts that address understanding the world as others experience it (Wagner, Kawulic & Garner, 2012). Assumptions about the nature of reality are considered fundamentally different to those of the positivist paradigm, particularly with regard to what constitutes knowledge, its sources and values and their role in the research process (Wagner, et al., 2012). Ontologically, the premise of interpretivism relates to the interpretation of reality as being socially constructed (Creswell, et al., 2003) and that a multitude of intangible realities exists. Epistemologically, the interpretivist paradigm lends itself to the belief that knowledge is subjective (Wagner, et al., 2012). The multiplicity of reality guides the qualitative research process; open-ended, descriptive and non-directional questions (Creswell, et al., 2003) are used as a tool for extracting respondents' broad views on the topic at hand so as not to limit the enquiry (Creswell, et al., 2003). A process using subsequent probing questions (or 'sub questions') is used to further strengthen material extracted from respondents (Spradley, 1979).

It is stressed that this research does not attempt to contribute to the methodology or paradigm literature. It is also stressed and acknowledged that causality cannot be established using statistical analyses. However, this research does aim to provide a holistic perspective of the relationships in question, in the South African context.

This study is associated with Creswell's (2003: 11) perspective of "pragmatic knowledge claims… instead of methods being important, the problem is most important" but at the same time makes use of mixed methods to also "establish a rationale for the combination of methods" (Creswell, 2003: 12). This study grounds itself in Campbell and Fiske's (1959) 'convergent and discriminant validity' which proclaims the use of mixed methods to strengthen the validity of any claims that will be made.

This study also follows the assertions of Popper (1959), who makes the distinction between subjective and objective knowledge, noting that objective interpretations can be tested (unlike subjective interpretations). Thus, "every test of a theory is an attempt to falsify it, or to refute it" (Popper, 1963: 7). As such, both qualitative research and quantitative methods are used to develop theory that will thereafter be tested quantitatively (Glaser & Strauss, 1967). It is important to note that the level of significance chosen for this study is 95%.

The significance level of 5% (α= 0.05) is used as the point where the probability of making a Type I error, or rejecting a true null hypothesis was considered equal to the

probability of making a Type II error or rejecting a false null hypothesis (Edwards, 1984).

3.4. Mixed Methods

For the purpose of this study, a mixed methods approach was chosen. Mixed methods have the ability to enrich findings from quantitative analyses with insights from qualitative data and vice versa (Brown, Kennedy, Tucker, Golinelli, & Wenzel 2013). A major incentive for using mixed methods is to uncover unexpected patterns and generate new research questions (Brown, et al, 2013). Mixed methods are considered highly resource-intensive, but still appropriate given the nature of the research at hand.

The pluralistic nature of the research methodology gives both the qualitative and quantitative methodologies equal status. It has been purported that quality criteria are emphasized in mixed methods research. The use of multiple quality criteria is termed multiple validities legitimation (Onwuegbuzie & Johnson, 2006; Johnson & Christensen, 2014).

Multiple validities legitimation "refers to the extent to which the mixed methods researcher successfully addresses and resolves all relevant validity types, including the quantitative and qualitative validity types… as well as the mixed validity dimensions. In other words, the researcher must identify and address all of the relevant validity issues facing a particular research study. Successfully addressing the pertinent validity issues will help researchers produce the kinds of inferences and meta-inferences that should be made in mixed research"(Johnson & Christensen, 2014: 311).

As a strategy, mixed methods research is consdiered desirable in the case of this research, due to a number of observations. Firstly, the combination of both qualitative and quantiative methodologies allows for approaching the study from different paradigms, thus allowing for a more holistic and robust perspective (Wagner, et al., 2012). Secondly, the strengths associated with both qualitative and quantitateivr esearch are taken to be extrapolated into a mixed research methodology and will thus allow for more meaningful explanations (Wagner, et al. 2012). Thirdly, the use of mixed methods research is essentially considered pragmatic (Brown, et al. 2013).

3.5. Population and Sample

The population and sample as well as the sampling processes of both the quantitative and qualitative studies are now discussed.

3.5.1. Population and Sample of the Quantitative Study

A process of comprehensive purposive sampling, in which all potential respondents within the population was used in order to fill the expected quota of 600 academic researchers as respondents for the quantitative portion of the study.

A total of 674 questionnaires were collected. 145 questionnaires were incomplete and were hence excluded from the analysis, bringing the total sample to 529 respondents. This sample size was deemed large enough for the purpose of this research. It is

acknowledged that provision for the number of incomplete questionnaires was underestimated.

The estimated total population of active academic researchers in South Africa is estimated at approximately 16 000 (Bunting, 2015). It is acknowledged that this number is a very broad estimate. From the five universities that granted permission to the researcher, the total population is much smaller, consisting of a total of 5603 respondents. Table 4 depicts the number of estimated permanent academic staff, per university (Bunting, 2015).

Table 4: Number of permanent academic staff, per South African university (Adapted from Bunting, 2015)

University	**Number of Permanent Academic Staff (2015)**
The University of Witwatersrand	985
The University of Cape Town	961
The University of Pretoria	1655
Nelson Mandela Metropolitan University	558
The University of Kwa-Zulu Natal	1444
Total	**5603**

In order to determine the sample size, the following formula is used:

$D = z_{1-\propto/2}\sigma/\sqrt{n}$ (Krommenhoek & Galpin, 2013).

In this case, n (sample size) = 529. The standard deviation of the sample is used as a proxy of the standard deviation of the population. A sample size of 529 is considered appropriate to obtain a significant effect for the tested variables.

A significance level of five percent ($\propto = 5$) was used as the point of probability of a Type I error (Edwards, 1984).

3.5.2. Population and Sample of the Qualitative Study

The maximum heterogeneity sampling technique was used for the qualitative research in order to ensure a diverse set of leading researchers in their respective fields. Individual researchers, identified as leaders in their field of study in South Africa, were identified as respondents. This sample is referred to as the 'expert' sample. The wide variance in the nature of fields of study justifies the use of maximum heterogeneity sampling, as any shared characteristics between fields of study will have more salience. The qualitative sample comprises of 30 respondents, ranging from several universities across South Africa. Respondents were identified using the National Research Foundation (NRF) rating system, which ranks academic researchers according to their recent output (NRF, 2015). A-Rated, B-Rated and C-Rated researchers were included in the sample. Qualitative interviews took place face-to-face, telephonically or via instant video conferencing (e.g. Skype). For the purpose of qualitative interviews, respondents were approached independently of their university or institutional affiliation.

3.6. Procedure of Ethical Clearance and Research Permissions

A full proposal to conduct the research in question was submitted to the ethics committee of The University of Witwatersrand by the end of April 2015. Ethics approval was granted in May 2015. The research proposal outlined a proposed research objective and research process that would be adhered to over the course of the research and was compliant with the stipulations specified by both the School of Economics and Business Science and The University of Witwatersrand. Prior to commencement of actual data collection, permission was obtained from the relevant the universities and institutions. These universities generally required proof of registration at The University of Witwatersrand, a full research proposal and samples of the intended questionnaire and interview schedule. All certificates of permission are included in the appendix. All five universities that cleared the research required no changes to be made to either the questionnaire, or the interview schedule. These universities include the following:

i) The University of Witwatersrand
ii) The University of Kwa-Zulu Natal
iii) The University of Cape Town
iv) The University of Pretoria
v) Nelson Mandela Metropolitan University

Once permissions were obtained, data collection commenced. Data collection commenced in August 2015. Both qualitative and quantitative data collection occurred simultaneously and both concluded in March 2016. The research instruments are now discussed.

3.7. Research Instruments and Data Collection Procedures

Two research instruments were used in this study. A questionnaire was designed to measure the constructs in the theoretical model. Additionally, a schedule of interview questions was conceived from pertinent theoretical concepts, in order to validate both the theoretical model and the findings of the empirical study. Both full research instruments are included in the appendix. Once university permissions had been obtained, data collection commenced.

3.7.1. Questionnaires

The quantitative questionnaire consists of six sections. Section A contains questions designed to capture respondent's human capital investments (HCI), or biographical information and consists of 12 questions, requiring one-word answers. Section B contains 12 questions relating to ARP, also each requiring one-word answers. Section C consists of 20 scale items using a shortened version of Costa and McCrae's (1992) NEO-FFI inventory. Section D contains the SGI scale, which was derived from the literature and measures respondent's SGI propensity. Section E contains the Work Extrinsic and Intrinsic Motivation Scale (Tremblay, et al. 2009) used to measure respondent's work motivation. Finally, Section F contains a scale designed to measure respondent's job satisfaction. The full questionnaire is included in the appendix.

Blanket e-mails detailing sample participation were sent to all potential quantitative respondents. All relevant details were enclosed, including a brief description of the research to be conducted, the expected amount of time for completion, a cover letter with the contact details of the researcher and the researcher's supervisor and a full

explanation of the research procedure as well as an invitation to participate, or decline if the respondent so wished. Both a cover letter and a consent form were attached to the research instrument (questionnaire) in order to guarantee anonymity and confidentiality for all respondents. Those who responded positively were sent a second e-mail, containing a web-link to the questionnaire, which was hosted on SurveyMonkey.com, a web-based, online survey host.

All blanket emails contained a consent form with provision for digital signatures of respondent and researcher as well as acknowledgement of the participatory regulations was also included, as were copies of the Ethics Committee's clearance certificate, once obtained.

Once respondents opened the web-link contained in the email, the first page of the questionnaire became available. Brief descriptions of the study, expected completion time, consent forms, cover letters and the researcher's details were all included as attachments in the blanket email, as was ethical clearance from the University of Witwatersrand and ethical clearance from the university by which the respondent in question was employed.

3.7.2. Interviews

An interview schedule was composed by identifying dominant themes in the literature pertaining to the theoretical model under study. The interview consists of eight inter-related questions, pertaining to the theoretical constructs under study. These questions related to i) innovation in academic research, ii) funding in academic research, iii) solving real-time problems in academic research, iv) the state of academic research in relation to paradigms, v) the innovative state of journal publications in academia, vi) personality characteristics associated with innovative academic researchers and vii) motivational factors associated with innovative academic researcher. The full interview schedule is included in the appendix. Prior to the commencement of the interview, respondents were informed that the interview was expected to span between fifteen to twenty minutes. Response times varied greatly, depending on the respondent. The shortest interview was completed in ten minutes and fifteen seconds; the longest interview was completed in fifty-three minutes and twenty seconds. The average time of completion for all 30 interviews was calculated to be seventeen minutes and twenty-three seconds.

The interviews were semi-structured to allow for variations in questions, probing for richer respondent output, variations in interview structure and a free-flow of participant engagement. The interviews were unstandardised to allow for flexibility and to permit for the standardisation of meaning of questions, taking into account the research objectives. The unstandardised approach was used to allow for broad open-ended questions, which allowed for greater levels of validity and reliability as well as richer answers from respondents.

Blanket emails detailing sample participation was sent to all potential qualitative respondents. Those who respond positively were contacted to arrange convenient dates, times and, if required, locations for the interviews. The researcher took on the role as the interviewer for the qualitative portion of the research. This is because the

interviews required a high level of knowledge and understanding of the topic at hand. Interviews occurred both face-to-face and telephonically.

During interviews, respondents were asked a series of open-ended questions in a chronological fashion. Interviews were recorded using standard iOS recording software for iPhone 5, which was then transcribed later. Interviews only proceeded once prior consent of the respondents in the form of a signed Sample Participation Form was obtained. These forms were signed either digitally, or by hand, which were then scanned and emailed to the researcher. Prior to the commencement of actual data collection, a pilot study was conducted.

3.8. Pilot Study

A pilot study preceding the main observation was conducted by a verification test of the qualitative and quantitative instruments. Several colleagues were asked to test the instruments by engaging in simulated interview processes as well as completing the questionnaire, in order to determine the length and appropriateness of the instruments. At a later stage, a pilot study on the first 60 complete quantitative questionnaires collected (an estimated 10% of the total quantitative sample) was conducted in order to assess the value of the research instrument and the value of the questions to elicit the correct information to answer the primary research question as well as to ensure validity.

The pilot study (both qualitative and quantitative) was conducted in the same manner as the full study; the same methodologies as described in this chapter as well as statistical analyses were used. IBM's SPSS 22.0 software for Mac was used to analyse the data. The results of the pilot studies indicated no serious problems with either the interview schedule, or the questionnaire. On completion of the pilot study, it was evident that the research design, research instrument and characteristics of the sample were all sufficient and appropriate for the duration of the full study. Data collection continued following the conclusion of the pilot studies. Following the conclusion of data collection, data analysis commenced.

3.9. The Quantitative Analysis Process

The details pertaining to the quantitative analysis and the accompanying instrument are now discussed.

3.9.1. Research Design

This research employs a mixed methods process, using both qualitative and quantitative research methods (Wagner, et al. 201). After building a theoretical model from the literature, the model was tested empirically and qualitatively.

3.9.2. Scope of the Study

The scope of this study was specifically chosen to reflect the design of an appropriate test for SGI theory.

The scope of this research is delimited by its focus on the relationships between SGI Propensity and ARP. It also is delimited in terms of measures of ARP, which were

defined by an aggregate measure of DOHET (local but not ISI/IBSS) accredited journal article publications and ISI-IBSS accredited journal articles publications.

It is stressed that the data collection and analysis phases was firmly guided by the principles of reliability and validity. Care was taken to phrase questions neutrally, to avoid social desirability bias (Murphy & Davidshofer, 2005).

3.9.3. Reliability

Care was taken to ensure the consistency of measures used in the research (Murphy & Davidshofer, 2005). In other words, the measures that were used displayed stability, inter-reliability and inter-observer consistency (Bryman, 2004) to account for true scores as well as random errors of measurement (Murphy & Davodshofer, 2005). Cronbach's Alpha tests were used in order to assure the reliability of each of the scale measurements included in the research instrument. This ensures reliable measures that are stable and internally reliable (Bryman, 2004).

3.9.4. Validity

Validity, or the extent to which the measures in question "actually do measure what it purports to measure" (Bryman, 2004) was ensured throughout. Any information relating to convergent and discriminant validity was carefully noted. Pilot tests were conducted in order to ensure validity. There are several different types of validity, which were all pursued thoroughly. These include:

i) Content validity, which is the extent to which the item sufficiently covers the area of study (Bryman, 2004). This was ensured by making the items of the question correctly sample what is meant to be sampled.
ii) Construct validity, or the assurance that convergent and discriminant validity is held (Campbell & Fisk, 2959). This was ensured by conducting exploratory factor analyses.
iii) Face validity, the extent to which the measure does not measure what it intends to (Bryman, 2004). This was ensured by using cover letters and consent forms to be provided to all potential participants.
iv) Criterion validity, or the extent to which the measure can predict performance (Bryman, 2004). This is especially important in the case of this study and was ensured by testing relationships in order to test theory.

3.10. The Qualitative Analysis Process

The process of coding and sampling used in the qualitative research is now discussed.

3.10.1. Verification of the Qualitative Process

The following four criteria need to be met in order for qualitative research to be trustworthy (Guba, 1981: 79).

1. Truth Value [Internal Validity]: to establish confidence in the 'truth' of the findings. Truth-value was attained through the strength of the linkages between quantitative and qualitative data

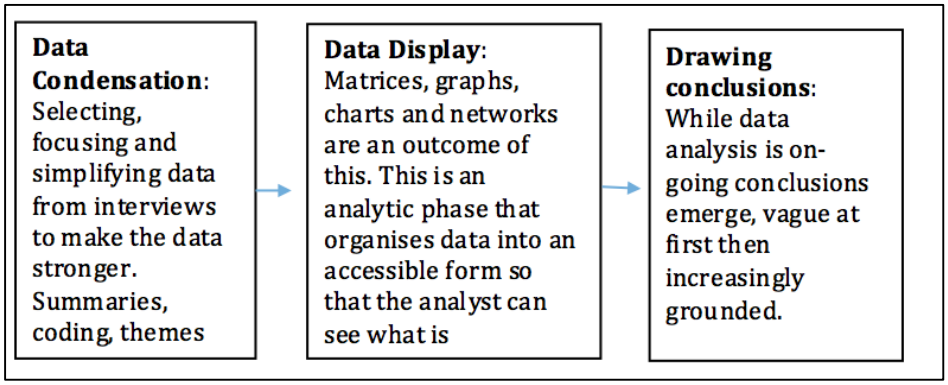
2. Applicability [External Validity/Generalisability]: to determine the extent to which the findings are applicable in different contexts or in the case of other respondents. Selecting respondents from a diverse range of fields of study and universities strengthens the applicability of this study
3. Consistency [Reliability]: to determine if the findings are replicable. By selecting diverse respondents, consistency in relationships that emerge from the qualitative research was obtained
4. Neutrality [Objectivity]: to establish the extent to which the findings are free of researcher bias. The use of a mixed methodology (Corbin & Strauss, 1967) supports neutrality.

3.10.2. Coding and Analysis

The derivation of codes from transcripts of the qualitative interviews were then developed into themes, as per the method defined by Miles and Huberman (1994) through the use of both inferential and descriptive codes. Coding resulted in the creation of the 'concept theme', which is the unit of analysis for the study. Thematic content analysis was used for the reporting and discussion of results. Interview questions were constructed to allow for sufficient probing and further exploration of responses in a flexible manner, as prescribed by Corbin and Strauss (2014).

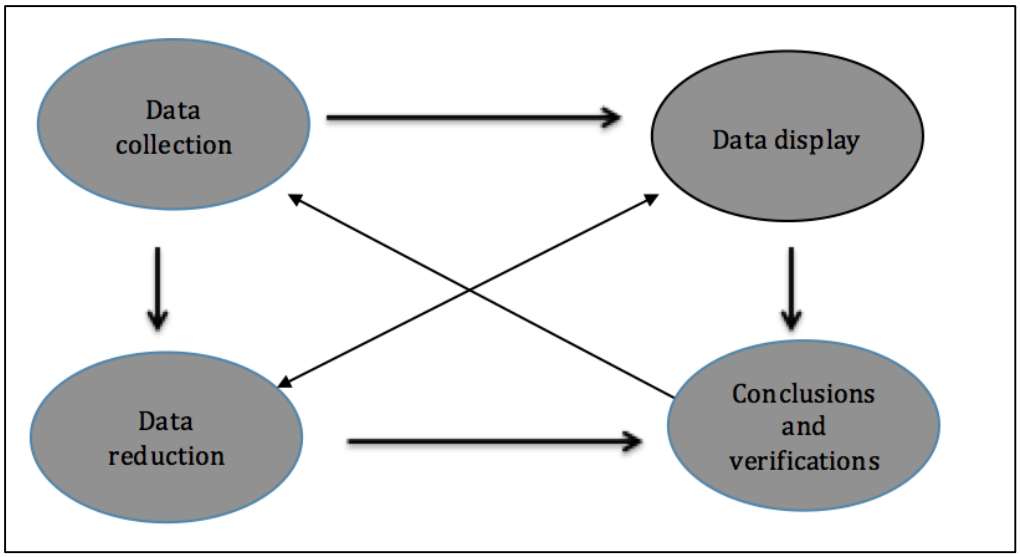
During interviews, responses were recorded and thereafter transcribed, coded and analysed. The iterative three-part process as prescribed by Miles and Huberman (2014) of qualitative data analysis are depicted below.

Figure 7: Three stages of qualitative data analysis (Adapted from Miles and Huberman, 2014: 429).



Depiction of the abovementioned modules of the cyclical qualitative analysis process in graphical form, is as follows:

Figure 8: Components of Data Analysis: Interactive Model (Adapted from Miles & Huberman, 1994: 429).



3.11. Quantitative Measures

3.11.1. NEO-FFI-R

This research assessed personality by making use of the shorter version of the Revised NEO Personality Inventory (NEO PI-R) (Costa & McCrae, 1985), namely the NEO-Five Factor Inventory (NEO-FFI) (McCrae & Costa, 2004), which has 60 items of the original 240 items from the NEO-PI-R, making use of 12 items to measure each of the five personality domains. These domains consist of Neuroticism, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience (McCrae & John, 1992). The NEO-FFI is a self-report, quick and reliable measure of the domains of the Five Factor Model and the internal consistencies were reported to be good to excellent: Neuroticism = .79, Extraversion = .79, Agreeableness = .75, Conscientiousness = .83, and Openness to experience = .80 (McCrae & Costa, 2004). In addition, the test-retest reliability shows consistency over long periods of time (McCrae & Costa, 2004).

However, a 60-item personality scale was deemed too long for the research in question. Therefore, the NEO-FFI scale has been shortened to include only 20 items (4 items per construct). This was achieved by comparing the results of several different studies that have used the 60-item version of the NEO-FFI and thereafter, extracting the items with the highest correlations (Roselinni & Brown, 2011; Aluja, Garcia & Rossier, 2004).

3.11.2. Work Extrinsic and Intrinsic Motivation Scale (WEIMS)

The WEIMS is divided into three-item six subscales, each of which corresponds to the six types of motivation in Self Determination Theory (Ryan & Deci, 2000). These include: intrinsic motivation (items 4, 8 and 15), integrated regulation (5, 10 and 18), identified regulation (1, 7 and 14), introjected regulation (6, 11 and 13) external regulation (2, 9 and 16), and amotivation (3, 12 and 17). Respondents were asked to indicate responses using a 5-point Likert scale.

The scale's Cronbach's alphas (Tremblay, et al., 2009) range from .64 to .83, suggesting adequate reliability: Intrinsic Motivation = .80, Integrated Regulation = .83, identified Regulation = .67, introjected Regulation = .70, External Regulation = .77 and Amotivation = .64.

3.11.3. Derivation of the SGI Propensity Scale

The SGI propensity construct was measured quantitatively by using a set of scale items derived from the literature. Four important dimensions of SGI are defined, including: i) crowdsourcing, ii) crowdfunding, iii) open orientation and iv) SGI propensity. Table 5 depicts the construction of the scale items, per SGI dimension. These questions were presented to respondents in the form of a 5-point Likert Scale and respondents were asked to indicate the extent to which they agree or disagree with each statement.

Table 5: Derivation of the SGI scale item questions

Crowdsourcing
1. I would make use of 'crowdsourcing' (obtaining inputs from a large undefined network of people) to help solve research problems (Brabham, 2013).
2. I would make use of 'crowdsourcing' to help complete smaller research tasks (Brabham, 2008)
3. Crowdsourcing would not improve my research productivity [R] (Saparito, 2013).
4. Crowdsourcing probably will not improve the quality of solutions to research problems [R] (Lawton, 2006).
5. I am concerned about quality control and validity issues of crowdsourcing (Wang, et al., 2011).
Crowdfunding
1. I would use crowd-funding (obtaining funds from a large undefined network of people to reach a monetary goal, e.g. KickStarter) to obtain research funds (Drake, 2014)
2. My research does not face budget/funding constraints [R] (Callaghan, 2014).
3. People around the world would not be interested in funding my research [R] (Callaghan, 2014).
4. I am open to using alternate methods of research funding (Torr-Brown, 2013).
5. Access to greater funds would greatly enhance my research productivity (Callaghan, 2014).
Open Orientation
1. External knowledge is essential in building new knowledge (Cohen & Levinthal, 1990).
2. My research would benefit from perspectives from people from different fields of expertise (Chesbrough, 2003).
3. Smaller teams would be more adept at solving problems rather than large numbers of people [R] (Yu & Nickerson, 2011).
4. External sources of knowledge (non-academic) would help improve my research productivity (Chesbrough, 2003).
5. Collaboration would not particularly help improve my research productivity [R] (Chesbrough, 2003).
SGI
1. Contemporary research methods are often not useful for solving practical problems (Callaghan, 2014).
2. My research requires problems to be solved in 'real time' (as the problem occurs) (Callaghan, 2014).
3. My research does not have potential to help solve societal problems [R] (Callaghan, 2014).
4. I believe contemporary research practices are flawed (Callaghan, 2014; McKenna, 2014).
5. I often pursue research projects that are high risk [R] (Callaghan, 2014).

Note: [R] denotes a reversed scale item.

3.11.4. Academic Research Productivity (ARP)

In order to measure academic research productivity, 11 measures of productivity were introduced in the questionnaire. These included: number of masters students supervised, number of PhD students supervised, number of internationally-accredited (ISI/IBSS) journal articles published, number of locally-accredited (DOHET) journal articles published, number of co-authored journal articles published, number of peer-reviewed conference proceedings published, number of conference presentations made, number of text books written, number of academic books written, number of academic text book chapters written and number of text book chapters written. For the purpose of measuring ARP, an aggregate total of internationally accredited (ISI/IBSS) journal articles publications and locally accredited (DOHET) journal article publications was used to measure of ARP, since these are both units that are quantity based measures.

Academia may be inherently non-innovative (Kuhn, 1970), or resistant to innovative change (Camparino, 2009). As a result, academic researchers may over time, become less innovative. Measures such as supervisory productivity, conference proceedings and presentations and book publication may not be subject to the same level of stringency (the effect of 'gatekeepers') as journal publications and hence may not represent a true reflection of ARP. For this reason, only journal publications are used as a measurement of ARP.

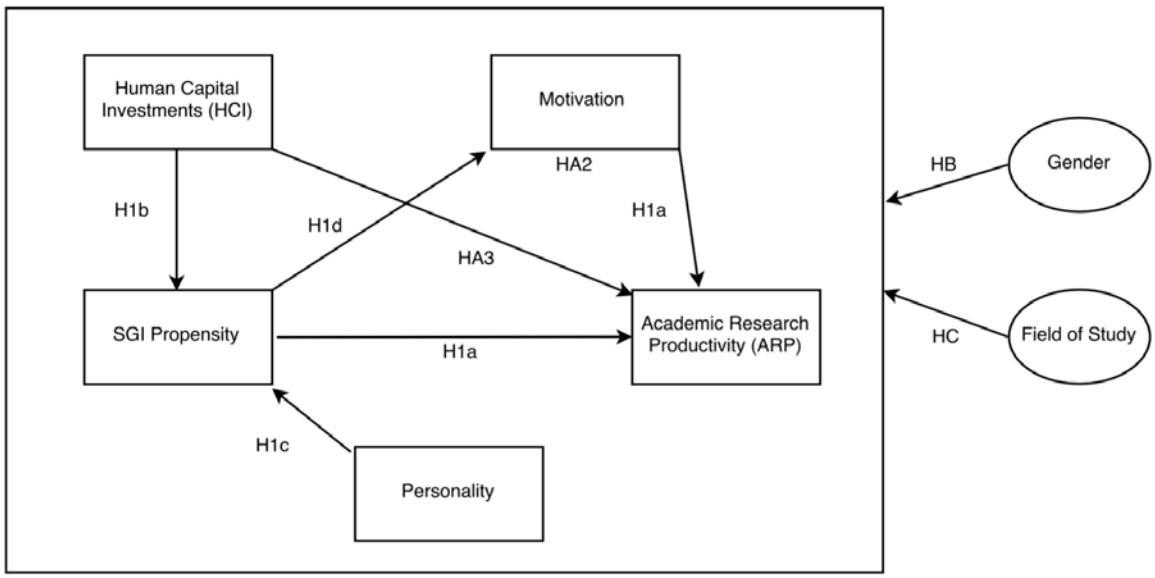
3.12. Quantitative Data Analysis

Following completion of quantitative data collection, data was analysed. Exploratory factor analyses and multiple hierarchical linear regressions were used to analyse the data. Thereafter, tests of moderation and mediation were conducted (Baron & Kenny, 1986). All statistical tests were conducted using IBM's SPSS 22.0 for Mac software.

3.12.1. Hypotheses

The overarching research question of this study is: *what is the relationship between SGI propensity and, personality, motivation and academic research performance (ARP)?* From this core research question, specific subordinate research questions and hypotheses were derived. The hypotheses, in relation to the theoretical model, are provided below.

Figure 9: Theoretical Model



Hypothesis A1a: SGI Propensity is significantly associated with ARP. This hypothesis was tested using hierarchical multiple regression (Field, 2012). Bivariate correlations were also conducted.
Hypothesis A1b: Human Capital Investments (HCI) are significantly associated with SGI Propensity. This hypothesis was tested using hierarchical multiple regression (Field, 2012). Bivariate correlations were also conducted.
Hypothesis A1c: Personality is significantly associated with SGI Propensity. This hypothesis was tested using hierarchical multiple regression (Field, 2012). Bivariate correlations were also conducted.
Hypothesis A1d: Motivation is significantly associated with SGI Propensity. This hypothesis was tested using hierarchical multiple regression (Field, 2012). Bivariate correlations were also conducted.

Hypothesis A2a: Amotivation mediates the relationship between SGI Propensity and ARP. This hypothesis was tested using a test of mediation (Baron & Kenny, 1986).
Hypothesis A2b: External Regulation mediates the relationship between SGI Propensity and ARP. This hypothesis was tested using a test of mediation (Baron & Kenny, 1986).
Hypothesis A2c: Introjected Regulation mediates the relationship between SGI Propensity and ARP. This hypothesis was tested using a test of mediation (Baron & Kenny, 1986).
Hypothesis A2d: Identified Regulation mediates the relationship between SGI Propensity and ARP. This hypothesis was tested using a test of mediation (Baron & Kenny, 1986).
Hypothesis A2e: Integrated Regulation mediates the relationship between SGI Propensity and ARP. This hypothesis was tested using a test of mediation (Baron & Kenny, 1986).

Hypothesis A2f: Intrinsic Motivation mediates the relationship between SGI Propensity and ARP. This hypothesis was tested using a test of mediation (Baron & Kenny, 1986).

Hypothesis A3: HCI are significantly associated with ARP. This hypothesis was tested using hierarchical multiple regression (Field, 2012). Bivariate correlations were also conducted.

Hypothesis B1: Gender moderates the relationship between SGI Propensity and ARP. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).
Hypothesis B2: Gender moderates the relationship between HCI and SGI Propensity. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).
Hypothesis B3: Gender moderates the relationship between Personality and SGI Propensity. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).
Hypothesis B4: Gender moderates the relationship between Motivation and SGI Propensity. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).
Hypothesis B5: Gender moderates the relationship between HCI and ARP. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).

Hypothesis C1: Field of Study moderates the relationship between SGI Propensity and ARP. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).
Hypothesis C2: Field of Study moderates the relationship between HCI and SGI Propensity. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).
Hypothesis C3: Field of Study moderates the relationship between Personality and SGI Propensity. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).
Hypothesis C4: Field of Study moderates the relationship between Motivation and SGI Propensity. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).
Hypothesis C5: Field of Study moderates the relationship between HCI and ARP. This hypothesis was tested using a test of moderation (Baron & Kenny, 1986).

It is important to note that these hypotheses were formally derived in the literature review section. The measurement of these variables also forms the basis of the research hypothesis. In its null form, the research hypothesis is stated as: *SGI propensity is significantly associated with ARP*. A significance level of 5% was used to accept or reject the research hypothesis.

3.12.2. Stages of Statistical Data Analysis

The following pertains to the precise method of how the data was processed and then analysed. The process of quantitative data analysis was apportioned into three areas – a univariate analysis (descriptive statistics), a bivariate analysis (correlations) and a multivariate analysis (factor analyses and regressions). Thereafter, tests of moderation

and mediation were conducted. All statistical tests were conducted using IBM's SPSS 22.0 for Mac software.

3.12.2.1 Univariate Analysis

Descriptive statistics enable the researcher to summarise and organise the data in an efficient and meaningful way (Ghauri & Gronhaug, 2010). According to Babi, Griffen and Zikmund (2010), calculating the averages, the frequency distributions and the percentage distributions of the collected data are the most common methods of summarising the data. The data is organised into a frequency distribution as a way of organising it into a logical order (Howell, 2008). This distribution shows how the variables are tabulated (Howell, 2008). The determination of the central tendency describes the centre of a frequency distribution of observations as measured by the mean, mode and median (Field, 2012). The univariate data is represented with a frequency distribution; the normal distribution will be checked using a histogram. Each biographical variable was measured in this fashion. Biographical variables include: age, gender, country of birth, first language, years of research experience, title, marital status, number of children supported in family, field of study, university affiliation, years of education, years of father's education and years of mother's education. It must be noted that biographical variables were used subsequently as covariate factors in the hierarchical multiple regressions. Descriptive statistics pertaining to the individual measures of academic research productivity (ARP) are also included.

Exploratory Factor Analyses (EFA) were conducted on each research-instrument Likert-scales – SGI Propensity, Personality and Motivation in order "to summarise the data in fewer dimensions" (Galpin & Krommenhoek, 2014: 433) or to uncover underlying latent variables (Field, 2012). Respective Cronbach's Alpha scores are also provided to measure scale reliability.

3.12.2.2. Bivariate Analysis

In order to determine the empirical association amongst variables, bivariate analysis (between 2 variables) was performed (Field, 2012). For the purpose of this study, non-parametric procedures were implemented as there were no underlying asumptions of the sampling distribution being normally distributed (Field, 2012), as per the results of the univariate analysis. The kurtosis identified in the univariate analysis was indicative of the suitability of using the Spearman's Correlation coefficient (Field, 2012).

3.12.2.3. Multivariate Analysis

Multivariate tests often relate to the analysis of several dependant variables that are of equal importance, occurring in situations of complex-interrelationships (Galpin & Krommenhoek, 2014: 423). Prior to discussion of the multiple linear regression employed in this research, it is important to discuss the model selection criteria.

A 'good' model chosen for empirical analysis should satisfy the following six criteria (Hendry & Richard, 1983):

1. *Be data admissible*: predictions made from the model must be logically possible.
2. *Be consistent with theory*: the model must make good economic sense.
3. *Have weakly exogenous regressors*: the explanatory variables (regressors) must be uncorrelated with the error term.
4. *Exhibit parameter constancy*: the values of the parameters should be stable (Friedman, 1953).
5. *Exhibit data coherency*: the residuals estimated from the model must be purely random, to avoid specification error.
6. *Be encompassing*: other models cannot be an improvement over the chosen model.

Hierarchical Multiple Linear Regression was used "to cover the prediction or estimation of the response variable from a number of predictor variables" (Galpin & Krommenhoek, 2014: 301) and was conducted on all derived sub hypotheses. Essentially, regression refers to the process whereby a linear model is fitted to the data, and then used to predict values of an outcome variable (dependent variable) from one or more predictor variables (Field, 2012). The general form of the regression equation is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon$$

Where Y represents the outcome variable and X represents each predictor variable. Each predictor has a regression coefficient (or, 'β'), where "β_0 is the value of the outcome when all predictors are zero" (Field, 2012: 880).

There are several criteria that have been used to compare models for forecasting purposes in this research, most importantly the value of R^2 and the value of the adjusted R^2. Both these criteria are used to minimise the residual sum of squares (RSS), or increasing the R^2 value (Guajarati & Porter, 2009).

The R^2 Criterion

One of the measures of a goodness of fit of a regression model is R^2, which is defined as:

$$R^2 = \frac{ESS}{TSS} = 1 - \frac{RSS}{TSS}$$

R^2 defined, lies between 0 and 1. The closerR^2 gets to 1, the better the fit. There are three problems that arise in the measurement of R^2. Firstly R^2 measures in-sample goodness of fit, in the sense of how close an estimated Y value is to its actual value in the given sample. Secondly, in comparing the two or more R^2's, the dependent variable, or regressand, must be the same. Thirdly and most importantly, an R^2 value cannot decrease when more variables are added to the model. Therefore, adding more variables to the model may increase R^2 but simultaneously, may also increase the variance of forecast error (Guajarati & Porter, 2009).

Adjusted R^2

As a penalty for adding regressors to increase the R^2 value, the adjusted R^2 was developed (denoted as $\overline{R^2}$).

$$\overline{R^2} = 1 - \frac{RSS\ /\ (n-k)}{TSS/(n-1)} = 1 - (1 - R^2)\ \frac{n-1}{n-k}$$

$\overline{R^2} \leq R^2$, Showing how the adjusted R^2 penalises for adding more regressors. Unlike R^2 , the adjusted R^2 will increase only if the absolute value of the added variable is greater than 1. For comparative purposes therefore, adjusted R^2 is a better measure than R^2. However, it is important that the regressand is the same for the comparison to be valid (Gujarati & Porter, 2009).

Assumptions of Multiple Linear Regression

The multiple linear regression model makes 5 assumptions (Guajarati & Porter, 2009), as follows:

Assumption 1: *Linear Relationship.*
The relationship between the dependant and independent variable must be linear in nature. This assumption was checked by visual examination of scatter plots (Gujarati & Porter, 2009).

Assumption 2: *Multivariate Normality.*
All variables need to be normal. This assumption was checked by the use of the goodness of fit test. The Kolmogorov-Smirnoff test was used in this research to test goodness of fit (Gujarati & Porter, 2009). In order to further check the assumption of multivariate normality, a process of outlier detection and removal was performed during the tests of hierarchical multiple regression (Krommenhoek & Galpin, 2014). The following methods were used to determine outliers, which were removed from the data. Outliers are considered data points that do not conform to normality (Field, 2012). Tests of hierarchical multiple regression were performed both before and after outlier removal in order to compare the differences in multivariate normality (Krommenhoek & Galpin, 2014).

Table 6: Summary of Outlier Detection

	Limits	**Calculation**
Standardised Residuals	Values outside of |3|	Standard (Fields, 2012)
Cook's Distance	Values > 1	Standard (Fields, 2012)
Leverage	Values >0.026	2p/n
Mahalanobis	Values > 25	Standard for large sample sizes (Fields, 2012)
DFFITS	[-0.23; +0.23]	$\pm 2\sqrt{p/n}$
DFBETAS	[-0.09; +0.09]	$\pm 2/\sqrt{n}$
Covariance Ratio	[0.96; 1.03]	$1 \pm 3p/n$

Assumption 3: *Multicollinearity*
Multicollinearity occurs when the independent variables are not independent from each other and the error of the mean must be uncorrelated. In other words, the standard error of the dependant variable is independent from the independent variables (Gujarati & Porter, 2009).

The occurrence of multicollinearity was checked against 4 criteria, as follows:

1. Correlation matrix: correlation coefficients of independent variables greater than 0.8 signals multicollinearity. This value can be checked when computing the matrix of Pearson's bivariate Correlation (Gujarati & Porter, 2009).
2. Tolerance: tolerance is the measure of influence of one independent variable on the other independent variables in the model, defined as T = 1 - R^2. T< 0.01 indicates multicollinearity. (Gujarati & Porter, 2009).
3. Variance Inflation Factor (VIF): A VIF greater than 10 indicates multicollinearity (Gujarati & Porter, 2009). SPSS provides VIF values.
4. Condition Index (CI): calculated through the use of a factor analysis on the independent variable. CI > 30 indicates high levels of multicollinearity (Gujarati & Porter, 2009).

Multicollinearity is notoriously difficult to remedy (Gujarati & Porter, 2009). For Blancahrd (1998): "multicollinearity is god's will." However, Gujarati and Porter offer 2 remedial measures to counteract multicollinearity, either to "do nothing" (Gujarati & Porter, 2009: 331) or to follow several rules of thumb, all of which will not be listed here. For the purpose of this research, the occurrence of multicollinearity was managed by using exploratory factor analyses to insure independence of the factors in the linear regression analysis (Gujarati & Porter, 2009).

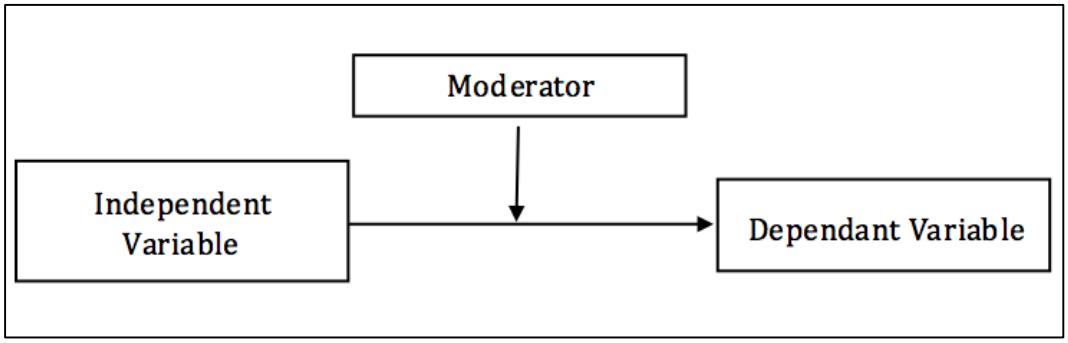
Assumption 4: *Autocorrelation*
Multiple linear regression requires that there is little to no autocorrelation in the data Gujarati & Porter, 2009). The occurrence of autocorrelation can be attributed to residuals that are not independent from each other. If this occurs, autocorrelation is present. This assumption was checked with the use of the Durbin-Watson's d, which tests the null hypothesis that the residuals are not linearly autocorrelated. The general rule of thumb applied to Durbin-Watson's d is that absolute values 1.5 < d <2.5 indicates no autocorrelation (Gujarati & Porter, 2009).

Assumption 5: *Homoscedasticity*
Homoscedasticity occurs if the error term along the regression line is equal (Guajarati & Porter, 2009). The Goldfield-Quandt test was used to test for homoscedasticity. This test splits the regression data into high and low values in order to detect significantly different samples (Gujarati & Porter, 2009).

3.12.2.4. Moderation

The term 'moderation' is used to describe the effect of a variable on the relationship between two other variables (MacKinnon, 2008). For Field (2012: 407), "moderation occurs when the relationship between the variables changes as a function of a third variable," as per the diagram below. The moderator variables under study in this research include gender and field of study, relating to hypotheses B and C, respectively.

Figure 10: The interactive effect of a moderating variable



The regression model, amended to include a moderating variable is as follows:

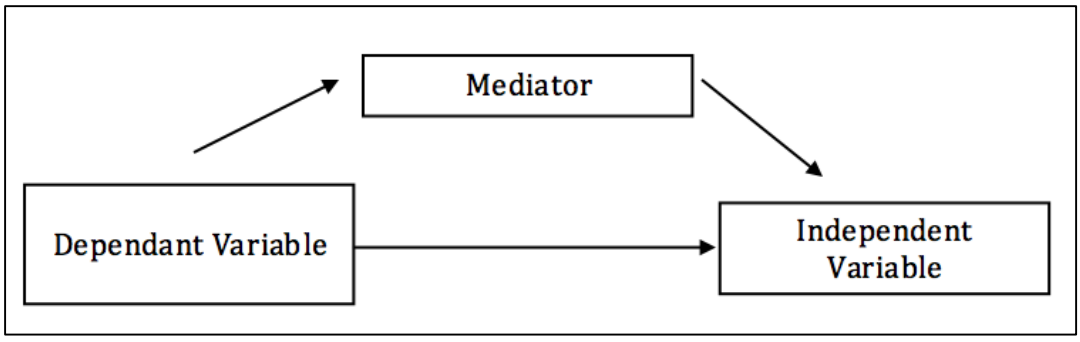
$Y_i = (b_0 + b_1A_i + b_2B_i + b_3C_i + b_5ABC_i) + \varepsilon_i$

Tests of mediation were performed for hypotheses B and C, using the method prescribed by Baron & Kenny (1986). These tests of moderation were conducted in order to find the potential interactive effect of gender (Hypothesis A3) and the potential interactive effect of 'Field of Study' (Hypothesis C) on Academic Research Productivity.

3.12.2.5. Mediation

Mediation is the term used to refer to the variable that "serves to clarify the nature of the relationship between the independent and dependant variables" (MacKinnon, 2008: 447). Essentially, this means that a mediator variable is one that influences the relationship between a dependant and independent variable, which in turn influences the mediating variable itself. This interaction is depicted in the diagram below.

Fig 11: The interactive effect of the mediating variable



A mediation analysis can be used to help deepen understanding of a relationship by exploring the underlying mechanisms by which one variable influences another, through a mediator variable (Cohen, Cohen, West & Aiken, 2003). Baron and Kenny's (1986) three-step process for mediation was employed in testing the mediating effect Motivation on the proposed relationships in the theoretical model.

It is also important to note that the Sobel test was administered for each test of mediation, in order to determine if the mediation effects were significant (Sobel, 1982).

3.13 Qualitative Data Analysis

The analysis of qualitative data followed the method prescribed by Corbin and Strauss (2008). This method stipulates a process of four successive steps.

The first step, 'analysis', pertains to reading through qualitative interview transcriptions. This is followed by a process of coding, where sections of data that contain similar themes and motifs are grouped together and labelled. Ultimately, a list of coded themes, or concepts was compiled, as they emerged from the data.

The second step is called 'elaborating analysis. In this step, axial coding, or "crosscutting or relating concepts to each other" (Corbin & Strauss, 2008: 195) was used to identify and analyse linkages between the concepts and themes that emerged in step 1.

The third step – 'integrating categories' – involves the development of conceptual framework, built from the emergent conceptual themes. The fourth and final step 'writing up' refers to the presentation of concepts into a holistic model of concepts.

3.14. Ethical Considerations

The researcher placed emphasis on the ethical issues at stake over the course of this study, specifically concerning the rights of the participants. A process of assessment was conducted in order to ensure participants were not exposed to any potential risk. Care was taken to include ethical conduct towards respondent's information and honest reporting of subsequent results. The ethical measures in this investigation included consent, confidentiality and anonymity, privacy, dissemination of results and the right to withdraw from the study at any time. The researcher's contact details were left with the respondents for any further questions or concerns.

3.15. Limitations

It is acknowledged that sample limitations exist. Many potential respondents refused or declined to participate, which may have skewed the representivity of the sample. There were no serious ethical limitations associated with this research, although it is acknowledged that some data collected from respondents may have been exaggerated or false. The nature of this research was primarily exploratory. The quantitative research instrument was formulated and administered to over 2000 academic researchers across South Africa, at the same institutions as mentioned above. In total, 675 respondents responded to the questionnaire. However only 529 respondents completed the questionnaire to a suitable extent. Those questionnaires that were not fully completed were discarded and excluded from the analysis.

Causality limitations were expected to form a limitation of this research. No attempt was made to explain the exact causes of certain phenomena. In the context of social research, the impossibility of measuring every single variable that may influence research productivity and personality is acknowledged. An attempt to include

justifiable measures of research productivity and personality was made. Common method bias was tested, by administering the Harmon test to the data (Podsakoff, et al. 2003).

3.16. Conclusion

In this section, the methodology applied in this research was introduced and discussed. Both the qualitative and quantitative research components were introduced and the research was located in relation to a suitable paradigm. The mixed methodologies approach was described. The method of testing the theoretical model empirically, then further testing those results with the qualitative research was described.

Discussion pertaining to the research design, the scope of the study and the study population and sample was provided. The sampling process and sample size calculation was discussed. Reliability and validity were also discussed. The verification of the qualitative process was discussed. The process of qualitative analysis was explained in relation to coding, analysing and the qualitative sampling process.

The hypotheses were introduced, in relation to the statistical methods and measures use to test them. The process used to formulate the SGI propensity scale and the inclusions of the WEIMS and reduced NEO-FFI scales were also explained. Potential limitations and delimitations of the research were discussed. Ethical considerations were also provided.

Having introduced and discussed the methodology of this research, the results are now reported. This chapter will extend the literature review and methodology chapters into an investigation of phenomena previously reviewed. The quantitative results are reported in Chapter 4 and the qualitative results are reported in Chapter 5.

CHAPTER 4

QUANTITATIVE RESULTS

4.1. Introduction

Chapter 3 pertained to the research methodology and design. Chapter 4 is now presented to analyses and interpret the findings of the empirical investigation. This chapter focuses on the statistical analyses of the study, which were conducted with the use of IBM's SPSS 22.0 software for Mac.

This chapter is sub-divided into sections. Firstly univariate, or descriptive statistics and frequencies will be presented. Thereafter, an assessment of the Likert scales used in this study will be provided including a detailed description of the exploratory factor analyses used. Next, the results of the results of the correlation analyses combined with the results of the multivariate analyses will be reported in relation to the research hypotheses. The results of the tests of moderation and mediation will also be reported in relation to the research hypotheses.

It is stressed that all statistical tests conducted follow the precedent in the literature and are guided by theory. Discussion on missing data now follows.

4.2. Missing Data

In total, 674 questionnaires were collected. However, 145 questionnaires were incomplete and were hence excluded from the analysis, bringing the total sample to 529 respondents. This sample size was deemed large enough for the purpose of this research. Still, some respondents left several questions unanswered. Table 7 shows missing values for age, years of experience as a researcher and the measures of ARP.

Table 7: Missing Values

Variable	Case numbers	Total Missing Values	Percentage of Sample	Procedure
Age	391, 268, 80	3	<10%	Replaced with mean value (44.0)
Years as Researcher (Experience, or HCI)	43, 47, 62, 73, 80, 156, 167, 237, 240, 291, 343, 391, 399, 158	14	<10%	Replaced with mean value (14.0)
Locally published Journal Articles	3, 19, 135, 164, 167, 171, 238, 245, 246, 258, 268, 285, 286, 235, 363, 375, 376, 377, 389, 391, 395, 396, 398, 402, 416, 418, 422, 423, 425, 429, 431, 432, 453, 460, 465, 470	36	<10%	Replaced with mean value (8.13)
Internationally published Journal Articles	8, 13, 27, 34, 135, 156, 159, 167, 171, 173, 174, 192, 224, 243, 258, 268, 270, 274, 303, 306, 317, 375, 376, 377, 389, 391, 395, 396, 398, 403, 417, 418, 422, 423, 425, 430, 433, 447, 482, 499	40	<10%	Replaced with mean value (14.31)

For both age, and years of experience as a researcher, the total missing value accounted for less than 10% of the total sample. As such, it was deemed appropriate

to replace missing data with mean values (Dong & Peng, 2013). Missing values in the Likert Scale questions were also replaced with mean values (Dong & Peng, 2013).

For variables pertaining to ARP (Academic Research Productivity), all missing values accounted for less than 10% of the total sample. These were replaced with mean values (Dong & Pend, 2013).

4.3. Univariate Analysis

A univariate analysis was performed on the data. This section contains the descriptive statistics and frequencies pertaining to the biographical variables, to be used as covariates in later statistical tests. The findings of the Univariate analyses are summarised in tables. The descriptive statistics on each of these variables is summarised in table form, in the order they were presented to respondents in the questionnaire instrument (See Appendix for full questionnaire).

4.3.1. Age

Question: What is your age?

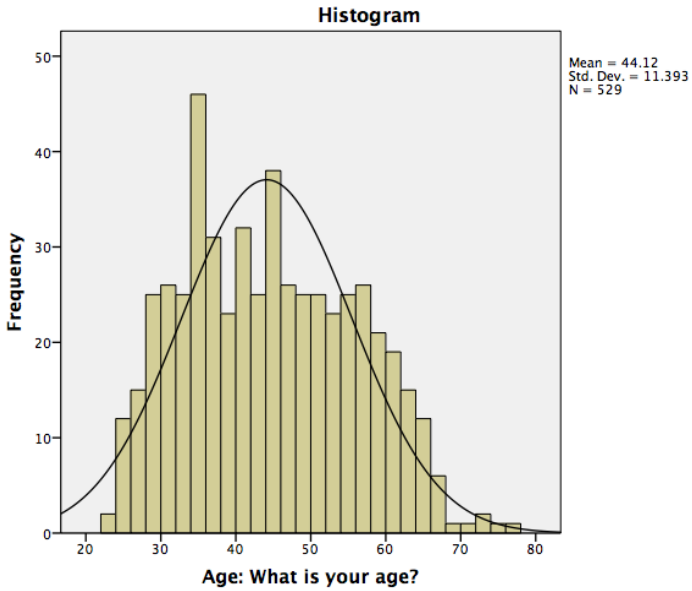
Table 8: Descriptive Statistics: Age

N	Valid	529
	Missing	0
Mean		44.12
Median		44.00
Mode		35
Std. Deviation		11.393
Skewness		.234
Std. Error of Skewness		.106
Kurtosis		-.828
Std. Error of Kurtosis		.212
Range		53
Minimum		23
Maximum		76

N = Sample Size
Std. = Standard

Table 8 shows that the mean age of the respondents was 44.12, but the median age was 44.00. The oldest respondent was 76 years old, the youngest 23. The sample is relatively well distributed, as seen in the histogram below.

Figure 12: Distribution of sample's age, with normal curve drawn over histogram



4.3.2. Gender

Question: What is your gender?

Table 9: Frequencies: Gender

		Frequency	Percent	Valid Percent
Valid	0 (female)	268	50.7	50.8
	1 (male)	260	49.1	49.2
	Total	528	99.8	100.0
Missing	System	1	.2	
Total		529	100.0	

Table 9 shows that male participants accounted for 50.7% of the respondents, while female participants accounted for 49.2% of the respondents, indicating a relatively evenly distributed gender distribution.

4.3.3. Nationality

Question: What country were you born in?

Table 10: Frequencies: Nationality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	387	73.2	73.2	73.2
	2	71	13.4	13.4	86.6
	3	48	9.1	9.1	95.7
	4	23	4.3	4.3	100.0
	Total	529	100.0	100.0	

Nat1: South African
Nat2: Rest of Africa
Nat3: European
Nat4: Rest of World

Table 10 shows that the dominant nationality is South African, which makes up 73% of the total nationality group, followed by Rest of Africa (defined as being born in any African country excluding South Africa) at 13.4%. Other nationalities made up for a smaller percentage of the total sample; Europeans at 9.1% and 4.3% from the 'Rest of World', which comprises of countries outside of Africa and Europe.

4.3.4. Language

Question: what language was spoken in your home when you were a child?

Table 11: Frequencies: Language

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.0	237	44.8	44.8	46.3
	2.0	148	28.0	28.0	74.3
	3.0	11	2.1	2.1	76.4
	4.0	9	1.7	1.7	78.1
	5.0	59	11.2	11.2	89.2
	6.0	57	10.8	10.8	100.0
Total		529	100.0	100.0	

1: English
2: Afrikaans
3: Xhosa
4: Zulu
5: Other South African Language
6: Foreign

Table 11 shows that the largest portion of the respondents were native English-speakers, accounting for 44.8% of the total sample. The most common official South African languages, besides English where Afrikaans, Xhosa and Zulu at 28%, 2.1% and 1.7% respectively. Other South African languages (including Ndebele, Northern

Sotho, Sotho, Swazi, Tsonga and Venda) accounted for 11.2% of the total sample, while 10.8% of the sample consists of foreign language speakers.

4.3.5. Human Capital Investments (Years of Experience)

Question: How many years have you been a researcher?

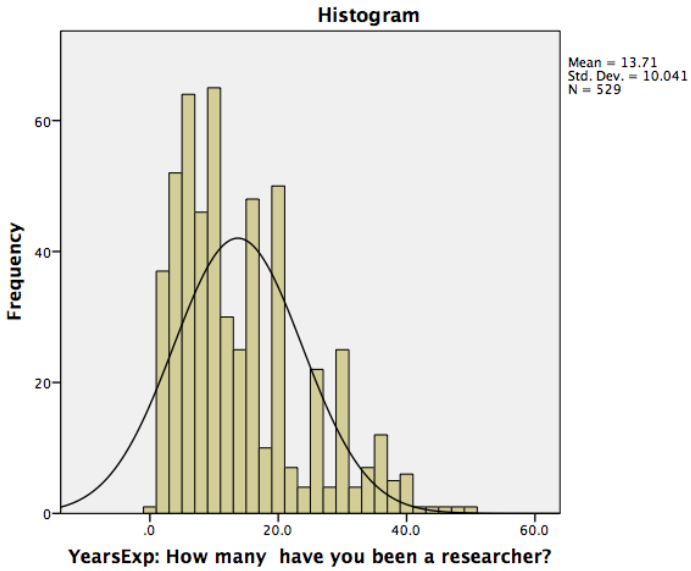
Human Capital Investments (HCI) is a measure of individual-level intangible investments that would result in a 'return on investment' through improved performance (Becker, 1962). HCI was measured by the number of years of research experience of respondents. Originally, age was included in this measurement but caused high levels of multicollinearity. The test for correlation between Age and Experience is included later in this chapter.

Table 12: Descriptive Statistics: HCI (Years of Research Experience)

N	Valid	529
	Missing	0
Mean		13.709
Median		10.000
Mode		10.0
Std. Deviation		10.0411
Skewness		.991
Std. Error of Skewness		.106
Kurtosis		.378
Std. Error of Kurtosis		.212
Range		50.0
Minimum		.0
Maximum		50.0

Table 12 indicates the mean value of years of research experience to be 13.71, indicating a relatively well-experienced sample of respondents. The median however, is 10.00.

Figure 13: Distribution of Years of Experience with normal curve drawn over histogram



4.3.6. Title

Question: what is your title?

Table 13: Frequencies: Title

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	140	26.5	26.5	26.5
	2	225	42.5	42.5	69.0
	3	55	10.4	10.4	79.4
	4	109	20.6	20.6	100.0
	Total	529	100.0	100.0	

1: Mr./Mrs./Ms.
2: Dr.
3: Adjunct/Associate Prof.
4: Prof.

The majority of respondents (42.5%) had attained PhDs, a further 30.6% were professors and only 10.4% were associate/adjunct professors. Those with a master's degree (or lower) accounted for 26.5% of the sample.

4.3.7. Marital Status

Question: are you married?

Table 14: Marital Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 (single)	182	34.4	34.4	34.4
	1 (married)	347	65.6	65.6	100.0
	Total	529	100.0	100.0	

The majority of respondents (65.6%) were married; the other 34.4% were not married. This question was asked with the intention of uncovering the effects of spillovers, which may be attributable to marital status.

4.3.8. Children

Table 15: Descriptive Statistics: Children

Question: how many children do you support in your family?

N	Valid	529
	Missing	0
Mean		1.22
Median		1.00
Mode		0
Std. Deviation		1.320
Skewness		.938
Std. Error of Skewness		.106
Kurtosis		.638
Std. Error of Kurtosis		.212
Minimum		0
Maximum		6

Table 16: Frequencies: Children

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 (none)	230	43.5	43.5	43.5
	1 (1-6 children)	299	56.5	56.5	100.0
	Total	529	100.0	100.0	

The majority of respondents (56.5%) support at least 1 child and at most 6 children in their family, while the remaining 43.5% do not support any children. This question was asked with the intention of uncovering spillovers resulting from supporting children. The average amount of children per researcher supporting children was 1.22.

4.3.9. Field of Study

Question: in what field(s) do you primarily research?

This question was open ended and respondents provided a wide range of answers. In order to simplify the data, respondents were grouped into four major categories of research area, or 'field'. These fields include the following:

Table 17: Frequencies: Field of Research

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.0	181	34.2	35.1	35.1
	2.0	89	16.8	17.2	52.3
	3.0	104	19.7	20.2	72.5
	4.0	142	26.8	27.5	100.0
	Total	516	97.5	100.0	
Missing	System	13	2.5		
Total		529	100.0		

Field 1: Medicine and Biology
Field 2: Commerce and Law
Field 3: Mathematics and Science
Field 4: Humanities

This table shows that the majority of respondents came from a background in medical and biological sciences (35.1%), an approximate third of the total population. Math & Science (20.2%) and Humanities (27.5%) account for almost half of the total population. The remainder is made up of respondents specialising in commerce and law (17.2%).

4.3.10. Education

Question: How many years of education have you received (in years)?

For the purpose of this study, measurement of education was subdivided into 4 categories (the same applies for parent's education, below). Education was measured on a scale of 1 to 4, with 1 representing Primary School education (1-7 years), 2 representing a high school education (8-12 years), 3 representing an undergraduate/honours-level education (13-16 years) and 4 representing a Masters/PhD-level education (17-20 years). It is noted that respondents with Primary School education were excluded from further analysis, as only categories 3, 4 and 5 are useful in the context of this research.

Table 18: Frequencies: Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	7	1.3	1.3	1.3
	1	1	.2	.2	1.5
	2	3	.6	.6	2.1
	3	17	3.2	3.2	5.3
	4	501	94.7	94.7	100.0
	Total	529	100.0	100.0	

The majority of the sample has obtained a Masters or PhD degree (94.7%). Only 3.2% of the samples were undergraduate/honours graduates and the small remainder had at least a high school education.

4.3.11. Father's Education

Question: What is the highest level of education your father has received (in years)?

Education levels of respondent's mothers and fathers were also measured. These measures are considered useful to discover underlying generational increases in education. The same ranking system above (for Education) was used to measure respondents' fathers' level of education

Table 19: Frequencies: Father's Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	10	1.9	1.9	1.9
	1	60	11.3	11.3	13.2
	2	194	36.7	36.7	49.9
	3	162	30.6	30.6	80.5
	4	103	19.5	19.5	100.0
	Total	529	100.0	100.0	

The majority of respondent's fathers had at least a high school education (36.7%) or an Undergraduate/Honours degree (30.6%). Only 19.5% of the sample's fathers were educated at a Masters/PhD level.

4.3.12. Mother's Education

Question: What is the highest level of education your mother has received (in years)?

The same ranking system above (for Education) was used to measure respondents' fathers' level of education

Table 20: Frequencies: Mother's Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	10	1.9	1.9	1.9
	1	75	14.2	14.2	16.1
	2	228	43.1	43.1	59.2
	3	186	35.2	35.2	94.3
	4	30	5.7	5.7	100.0
	Total	529	100.0	100.0	

Only 5.7% of the sample's mothers have obtained a Masters/PhD degree, a much smaller percentage in contrast to Father's education. The majority of the samples' mothers have received a high school education (43.1%) while 35.2% have received at least an Undergraduate/Honours degree.

4.3.13. University Affiliation

Question: at which university/institution do you currently conduct research?

University affiliation was not included in the statistical analysis in this research. However, distribution of university affiliation provides for an interesting statistic and to provide a clearer view of the universities involved in this study. The universities are categorised as follows:

Table 21: Frequencies: University Affiliation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.0	67	12.7	13.0	13.0
	2.0	42	7.9	8.1	21.1
	3.0	120	22.7	23.3	44.4
	4.0	45	8.5	8.7	53.1
	5.0	106	20.0	20.5	73.6
	6.0	136	25.7	26.4	100.0
	Total	516	97.5	100.0	
Missing	System	13	2.5		
Total		529	100.0		

Uni1: University of Kwa Zulu Natal
Uni2: Nelson Mandela Metropolitan University
Uni3: University of Witwatersrand
Uni4: University of Pretoria
Uni5: University of Cape Town
Uni6: No Affiliation

The sample was distributed across South African universities, made possible by digitally distributed questionnaires.

The University of Witwatersrand accounted for the 23.3% of the sample. The University of Cape Town accounted for 20.5% of the sample. A total of 26.4% declined to provide their university affiliation, or left the answer space blank. The remainder of the sample came from The University of Pretoria, The Nelson Mandela Metropolitan University and The University of Kwa Zulu Natal.

4.3.14. Academic Research Productivity (ARP)

A general measure of research productivity, consisting of 11 different measures was included in the questionnaire.

Prod1: Number of Masters students supervised
Prod2: Number of PhD students supervised
Prod3: Number of local journal articles published
Prod4: Number of international journal articles published
Prod5: Number of journal co-authored journal articles published
Prod6: Number of peer reviewed conference proceedings
Prod7: Number of presentations made at peer-reviewed conferences
Prod8: Number of academic books published
Prod9: Number of textbooks published
Prod10: Number of academic books chapters published
Prod11: Number of textbook chapters published

In order to measure ARP, an aggregated total of internationally (ISI/IBSS) and locally (DOHET) published journal articles was used. Descriptive statistics pertaining to the other 9 measures of productivity are included in the appendix.

Questions:

1. Prod 3: How many South African Department of Higher Education and Training (DOHET) Local (South African but not ISI/IBSS) accredited journal articles (in total) have you had published (including those accepted for publication)
2. Prod4: How many ISI/IBSS indexed (or *internationally accredited)* journal articles (in total) have you had published (including those accepted for publication)?

The descriptive statistics pertaining to the ARP measures are as follows:

Table 22: Descriptive Statistics: ARP

		Prod3	Prod4	ARP
N	Valid	529	529	529
	Missing	0	0	0
Mean		8.13	14.31	22.44
Median		2.00	4.00	9.00
Mode		0	0	0
Std. Deviation		20.320	29.772	43.713
Skewness		5.728	4.636	4.795
Std. Error of Skewness		.106	.106	.106
Kurtosis		43.695	29.254	31.386
Std. Error of Kurtosis		.212	.212	.212
Minimum		0	0	0
Maximum		230	303	460

Table 22 shows the mean values for locally and internationally published journal articles and academic are provided. The total ARP score (an aggregated total of all journal article measures) is provided as well, with the mean value being 22.44.

The univariate descriptive statistics section is now concluded. Discussion of the Likert scales and Exploratory Factor Analyses now follows.

4.4. Exploratory Factor Analysis of Likert Scales

Exploratory Factor Analysis (EFA) was conducted on the Personality, SGI Propensity, and WEIMS scales respectively, in order test for discriminant and convergent validity (Campbell & Fisk, 1959).

Field (2012) suggests that a sample size over 300 is generally considered adequate for a Factor Analysis. Exploratory Factor Analysis was conducted in order to identify correlations between observations that stem from their relationship to latent variables in the data, each of which takes the form of a linear model (Field, 2012). Prior to each EFA, a process of data screening was conducted, in order to detect any problematic inter-correlation between variables and issues relating to singularity (Field, 2012). The details of the data screening and subsequent exploratory factor analyses performed on Personality, SGI Propensity and Motivation now follow, respectively. Thereafter, Cronbach's Alpha scores and calculated and reported.

4.4.1. Personality (The New Reduced NEO-FFI Scale)

The NEO-FFI scale (Costa & McCrae, 1989) was reduced to 20 crucial questionnaire items, in the interest of shortening the length of the questionnaire to include only 20 items (4 items per construct). This was achieved by comparing the results of several different studies that have used the 60-item version of the NEO-FFI and thereafter, extracting the items with the highest correlations (Roselinni & Brown, 2011; Aluja, Garcia, Rossier, 2004).

The scale consists of 5 constructs, each measured with five 5-point Likert Scale questions from Strongly Disagree (1) to Strongly Agree (5), as follows. Reversed items are denoted by an [R].

Construct 1: Neuroticism (NTOT)

N1: I often feel inferior to others.
N2: When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.
N3: Sometimes I feel completely worthless.
N4: Too often, when things go wrong, I get discouraged and feel like giving up.

Construct 2: Openness to Experience (OTOT)

O1: Once I find the right way to do something, I stick to it. [R]
O2: I seldom notice the moods or feelings that different environments produce.
O3: I believe we should look to our religious authorities for decisions on moral issues. [R]
O4: Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement

Construct 3: Agreeableness (ATOT)

A1: I often get into arguments with my family and co-workers. [R]
A2: I tend to be cynical and skeptical of others' intentions. [R]
A3: I believe that most people will take advantage of you if you let them. [R]
A4: I generally try to be thoughtful and considerate.

Construct 4: Contentiousness (CTOT)

C1: I'm pretty good about pacing myself so as to get things done on time.
C2: I waste a lot of time before settling down to work. [R]
C3: Sometimes I'm not as dependable or reliable as I should be. [R]
C4: I never seem to be able to get organised. [R]

Construct 5: Extraversion (ETOT)

E1: I don't consider myself especially light hearted
E2: I am a cheerful, high-spirited person.
E3: I am not a cheerful optimist. [R]
E4: I would rather go my own way than be a leader of others. [R]

It is important to note that the NEO-FFI scale, as defined by Costa and McCrae (1989) consists of a large number of subscales, or 'facets' (beyond the five constructs presented here), which were not specifically, measured in this study in the interest of shortening the questionnaire (see Table 2, Chapter 2). Thus, it is to be expected that the exploratory factor analysis may inadvertently uncover some of these sub-scale items.

4.4.1.1. Exploratory Factor Analysis for Personality (The New Reduced NEO-FFI Scale)

The correlation matrix is used to check the patterns of relationships (Field, 2012). The correlation matrix provides a determinant of 0.23, which is greater than 0.00001, meaning that multicollinearity is most likely not problematic for these data (Field, 2012). This means that all data in the Reduced NEO-FFI Personality scale correlates relatively well and none of the correlation coefficients are too large. Therefore, there is no need to eliminate any observations.

Table 23: KMO & Bartlett's Test for Sphericity for Reduced NEO-FFI Personality Scale

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.803
Bartlett's Test of Sphericity	Approx. Chi-Square	1919.878
	df	190
	Sig.	.000

The KMO value of 0.803 is greater than 0.5 and the factor analysis for the new Reduced NEO-FFI Personality scale is considered appropriate. Batlett's test of sphericity is significant (p=0.000).

Table 24: Total Variance Explained for Reduced NEO-FFI Personality Scale

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.118	20.592	20.592	3.557	17.783	17.783	1.762	8.811	8.811
2	1.874	9.371	29.963	1.251	6.257	24.039	1.596	7.979	16.790
3	1.447	7.236	37.199	.809	4.047	28.086	1.167	5.834	22.624
4	1.379	6.894	44.093	.756	3.781	31.867	1.106	5.530	28.154
5	1.165	5.826	49.919	.557	2.783	34.650	.915	4.574	32.728
6	1.085	5.423	55.342	.460	2.298	36.947	.844	4.219	36.947
7	.944	4.718	60.060						
8	.868	4.340	64.400						
9	.826	4.129	68.528						
10	.756	3.778	72.306						
11	.714	3.569	75.876						
12	.692	3.459	79.335						
13	.661	3.305	82.640						
14	.615	3.075	85.715						
15	.552	2.759	88.474						
16	.505	2.523	90.997						
17	.470	2.348	93.345						
18	.463	2.313	95.658						
19	.447	2.234	97.892						
20	.422	2.108	100.000						

Extraction Method: Principal Axis Factoring.

In total, six factors had eigenvalues greater than one. The cumulative variance accounts for 36.947 %, which is considered low but suitable for opinion-based surveys (Field, 2012). Six factors with eigenvalues greater 1 were identified. The point of inflection on the scree plot below, confirms this.

Figure 14: Scree Plot for Reduced NEO-FFI Personality Scale

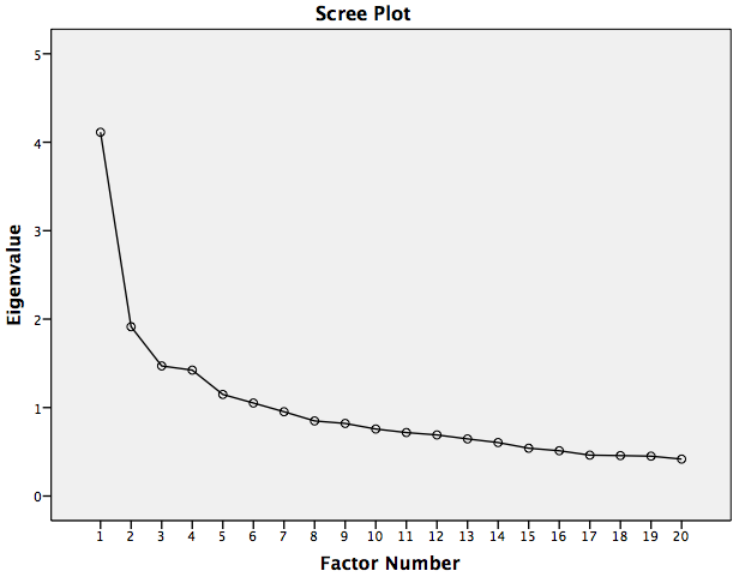


Table 25: Communalities for new Reduced NEO-FFI Personality Scale

	Initial	Extraction
N1: I often feel inferior to others.	.277	.363
N2: When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.	.275	.310
N3: Sometimes I feel completely worthless.	.419	.556
N4: Too often, when things go wrong, I get discouraged and feel like giving up.	.409	.510
O1: Once I find the right way to do something, I stick to it.	.173	.373
O2: I seldom notice the moods or feelings that different environments produce.	.133	.195
O3: I believe we should look to our religious authorities for decisions on moral issues.	.099	.161
O4: Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.	.128	.141
A1: I often get into arguments with my family and co-workers.	.207	.351
A2: I tend to be cynical and sceptical of others' intentions.	.252	.384
A3: I believe that most people will take advantage of you if you let them.	.230	.326
A4: I generally try to be thoughtful and considerate.	.183	.351
C1: I'm pretty good about pacing myself so as to get things done on time.	.324	.467
C2: I waste a lot of time before settling down to work.	.327	.469
C3: Sometimes I'm not as dependable or reliable as I should be.	.274	.352
C4: I never seem to be able to get organised.	.388	.551
E1: I don't consider myself especially "light-hearted".	.200	.252
E2: I am a cheerful, high-spirited person.	.335	.622
E3: I am not a cheerful optimist.	.356	.464
E4: I would rather go my own way than be a leader of others.	.166	.192

Extraction Method: Principal Axis Factoring.

Extraction communalities greater than 0.3 are considered appropriate (Field, 2012). However, Table 25 indicates that several items may need to be excluded from the factor analysis and from further study, as they are associated with extraction communalities. Items that fall under this category include: O2, O3, O4, E1 and E4.

Orthogonal rotation was used in this factor analysis. This is because the constructs of the new NEO-FFEI Personality scale are not theoretically closely related to one another. The results of the varimax rotation are as follows:

Table 26: Rotated Factor Matrix for Reduced NEO-FFI Personality Scale

	Factor					
	1	2	3	4	5	6
N1: I often feel inferior to others.	.568					
N2: When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.						
N3: Sometimes I feel completely worthless.	.669					
N4: Too often, when things go wrong, I get discouraged and feel like giving up.	.586					
O1: Once I find the right way to do something, I stick to it.					-.586	
O2: I seldom notice the moods or feelings that different environments produce.						
O3: I believe we should look to our religious authorities for decisions on moral issues.						
O4: Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.						
A1: I often get into arguments with my family and co-workers.				-.537		
A2: I tend to be cynical and skeptical of others' intentions.				.537		
A3: I believe that most people will take advantage of you if you let them.					-.408	
A4: I generally try to be thoughtful and considerate.						-.566
C1: I'm pretty good about pacing myself so as to get things done on time.		.624				
C2: I waste a lot of time before settling down to work.		.643				
C3: Sometimes I'm not as dependable or reliable as I should be.						
C4: I never seem to be able to get organised.		.642				
E1: I don't consider myself especially "light-hearted".						
E2: I am a cheerful, high-spirited person.			.742			
E3: I am not a cheerful optimist.			.525			
E4: I would rather go my own way than be a leader of others.						

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalisation.

a. Rotation converged in 8 iterations.

Table 26 shows the output for the rotated factor matrix for personality.

A 'high loading' is considered one that is greater than 0.4. The matrix above shows most variables loaded highly onto each factor, items that loaded less than 0.4 were suppressed, or excluded from the SPSS printout. Also, items with communalities lower than 0.3 (as above) are excluded from this analysis. These included items O2, O3, O4, E1 and E4, which did not load highly onto any factor.

The questions that load highly on Factor 1 include: N1, N3 and N4. The combination of these high-loaded items indicates a factor related closely to neuroticism, as defined by Costa and McCrae (1989).

The questions that load highly on Factor 2 include: C1, C2 and C4. The combination of these high-loaded items indicates factor most closely related to conscientiousness, as defined by Costa & McCrae (1989).

The questions that load highly on Factor 3 include: E2 and E3, relating most closely to Extraversion, as defined by Costa and McCrae (1989).

The questions that load highly on Factor 4 include: A1 and A2, which load negatively on this factor. These 2 items relate closely to Agreeableness, as defined by Costa and McCrae (1989).

The questions that load highly on Factor 5 include: O1 and A3, which also load negatively on this factor. O1 asked respondents to respond to the statement "once I find the right way to do something, I stick to it", while A3 asks respondents to respond to the statement "I believe that most people will take advantage of you if you let them." However, both of these items were inverse items. This means that the combination of these 2 items may represent one of the subscales, or facets that is measured by the full NEO-FFI (Costa & McCrae, 1989). For the purposes of this EFA, this item may be referred to as a combination of the facets known as Actions (O1) and Trust (A3).

The questions that load highly on Factor 6 include: A4, which asked respondents to respond to the statement "I generally try to be thoughtful and considerate". This item may also represent a sub-scale measured by the full NEO-FFI (Costa & McCrae, 1989). It seems this item may be most closely related to the sub-scale known as 'Altruism'.

As per the results of the EFA (and the test for communalities) items C3, O2, O4, O3, E1 and E4 do not load highly on any latent factors in the personality scale.

This analysis seems to reveal that the new Reduced NEO-FFI Personality scale is relatively appropriate, as the factor loadings seem to correlate with the personality traits defined by Costa and McCrae (1989). However, it may be possible that some of the items included in the questionnaire are measuring certain sub-scales, or 'facets' that are present in the full NEO-FII scale (Costa & McCrae, 1989). The outcome of the EFA is as follows:

1. Neuroticism (N): N1, N3, N4
2. Conscientiousness (C): C1, C2, C4
3. Extraversion (E): E2, E3
4. Agreeableness (A): A1, A2
5. Actions and Trust: O1, A3
6. Altruism: A4

Following the removal of C3, O4, O3, E1 and E4, it is assumed from now that no further questions need to be removed from this scale and the new 13-item reduced NEO-FFI personality scores (as above) are used here forth in this research.

It is important to note that the facets of personality are acknowledged here, but the 'big five' theory of Costa and McCrae (1989) was tested. It is acknowledged that factors consisting of only one item may be a limitation.

4.4.1.2. Reliability statistics for Personality (New Reduced NEO-FFI)

The Cronbach's Alpha scores provide measurements of discriminant validity. Because the above-mentioned factors should be theoretically uncorrelated, reliability statistics are provided for each individual construct, as follows:

Table 27: Reliability statistics for Personality

Construct	Number of items	Cronbach Alpha	Reliable
Neuroticism	3	.702	Yes
Conscientiousness	3	.794	Yes
Extraversion	2	.740	Yes
Agreeablness	3	.720	Yes
Openness	1	n/a	n/a

4.4.2. Exploratory Factor Analysis for SGI Propensity (The SGI Propensity Scale)

The SGI Propensity scale was derived from the seminal literature pertaining to innovation and knowledge management, open innovation and SGI theory (Callaghan, 2014a, 2014b, 2014c, 2015).

The scale consists of 5 constructs, each measured with five 5-point Likert Scale questions from Strongly Disagree (1) to Strongly Agree (5), as follows. Revered items are denoted by an [R].

Construct 1: Crowdsourcing Propensity

CSP1: I would make use of 'crowdsourcing' (obtaining inputs from a large undefined network of people) to help solve research problems.
CSP2: I would make use of 'crowdsourcing' to help complete smaller research tasks.
CSP3: Crowdsourcing would not improve my research productivity [R].
CSP4: Crowdsourcing probably will not improve the quality of solutions to research problems [R]
CSP5: I am concerned about quality control and validity issues of crowdsourcing
Construct 2: Crowdfunding Propensity

CFP1: I would use crowd-funding (obtaining funds from a large undefined network of people to reach a monetary goal, e.g. KickStarter) to obtain research funds.
CFP2: My research does not face budget/funding constraints [R].
CFP3: People around the world would not be interested in funding my research [R].
CFP4: I am open to using alternate methods of research funding.
CFP5: Access to greater funds would greatly enhance my research productivity.

Construct 3: Open Orientation

OO1: External knowledge is essential in building new knowledge.
OO2: My research would benefit from perspectives from people from different fields of expertise.
OO3: Smaller teams would be more adept at solving problems rather than large numbers of people [R].
OO4: External sources of knowledge (non-academic) would help improve my research productivity.
OO5: Collaboration would not particularly help improve my research productivity [R].

Construct 4: SGI Propensity

SGIPROP1: Contemporary research methods are often not useful for solving practical problems.
SGIPROP2: My research requires problems to be solved in 'real time' (as the problem occurs).
SGIPROP3: My research does not have potential to help solve societal problems [R].
SGIPROP4: I believe contemporary research practices are flawed.
SGIPROP5: I often pursue research projects that are high risk [R].

4.4.2.1 Exploratory Factor Analysis for SGI Propensity (The SGI Propensity Scale)

Principal axis factoring was used for the factor analysis for the SGI Propensity scale. Principal axis factoring is based on maximising the reliability of factors, assuming variables are randomly sampled (Field, 2012).

The correlation matrix is used to check the patterns of relationships (Field, 2012). The correlation matrix provides a determinant of 0.38, which is greater than 0.00001, meaning that multicollinearity is most likely not problematic for these data (Field, 2012). This means that all data in the SGI Propensity scale correlates relatively well and none of the correlation coefficients are too large. Therefore, there is no need to eliminate any observations.

Kaiser (1974) suggests accepting KMO values greater than 0.5, as an indication of the appropriateness of the factor analysis. In this case, 0.778 is considered appropriate and so a factor analysis is required. Bartlett's test of sphericity tests the null hypothesis that the original correlation matrix is an identity matrix (Field, 2012). The value of 0.000 is less than 0.05 and is therefore considered significant.

Table 28: KMO and Bartlett's Test of Sphericity for SGI Propensity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.778
Bartlett's Test of Sphericity	Approx. Chi-Square	2158.656
	df	190
	Sig.	.000

Table 29: Total Variance Explained for SGI Propensity

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.994	19.971	19.971	3.512	17.558	17.558	2.393	11.966	11.966
2	1.763	8.817	28.789	1.155	5.774	23.332	1.239	6.197	18.163
3	1.675	8.376	37.165	.990	4.950	28.282	1.183	5.916	24.079
4	1.468	7.339	44.503	.811	4.053	32.335	1.168	5.841	29.920
5	1.194	5.969	50.473	.546	2.731	35.066	1.029	5.146	35.066
6	.988	4.941	55.414						
7	.935	4.674	60.088						
8	.899	4.497	64.585						
9	.847	4.237	68.822						
10	.820	4.101	72.923						
11	.763	3.816	76.739						
12	.729	3.646	80.385						
13	.687	3.436	83.821						
14	.639	3.195	87.016						
15	.594	2.970	89.986						
16	.533	2.665	92.651						
17	.480	2.399	95.050						
18	.415	2.073	97.122						
19	.334	1.671	98.794						
20	.241	1.206	100.000						

Extraction Method: Principal Axis Factoring.

Table 29 lists the eigenvalues associated with each linear component (factor) before and after extraction and after rotation (Field, 2012). Before extraction, 20 linear components (factors) were discovered within the data. It is clear that the first few factors explain relatively large amounts of variance but subsequent factors account for less. After extracting all factors with eigenvalues greater than one, five factors remain. The cumulative variance accounts for 35.066%, which is considered relatively low but still suitable for opinion-based surveys (Field, 2012).

The third sub-section of Table 29 shows the rotation sums of squared loadings, which displays the eigenvalues of the factors after rotation. It is noted that these eigenvalues and percentages of variance explained are significantly lower than before rotation (Field, 2012).

Table 30: Communalities for SGI Propensity

	Initial	Extraction
SGIPROP1: Contemporary research methods are often not useful for solving practical problems	.229	.409
SGIPROP2: My research requires problems to be solved in 'real time' (as the problem occurs)	.095	.105
SGIPROP3: My research does not have potential to help solve societal problems	.174	.230
SGIPROP4: I believe contemporary research practices are flawed	.240	.426
SGIPROP5: I often pursue research projects that are high risk	.103	.110
OO1: External knowledge (non-academic knowledge) is essential in building new knowledge	.163	.254
OO2: My research would benefit from perspectives from people from different fields of expertise	.199	.290
OO3: Smaller teams would be more adept at solving problems rather than large numbers of people	.121	.144
OO4: External sources of knowledge (non-academic) would help improve my research productivity	.221	.282
OO5: Collaboration (with experts from different fields of expertise) would not particularly help improve my research productivity	.154	.222
CFP1: I would use crowd-funding (obtaining funds from a large undefined network of people to reach a monetary goal, e.g. KickStarter) to obtain research funds	.311	.402
CFP2: My research does not face budget/funding constraints	.250	.390
CFP3: People around the world (non-academics) would not be interested in funding my research	.125	.145
CFP4: I am open to using alternate methods of research funding	.285	.316
CFP5: Access to more funds would greatly enhance my research productivity	.405	.609
CSP1: I would make use of 'crowdsourcing' (obtaining inputs from a large undefined network of people) to help solve research problems	.634	.713
CSP2: I would make use of 'crowdsourcing' to help complete smaller research tasks	.603	.671
CSP3: Crowdsourcing would not improve my research productivity	.523	.635
CSP4: Crowdsourcing probably will not improve the quality of solutions to research problems	.458	.515
CSP5: I am concerned about quality control and validity issues of crowdsourcing	.116	.146

Extraction Method: Principal Axis Factoring.

Table 30 (Communalities) shows communalities before and after extraction.

Principal Axis Factoring analysis assumes that all variance is not common (Field, 2012). The second column (extraction) reflects the common variance in the data structure (Field, 2012). Extraction communalities greater than 0.3 are considered appropriate (Field, 2012). However, Table 30 indicates that several items need to be

excluded from the factor analysis, as they are associated with extraction communalities. These are 7 items that fall under this category, including: SGIPROP2, SGIPROP3, SGIPROP5, OO1, OO2, OO3, OO4, OO5, CFP3 and CSP5.

Table 31: Rotated Factor Matrix for SGI Propensity

	Factor				
	1	2	3	4	5
SGIPROP1: Contemporary research methods are often not useful for solving practical problems					.621
SGIPROP2: My research requires problems to be solved in 'real time' (as the problem occurs)					
SGIPROP3: My research does not have potential to help solve societal problems					
SGIPROP4: I believe contemporary research practices are flawed					.642
SGIPROP5: I often pursue research projects that are high risk					
OO1: External knowledge (non-academic knowledge) is essential in building new knowledge				.480	
OO2: My research would benefit from perspectives from people from different fields of expertise				.504	
OO3: Smaller teams would be more adept at solving problems rather than large numbers of people					
OO4: External sources of knowledge (non-academic) would help improve my research productivity				.448	
OO5: Collaboration (with experts from different fields of expertise) would not particularly help improve my research productivity					
CFP1: I would use crowd-funding (obtaining funds from a large undefined network of people to reach a monetary goal, e.g. KickStarter) to obtain research funds		.533			
CFP2: My research does not face budget/funding constraints			.590		
CFP3: People around the world (non-academics) would not be interested in funding my research					
CFP4: I am open to using alternate methods of research funding		.416			
CFP5: Access to more funds would greatly enhance my research productivity		.462	.602		
CSP1: I would make use of 'crowdsourcing' (obtaining inputs from a large undefined network of people) to help solve research problems	.720	.401			
CSP2: I would make use of 'crowdsourcing' to help complete smaller research tasks	.705				
CSP3: Crowdsourcing would not improve my research productivity	.735				
CSP4: Crowdsourcing probably will not improve the quality of solutions to research problems	.679				

CSP5: I am concerned about quality control and validity issues of crowdsourcing					

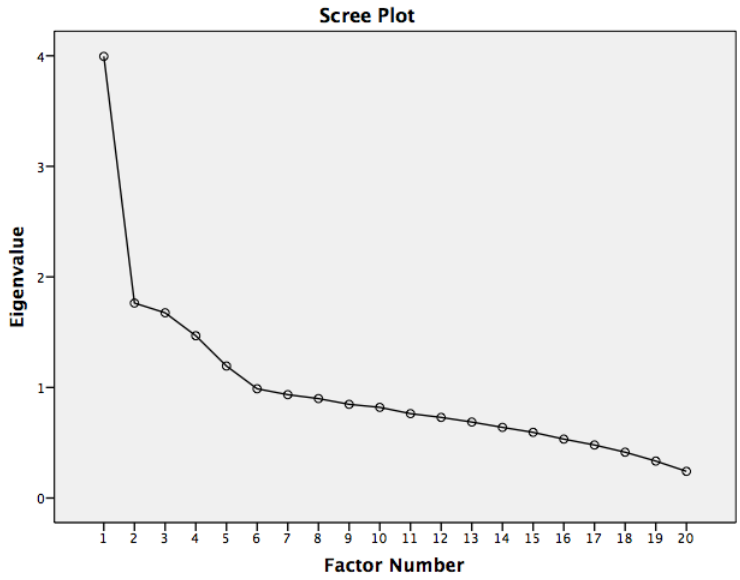
Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalisation.

a. Rotation converged in 8 iterations.

The rotated factor matrix above shows the loadings of each variable onto each factor, after rotation, with items that load lower than 0.4 being suppressed. Five factors (or 'latent variables') have been extracted. The scree plot below, confirms that five latent variables have been extracted, with the point of inflection indicating 5 component numbers with eigenvalues greater than 1.

Figure 15: Scree Plot for SGI Propensity



The rotated factor matrix above shows factor loadings after rotation. It is important to note that orthogonal rotation was used in this factor analysis. This is because orthogonal rotation assumes that there is no correlation between the latent variables (Field, 2012).

A 'high loading' is considered one that is greater than 0.4.

The questions that load highly on Factor 1 include: CSP1, CSP2, CSP3 and CSP4. Clearly, this factor relates closely to a crowdsourcing propensity.

The questions that load highly on Factor 2 include: CFP1 and CFP4, CFP5 and CSP1. These items link closely to the crowdfunding propensity, although the inclusion of CSP1 indicates an inclination towards crowdsourcing propensity as well.

The questions that load highly on Factor 3 include: CFP2 and CFP5, which also related most closely to crowdfunding propensity. However the phrasing of these questions would indicate financial constraints in research funding that may in turn,

lead to crowdfunding propensity, rather than a clear measure of crowdsourcing propensity.

The questions that load highly on Factor 4 include: OO1, OO2 and OO4. These items associate most closely to open orientation.

The questions that load highly on Factor 5 include: SGIProp1 and SGIProp4. These 2 items are associated most closely with the measurement of SGI Propensity, or the belief that first generation innovation is flawed.

It is important to bear in mind that the SGI scale was derived from the literature for the purpose of this research. The results of the factor analysis seem to indicate that the derived scale is relatively appropriate, but may require certain changes, as five factors were discovered, instead of the four factor hypothesised. It is possible that the measurement of crowdfunding propensity may actually be a measure of two separate constructs; one being crowdfunding propensity itself, and another being the financial constraints that lead to crowdfunding propensity.

1. Crowdsourcing Propensity: CSP1, CSP2, CSP3 and CSP4
2. Crowdfunding Propensity: CFP1, CFP4, CFP5 and CSP1
3. Crowdfunding Propensity (Financial Constraints): CFP2 and CFP5
4. Open Orientation: OO1, OO2 and OO4
5. SGI Propensity: SGIPROP1 and SGIPROP4

The items CSP5, CFP3, OO5, SGIPROP2, SGIPROP3 and SGIPROP5 need to be removed from further measurements of SGI Propensity, as they do not load highly on to any latent variables uncovered in the exploratory factor analysis.

4.4.2.2 Reliability statistics for SGI Propensity (The SGI Propensity Scale)

The Cronbach's Alpha scores provide measurements of discriminant validity. Because the above-mentioned factors should be theoretically uncorrelated, reliability statistics are provided for each individual construct, as follows:

Table 32: Reliability statistics for SGI Propensity

Construct	Number of items	Cronbach Alpha	Reliable
Crowdsourcing Propensity	4	.838	Yes
Crowdfunding Propensity	3	.735	Yes
Open Orientation	3	.703	Yes
SGI Propensity	2	.684	Yes

4.4.3. Exploratory Factor Analysis for Motivation (The WEIMS Scale)

The WEIMS (Work Extrinsic-Intrinsic Motivation Scale) was developed by Tremblay, et al. (2009) as an intended measurement of the self-determination continuum (Ryan & Deci, 2000) in the workplace. The scale measures 6 constructs, which all exist along a continuum of motivation from amotivation to pure intrinsic motivation, each construct measured with 3 item questions. There are no reversed items. Respondents were asked to respond to the question 'why do you do your job?' Responses were

recorded on a 5-point Likert scale, with options ranging from Strongly Disagree (1) to Strongly Agree (5), as follows.

Construct 1: Amotivation

AMOT1: I don't seem to be able to manage the impor
AMOT2: I am provided with unrealistic working conditions.
AMOT3: Too much is expected of us

Construct 2: External Regulation

EXTREG1: For the income it provides me.
EXTREG2: Because it allows me to earn money
EXTREG3: Because this type of work provides me with security.

Construct 3: Introjected Regulation

INTROREG1: Because I want to succeed at this job
INTROREG2: Because I want to be a leading expert in this field
INTROREG3: Because this job helps me attain my life's goals

Construct 4: Identified Regulation

IDREG1: Because this is the type of work I chose to do to attain a certain lifestyle.
IDREG2: Because I chose this type of work to attain my career goals
IDREG3: Because it is the type of work I have chosen to attain certain importan objectives.

Construct 5: Integrated Regulation

INTREG1: Because it has become a fundamental part of who I am
INTREG2: Because it is part of the way in which I have chosen to live my life.
INTREG3: Because this job is a part of my life.

Construct 6: Intrinsic Motivation

INMOT1: Because I derive much pleasure from learning new things
INMOT2: From the satisfaction I experience from taking on interesting challenges
INMOT3: For the satisfaction I experience when I am successful at doing difficult tasks.

4.4.3.1. Exploratory Factor Analysis for Motivation (The WEIMS Scale)

Principal Axis Factoring was used for the WEIMS Scale. Orthogonal rotation was used because it assumes that dimensions are uncorrelated (Field, 2012).

The correlation matrix provides a determinant of 0.004, which is greater than 0.00001, meaning that multicollinearity is most likely not problematic for these data (Field, 2012). This means that all data in the WEIMS scale correlates relatively well

and none of the correlation coefficients are too large. Therefore, there is no need to eliminate any observations.

The KMO value of 0.791 is greater than 0.5 and the factor analysis for WEIMS is therefore considered appropriate. Bartlett's test of sphericity is significant (p = 0.000)

Table 33: KMO & Bartlett's Test for Sphericity for WEIMS

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.792
Bartlett's Test of Sphericity	Approx. Chi-Square	2839.821
	df	153
	Sig.	.000

Table 34: Total Variance Explained for the WEIMS Scale

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.560	25.336	25.336	4.066	22.591	22.591	2.664	14.802	14.802
2	2.311	12.838	38.174	1.787	9.931	32.522	1.648	9.156	23.958
3	1.619	8.996	47.170	1.160	6.444	38.966	1.645	9.138	33.096
4	1.345	7.473	54.643	.872	4.846	43.812	1.268	7.046	40.142
5	1.104	6.136	60.778	.584	3.243	47.055	1.244	6.914	47.055
6	.880	4.887	65.666						
7	.810	4.501	70.167						
8	.778	4.322	74.489						
9	.662	3.680	78.169						
10	.608	3.378	81.546						
11	.550	3.058	84.604						
12	.520	2.888	87.492						
13	.448	2.491	89.983						
14	.442	2.456	92.440						
15	.400	2.225	94.664						
16	.369	2.049	96.714						
17	.345	1.915	98.628						
18	.247	1.372	100.000						

Extraction Method: Principal Axis Factoring.

Before extraction, 18 linear components (factors) were discovered within the data. After extracting all factors with eigenvalues greater than one, five factors remain. The cumulative variance accounts for 47.055%, which is considered suitable for opinion-based surveys (Field, 2012).

Table 35: Communalities for the WEIMS Scale

	Initial	Extraction
IDREG1: Because this is the type of work I chose to do to attain a certain lifestyle.	.219	.224
IDREG2: Because I chose this type of work to attain my career goals	.582	.610
IDREG3: Because it is the type of work I have chosen to attain important objectives.	.410	.521
EXTREG1: For the income it provides me.	.434	.642
EXTREG2: Because it allows me to earn money	.368	.503
EXTREG3: Because this type of work provides me with security.	.294	.335
AMOT1: I don't seem to be able to work.	.182	.204
AMOT2: I am provided with unrealistic working conditions.	.344	.671
AMOT3: Too much is expected of us	.312	.377
INMOT1: Because I derive much pleasure from learning new things	.415	.470
INMOT2: From the satisfaction I experience from taking on interesting challenges	.467	.508
INMOT3: For the satisfaction I experience when I am successful at difficult tasks.	.332	.282
INTREG1: Because it has become a fundamental part of who I am	.452	.522
INTREG2: Because it is part of the way in which I have chosen to	.374	.625
INTREG3: Because this job is a part of my life.	.392	.411
INTROREG1: Because I want to succeed at this job	.602	.707
INTROREG2: Because I want to be a leading expert in this field	.384	.421
INTROREG3: Because this job helps me attain my life's goals	.333	.437

Extraction Method: Principal Axis Factoring.

Extraction communalities greater than 0.3 are considered appropriate (Field, 2012). However, Table 25 indicates that several items need to be excluded from the factor analysis, as they are associated with extraction communalities. The items that fall under this category include IDREG1, AMOT1 and INMOT3.

Table 36: Rotated Factor Matrix for SGI Propensity

	Factor				
	1	2	3	4	5
IDREG1: Because this is the type of work I chose to do to attain a certain lifestyle.					
IDREG2: Because I chose this type of work to attain my career goals	.534		.540		
IDREG3: Because it is the type of work I have chosen to attain certain important objectives.			.656		
EXTREG1: For the income it provides me.		.783			
EXTREG2: Because it allows me to earn money		.706			
EXTREG3: Because this type of work provides me with security.		.513			
AMOT1: I don't seem to be able to related to this work.					
AMOT2: I am provided with unrealistic working conditions.					.793
AMOT3: Too much is expected of us					.593
INMOT1: Because I derive much pleasure from learning new things	.658				
INMOT2: From the satisfaction I experience from taking on interesting challenges	.633				
INMOT3: For the satisfaction I experience when I am successful at doing difficult tasks.					
INTREG1: Because it has become a fundamental part of who I am	.552			.462	
INTREG2: Because it is part of the way in which I have chosen to live my life.				.759	
INTREG3: Because this job is a part of my life.	.420			.424	
INTROREG1: Because I want to succeed at this job	.735				
INTROREG2: Because I want to be a leading expert in this field	.473		.416		
INTROREG3: Because this job helps me attain my life's goals			.628		

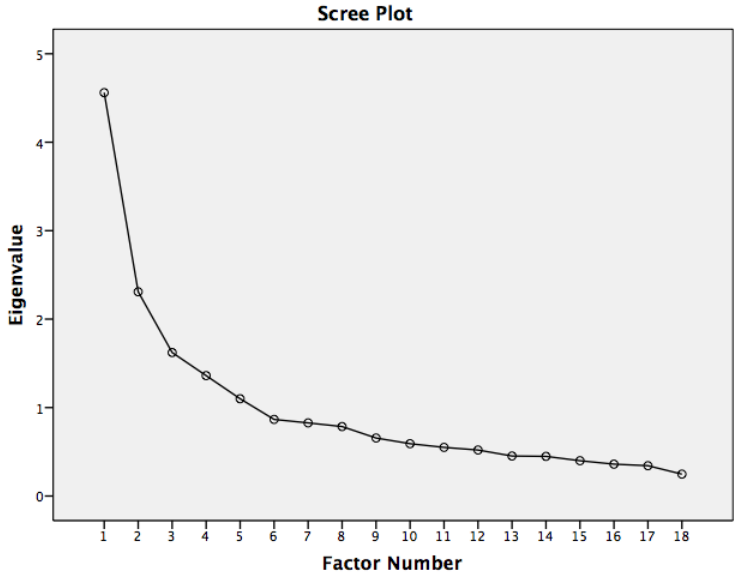
Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalisation.

a. Rotation converged in 7 iterations.

The rotated factor matrix above shows the loadings of each variable onto each factor, after rotation. Loadings lower than 0.4 have been suppressed. Five factors (or 'latent variables') have been extracted. The scree plot below, confirms that five latent variables have been extracted, with the point of inflection indicating 5 component numbers with eigenvalues greater than 1.

Figure 15: Scree Plot for the WEIMS Scale



Once again, orthogonal rotation was used in this factor analysis. This is because the constructs of WEIMS (motivation) are purported to be theoretically uncorrelated (Field, 2012).

A 'high loading' is considered one that is greater than 0.4. The rotated factor matrix above shows most variables loaded highly onto each factor. It is useful to consider the self-determination continuum (Ryan & Deci, 2000) in analysing the output of the rotated factor matrix.

Table 37: The Self-Determination Continuum (Adapted from Ryan & Deci, 2000: 237)

Behaviour	Nonself determined	Self determined				
Type of Motivation	Amotivation	Extrinsic Motivation				Intrinsic Motivation
Type of Regulation	Non-Regulation	External Regulation	Introjected Regulation	Identified Regulation	Integrated Regulation	Intrinsic Regulation
Locus of Causality	Impersonal	External	Somewhat External	Somewhat Internal	Internal	Internal

The questions that load highly on Factor 1 include: IDREG2, INMOT1, INMOT2, INTREG1, INTREG3, INTROREG1 and INTROREG3.

In considering the Self-Determination continuum above, it is clear that the items that load highly on Factor 1 range from extrinsic to intrinsic motivation, but inclines most closely to the intrinsic extreme of the continuum, from introjected regulation to the extreme – intrinsic motivation. The items mentioned above asked respondent to respond to the following statements, in relation to the question provided in the questionnaire: "why do you do your job?"

Hence, it can be deduced that this factor is a combination of internal external motivational factors, although most of the extrinsic factors incline towards pure intrinsic motivation. However, it is also clear that this factor cannot be termed 'pure' intrinsic motivation as some external factors, particularly INTROREG2 (to be a leading expert) are also present. Taking all these items into account, this factor can be termed 'Proximal Internal Motivation'.

The questions that load highly on Factor 2 include: EXTREG1, EXTREG2 and EXTREG3. These items correlate most closely to the extrinsic or external motivation construct, as defined by Ryan and Deci (2000), linking to motivational factors such as financial gains and job security.

The questions that load highly on Factor 3 include: IDREG2, IDREG3, INTROREG2 ad INTROREG3. These items are relatively close together on the Self-Determination continuum and may represent a construct that related to attaining objectives and goals and is thus termed 'Objective Motivation' (OM).

The questions that load highly on Factor 4 include: INTREG1, INTREG2 and INTREG3, linking directly to integrated regulation, which Tremblay, et al. (2009: 214) define as "identifying with the value of an activity to the point that it becomes part of the individual's sense of self. This is the form of extrinsic motivation that is most fully internalised and hence, is said to be autonomous."

The questions that load highly on Factor 5 include: AMOT2 and AMOT3. These items link to the extreme end of the continuum with Amotivation. Respondents that score highly in this category can be considered to be unmotivated to perform their jobs or feel overwhelmed by large workloads.

This analysis seems to reveal that the WEIMS scale (Tremblay, et al., 2009) is relatively appropriate, as the factor loadings seem to correlate relatively closely with the points along the self-determination continuum. Items INMOT3, IDREG1 and AMOT1 did not load highly on to any latent variables and are therefore excluded from further analysis. It is clear that the WEIMS scale may indeed consist of 5 constructs, rather than 6 as previously hypothesised. These 5 constructs and their items include:

1. Proximal Intrinsic Motivation: IDREG2, INMOT1, INMOT2, INTREG1, INTREG3, INTROREG1 and INTROREG3.
2. Extrinsic Motivation: EXTREG1, EXTREG2 and EXTREG3
3. Objective Motivation: IDREG2, IDREG3, INTROREG2 ad INTROREG3.
4. Integrated Regulation: INTREG1, INTREG2 and INTREG3
5. Amotivation: AMOT2, AMOT3

4.4.3.2. Reliability statistics for Motivation (The WEIMS scale)

The Cronbach's Alpha scores provides for a measurement of discriminant validity. Excluding the items that did not load highly in the EFA, reliability statistics are provided for each individual construct, as follows:

Table 38: Reliability statistics for Motivation

Construct	Number of items	Cronbach Alpha	Reliable
Amotivation	2	.639	Yes
External Regulation	3	.702	Yes
Introjected Regulation	3	.674	Yes
Identified Regulation	2	.665	Yes
Integrated Regulation	3	.699	Yes
Intrinsic Motivation	2	.674	Yes

The discussion on Likert scales and the exploratory factor analyses is now concluded. Testing of research hypotheses now follows.

4.5. Hypothesis Testing

All sub-hypotheses relating to hypotheses A1 and A2 were tested using tests of bivariate correlation as well as hierarchical multiple regressions.

Correlation measures the magnitude and direction of a relationship between variables. Multiple and partial correlation analysis extend the same notion between a single variable and a set of variables (Field, 2012). The correlation coefficient may take on any value between +1 and -1 (Field, 2012). The sign of the correlation coefficient (+/-) defines the direction of the relationship, either positive or negative. Each tests of correlation was performed to test the hypotheses. Thereafter, tests of hierarchical multiple regression was performed for each hypothesis. A significance level of 0.05 (5%) was chosen for this research.

The objective of multiple linear regression is to use several independent (predictor) variables to predict a single outcome. In hierarchical (or 'sequential') regression, the predictor variables are entered into the model in the order specified by theoretical grounds. In other words, variables are entered in 'steps', with the independent variable being assessed in terms of what it adds to the prediction, or the outcome variable, after previous variables have been controlled for (Field, 2012). Essentially, hierarchical multiple regression is a method that controls for the effects of variables which may be confounding, or covariate type variables and ultimately build a better prediction model for the outcome (Field, 2012).

The regression equations for multiple linear regression can be represented as follows:

$$Y_i = \alpha + \beta_{0+} \beta_1 x_{i+} \beta_2 x^2_{i+\ldots+} \beta_{0+} \beta_p x^2_i + \varepsilon_i$$

Where Y_i is the independent variable and p is the number of predictor variables (Field, 2012). The process of dummy variable coding, selection of covariates and outlier detection process now follows.

4.5.1. Dummy Variables

In order to include categorical variables as covariates in the hierarchical multiple regressions, dummy variables were coded (Gujarati & Porter, 2009). To code a dummy variable requires that each categorical variable have a reference category (Suits, 1957). This means that one category of the variable is removed, using the equation k-1, where k is the number of categories in the categorical variable (Suits, 1957; Field, 2012). This process of dummy coding was used on 5 variables, each to be included as covariates in the hierarchical multiple regressions. These variables include: field of study, title, nationality, university and language. The dummy coding procedure was as follows, with the symbol '*' used to denote the category that was used as a reference variable for each categorical variable. All the other categories were then coded as 1 or 0, essentially a 'yes' or 'no'.

Table 39: Summary of Dummy Coding Procedure

Categorical Variable	Original Categories	Dummy Coded
Field of Study	1= Field 1: Medicine & Biology 2= Field 2: Commerce & Law (*) 3= Field 3: Math & Science 4= Field 4: Humanities	Field1: 1 = Field1; 0 = Other Field3: 1 = Field3; 0 = Other Field4: 1 = Field4; 0 = Other
Title	1= Title 1: Mr./Mrs./Ms. (*) 2= Title 2: Dr. 3= Title 3: Associate/Adjunct Professor 4= Title 4: Professor	Title 2: 1 = Dr.; 0 = Other Title 3: 1 = Associate/Adjunct Professor; 0 = Other Title 4: 1 = Professor; 0 = Other
Nationality	1 = Nat1: South African 2 = Nat2: African 3 = Nat3: European 4 = Nat4: International (*)	Nat1: 1 = South African; 0 = Other Nat2: 1 = African; 0 = Other Nat3: 1 = European; 0 = Other
Language	1= Lang1: English 2= Lang2: Afrikaans 3= Lang3: Xhosa 4= Lang4: Zulu 5= Lang5: South African (Other) 6= Lang 6:Foreign (*)	1 = English; 0 = Other 1 = Afrikaans; 0 = Other 1 = Xhosa; 0 = Other 1 = Zulu; 0 = Other 1 = Other South African; 0 = Other
University	1 = Uni1: UKZN 2 = Uni2: NMU 3 = Uni3: Wits 4 = Uni4: UP 5 = Uni5: UCT 6 = Unit6: No Affiliation	1 = UKZN; 0 = Other 1 = Wits; 0 = Other 1 = UP; 0 = Other 1 = UCT; 0 = Other 1 = No Affilliation; 0 = Other

Table 40: Selection of Reference Variables

Categorical Variable	Reference Variable Selected	Reason
Field of Study	Field2: Commerce & Law	The inclusion of this field may introduce heterogeneity bias, given the varied nature of the field, which includes very broad fields of study such as accounting, law, economics and management sciences.
Title	Title 1: Mr./Mrs./Ms.	If a respondent in this sample does not have the title Dr., Associate/Adjunct Professor or Professor, they must be given the title Mr./Mrs./Ms.
Nationality	Nat4: International	The importance of this research in the South African context means that international respondents can be used as a reference category.
Language	Lang6: Foreign	The importance of this research in the South African context means that foreign language speaking respondents can be used as a reference category.
University	Uni2: NMU	Respondents from the Nelson Mandela Metropolitan University contributed the least to the total population (8.1%)

4.5.2. Selection of Covariates (EFA for Dummy Variables)

To reduce the number of covariates to be entered into the hierarchical multiple regressions and in order to adhere to the principles of parsimony (Gujarati & Porter, 2009), an exploratory factor analysis was used to determine which covariates should be included in the hierarchical multiple regressions. The full output of the results of the EFA on covariates is included in the appendix.

Extraction communalities greater than 0.3 are considered appropriate (Field, 2012). The table of communalities indicated that several items may need to be excluded from the factor analysis and from further study, as they are associated with extraction communalities. Items that fall under this category include: Gender, Uni4: UP, Xhosa, Zulu and Edu2: High. Orthogonal rotation was used in this factor analysis. This is because the covariates are not theoretically related to one another. The results of the varimax rotation are also included in the appendix. The rotation matrix showed most variables loaded highly onto each factor, items that loaded less than 0.4 were suppressed, or excluded from the output. High factor loadings occurred as follows:

Factor 1: Field1, Field2, Uni6
Factor 2: South African and African
Factor 3: Edu3, Edu4
Factor 4: MEdu, Medu3
Factor 5: Age, Prof and Marital Status
Factor 6: English, Afrikaans
Factor 7: English, Other South African, Children
Factor 8: Uni3, Uni5
Factor 9: South African, European, MEdu4
Factor 10: FEdu2, FEdu4,
Factor 11: Field3
Factor 12: Uni1
Factor 13: Associate/Adjunct Professor

The result of the EFA provides covariate factors that should be included in further analysis. However, some covariates of theoretical significance have been excluded, as per the results of the above test. It was deemed necessary to use a combination of covariate factors – those that were identified as significant from the EFA and those that are of theoretical importance and must therefore be included in further analysis, as per the theoretical model under study (Field, 2012). As such, the following predictor variables (covariates) were chosen for inclusion in hierarchical multiple regressions in order to avoid problems with singularity (Gujarati & Porter, 2009) and to assess how much influence each of these variables has on the outcome (Field, 2012).

Therefore, the list of covariate factors to be included in the further analysis, include the following:

- Gender
- South African
- English
- Professor
- Wits
- Field1: Math & Science

4.5.3. Process of Outlier Detection

Each regression was checked for significant outliers. Outliers were removed and the regressions were run once more. The following table summarises the procedure pertaining to the detection of outliers:

Table 41: Summary of Outlier Detection

	Limits	**Calculation**
Standardised Residuals	Values outside of |3|	Standard (Fields, 2012)
Cook's Distance	Values > 1	Standard (Fields, 2012)
Leverage	Values >0.026	2p/n
Mahalanobis	Values > 25	Standard for large sample sizes (Fields, 2012)
DFFITS	[-0.23; +0.23]	$\pm 2\sqrt{p/n}$
DFBETAS	[-0.09; +0.09]	$\pm 2/\sqrt{n}$
Covariance Ratio	[0.96; 1.03]	$1 \pm 3p/n$

Note: p = 7 (6 predictor variables and one constant)
n =529

Having established criteria for dummy variable coding, covariate selection and outlier detection, the results of the hypothesis testing, using tests of correlation and hierarchical multiple regression are presented.

4.5.4 Hypothesis A1a: SGI Propensity is significantly associated with ARP

The following pertains to the test for correlation between SGI propensity and ARP. Thereafter, the results of the test for hierarchical multiple regression follows.

Table 42: Correlation between SGI Propensity and Academic Research Productivity (ARP)

			ARP	SGI Propensity
Spearman's rho	ARP	Correlation Coefficient	1.000	-.116**
		Sig. (2-tailed)	.	.008
		N	529	529
	SGI Propensity	Correlation Coefficient	-.116**	1.000
		Sig. (2-tailed)	.008	.
		N	529	529

**. Correlation is significant at the 0.01 level (2-tailed).

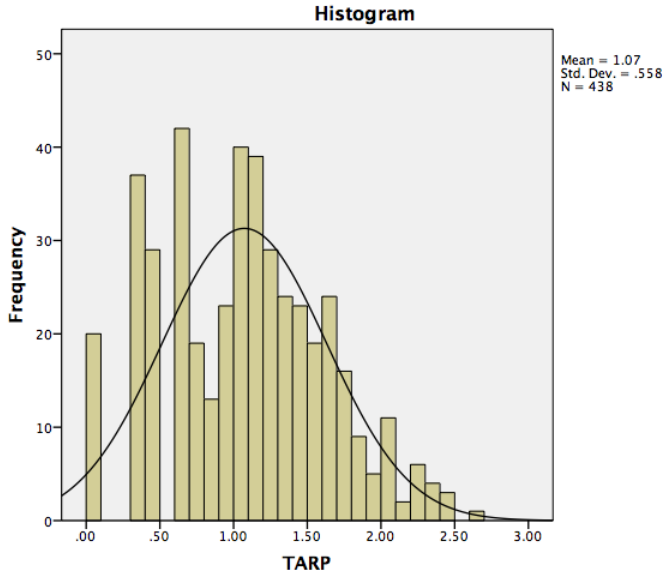
The p-value of 0.008 is less than the significance level of 0.05; therefore the null hypothesis is rejected, at the .05 level of significance. The Spearman's Rho of -0.116 indicates a negative correlation between SGI Propensity and Academic Research Productivity.

Prior to each regression, the dependent variable is transformed, using a natural log transformation in order to improve the robustness of the measure. For hypothesis A1, ARP is the dependent variable. The natural log transformation of ARP yielded the following results:

Table 43: Descriptive Statistics for Natural Log Transformation of ARP

N	Valid	438
	Missing	91
Mean		1.0729
Median		1.0792
Mode		.30
Std. Deviation		.55831
Skewness		.145
Std. Error of Skewness		.117
Kurtosis		-.403
Std. Error of Kurtosis		.233
Minimum		.00
Maximum		2.66

Figure 16: Histogram for Natural Log Transformation of ARP



Following the transformation of the dependent variable, the results of the hierarchical multiple regression are provided:

Table 44: ANOVA for Hypothesis A1a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	44.420	6	7.403	34.797	.000[b]
	Residual	91.485	430	.213		
	Total	135.905	436			
2	Regression	46.298	7	6.614	31.665	.000[c]
	Residual	89.607	429	.209		
	Total	135.905	436			

a. Dependent Variable: TARP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, SGIPROPENSITY

The ANOVA table above shows the degree to which the model, as a whole is a good predictor of the variable outcome. In Model 1, the covariate factors were added into the regression equation, in model 2, the independent variable (SGI Propensity) was added into the regression equation. The ANOVA table indicates that the combination of both Model 1 and Model 2 is a statistically significant predictor of ARP. It can be said that the predictors make for a good model fit, since for Model 1 $p = 0.000$ and for Model 2 $p = 0.000$.

Table 45: Model Summary for Hypothesis A1a

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.572[a]	.327	.317	.46125	.327	34.797	6	430	.000
2	.584[b]	.341	.330	.45703	.014	8.991	1	429	.003

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, SGIPROPENSITY

c. Dependent Variable: TARP

The R^2 values for Model 1 indicates that the control variables account for 32.7% of the variance in the outcome. The R^2 value in the Model 2 row shows the cumulative variance that can be attributed to the control and independent variables, which accounts for a total of 34.1% of the variance in the outcome. This means that SGI Propensity, as an independent variable accounts for 1.4% of the total variance in ARP, as indicated in the 'R-Square Change' column.

The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, as is the contribution to variance of SGI Propensity, $p < 0.05$.

In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 46: Coefficients Table for Hypothesis A1a

Model		Unstandardised Coefficients		Standardised Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.764	.060		12.792	.000					
	Gender	.103	.046	.093	2.260	.024	.178	.108	.089	.933	1.072
	SouthAfrican	-.073	.051	-.058	-1.414	.158	-.096	-.068	-.056	.942	1.062
	English	.157	.045	.140	3.461	.001	.129	.165	.137	.959	1.043
	Prof	.720	.057	.522	12.720	.000	.502	.523	.503	.930	1.075
	Field1Med&Bio	.207	.048	.176	4.294	.000	.098	.203	.170	.930	1.075
	Uni3: Wits	.093	.053	.071	1.752	.080	.111	.084	.069	.964	1.037
2	(Constant)	1.264	.177		7.143	.000					
	Gender	.103	.045	.092	2.269	.024	.178	.109	.089	.933	1.072
	SouthAfrican	-.070	.051	-.056	-1.383	.167	-.096	-.067	-.054	.942	1.062
	English	.142	.045	.127	3.152	.002	.129	.150	.124	.948	1.055
	Prof	.697	.057	.505	12.320	.000	.502	.511	.483	.913	1.095
	Field1Med&Bio	.211	.048	.179	4.404	.000	.098	.208	.173	.929	1.076
	Uni3: Wits	.084	.053	.064	1.594	.112	.111	.077	.063	.961	1.041
	SGIPROPENSITY	-.151	.050	-.120	-2.999	.003	-.205	-.143	-.118	.965	1.036

a. Dependent Variable: TARP

Model 2 summarises the results of all the variables entered into the equation. The 'Sig' column shows that Gender, English Prof, Field1: Med&Bio and SGI Propesnity make statistically significant contribution to this model, since $p < 0.05$.. The standardized coefficients (Beta) column shows which variables make the most statistically significant contribution to the model. These beta values represent the unique contribution of each variable, when the overlapping effects of all the other variables have been statistically removed. VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data. It is important to note that the output in Table 46 is specific to the collection of variables in this equation, only.

The regression equation is as follows:

Y (Transformed ARP) = 1.264 + 0.103(Gender) - 0.070(SouthAfrican) + 0.142(English) + 0.697(Prof) + 0.211(Field1: Med&Bio) +0.084(Uni3: Wits) – 0.151(SGIProp).

The null hypothesis is rejected at the .05 level of significance. Therefore, it can be concluded when controlling for Gender, English, Prof, Field1: Med&Bio, Uni3: Wits, SGI Propensity is a significant predictor of Academic Research Productivity (ARP). The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with ARP as the dependent variable are provided as well.

Figure 17: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: ARP) for Hypothesis A1a

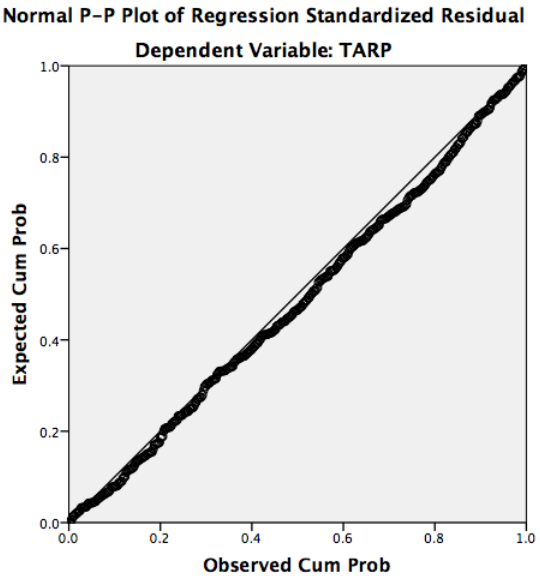
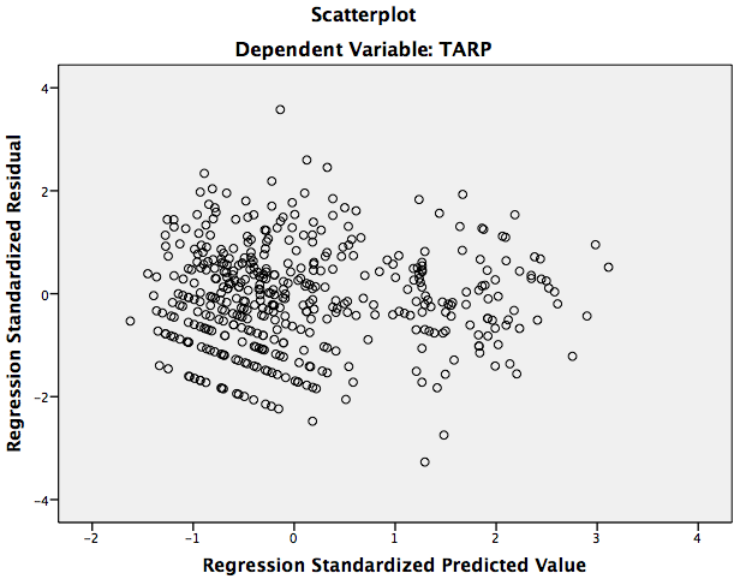


Figure 18: Scatterplot (Dependant Variable: ARP) for Hypothesis A1a



4.5.5. Outlier Removal for Hypothesis A1a: SGI propensity is significantly associated with academic research productivity (ARP).

Outliers are now removed by inspection of the residual statistics and plots generated by SPSS, as follows:

Table 47: Outliers for Hypothesis A1a

	Limits	Cases	Total
Standardised Residuals	Values outside of |3|	33, 78	2
Cook's Distance	Values > 1	none	0
Leverage	Values >0.026	36, 43, 47, 56, 65, 67, 73, 75, 83, 98, 117, 121, 126, 128, 159, 173, 174, 180, 192, 200, 224, 230, 247, 268, 285, 315, 339, 401, 431, 463, 493, 498, 501, 503, 507, 515, 520, 523, 524, 526, 529	41
Mahalanobis	Values > 25	none	0
DFFits	[-0.27; +0.27]	none	0
DFBETAS	[-0.09; +0.09]	None	0
Covariance Ratio	[0.94; 1.05]	33, 67, 78, 91, 98, 159, 192, 230, 285, 326, 401, 431, 457, 470, 507, 520, 526, 529	18
			47 (excluding the same outliers identified by different measures)

The dependent variable ARP was once again transformed. The results of the regression, with outliers removed is as follows:

Table 48: ANOVA Table for Hypothesis A1a with Outliers Removed

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	31.061	6	5.177	27.389	.000[b]
	Residual	73.148	387	.189		
	Total	104.209	393			
2	Regression	31.675	7	4.525	24.080	.000[c]
	Residual	72.535	386	.188		
	Total	104.209	393			

a. Dependent Variable: TARP

b. Predictors: (Constant), Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio

c. Predictors: (Constant), Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio, SGIPROPENSITY

The ANOVA table above shows the degree to which the model, as a whole is a good predictor of the variable outcome. In Model 1, the covariate factors were added into the regression equation, in model 2, the independent variable (SGI Propensity) was added into the regression equation. The ANOVA table indicates that the combination of both Model 1 and Model 2 is a statistically significant predictor of ARP. It can be said that the predictors make for a good model fit, since for Model 1 $p = 0.000$ and for Model 2 $p = 0.000$.

Table 49: Model Summary for Hypothesis A1a with outliers removed

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.546[a]	.298	.287	.43476	.298	27.389	6	387	.000
2	.551[b]	.304	.291	.43349	.006	3.263	1	386	.072

a. Predictors: (Constant), Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio

b. Predictors: (Constant), Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio, SGIPROPENSITY

c. Dependent Variable: TARP

The R^2 values for Model 1 indicates that the control variables account for 29.8% of the variance in the outcome. The R^2 value in the Model 2 row shows the cumulative variance that can be attributed to the control and independent variables, which accounts for a total of 30.4% of the variance in the outcome. This means that SGI Propensity, as an independent variable accounts for 0.6% of the total variance in ARP, as indicated in the 'R-Square Change' column.

The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, but the contribution to variance of SGI Propensity is not, $p > 0.05$.

In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 50: Coefficients Table for Hypothesis A1a with outliers removed

Model		Unstandardised Coefficients		Standardised Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.731	.060		12.253	.000					
	Gender	.097	.045	.094	2.140	.033	.166	.108	.091	.938	1.066
	SouthAfrican	-.031	.052	-.025	-.582	.561	-.027	-.030	-.025	.960	1.042
	English	.142	.045	.137	3.153	.002	.112	.158	.134	.962	1.039
	Prof	.713	.062	.518	11.593	.000	.481	.508	.494	.907	1.103
	Field1Med&Bio	.170	.049	.155	3.475	.001	.052	.174	.148	.912	1.097
	Uni3: Wits	.133	.055	.104	2.408	.016	.086	.122	.103	.974	1.027
2	(Constant)	1.077	.200		5.370	.000					
	Gender	.095	.045	.093	2.115	.035	.166	.107	.090	.937	1.067
	SouthAfrican	-.034	.052	-.028	-.642	.521	-.027	-.033	-.027	.959	1.043
	English	.131	.045	.126	2.885	.004	.112	.145	.122	.944	1.059
	Prof	.704	.062	.511	11.423	.000	.481	.503	.485	.900	1.111
	Field1Med&Bio	.174	.049	.158	3.557	.000	.052	.178	.151	.910	1.099
	Uni3: Wits	.127	.055	.100	2.314	.021	.086	.117	.098	.971	1.030
	SGIPROPENSITY	-.103	.057	-.078	-1.806	.072	-.139	-.092	-.077	.969	1.032

a. Dependent Variable: TARP

In Model 2 English, Prof, Field1: Medicine and Biology and Uni3: Wits make statistically significant contribution to this model, since $p < 0.05$. The independent variable, SGI Propensity does not contribute significantly to the model since $p=.072 > .05$.

VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data.

The new regression equation (with outliers removed) is as follows:

Y (Transformed ARP) = 1.077 + 0.095(Gender) - 0.034(SouthAfrican) + 0.131(English) + 0.704(Prof) + 0.174(Field1: Med&Bio) +0.127(Uni3: Wits) – .103(SGIProp).

With outliers removed, there is sufficient evidence to fail to reject the null hypothesis at the .05 level of significance. Therefore, it can be concluded that when the outliers have been removed, SGI Propensity is not a significant predictor of Academic

Research Productivity (ARP). The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with ARP as the dependent variable are provided as well for the case where outliers have been removed.

Figure 19: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: ARP) with Outliers Removed for Hypothesis A1a

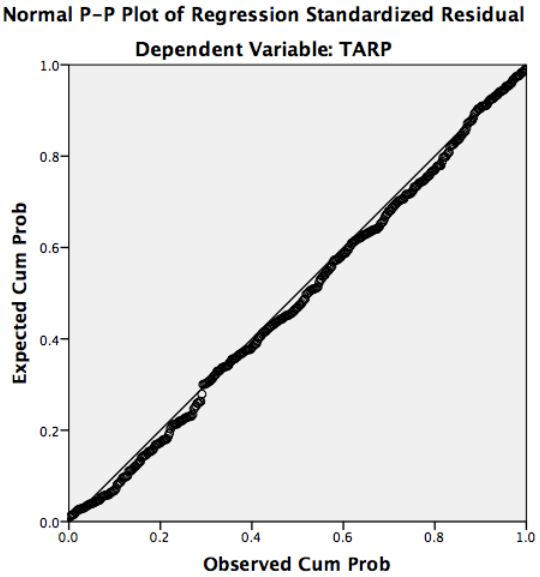
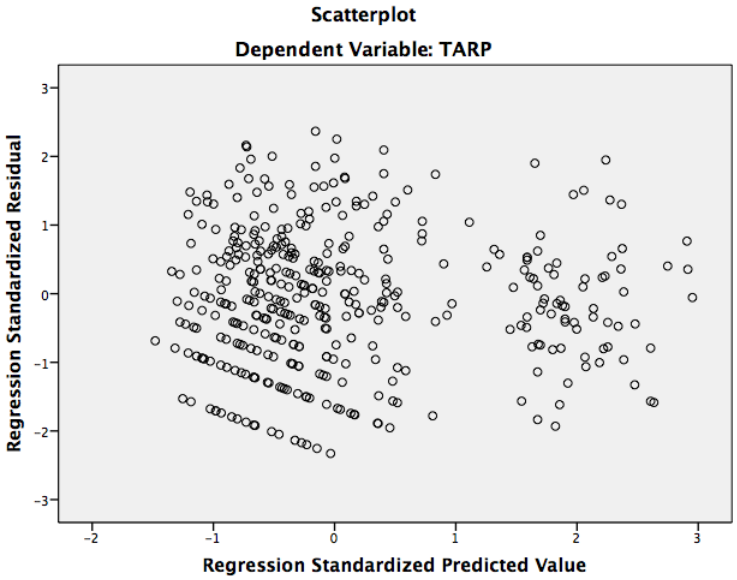


Figure 20: Scatterplot (Dependant Variable: ARP) with outliers removed for Hypothesis A1a



4.5.6. Hypothesis A1b: Human Capital Investments (HCI) are significantly associated with SGI Propensity

Table 51: Correlation between HCI and SGI Propensity

			SGI Propensity	HCI
Spearman's rho	SGI Propensity	Correlation Coefficient	1.000	-.168**
		Sig. (2-tailed)	.	.000
		N	529	529
	HCI	Correlation Coefficient	-.168**	1.000
		Sig. (2-tailed)	.000	.
		N	529	529

**. Correlation is significant at the 0.01 level (2-tailed).

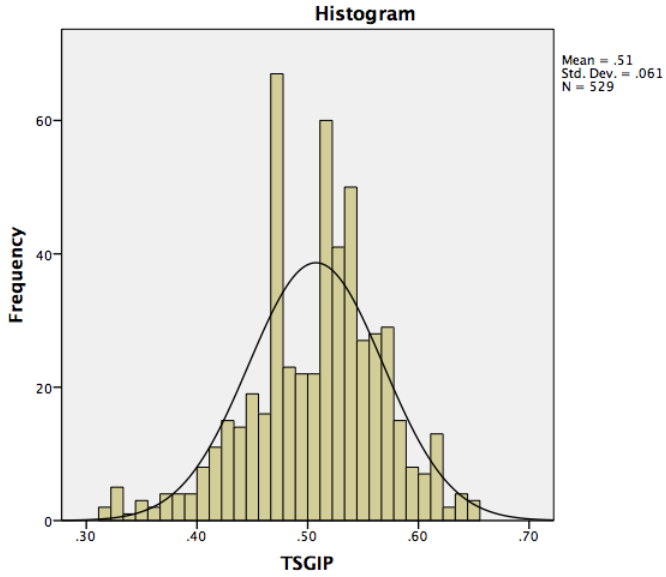
The p-value of 0.000 is less than the significance level of 0.05; therefore the null hypothesis is rejected, at the .05 level of significance. The Spearman's Rho of -0.168 indicates a negative correlation between HCI and SGI Propensity.

For hypothesis A1b, SGI Propensity is the dependent variable. The natural log transformation of SGI Propensity yielded the following results:

Table 52: Descriptive Statistics for Natural Log Transformation of SGI Propensity

N	Valid	529
	Missing	0
Mean		.5075
Median		.5119
Mode		.53
Std. Deviation		.06064
Skewness		-.417
Std. Error of Skewness		.106
Kurtosis		.408
Std. Error of Kurtosis		.212
Minimum		.31
Maximum		.65

Figure 21: Histogram for Natural Log Transformation of SGI Propensity



Following the transformation of the dependent variable, the results of the hierarchical multiple regression are provided:

Table 53: ANOVA for Hypothesis A1b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.074	6	.012	3.461	.002[b]
	Residual	1.864	521	.004		
	Total	1.938	527			
2	Regression	.102	7	.015	4.133	.000[c]
	Residual	1.836	520	.004		
	Total	1.938	527			

a. Dependent Variable: TSGIP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

In Model 1, the covariate factors were added into the regression equation, in model 2, the independent variable (HCI) was added into the regression equation. The combination of both Model 1 and Model 2 is a statistically significant predictor of SGI Propensity. The predictors make for a good model fit, since for Model 1, $p = 0.002<0.05$ and for Model 2 $p = 0.000<0.05$.

Table 54: Model Summary for Hypothesis A1b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.196[a]	.038	.027	.05981	.038	3.461	6	521	.002
2	.230[b]	.053	.040	.05942	.014	7.889	1	520	.005

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

c. Dependent Variable: TSGIP

The R^2 values for Model 1 indicates that the control variables account for 3.8% of the variance in the outcome, while the cumulative variance in Model 2 accounts for a total of 5.3% of the variance in the outcome. This means that HCI, as an independent variable accounts for 1.4% of the total variance in SGI Propensity.

The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, as is the contribution to variance of HCI, $p < 0.05$.

In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 55: Coefficients Table for Hypothesis A1b

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.517	.007		73.320	.000					
	Gender	-.001	.005	-.008	-.173	.863	-.028	-.008	-.007	.933	1.072
	SouthAfrican	.004	.006	.026	.589	.556	.043	.026	.025	.942	1.062
	English	-.013	.005	-.108	-2.460	.014	-.096	-.107	-.106	.959	1.043
	Prof	-.022	.007	-.147	-3.299	.001	-.149	-.143	-.142	.930	1.075
	Field1Med&Bio	.003	.006	.024	.546	.586	.033	.024	.023	.930	1.075
	Uni3: Wits	-.008	.006	-.057	-1.297	.195	-.069	-.057	-.056	.964	1.037
2	(Constant)	.525	.008		68.925	.000					
	Gender	.001	.005	.004	.093	.926	-.028	.004	.004	.924	1.082
	SouthAfrican	.003	.006	.022	.497	.620	.043	.022	.021	.941	1.063
	English	-.011	.005	-.092	-2.081	.038	-.096	-.091	-.089	.942	1.062
	Prof	-.010	.008	-.064	-1.194	.233	-.149	-.052	-.051	.641	1.559
	Field1Med&Bio	.004	.006	.030	.686	.493	.033	.030	.029	.928	1.078
	Uni3: Wits	-.009	.006	-.064	-1.463	.144	-.069	-.064	-.062	.961	1.041
	HCI	-.001	.000	-.148	-2.809	.005	-.191	-.122	-.120	.659	1.518

a. Dependent Variable: TSGIP

In Model 2, English and HCI make significant contributions the model since $p < 0.05$.

VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data.

The regression equation is as follows:

Y (Transformed SGI Propensity) = 0.525 + 0.001(Gender) + 0.003(SouthAfrican) - 0.011(English) - 0.010(Prof) + 0.004(Field1: Med&Bio) - 0.009(Uni3: Wits) – 0.001(HCI).

The null hypothesis is rejected at the .05 level of significance. Therefore, it can be concluded when controlling for Gender, English, Prof, Field1:Med&Bio, Uni3: Wits, HCI is a significant predictor of SGI Propensity. The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with SGI Propensity as the dependent variable are provided as well.

Figure 22: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: SGI Propensity) for Hypothesis A1b

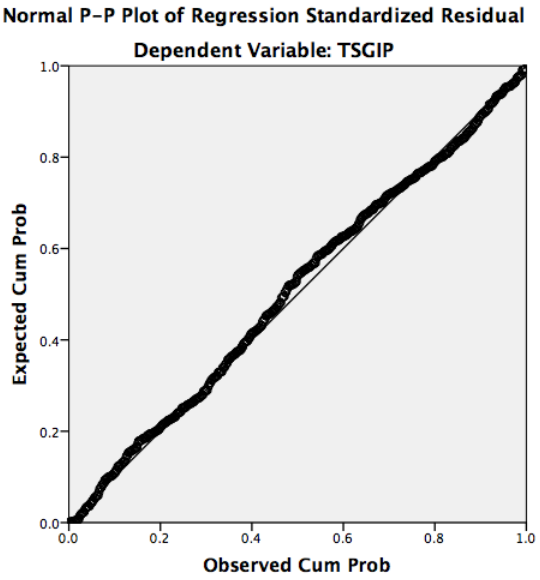
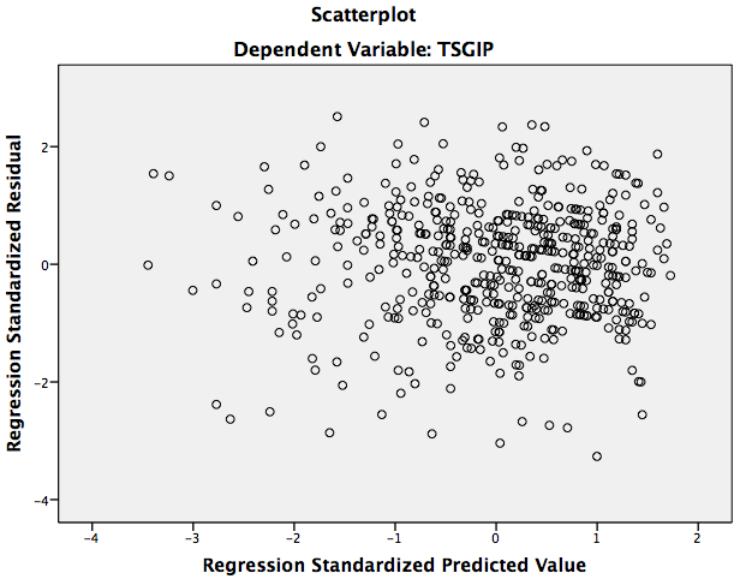


Figure 23: Scatterplot (Dependent Variable: SGI Propensity) for Hypothesis A1b



4.5.7. Outlier Removal for Hypothesis A1b: HCI are significantly associated with SGI Propensity

Outliers are now removed by inspection of the residual statistics and plots generated by SPSS, as follows:

Table 56: Outliers for Hypothesis A1b

	Limits	**Cases**	**Total**
Standardised Residuals	Values outside of |3|	65, 314	2
Cook's Distance	Values > 1	None	0
Leverage	Values >0.026	47, 67, 75, 87, 100, 124, 160, 188, 363, 481, 494, 498, 507, 520	14
Mahalanobis	Values > 25	None	0
DFFits	[-0.27; +0.27]	None	0
DFBETAS	[-0.09; +0.09]	None	0
Covariance Ratio	[0.94; 1.05]	11, 33, 36, 65, 67, 100, 126, 192, 230, 278, 314, 339, 431, 520, 526	15
			26 (excluding the same outliers identified by different measures)

The dependent variable SGI Propensity was once again transformed. The results of the regression, with outliers removed is as follows:

Table 57: ANOVA Table for Hypothesis A1b with Outliers Removed

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.072	6	.012	4.111	.000[b]
	Residual	1.453	495	.003		
	Total	1.526	501			
2	Regression	.086	7	.012	4.198	.000[c]
	Residual	1.440	494	.003		
	Total	1.526	501			

a. Dependent Variable: TSGIP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

With outliers removed, the combination of both Model 1 and Model 2 is a statistically significant predictor of SGI Propensity. The predictors make for a good model fit, since for Model 1, $p = 0.000<0.05$ and for Model 2 $p = 0.000<0.05$.

Table 58: Model Summary for Hypothesis A1b with outliers removed

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.218[a]	.047	.036	.05419	.047	4.111	6	495	.000
2	.237[b]	.056	.043	.05400	.009	4.545	1	494	.034

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

c. Dependent Variable: TSGIP

With outliers removed, the R^2 values for Model 1 indicates that the control variables account for 4.7% of the variance in the outcome, while the cumulative variance Model 2 can be attributed to the control and independent variables, which accounts for a total of 5.6% of the variance in the outcome. This means that HCI, as an independent variable accounts for 0.9% of the total variance in SGI Propensity.

The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, as is the contribution to variance of HCI, $p < 0.05$.

In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 59: Coefficients Table for Hypothesis A1b with outliers removed

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.522	.007		79.454	.000					
	Gender	-.001	.005	-.014	-.298	.766	-.025	-.013	-.013	.935	1.069
	SouthAfrican	.000	.006	.003	.076	.939	.015	.003	.003	.948	1.055
	English	-.017	.005	-.155	-3.445	.001	-.132	-.153	-.151	.955	1.047
	Prof	-.020	.006	-.142	-3.104	.002	-.144	-.138	-.136	.923	1.083
	Field1Med&Bio	.008	.005	.065	1.432	.153	.068	.064	.063	.928	1.077
	Uni3: Wits	-.006	.006	-.042	-.935	.350	-.047	-.042	-.041	.970	1.031
2	(Constant)	.528	.007		73.618	.000					
	Gender	.000	.005	-.004	-.093	.926	-.025	-.004	-.004	.927	1.079
	SouthAfrican	.000	.006	.003	.068	.946	.015	.003	.003	.948	1.055
	English	-.016	.005	-.142	-3.141	.002	-.132	-.140	-.137	.938	1.066
	Prof	-.010	.008	-.074	-1.340	.181	-.144	-.060	-.059	.622	1.608
	Field1Med&Bio	.008	.005	.066	1.461	.145	.068	.066	.064	.928	1.077
	Uni3: Wits	-.007	.006	-.051	-1.141	.254	-.047	-.051	-.050	.961	1.041
	HCI	-.001	.000	-.117	-2.132	.034	-.170	-.095	-.093	.638	1.567

a. Dependent Variable: TSGIP

In Model 2 English and HCI make statistically significant contributions to this model, since $p < 0.05$.

VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data.

The new regression equation (with outliers removed) is as follows:

Y (Transformed SGI Propensity) = 0.528 + 0.000(Gender) + 0.000(SouthAfrican) - 0.016(English) - 0.010(Prof) + 0.008(Field1: Med&Bio) - 0.007(Uni3: Wits) – .001(HCI).

With outliers removed, the null hypothesis is rejected at the .05 level of significance. Therefore, it can be concluded that when the outliers have been removed, HCI is a significant predictor of SGI Propensity. The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with SGI Propensity as the dependent variable are provided as well for the case where outliers have been removed.

Figure 24: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: SGI Propensity) with Outliers Removed for Hypothesis A1b

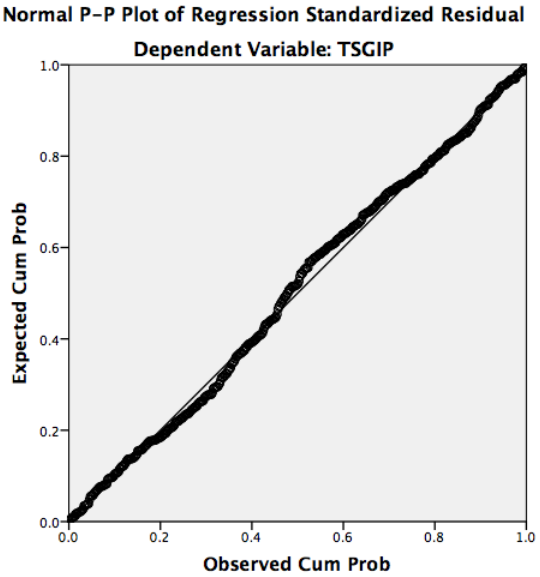
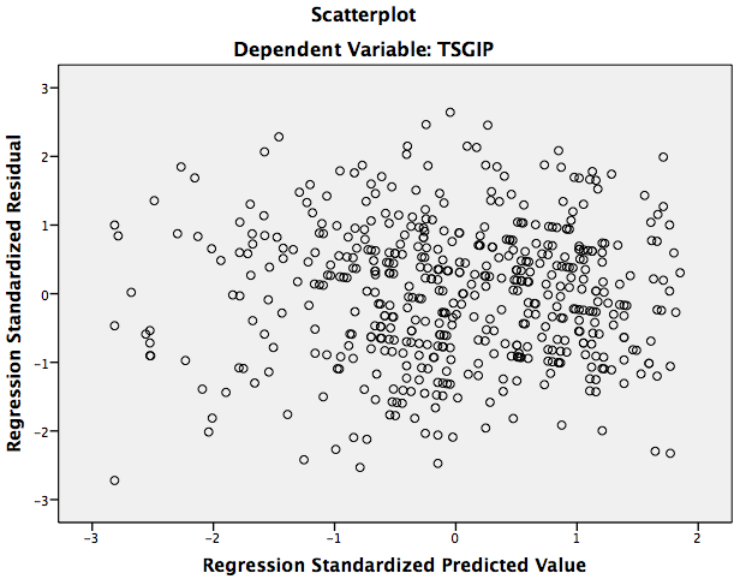


Figure 25: Scatterplot (Dependant Variable: SGI Propensity) with outliers removed for Hypothesis A1b



4.5.8. Hypothesis A1c: Personality is significantly associated with SGI Propensity

The components of personality are orthogonal (Field, 2012). Because of this, each dimension of personality was tested against the dependent variable, SGI Propensity.

Table 60: Correlation between Personality and SGI Propensity

			SGIPROP	NTOT	OTOT	ATOT	CTOT	ETOT
Spearman's rho	SGIPROP	Correlation Coefficient	1.000	.021	.128**	-.045	.018	-.016
		Sig. (2-tailed)	.	.634	.003	.301	.685	.713
		N	529	529	528	528	529	527
	NTOT	Correlation Coefficient	.021	1.000	.093*	-.138**	.354**	.380**
		Sig. (2-tailed)	.634	.	.032	.002	.000	.000
		N	529	529	528	528	529	527
	OTOT	Correlation Coefficient	.128**	.093*	1.000	.078	.112**	.001
		Sig. (2-tailed)	.003	.032	.	.075	.010	.990
		N	528	528	528	527	528	527
	ATOT	Correlation Coefficient	-.045	-.138**	.078	1.000	-.137**	-.131**
		Sig. (2-tailed)	.301	.002	.075	.	.002	.003
		N	528	528	527	528	528	527
	CTOT	Correlation Coefficient	.018	.354**	.112**	-.137**	1.000	.221**
		Sig. (2-tailed)	.685	.000	.010	.002	.	.000
		N	529	529	528	528	529	527
	ETOT	Correlation Coefficient	-.016	.380**	.001	-.131**	.221**	1.000
		Sig. (2-tailed)	.713	.000	.990	.003	.000	.
		N	527	527	527	527	527	527

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

SGI propensity-Neuroticism: Rho=.021, p >.05
SGI propensity-Openness: Rho= .128, p<.05
SGI propensity-Agreeableness: Rho=-.045, p>.05
SGI propensity- Conscientiousness: Rho = .018, p>.05
SGI propensity-Extraversion: Rho=-.016, p>.05

The relationship between SGI propensity and openness is the only significant correlation (Rho-.128, p <.05). All other correlations included in Table 60 are not

significant.

For Hypothesis A1c, SGI Propensity is the dependent variable. The transformed version of SGI Propensity is used for this regression. Following the transformation of the dependent variable, the results of the hierarchical multiple regression are provided:

Table 61: ANOVA for Hypothesis A1c

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.074	6	.012	3.461	.002[b]
	Residual	1.864	521	.004		
	Total	1.938	527			
2	Regression	.075	7	.011	2.992	.004[c]
	Residual	1.863	520	.004		
	Total	1.938	527			

a. Dependent Variable: TSGIP
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, PERSONALITY

In Model 1, the covariate factors were added into the regression equation, in model 2, the independent variable (Personality) was added into the regression equation. The combination of both Model 1 and Model 2 is a statistically significant predictor of SGI Propensity. The predictors make for a good model fit, since for Model 1, $p = 0.002<0.05$ and for Model 2 $p = 0.004<0.05$.

Table 62: Model Summary for Hypothesis A1c

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.196[a]	.038	.027	.05981	.038	3.461	6	521	.002
2	.197[b]	.039	.026	.05985	.000	.210	1	520	.647

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, PERSONALITY
c. Dependent Variable: TSGIP

The R^2 values for Model 1 indicates that the control variables account for 3.8% of the variance in the outcome, while the cumulative variance in Model 2 accounts for a total of 3.9% of the variance in the outcome. This means that Personality, as an independent variable accounts for 0.1% of the total variance in SGI Propensity.

The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, but the contribution to variance of Personality is not, $p > 0.05$.

In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 63: Coefficients Table for Hypothesis A1c

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.517	.007		73.320	.000					
	Gender	-.001	.005	-.008	-.173	.863	-.028	-.008	-.007	.933	1.072
	SouthAfrican	.004	.006	.026	.589	.556	.043	.026	.025	.942	1.062
	English	-.013	.005	-.108	-2.460	.014	-.096	-.107	-.106	.959	1.043
	Prof	-.022	.007	-.147	-3.299	.001	-.149	-.143	-.142	.930	1.075
	Field1Med&Bio	.003	.006	.024	.546	.586	.033	.024	.023	.930	1.075
	Uni3: Wits	-.008	.006	-.057	-1.297	.195	-.069	-.057	-.056	.964	1.037
2	(Constant)	.513	.011		47.128	.000					
	Gender	-.001	.005	-.008	-.183	.855	-.028	-.008	-.008	.932	1.073
	SouthAfrican	.003	.006	.025	.575	.566	.043	.025	.025	.941	1.063
	English	-.013	.005	-.109	-2.482	.013	-.096	-.108	-.107	.955	1.047
	Prof	-.022	.007	-.146	-3.283	.001	-.149	-.143	-.141	.929	1.076
	Field1Med&Bio	.003	.006	.023	.523	.601	.033	.023	.022	.928	1.078
	Uni3: Wits	-.008	.006	-.058	-1.330	.184	-.069	-.058	-.057	.957	1.045
	PERSONALITY	.002	.004	.020	.458	.647	.014	.020	.020	.982	1.018

a. Dependent Variable: TSGIP

In Model 2, English and Prof make significant contributions the model since $p < 0.05$. The independent variable, Personality does not since $p = .647 > 0.05$.

VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data.

The regression equation is as follows:

Y (Transformed SGI Propensity) = 0.513 - 0.001(Gender) + 0.003(SouthAfrican) - 0.013(English) - 0.022(Prof) + 0.003(Field1: Med&Bio) - 0.008(Uni3: Wits) + 0.002(Personality).

There is sufficient evidence to fail to reject the null hypothesis at the .05 level of significance. Therefore, it can be concluded when controlling for Gender, English, Prof, Field1:Med&Bio, Uni3: Wits, Personality is not a significant predictor of SGI Propensity. The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with SGI Propensity as the dependent variable are provided as well.

Figure 26: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: SGI Propensity) for Hypothesis A1c

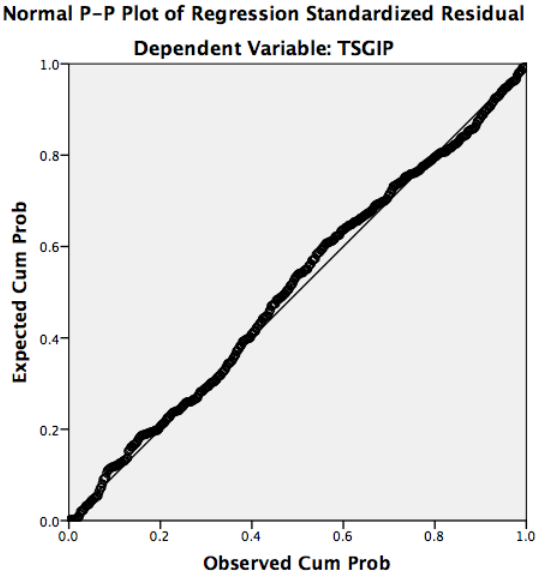
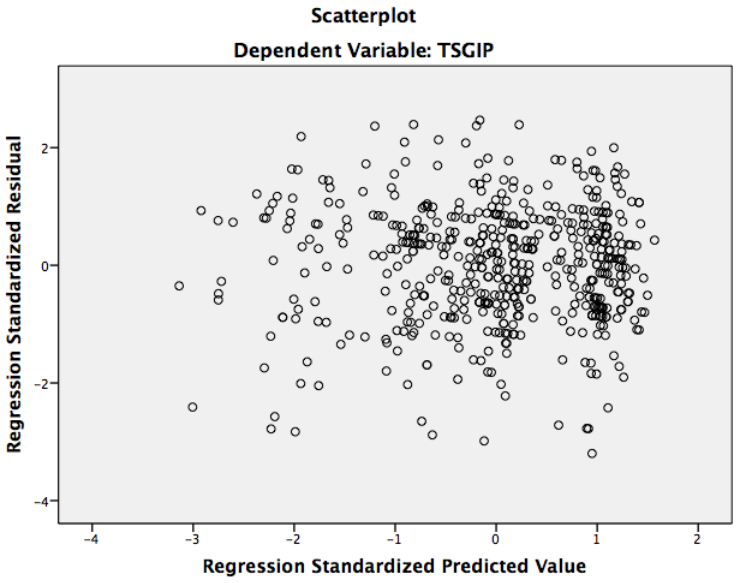


Figure 27: Scatterplot (Dependent Variable: SGI Propensity) for Hypothesis A1c



4.5.9. Outlier Removal for Hypothesis A1c: Personality is significantly associated with SGI Propensity

Outliers are now removed by inspection of the residual statistics and plots generated by SPSS, as follows:

Table 64: Outliers for Hypothesis A1c

	Limits	**Cases**	**Total**
Standardised Residuals	Values outside of |3|	314	1
Cook's Distance	Values > 1	None	0
Leverage	Values >0.026	38, 47, 83, 98, 306, 451, 493, 498, 511, 523	10
Mahalanobis	Values > 25	None	0
DFFits	[-0.27; +0.27]	None	0
DFBETAS	[-0.09; +0.09]	None	0
Covariance Ratio	[0.94; 1.05]	11, 33, 36, 65, 192, 230, 278, 314, 339, 431, 520, 526	12
			22 (excluding the same outliers identified by different measures)

The dependent variable SGI Propensity was once again transformed. The results of the regression, with outliers removed is as follows:

Table 65: ANOVA Table for Hypothesis A1c with Outliers Removed

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.053	6	.009	2.968	.007[b]
	Residual	1.480	499	.003		
	Total	1.533	505			
2	Regression	.054	7	.008	2.594	.012[c]
	Residual	1.479	498	.003		
	Total	1.533	505			

a. Dependent Variable: TSGIP
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, PERSONALITY

With outliers removed, the combination of both Model 1 and Model 2 is a statistically significant predictor of SGI Personality. The predictors make for a good model fit, since for Model 1, $p = 0.007<0.05$ and for Model 2 $p = 0.012<0.05$.

Table 66: Model Summary for Hypothesis A1c with outliers removed

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.186[a]	.034	.023	.05447	.034	2.968	6	499	.007
2	.188[b]	.035	.022	.05450	.001	.374	1	498	.541

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, PERSONALITY
c. Dependent Variable: TSGIP

With outliers removed, the R^2 values for Model 1 indicates that the control variables account for 3.4% of the variance in the outcome, while the cumulative variance Model 2 can be attributed to the control and independent variables, which accounts for a total of 3.5% of the variance in the outcome. This means that Personality, as an independent variable accounts for 0.1% of the total variance in SGI Propensity.

The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, but the contribution to variance of Personality is not, $p < 0.05$.

In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 67: Coefficients Table for Hypothesis A1c with outliers removed

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.521	.007		79.222	.000					
	Gender	.001	.005	.006	.141	.888	-.003	.006	.006	.935	1.069
	SouthAfrican	-.001	.006	-.004	-.093	.926	.002	-.004	-.004	.946	1.057
	English	-.014	.005	-.129	-2.862	.004	-.112	-.127	-.126	.957	1.045
	Prof	-.018	.006	-.131	-2.856	.004	-.125	-.127	-.126	.924	1.082
	Field1Med&Bio	.005	.005	.045	.986	.325	.047	.044	.043	.930	1.075
	Uni3: Wits	-.005	.006	-.041	-.915	.360	-.038	-.041	-.040	.968	1.033
2	(Constant)	.516	.010		49.432	.000					
	Gender	.001	.005	.007	.145	.884	-.003	.007	.006	.935	1.069
	SouthAfrican	-.001	.006	-.005	-.116	.907	.002	-.005	-.005	.944	1.059
	English	-.014	.005	-.130	-2.879	.004	-.112	-.128	-.127	.955	1.047
	Prof	-.018	.006	-.130	-2.830	.005	-.125	-.126	-.125	.923	1.083
	Field1Med&Bio	.005	.005	.043	.946	.344	.047	.042	.042	.927	1.079
	Uni3: Wits	-.006	.006	-.043	-.966	.335	-.038	-.043	-.043	.960	1.042
	PERSONALITY	.002	.004	.027	.612	.541	.027	.027	.027	.981	1.019

a. Dependent Variable: TSGIP

In Model 2 English and Prof make statistically significant contributions to this model, since $p < 0.05$. The independent variable, Personality does not contribute significantly to the model, $p = .541 > 0.05$.

VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data. The new regression equation (with outliers removed) is as follows:

Y (Transformed SGI Propensity) = 0.516 + 0.001(Gender) - 0.001(SouthAfrican) - 0.014(English) - 0.018(Prof) + 0.005(Field1: Med&Bio) - 0.006(Uni3: Wits) + .002(Personality).

With outliers removed, there is sufficient evidence to fail to reject the null hypothesis at the .05 level of significance. Therefore, it can be concluded that when the outliers have been removed, Personality is not a significant predictor of SGI Propensity. The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with SGI Propensity as the dependent variable are provided as well for the case where outliers have been removed.

Figure 28: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: SGI Propensity) with Outliers Removed for Hypothesis A1c

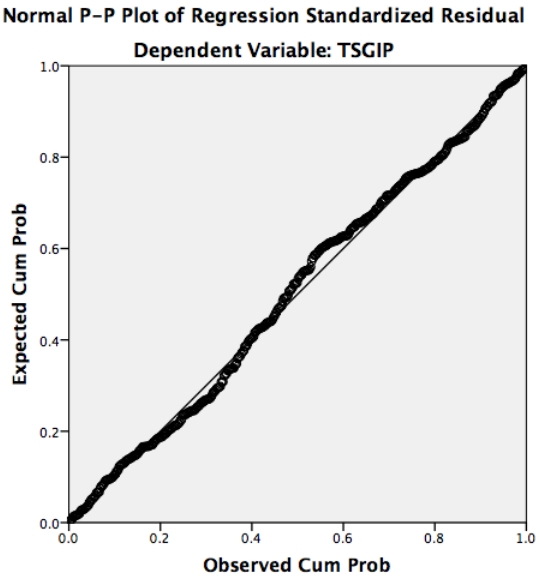
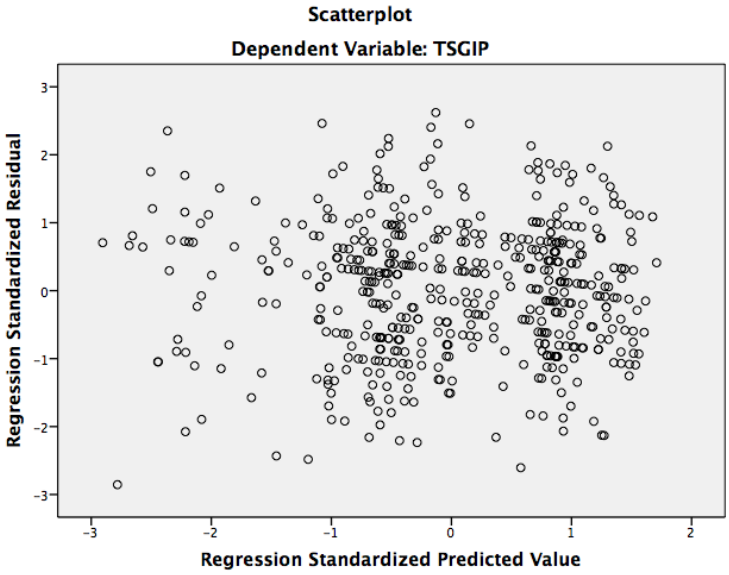


Figure 29: Scatterplot (Dependant Variable: SGI Propensity) with outliers removed for Hypothesis A1c



4.5.10. Hypothesis A1d: SGI Propensity is significantly associated with Motivation

Because the constructs of motivation are orthogonal, each motivational construct was tested against the dependent variable (Field, 2012).

Table 68: Correlation between SGI Propensity and Motivation

			SGIPROP	IDREG	EXTREG	AMOT	INMOT	INTREG	INTROREG
Spearman's rho	SGIPROP	Correlation Coefficient	1.000	.193**	-.027	.094*	.165**	.070	.274**
		Sig. (2-tailed)	.	.000	.538	.030	.000	.109	.000
		N	529	529	529	529	529	529	529
	IDREG	Correlation Coefficient	.193**	1.000	.201**	-.194**	.379**	.442**	.637**
		Sig. (2-tailed)	.000	.	.000	.000	.000	.000	.000
		N	529	529	529	529	529	529	529
	EXTREG	Correlation Coefficient	-.027	.201**	1.000	.036	-.040	.086*	.207**
		Sig. (2-tailed)	.538	.000	.	.414	.364	.048	.000
		N	529	529	529	529	529	529	529
	AMOT	Correlation Coefficient	.094*	-.194**	.036	1.000	-.268**	-.176**	-.102*
		Sig. (2-tailed)	.030	.000	.414	.	.000	.000	.019
		N	529	529	529	529	529	529	529
	INMOT	Correlation Coefficient	.165**	.379**	-.040	-.268**	1.000	.529**	.421**
		Sig. (2-tailed)	.000	.000	.364	.000	.	.000	.000
		N	529	529	529	529	529	529	529
	INTREG	Correlation Coefficient	.070	.442**	.086*	-.176**	.529**	1.000	.413**
		Sig. (2-tailed)	.109	.000	.048	.000	.000	.	.000
		N	529	529	529	529	529	529	529
	INTROREG	Correlation Coefficient	.274**	.637**	.207**	-.102*	.421**	.413**	1.000
		Sig. (2-tailed)	.000	.000	.000	.019	.000	.000	.
		N	529	529	529	529	529	529	529

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

SGI Propensity – IDREG: Rho= .193, p <.05
SGI Propensity – EXTREG: Rho= -.027, p > .05
SGI Propensity – AMOT: Rho= .094, p <.05
SGI Propensity – INMOT: Rho= .165, p <.05
SGI Propensity – INTREG: Rho= .070, p > .05
SGI Propensity – INTROREG: Rho= .274, p <.05

External regulation and integrated regulation do significantly associate with SGI propensity (p>.05). Identified regulation, amotivation, intrinsic motivation and Introjected regulation all associate significantly with SGI propensity.

For Hypothesis A1d, SGI Propensity is the dependent variable. The transformed version of SGI Propensity is used for this regression. Following the transformation of the dependent variable, the results of the hierarchical multiple regression are provided:

Table 69: ANOVA for Hypothesis A1d

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.074	6	.012	3.461	.002[b]
	Residual	1.864	521	.004		
	Total	1.938	527			
2	Regression	.099	7	.014	4.017	.000[c]
	Residual	1.839	520	.004		
	Total	1.938	527			

a. Dependent Variable: TSGIP
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, MOTIVATIONTOTAL

In Model 1, the covariate factors were added into the regression equation, in model 2, the independent variable (Motivation) was added into the regression equation. The combination of both Model 1 and Model 2 is a statistically significant predictor of SGI Propensity. The predictors make for a good model fit, since for Model 1, p = 0.002<0.05 and for Model 2 p = 0.000<0.05.

Table 70: Model Summary for Hypothesis A1d

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.196[a]	.038	.027	.05981	.038	3.461	6	521	.002
2	.227[b]	.051	.039	.05946	.013	7.108	1	520	.008

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, MOTIVATIONTOTAL
c. Dependent Variable: TSGIP

The R^2 values for Model 1 indicates that the control variables account for 3.8% of the variance in the outcome, while the cumulative variance in Model 2 accounts for a total of 5.1% of the variance in the outcome. This means that Motivation, as an independent variable accounts for 1.3% of the total variance in SGI Propensity.

The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, as is the contribution to variance of Motivation, $p < 0.05$.

In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 71: Coefficients Table for Hypothesis A1d

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	.517	.007		73.320	.000					
Gender	-.001	.005	-.008	-.173	.863	-.028	-.008	-.007	.933	1.072
SouthAfrican	.004	.006	.026	.589	.556	.043	.026	.025	.942	1.062
English	-.013	.005	-.108	-2.460	.014	-.096	-.107	-.106	.959	1.043
Prof	-.022	.007	-.147	-3.299	.001	-.149	-.143	-.142	.930	1.075
Field1Med&Bio	.003	.006	.024	.546	.586	.033	.024	.023	.930	1.075
Uni3: Wits	-.008	.006	-.057	-1.297	.195	-.069	-.057	-.056	.964	1.037
2 (Constant)	.470	.019		24.962	.000					
Gender	-.001	.005	-.006	-.135	.892	-.028	-.006	-.006	.933	1.072
SouthAfrican	.003	.006	.020	.456	.649	.043	.020	.019	.939	1.065
English	-.012	.005	-.097	-2.212	.027	-.096	-.097	-.094	.950	1.053
Prof	-.021	.007	-.142	-3.207	.001	-.149	-.139	-.137	.928	1.077
Field1Med&Bio	.004	.006	.035	.787	.432	.033	.034	.034	.922	1.084
Uni3: Wits	-.009	.006	-.062	-1.427	.154	-.069	-.062	-.061	.962	1.040
MOTIVATIONTOTAL	.013	.005	.115	2.666	.008	.124	.116	.114	.977	1.023

a. Dependent Variable: TSGIP

In Model 2, Prof and Motivation make significant contributions the model since $p < 0.05$.

VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data.

The regression equation is as follows:

Y (Transformed SGI Propensity) = 0.470 - 0.001(Gender) + 0.003(SouthAfrican) - 0.012(English) - 0.021(Prof) + 0.004(Field1: Med&Bio) - 0.009(Uni3: Wits) + 0.013(Motivation).

The null hypothesis is rejected at the .05 level of significance. Therefore, it can be concluded when controlling for Gender, English, Prof, Field1:Med&Bio, Uni3: Wits, Motivation is a significant predictor of SGI Propensity. The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with SGI Propensity as the dependent variable are provided as well.

Figure 30: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: SGI Propensity) for Hypothesis A1d

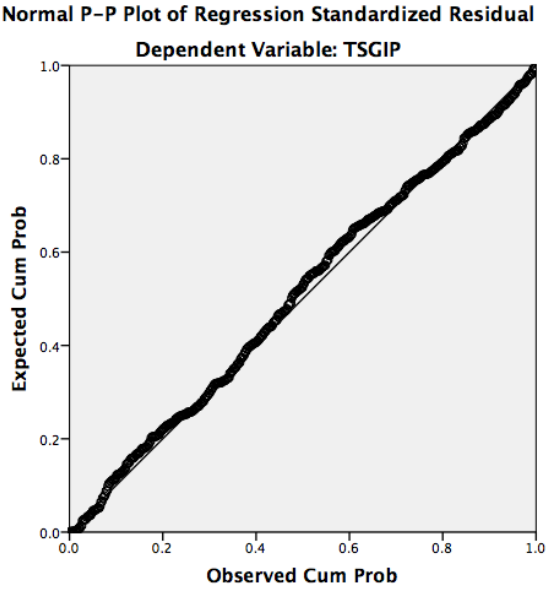
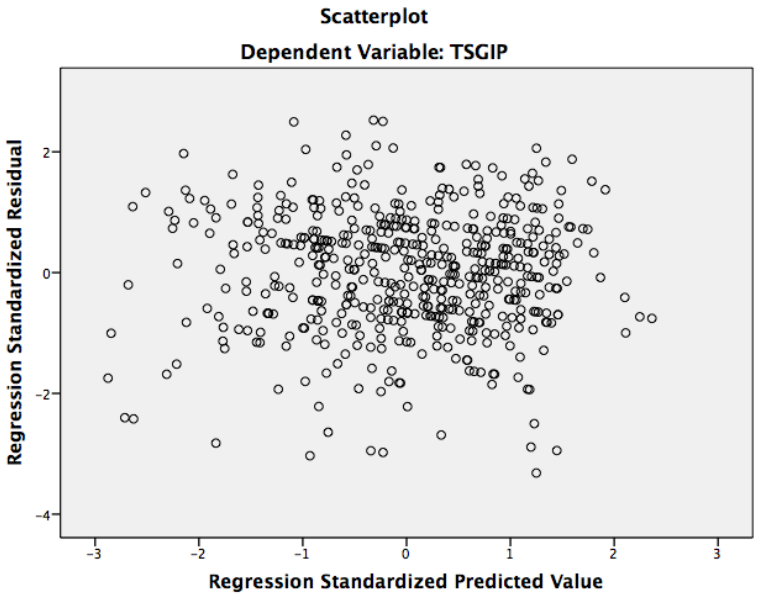


Figure 31: Scatterplot (Dependent Variable: SGI Propensity) for Hypothesis A1d



4.5.11. Outlier Removal for Hypothesis A1d: Motivation is significantly associated with SGI Propensity

Outliers are now removed by inspection of the residual statistics and plots generated by SPSS, as follows:

Table 72: Outliers for Hypothesis A1d

	Limits	**Cases**	**Total**
Standardised Residuals	Values outside of |3|	314, 526	2
Cook's Distance	Values > 1	None	0
Leverage	Values >0.026	73, 75, 83, 128, 224, 247, 260, 491, 503, 511, 525	11
Mahalanobis	Values > 25	None	0
DFFits	[-0.27; +0.27]	None	0
DFBETAS	[-0.09; +0.09]	None	0
Covariance Ratio	[0.94; 1.05]	11, 33, 36, 65, 121, 192, 278, 314, 339, 431, 520, 526	12
			23 (excluding the same outliers identified by different measures)

The dependent variable SGI Propensity was once again transformed. The results of the regression, with outliers removed is as follows:

Table 73: ANOVA Table for Hypothesis A1d with Outliers Removed

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.062	6	.010	3.502	.002[b]
	Residual	1.464	498	.003		
	Total	1.526	504			
2	Regression	.093	7	.013	4.595	.000[c]
	Residual	1.433	497	.003		
	Total	1.526	504			

a. Dependent Variable: TSGIP
b. Predictors: (Constant), Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio
c. Predictors: (Constant), Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio, MOTIVATIONTOTAL

With outliers removed, the combination of both Model 1 and Model 2 is a statistically significant predictor of SGI Propensity. The predictors make for a good model fit, since for Model 1, $p = 0.002<0.05$ and for Model 2 $p = 0.000<0.05$.

Table 74: Model Summary for Hypothesis A1d with outliers removed

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.201[a]	.040	.029	.05423	.040	3.502	6	498	.002
2	.247[b]	.061	.048	.05370	.020	10.747	1	497	.001

a. Predictors: (Constant), Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio
b. Predictors: (Constant), Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio, MOTIVATIONTOTAL
c. Dependent Variable: TSGIP

With outliers removed, the R^2 values for Model 1 indicates that the control variables account for 4.0% of the variance in the outcome, while the cumulative variance Model 2 can be attributed to the control and independent variables, which accounts for a total of 6.1% of the variance in the outcome. This means that Personality, as an independent variable accounts for 2.0% of the total variance in SGI Propensity.

The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, as is the contribution to variance of Motivation, $p > 0.05$.

In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 75: Coefficients Table for Hypothesis A1d with outliers removed

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.520	.007		79.393	.000					
	Gender	-.001	.005	-.012	-.263	.793	-.020	-.012	-.012	.941	1.063
	SouthAfrican	.002	.006	.012	.277	.782	.028	.012	.012	.950	1.052
	English	-.016	.005	-.148	-3.315	.001	-.132	-.147	-.146	.963	1.038
	Prof	-.016	.006	-.117	-2.559	.011	-.121	-.114	-.112	.922	1.085
	Field1Med&Bio	.007	.005	.057	1.248	.213	.057	.056	.055	.917	1.090
	Uni3: Wits	-.007	.006	-.052	-1.159	.247	-.055	-.052	-.051	.970	1.031
2	(Constant)	.465	.018		26.105	.000					
	Gender	-.001	.005	-.009	-.206	.837	-.020	-.009	-.009	.940	1.063
	SouthAfrican	1.377E-5	.006	.000	.002	.998	.028	.000	.000	.944	1.060
	English	-.015	.005	-.135	-3.028	.003	-.132	-.135	-.132	.955	1.047
	Prof	-.015	.006	-.111	-2.441	.015	-.121	-.109	-.106	.920	1.087
	Field1Med&Bio	.009	.005	.074	1.627	.104	.057	.073	.071	.905	1.105
	Uni3: Wits	-.008	.006	-.059	-1.334	.183	-.055	-.060	-.058	.968	1.033
	MOTIVATIONTOTAL	.015	.005	.145	3.278	.001	.151	.145	.143	.969	1.032

a. Dependent Variable: TSGIP

In Model 2 English, Prof and Motivation make statistically significant contributions to this model, since $p < 0.05$.

VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data.

The new regression equation (with outliers removed) is as follows:

Y (Transformed SGI Propensity) = 0.465 - 0.001(Gender) + 1.377(SouthAfrican) - 0.015(English) - 0.015(Prof) + 0.009(Field1: Med&Bio) - 0.008(Uni3: Wits) + .015(Motivation).

With outliers removed, the null hypothesis is rejected at the .05 level of significance. Therefore, it can be concluded that when the outliers have been removed, Motivation is a significant predictor of SGI Propensity. The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with SGI Propensity as the dependent variable are provided as well for the case where outliers have been removed.

Figure 32: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: SGI Propensity) with Outliers Removed for Hypothesis A1d

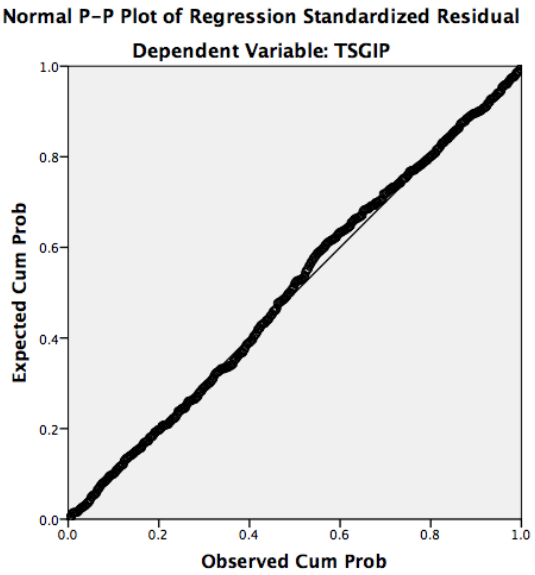
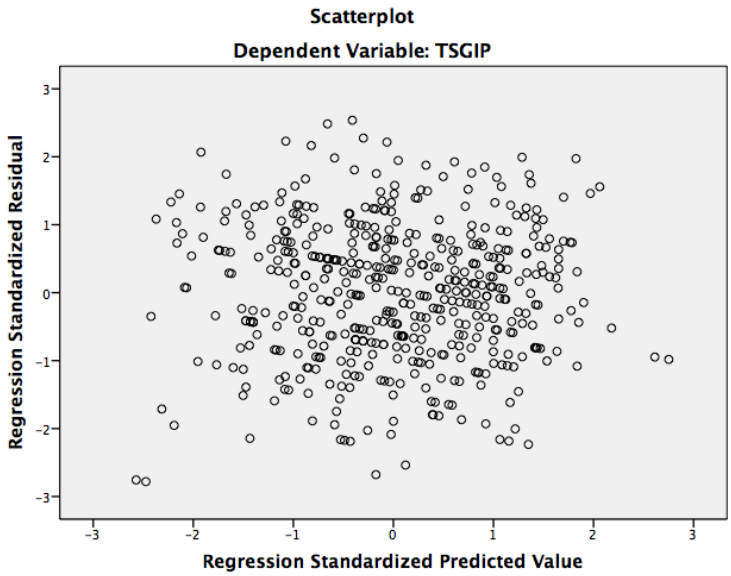


Figure 33: Scatterplot (Dependant Variable: SGI Propensity) with outliers removed for Hypothesis A1d



4.5.12. Hypothesis A3: HCI are significantly associated with ARP

Table 76: Correlation between HCI and Academic Research Productivity (ARP)

			HCI	ARP
Spearman's rho	HCI	Correlation Coefficient	1.000	.649**
		Sig. (2-tailed)	.	.000
		N	529	529
	ARP	Correlation Coefficient	.649**	1.000
		Sig. (2-tailed)	.000	.
		N	529	529

**. Correlation is significant at the 0.01 level (2-tailed).

The p-value of 0.000 is less than the significance level of 0.05; therefore the null hypothesis is rejected, at the .05 level of significance. The Spearman's Rho of 0.649 indicates a positive correlation between HCI and ARP.

For Hypothesis A3, ARP is the dependent variable. The transformed version of ARP is used for this regression. Following the transformation of the dependent variable, the results of the hierarchical multiple regression are provided:

Table 77: ANOVA for Hypothesis A3

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	44.420	6	7.403	34.797	.000b
	Residual	91.485	430	.213		
	Total	135.905	436			
2	Regression	57.224	7	8.175	44.573	.000c
	Residual	78.681	429	.183		
	Total	135.905	436			

a. Dependent Variable: TARP
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

In Model 1, the covariate factors were added into the regression equation, in model 2, the independent variable (HCI) was added into the regression equation. The combination of both Model 1 and Model 2 is a statistically significant predictor of ARP. The predictors make for a good model fit, since for Model 1, $p = 0.000<0.05$ and for Model 2 $p = 0.000<0.05$.

Table 78: Model Summary for Hypothesis A3

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.572[a]	.327	.317	.46125	.327	34.797	6	430	.000
2	.649[b]	.421	.412	.42826	.094	69.812	1	429	.000

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI
c. Dependent Variable: TARP

The R^2 values for Model 1 indicates that the control variables account for 32.7% of the variance in the outcome, while the cumulative variance in Model 2 accounts for a total of 41.2% of the variance in the outcome. This means that HCI, as an independent variable accounts for 9.4% of the total variance in ARP. The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, as is the contribution to variance of Motivation, $p < 0.05$. In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 79: Coefficients Table for Hypothesis A3

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	.764	.060		12.792	.000					
Gender	.103	.046	.093	2.260	.024	.178	.108	.089	.933	1.072
SouthAfrican	-.073	.051	-.058	-1.414	.158	-.096	-.068	-.056	.942	1.062
English	.157	.045	.140	3.461	.001	.129	.165	.137	.959	1.043
Prof	.720	.057	.522	12.720	.000	.502	.523	.503	.930	1.075
Field1Med&Bio	.207	.048	.176	4.294	.000	.098	.203	.170	.930	1.075
Uni3: Wits	.093	.053	.071	1.752	.080	.111	.084	.069	.964	1.037
2 (Constant)	.565	.060		9.363	.000					
Gender	.070	.043	.062	1.631	.104	.178	.079	.060	.924	1.082
SouthAfrican	-.059	.048	-.047	-1.236	.217	-.096	-.060	-.045	.941	1.063
English	.110	.042	.098	2.583	.010	.129	.124	.095	.942	1.062
Prof	.425	.063	.308	6.725	.000	.502	.309	.247	.641	1.559
Field1Med&Bio	.189	.045	.161	4.209	.000	.098	.199	.155	.928	1.078
Uni3: Wits	.117	.050	.088	2.361	.019	.111	.113	.087	.961	1.041
HCI	.021	.003	.378	8.355	.000	.562	.374	.307	.659	1.518

In Model 2, English, Prof, Field1: Med&Bio, Uni3: Wits and HCI make significant contributions the model since $p < 0.05$.

VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data.

The regression equation is as follows:

Y (Transformed SGI Propensity) = 0.565 + 0.070(Gender) - 0.059(SouthAfrican) + 0.110(English) - 0.425(Prof) + 0.189(Field1: Med&Bio) + 0.117(Uni3: Wits) + 0.021(Motivation).

The null hypothesis is rejected at the .05 level of significance. Therefore, it can be concluded when controlling for Gender, English, Prof, Field1:Med&Bio, Uni3: Wits, HCI is a significant predictor of ARP. The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with SGI Propensity as the dependent variable are provided as well.

Figure 34: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: ARP) for Hypothesis A3

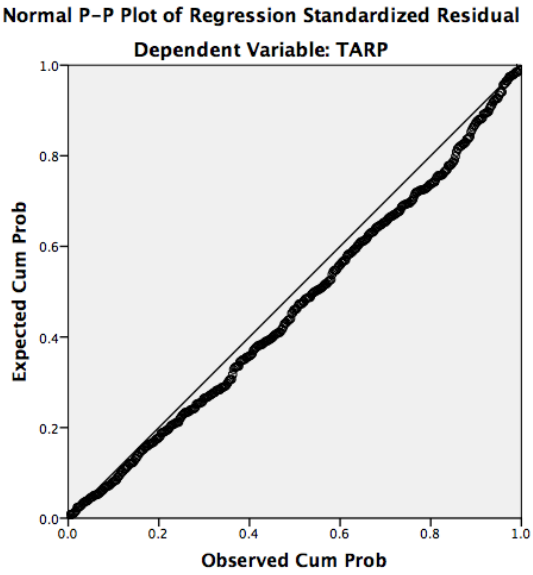
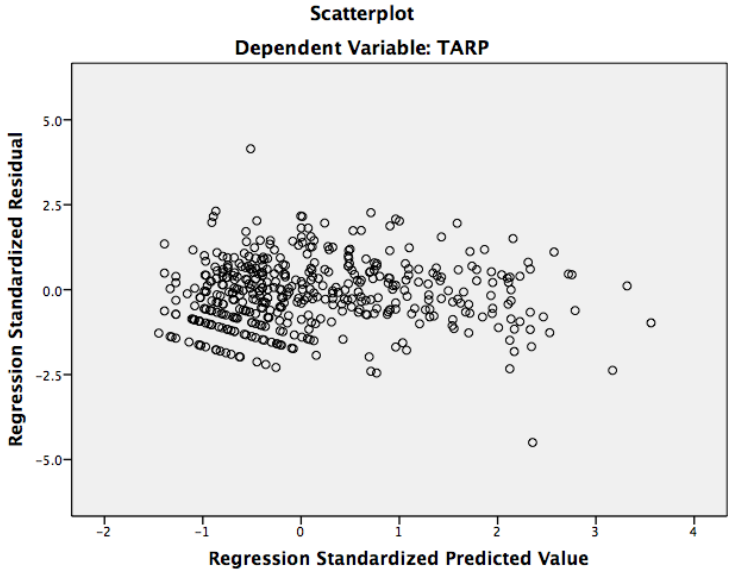


Figure 35: Scatterplot (Dependent Variable: ARP) for Hypothesis A3



4.5.13. Outlier Removal for Hypothesis A3: HCI is significantly associated with ARP

Outliers are now removed by inspection of the residual statistics and plots generated by SPSS, as follows:

Table 80: Outliers for Hypothesis A3

	Limits	Cases	Total
Standardised Residuals	Values outside of |3|	33, 78	2
Cook's Distance	Values > 1	None	0
Leverage	Values >0.026	27, 40, 42, 43, 47, 62, 67, 75, 78, 83, 87, 98, 100, 124, 160, 173, 174, 188, 200, 224, 247, 257, 268, 285, 306, 330, 363, 391, 401, 420, 453, 481, 483, 485, 492, 494, 498, 507, 509, 510, 512, 520, 527	43
Mahalanobis	Values > 25	None	0
DFFits	[-0.27; +0.27]	67, 78, 363	3
DFBETAS	[-0.09; +0.09]	None	0
Covariance Ratio	[0.94; 1.05]	33, 75, 78, 87, 98, 100, 127, 160, 171, 278, 453, 470, 481, 498	14
			47 (excluding the same outliers identified by different measures)

The dependent variable ARP was once again transformed. The results of the regression, with outliers removed is as follows:

Table 81: ANOVA Table for Hypothesis A3 with Outliers Removed

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32.777	6	5.463	28.318	.000[b]
	Residual	75.429	391	.193		
	Total	108.205	397			
2	Regression	45.181	7	6.454	39.941	.000[c]
	Residual	63.024	390	.162		
	Total	108.205	397			

a. Dependent Variable: TARP
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

With outliers removed, the combination of both Model 1 and Model 2 is a statistically significant predictor of ARP. The predictors make for a good model fit, since for Model 1, $p = 0.000<0.05$ and for Model 2 $p = 0.000<0.05$.

Table 82: Model Summary for Hypothesis A3 with outliers removed

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.550[a]	.303	.292	.43922	.303	28.318	6	391	.000
2	.646[b]	.418	.407	.40200	.115	76.761	1	390	.000

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof
b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI
c. Dependent Variable: TARP

With outliers removed, the R^2 values for Model 1 indicates that the control variables account for 30.3% of the variance in the outcome, while the cumulative variance Model 2 can be attributed to the control and independent variables, which accounts for a total of 41.8% of the variance in the outcome. This means that HCI, as an independent variable accounts for 2.0% of the total variance in ARP.

The contribution to variance in Model 1 (control variables) is significant, $p < 0.05$, as is the contribution to variance of HCI, $p > 0.05$.

In order to investigate how much each of the individual variables contribute to variance in the outcome, the coefficients table (below) is examined.

Table 83: Coefficients Table for Hypothesis A3 with outliers removed

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.753	.060		12.489	.000					
	Gender	.084	.046	.081	1.838	.067	.170	.093	.078	.924	1.083
	SouthAfrican	-.063	.052	-.053	-1.215	.225	-.075	-.061	-.051	.933	1.072
	English	.168	.045	.161	3.727	.000	.150	.185	.157	.960	1.042
	Prof	.726	.063	.515	11.580	.000	.479	.505	.489	.901	1.110
	Field1Med&Bio	.183	.049	.166	3.739	.000	.062	.186	.158	.908	1.101
	Uni3: Wits	.084	.055	.066	1.521	.129	.062	.077	.064	.958	1.044
2	(Constant)	.511	.062		8.281	.000					
	Gender	.059	.042	.056	1.397	.163	.170	.071	.054	.919	1.088
	SouthAfrican	-.041	.048	-.034	-.849	.396	-.075	-.043	-.033	.930	1.075
	English	.123	.042	.118	2.958	.003	.150	.148	.114	.945	1.058
	Prof	.391	.069	.277	5.663	.000	.479	.276	.219	.624	1.604
	Field1Med&Bio	.174	.045	.157	3.878	.000	.062	.193	.150	.908	1.102
	Uni3: Wits	.108	.050	.085	2.139	.033	.062	.108	.083	.955	1.047
	HCI	.025	.003	.419	8.761	.000	.573	.406	.339	.654	1.529

a. Dependent Variable: TARP

In Model 2 English, Prof, Field:Med&Bio, Uni3: Wits and HCI make statistically significant contributions to this model, since $p < 0.05$.

VIF values are all below 10, which indicates that multicollinearity seems within reasonable limits for this data.

The new regression equation (with outliers removed) is as follows:

Y (Transformed SGI Propensity) = 0.511 + 0.059(Gender) - 0.041(SouthAfrican) - 0.123(English) - 0.391(Prof) + 0.174(Field1: Med&Bio) + 0.108(Uni3: Wits) + .025(Motivation).

With outliers removed, the null hypothesis is rejected at the .05 level of significance. Therefore, it can be concluded that when the outliers have been removed, HCI is a significant predictor of ARP. The Normal P-P Plot of Regression Standardised residuals as well as the scatterplot, with ARP as the dependent variable are provided as well for the case where outliers have been removed.

Figure 36: Normal P-P Plot of Regression Standardised Residual (Dependent Variable: ARP) with Outliers Removed for Hypothesis A3

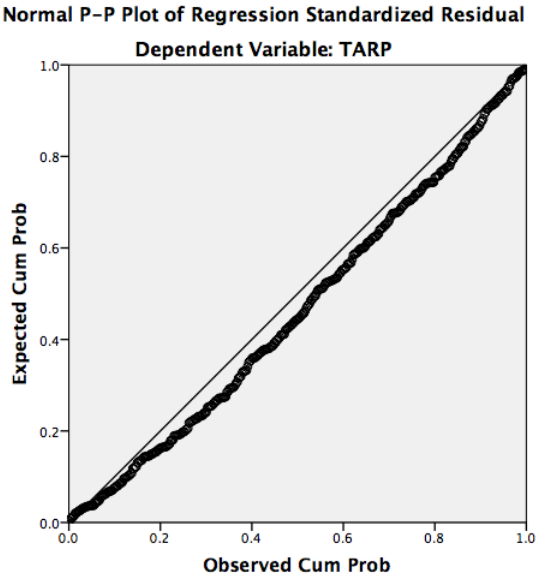
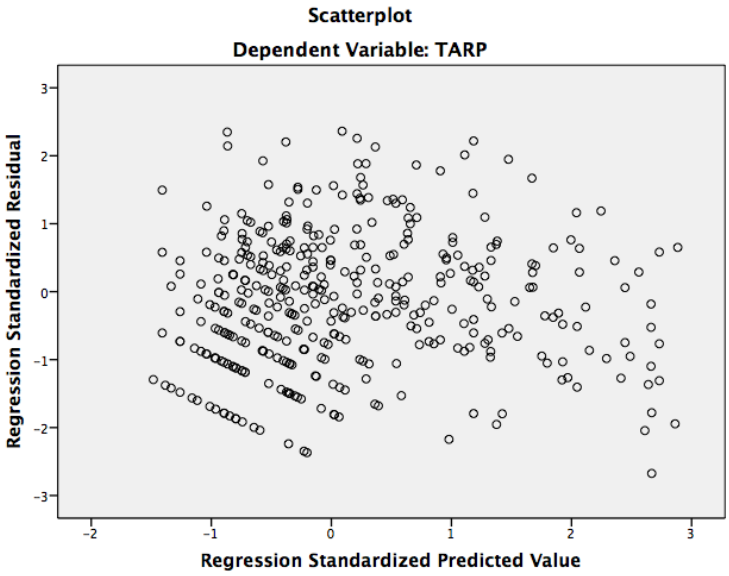


Figure 37: Scatterplot (Dependant Variable: ARP) with outliers removed for Hypothesis A3



4.5.14. Summary of Findings

The findings of the tests of bivariate correlations are summarised as follows:

Table 84: Summary of Findings of Bivariate Correlations

	Correlation Test	**Sig.**	**Spearman's Rho**	**Correlation**	H_0	H_1
HA1a	**SGI Propensity-ARP**	.008	-.116	Negative	Reject	Accept
HA1b	**HCI-SGI Propensity**	.000	-.168	Negative	Reject	Accept
HA1c	**Personality-SGI Propensity**	N: .634	N: .021	Positive	Accept	Reject
		O: .003	O: .128	Positive	Reject	Accept
		A: .301	A: -.045	Negative	Accept	Reject
		C: .685	C: .018	Positive	Accept	Reject
		E: .713	E: -.016	Negative	Accept	Reject
HA1d	**SGI Propensity-Motivation**	IDREG: .000	IDREG: .193	Positive	Accept	Reject
		EXTREG: .538	EXTREG: -.027	Negative	Reject	Accept
		AMOT: .030	AMOT: .094	Positive	Accept	Reject
		INMOT: .000	INMOT: .165	Positive	Accept	Reject
		INTREG: .109	INTREG: .070	Positive	Reject	Accept
		INTROREG: .000	INTROREG:.274	Positive	Accept	Reject
HA3	**HCI-ARP**	.000	.649	Positive	Reject	Accept

The findings of the hierarchical multiple regressions are summarised as follows:

Table 85: Regressions Before Outlier Removal

	Model 1				Model 2				Hypothesis	
Hypothesis	F	Sig.	R^2	Sig. F Change	F	Sig.	R^2	Sig. F Change	H_0	H_1
HA1a	F (6, 430) = 34.797	.000	.327	.000	F (7, 429) = 31.665	.000	.341	.003	Reject	Accept
HA1b	F (6, 521) = 3.461	.002	.038	.002	F (7, 520) = 4.133	.000	.053	.005	Reject	Accept
HA1c	(6, 521) = 3.461	.002	.038	.002	(7, 520) = 2.992	.004	.039	.647	Accept	Reject
HA1d	F (6, 521) = 3.461	.002	.038	.002	F (7, 520) = 4.017	.000	.051	.008	Reject	Accept
HA3	F (6, 430) = 34.797	.000	.327	.000	F (7, 429) = 44.573	.000	.421	.000	Reject	Accept

Table 86: Summary of Regression Equations for each hypothesis

HA1a	Y (Transformed ARP) = 1.264 + 0.103(Gender) - 0.070(SouthAfrican) + 0.142(English) + 0.697(Prof) + 0.211(Field1: Med&Bio) +0.084(Uni3: Wits) – 0.151(SGIProp).
HA1b	Y (Transformed SGI Propensity) = 0.525 + 0.001(Gender) + 0.003(SouthAfrican) - 0.011(English) - 0.010(Prof) + 0.004(Field1: Med&Bio) - 0.009(Uni3: Wits) – 0.001(HCI).
HA1c	Y (Transformed SGI Propensity) = 0.513 - 0.001(Gender) + 0.003(SouthAfrican) - 0.013(English) - 0.022(Prof) + 0.003(Field1: Med&Bio) - 0.008(Uni3: Wits) + 0.002(Personality).
HA1d	Y (Transformed SGI Propensity) = 0.470 - 0.001(Gender) + 0.003(SouthAfrican) - 0.012(English) - 0.021(Prof) + 0.004(Field1: Med&Bio) - 0.009(Uni3: Wits) + 0.013(Motivation).
HA3	Y (Transformed SGI Propensity) = 0.565 + 0.070(Gender) - 0.059(SouthAfrican) + 0.110(English) - 0.425(Prof) + 0.189(Field1: Med&Bio) + 0.117(Uni3: Wits) + 0.021(Motivation).

Table 87: Regressions with Outliers Removed

	Model 1				Model 2				Hypothesis	
Hypothesis	F	Sig.	R^2	Sig. F Change	F	Sig.	R^2	Sig. F Change	H_0	H_1
HA1a	F (6, 387) = 27.389	.000	.298	.000	F (7, 386) = 24.080	.000	.304	.072	Accept	Reject
HA1b	F (6, 495) = 4.111	.000	.047	.000	F (7, 494) = 4.198	.000	.056	.034	Reject	Accept
HA1c	F (6, 495) = 4.111	.007	.034	.007	F (7, 494) = 4.198	.012	.035	.541	Accept	Reject
HA1d	F (6, 498) = 3.502	.002	.040	.002	F (7, 497) = 4.595	.000	.061	.001	Reject	Accept
HA3	F (6, 391) = 28.318	.000	.303	.000	F (7, 390) = 39.941	.000	.418	.000	Reject	Accept

Table 88: Summary of Regression Equations for each hypothesis (with outliers removed)

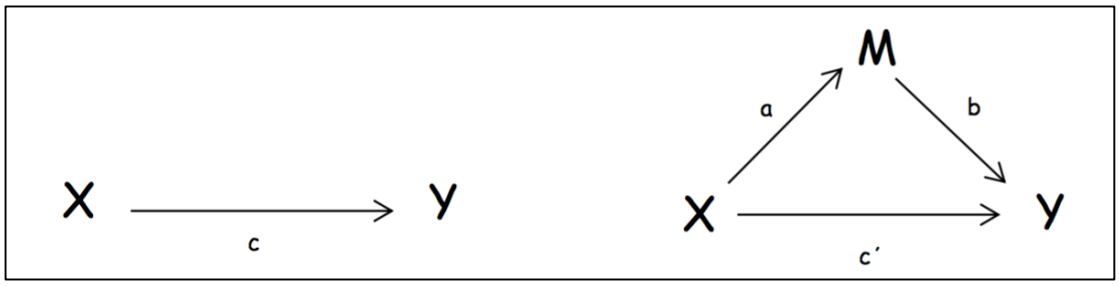
HA1a	Y (Transformed ARP) = 1.077 + 0.095(Gender) - 0.034(SouthAfrican) + 0.131(English) + 0.704(Prof) + 0.174(Field1: Med&Bio) +0.127(Uni3: Wits) – .103(SGIProp).
HA1b	Y (Transformed SGI Propensity) = 0.528 + 0.000(Gender) + 0.000(SouthAfrican) - 0.016(English) - 0.010(Prof) + 0.008(Field1: Med&Bio) - 0.007(Uni3: Wits) – .001(HCI).
HA1c	Y (Transformed SGI Propensity) = 0.516 + 0.001(Gender) - 0.001(SouthAfrican) - 0.014(English) - 0.018(Prof) + 0.005(Field1: Med&Bio) - 0.006(Uni3: Wits) + .002(Personality).
HA1d	Y (Transformed SGI Propensity) = 0.465 - 0.001(Gender) + 1.377(SouthAfrican) - 0.015(English) - 0.015(Prof) + 0.009(Field1: Med&Bio) - 0.008(Uni3: Wits) + .015(Motivation).
HA3	Y (Transformed SGI Propensity) = 0.511 + 0.059(Gender) - 0.041(SouthAfrican) - 0.123(English) - 0.391(Prof) + 0.174(Field1: Med&Bio) + 0.108(Uni3: Wits) + .025(Motivation).

4.6. Mediation

Tests of mediation have been conducted in order to test Hypothesis A2: Motivation mediates the relationship between SGI Propensity and ARP. (Fields, 2012). Each test of mediation is tested (Baron & Kenny, 1986), as per the model given below.

Mediation implies a situation where the effect of the independent variable on the dependent variable can be best be explained using a third mediator variable which is caused by the independent variable itself and is itself a cause for the dependent variable. That is, instead of X causing Y directly, X causes the mediator, M and M, in turn, causes Y. The relationship between X and Y is in this case said to be indirect (Field, 2012). The relationship between the independent, the mediator and the dependent variables can be depicted as follows:

Figure 38: Direct vs. Indirect Relationships



Each arrow in a path represents the relationship between two variables to which a coefficient or weight is assigned. These coefficients are the standardised regression coefficients (betas) showing the direction and magnitude of the effect of one variable on another (Field, 2012). In the context of path models, the terms ‘exogenous’ and ‘endogenous’ variables are used instead of ‘dependant’ and ‘independent’ variables. In the case of the models above, exogenous variables have no explicit causes; that is they have no arrows going to them while endogenous are causally affected by other variables; that is they have arrows going to them (Baron & Kenny, 1986) It must be noted that the dependent variable (X, or ARP) was transformed prior to running the tests of mediation, using natural log transformations for each hypothesis in order to improve the robustness of the model.

Andrew Haye’s (2013) PROCESS method for SPSS was used to test Hypthesis 5A and all relevant sub-hypotheses, in relation to Baron and Kenny’s (1986) model.

The following steps are used to interpret the output of the PROCESS method:

1) Path C: SGI Propensity (X) predicts ARP (Y) (Total Effect Model)
    a. Significance of overall model
    b. Significance of X predicting Y
2) Path A: SGI Propensity (X) predicts Motivation (M) (Outcome: Motivation Construct)
    a. Significance of overall model
    b. Significance of X predicting M

3) SGI Propensity (Y) and Motivation (M) together, predict ARP (Y) (Outcome Transformed ARP)
    a. Significance of overall model
    b. Path B: Motivation (M) predicting ARP (Y)
        i. Significance of M predicting Y
    c. Path C': SGI Propensity (X) no longer predicts ARP (Y), or is lessened, predicting ARP (Y)
        i. X and M predicting Y
4) Sobel Test (normal theory test) = z score test if c – c' =/0
    a. Z and, K^2 (Kappa-Squared) values

(Baron & Kenny, 1986; Field, 2012)

Essentially, what these four encompass the following objectives (Field, 2012):

Step 1: Confirm the significance of the relationship between the initial independent variable and dependent variable (X → Y)
Step 2: Confirm the significance of the relationship between the initial independent variable and the mediator (X → M)
Step 3: Confirm the significance of relationship between the mediator and the dependent variable in the presence of the independent variable (M|X → Y)
Step 4: Confirm the insignificance (or the meaningful reduction in effect) of the relationship between the initial independent variable and the dependent va
the presence of the mediator (X|M → Y).

Each sub-hypothesis of Hypothesis A2 is now tested, using Hayes' (2013) PROCESS for SPSS method.

4.6.1. Hypothesis A2a: Amotivation mediates the relationship between SGI Propesnity and ARP

The output of Andre Hayes' (2013) PROCESS for SPSS procedure for mediation is included in the appendix.

The first part of the output lists all variables in the analysis, indicating which is considered as a dependent variable (X, or ARP), which an independent variable (Y, or SGI Propensity) and the mediator (M, or Amotivation). The total sample size is also displayed.

Thereafter, a series of regression models are fitted; first predicting the mediator variable using the independent variable (step 2); then the dependent variable using both the independent variable and the mediator (steps 3 and 4); and finally the dependent variable using the independent variable (step 1).

Following the 4 steps of output interpretation, the following can be concluded:

1) Path C: SGI Propensity (X) predicts ARP (Y) (Total Effect Model)
    a. $F(1, 436) = 19.043$, $p > 0.05$, $R^2 = 0.042$
    b. $b = -.253$, $t(436) = -4.364$, $p < 0.05$
2) Path A: SGI Propensity (X) predicts Amotivation (M) (Outcome: AMOT)

   a. F(1, 436) = 8.582, p <0.05, R^2 = 0.19
   b. b = .241, t(436) = 2.930, p<0.05
   c. This model is significant (X predicts M)
3) SGI Propensity (Y) and Amotivation (M) together, predict ARP (Y) (Outcome TARP)
   a. Overall model: F(1, 435) = 11.795, p< 0.05, R^2 = 0.51
   b. Path B: Amotivation (M) predicting ARP (Y)
      i. b = -.070, t (435) = -2.097, p <0.05
   c. Path C': SGI Propensity (X) no longer predicts ARP (Y), or is lessened, predicting ARP (Y)
      i. [X and M predicting Y] b = -.236, t (435) = -4.047, p <0.05
4) Sobel Test (normal theory test) = z score test if c – c' =/0
   a. Z = -1.643, p = .100, K^2 (Kappa-Squared) = .014

Because Path C' is significant, this indicates partial mediation. The Sobel Test then shows that C and C' are different when M is included in the model. With no mediator present, ARP = -.253, but with the mediator present, ARP = -.236, which means an increase in ARP when controlling for Amotivation. Under 'Total, Direct and Indirect Effects',, the total effect of X on T (-.253) – the direct of X on Y (.-236) = the indirect of X on Y(-.017).

A measure for the indirect effect of X on Y is also presented after the regression models. In this case the effect size was -0.017, with a 95% confidence interval which did not include zero; that is to say the effect was significantly greater that zero at α = .05.

In summary, the following can be concluded:

1) X does predict Y
2) X does predict M
3) M predicts Y, while controlling for X
4) X predicts Y, controlling for M

Thus it can be concluded that Amotivation does change the relationship between SGI Propensity and ARP and mediation does indeed occur, with a small effect size, K^2 = .014. The null hypothesis is rejected at the .05 level of significance.

4.6.2. Hypothesis A2b: External Regulation mediates the relationship between SGI Propesnity and ARP

Following the 4 steps of output interpretation, the following can be concluded:

1) Path C: SGI Propensity (X) predicts ARP (Y) (Total Effect Model)
   b. F(1, 436) = 19.043, p < 0.05, R^2 = .042
   c. b = -.253, t(436) = -4.364, p <.05
2) Path A: SGI Propensity (X) predicts Amotivation (M) (Outcome: EXTREG)
   a. F(1, 436) = .257, p >0.05, R^2 = .001
   b. b = .-.046, t(436) = -.507, p<0.05
   c. This model is not significant (X does not predicts M)

3) SGI Propensity (Y) and External Regulation (M) together, predict ARP (Y) (Outcome: TARP)
    a. Overall model: F(1, 435) = 14.557, p< 0.05, R^2 = .063
    b. Path B: External Regulation (M) predicting ARP (Y)
        i. b = -.095, t (435) = -3.113, p <0.05
    c. Path C': SGI Propensity (X) no longer predicts ARP (Y), or is lessened, predicting ARP (Y)
        i. [X and M predicting Y] b = -.257, t (435) = -4.481, p <0.05
4) Sobel Test (normal theory test) = z score test if c – c' =/0
    a. Z = .477, p = .633, K^2 (Kappa-Squared) = .004

Because Path C' is significant, this indicates partial mediation. The Sobel Test then shows that C and C' are different when M is included in the model. With no mediator present, ARP = -.253, but with the mediator present, ARP = -.257, which means a decrease in ARP when controlling for External Regulation. Under 'Total, Direct and Indirect Effects',, the total effect of X on T (-.253) – the direct of X on Y (.-257) = the indirect of X on Y(-.004).

A measure for the indirect effect of X on Y is also presented after the regression models. In this case the effect size was .004, with a 95% confidence interval which did not include zero; that is to say the effect was significantly greater that zero at α = .05.

In summary, the following can be concluded:

1) X does predict Y
2) X does not predict M
3) M predicts Y, while controlling for X
4) X predicts Y, controlling for M

Thus it can be concluded that External Regulation does change the relationship between SGI Propensity and ARP, very slightly and mediation does indeed occur, with a small effect size, K^2 = .004. The null hypothesis is rejected at the .05 level of significance.

4.6.3. Hypothesis A2c: Introjected Regulation mediates the relationship between SGI Propesnity and ARP

Following the 4 steps of output interpretation, the following can be concluded:

1) Path C: SGI Propensity (X) predicts ARP (Y) (Total Effect Model)
    d. F(1, 436) = 19.043, p < 0.05, R^2 = .060
    e. b = -.253, t(436) = -4.364, p <.05
2) Path A: SGI Propensity (X) predicts Introjected Regulation (M) (Outcome: INTROREG)
    a. F(1, 436) = 27.932, p >0.05, R^2 = .001
    b. b = .371, t(436) = 5.285, p<0.05
    c. This model is significant (X predicts M)
3) SGI Propensity (Y) and Introjected Regulation (M) together, predict ARP (Y) (Outcome: TARP)

   a. Overall model: F(1, 435) = 19.043, p< 0.05, R^2 = .042
   b. Path B: Introjected Regulation (M) predicting ARP (Y)
      i. b = -.030, t (435) = -.754, p >0.05 (not significant)
   c. Path C': SGI Propensity (X) no longer predicts ARP (Y), or is lessened, predicting ARP (Y)
      i. [X and M predicting Y] b = -.242, t (435) = -4.043, p <0.05
4) Sobel Test (normal theory test) = z score test if c – c' =/0
   a. Z = -.734, p = .463, K^2 (Kappa-Squared) = .009

Because Path C' is significant, this indicates partial mediation. The Sobel Test then shows that C and C' are different when M is included in the model. With no mediator present, ARP = -.253, but with the mediator present, ARP = -.242, which means a slight increase in ARP when controlling for Introjected Regulation. Under 'Total, Direct and Indirect Effects',, the total effect of X on T (-.253) – the direct of X on Y (.-242) = the indirect of X on Y(-.009).

A measure for the indirect effect of X on Y is also presented after the regression models. In this case the effect size was .253, with a 95% confidence interval which did not include zero; that is to say the effect was significantly greater that zero at α = .05.

In summary, the following can be concluded:

1) X does predict Y
2) X does predict M
3) M does not predict Y, while controlling for X
4) X predicts Y, controlling for M

Thus it can be concluded that Introjected Regulation does change the relationship between SGI Propensity and ARP, very slightly and mediation does indeed occur, with a small effect size, K^2 = .009. The null hypothesis is rejected at the .05 level of significance.

4.6.4. Hypothesis A2d: Identified Regulation mediates the relationship between SGI Propesnity and ARP

Following the 4 steps of output interpretation, the following can be concluded:

1) Path C: SGI Propensity (X) predicts ARP (Y) (Total Effect Model)
   f. F(1, 436) = 19.043, p < 0.05, R^2 = .060
   g. b = -.253, t(436) = -4.364, p <.05
2) Path A: SGI Propensity (X) predicts Identified Regulation (M) (Outcome: IDREGTOT)
   a. F(1, 436) = 8.713, p <0.05, R^2 = .020
   b. b = .237, t(436) = 2.952, p<0.05
   c. This model is significant (X predicts M)
3) SGI Propensity (Y) and Identified Regulation (M) together, predict ARP (Y) (Outcome: TARP)
   a. Overall model: F(1, 435) = 12.660, p< 0.05, R^2 = .055
   b. Path B: Identified Regulation (M) predicting ARP (Y)

i. b = -.085, t (435) = -2.461, p <0.05

c. Path C': SGI Propensity (X) no longer predicts ARP (Y), or is lessened, predicting ARP (Y)

i. [X and M predicting Y] b = -.233, t (435) = -4.001, p <0.05

4) Sobel Test (normal theory test) = z score test if c – c' =/0

a. Z = -1.829, p = .067, K^2 (Kappa-Squared) = .016

Because Path C' is significant, this indicates partial mediation. The Sobel Test then shows that C and C' are different when M is included in the model. With no mediator present, ARP = -.253, but with the mediator present, ARP = -.233, which means a slight decrease in ARP when controlling for Identified Regulation. Under 'Total, Direct and Indirect Effects',, the total effect of X on T (-.253) – the direct of X on Y (.-233) = the indirect of X on Y(-.020).

A measure for the indirect effect of X on Y is also presented after the regression models. In this case the effect size was -.253, with a 95% confidence interval which did not include zero; that is to say the effect was significantly greater that zero at α = .05.

In summary, the following can be concluded:

1) X does predict Y
2) X does predict M
3) M does predict Y, while controlling for X
4) X predicts Y, controlling for M

Thus it can be concluded that Identified Regulation does change the relationship between SGI Propensity and ARP, very slightly and mediation does indeed occur, with a small effect size, $K^2 =$ .016. The null hypothesis is rejected at the .05 level of significance.

4.6.5. Hypothesis A2e: Integrated Regulation mediates the relationship between SGI Propesnity and ARP

The following is the output of Andre Haye's (2013) PROCESS for SPSS procedure, for mediation, with the mediator being Integrated Regulation

Following the 4 steps of output interpretation, the following can be concluded:

1) Path C: SGI Propensity (X) predicts ARP (Y) (Total Effect Model)
    h. F(1, 436) = 19.043, p < 0.05, R^2 = .060
    i. b = -.253, t(436) = -4.364, p <.05
2) Path A: SGI Propensity (X) predicts Integrated Regulation (M) (Outcome: INTREG)
    a. F(1, 436) = 1.551, p >0.05, R^2 = .004
    b. b = .080, t(436) = 1.246, p>0.05
    c. This model is not significant (X does not predict M)
3) SGI Propensity (Y) and Integrated Regulation (M) together, predict ARP (Y) (Outcome: TARP)
    a. Overall model: F(1, 435) = 12.787, p< 0.05, R^2 = .236

   b. Path B: Integrated Regulation (M) predicting ARP (Y)
      i. b = .108, t (435) = -2.510, p <0.05
   c. Path C': SGI Propensity (X) no longer predicts ARP (Y), or is lessened, predicting ARP (Y)
      i. [X and M predicting Y] b = -.261, t (435) = -4.532, p <0.05
4) Sobel Test (normal theory test) = z score test if c – c' =/0
   a. Z = 1.051, p = .293, K^2 (Kappa-Squared) = .007

Because Path C' is significant, this indicates partial mediation. The Sobel Test then shows that C and C' are different when M is included in the model. With no mediator present, ARP = -.253, but with the mediator present, ARP = -.261, which means a slight decrease in ARP when controlling for Integrated Regulation. Under 'Total, Direct and Indirect Effects',, the total effect of X on Y (-.253) – the direct of X on Y (.-261) = the indirect of X on Y(-.009).

A measure for the indirect effect of X on Y is also presented after the regression models. In this case the effect size was .009, with a 95% confidence interval which did not include zero; that is to say the effect was significantly greater that zero at α = .05.

In summary, the following can be concluded:

1) X does predict Y
2) X does not predict M
3) M does predict Y, while controlling for X
4) X predicts Y, controlling for M

Thus it can be concluded that Integrated Regulation does change the relationship between SGI Propensity and ARP, very slightly and mediation does indeed occur, with a small effect size, K^2 = .007. The null hypothesis is rejected at the .05 level of significance.

4.6.6. Hypothesis A2f: Intrinsic Motivation mediates the relationship between SGI Propesnity and ARP

Following the 4 steps of output interpretation, the following can be concluded:

1) Path C: SGI Propensity (X) predicts ARP (Y) (Total Effect Model)
   j. F(1, 436) = 19.043, p < 0.05, R^2 = .060
   k. b = -.253, t(436) = -4.364, p <.05
2) Path A: SGI Propensity (X) predicts Intrinsic Motivation (M) (Outcome: INMOT)
   a. F(1, 436) = 2.233, p <0.05, R^2 = .071
   b. b = .091, t(436) = 1.494, p>0.05
   c. This model is not significant (X does not predict M)
3) SGI Propensity (Y) and Intrinsic Motivation (M) together, predict ARP (Y) (Outcome: TARP)
   a. Overall model: F(1, 435) = 16.115, p< 0.05, R^2 = .069
   b. Path B: Intrinsic Motivation (M) predicting ARP (Y)
      i. b = .160, t (435) = 3.560, p <0.05

c. Path C': SGI Propensity (X) no longer predicts ARP (Y), or is lessened, predicting ARP (Y)
    i. [X and M predicting Y] b = -.267, t (435) = -4.665, p <0.05

4) Sobel Test (normal theory test) = z score test if c – c' =/0
    a. Z = 1.334, p = .182, K^2 (Kappa-Squared) = .013

Because Path C' is significant, this indicates partial mediation. The Sobel Test then shows that C and C' are different when M is included in the model. With no mediator present, ARP = -.253, but with the mediator present, ARP = -.267, which means a slight decrease in ARP when controlling for Intrinsic Motivation. Under 'Total, Direct and Indirect Effects', the total effect of X on Y (-.253) – the direct of X on Y (.-267) = the indirect of X on Y(-.009).

A measure for the indirect effect of X on Y is also presented after the regression models. In this case the effect size was .015, with a 95% confidence interval which did not include zero; that is to say the effect was significantly greater that zero at α = .05.

In summary, the following can be concluded:

1) X does predict Y
2) X does not predict M
3) M does predict Y, while controlling for X
4) X predicts Y, controlling for M

Thus it can be concluded that Intrinsic Motivation does change the relationship between SGI Propensity and ARP, very slightly and mediation does indeed occur, with a small effect size, $K^{2 =}$ .013. The null hypothesis is rejected at the .05 level of significance.

4.6.7. Summary of Mediation Findings (Does Motivation mediate the relationship between SGI Propensity and ARP?)

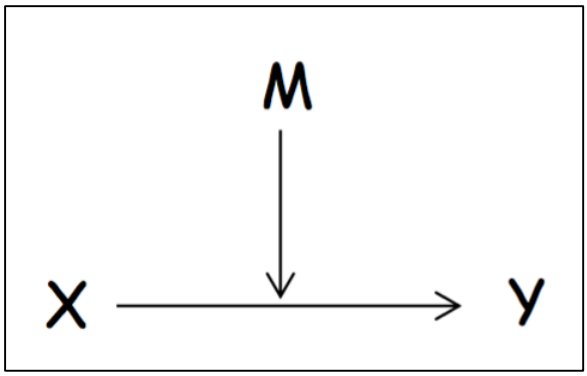
Table 89: Summary of Mediation Findings

Hypothesis	Motivation Construct	Total Effect of X on Y	Direct Effect of X on Y	Indirect Effect of X on Y	K^2	Z	H_0	H_1
HA2a	Amotivation	-.253	.-236	-.017	.014	-1.643	Reject	Accept
HA2b	External Regulation	-.253	.-257	-.004	.004	.477	Reject	Accept
HA2c	Introjected Regulation	-.253	.-242	-.011	.009	-.734	Reject	Accept
HA2d	Identified Regulation	-.253	.-233	-.20	.016	-1.829	Reject	Accept
HA2e	Integrated Regulation	-.253	.-261	.009	.007	1.051	Reject	Accept
HA2f	Intrinsic Motivation	-.253	-267	.015	.013	1.334	Reject	Accept

4.7. Moderation

Tests of moderation have been conducted in order to test Hypotheses B and C, relating to the interactive effects of Gender and Field of Study on the different relationships in the theoretical model, respectively. A moderator variable is one that affects the relationship between two others (Fields, 2012). Each test of moderation is tested (Baron & Kenny, 1986), as per the model given below.

Figure 39: Moderation



The model that tests for moderation is: $(Y)_I = (b_0 + (b_1(X1) + b_2(\text{Interaction})) + \Sigma_i$

In order to confirm the moderation effect of a third variable on the relationship between the dependent and independent variables, the interaction term is used to show the nature of the relationship changes, as the moderating variable changes. Andre Hayes' (2013) PROCESS for SPSS was used for tests of moderation. The PROCESS plug-in automatically centres the variables, in order to avoid multicollinearity and also automatically creates the interaction term.

It is noted that the transformed versions of the dependent variable, for each test of moderation is transformed, as shown previously. The tests of moderation involving dichotomous and categorical variables, such as is the case for Gender and Field of Study requires the use of dummy coded variables. It should also be noted that covariate factors were not included in the tests of moderation, as the focus of this research is primarily on the overall model effect of the moderators.

4.7.1. Hypothesis B1: Gender moderates the relationship between SGI Propensity and ARP

Outcome: TARP in PROCESS output

Model Summary: $F(3, 433) = 12.726$, $p < 0.05$, $R^2 = 0.84$

This means that the overall model is significant and SGI Propensity and Gender account for 84% of the variance in ARP.

Model:
Gender: $b = .194$, $t(433) = 3.765$, $p < 0.05$

This means Gender is a significant predictor of ARP, for every 1 (male) = .194 increase in ARP

SGI Propensity: b = -.233, t (433) = -3.975, p <0.05

This means that SGI propensity is a significant predictor or ARP, for every 1-unit increase in SGI Propensity = -.233 increase in ARP

The Interaction: (both SGI Propensity and Gender simultaneously)
b = -.286, t (433) = -2.438

Y (TARP) = 1.070 + .194 (Gender) - .233 (SGI Propensity) - .286 (SGI Propensity * Gender)

Conditional effects of X on Y (SGI Propensity predicting ARP at each level (male or female) of Gender)

Y (ARP) = Constant -.087 (0, or female) -.373 (1, or male)

Females (0): b = -.087, t(433) = -1.035, p >0.05
Males (0): b = -.373, t (433) = -4.565, p <0.05

It can be concluded that for females, there is no relationship between SGI Propensity and ARP. For males; there is a relationship between SGI Propensity and ARP. For males, every 1-unit increase in SGI Propensity results in -.373 less ARP. The null hypothesis is rejected at the .05 level of significance; gender does moderate the relationship between SGI Propensity and ARP.

4.7.2. Hypothesis B2: Gender moderates the relationship between HCI and SGI Propensity

Outcome: TSGIP in PROCESS output

Model Summary: F(3, 524) = 5.370, p <0.05, R^2 = 0.035

This means that the overall model is significant and HCI and Gender account for 35% of the variance in SGI Propensity.

Model:
Gender: b = .001, t(524) = 190.714, p >0.05

This means Gender is a not significant predictor of SGI Propensity.

HCI: b = -.001, t (524) = -3.727, p <0.05

This means that HCI is a significant predictor or SGI Propensity, for every 1-unit increase in SGI Propensity = -.001 decrease in SGI Propensity

The Interaction: (both HCI and Gender simultaneously)
b = -.000, t (524) = -.481

Y (TARP) = .508 + .001 (Gender) - .001 (HCI) - .286 (HCI* Gender)

Conditional effects of X on Y (HCI predicting SGI Propensity at each level (male or female) of Gender)

Y (ARP) = Constant -.492 (0, or female) -.508 (1, or male)

Females (0): b = -.492, t(524) = -2.085, p <0.05
Males (0): b = -.508, t (433524 = -3.401, p <0.05

It can be concluded that for females, there is a relationship between HCI and SGI Propensity; for every 1-unit increase in HCI (1 year of experience), SGI Propensity decreases by. -492. For males; there is also a relationship between HCI and SGI Propensity. For every 1-unit increase in HCI (1 year of experience), SGI Propensity decreases by -.508. The null hypothesis is rejected at the .05 level of significance; gender does moderate the relationship between HCI and SGI Propensity.

4.7.3. Hypothesis B3: Gender moderates the relationship between Personality and SGI Propensity.

Model Summary: F(3, 524) = 1.685, p >0.05, R^2 = 0.010

This means that the overall model is not significant. It can be concluded that Gender does not moderate the relationship between Personality and SGI Propensity. There is sufficient evidence to fail to reject the null hypothesis at the .05 level of significance.

4.7.4. Hypothesis B4: Gender moderates the relationship between Motivation and SGI Propensity.

Outcome: TSGIP in PROCESS output

Model Summary: F(3, 524) = 2.769, p <0.05, R^2 = 0.016

This means that the overall model is significant and Motivation and Gender account for 1.6% of the variance in SGI Propensity.

Model:
Gender: b = .003, t(524) = 192.741, p >0.05

This means Gender is a not significant predictor of SGI Propensity.

Motivation: b = .014, t (524) = 2.783, p <0.05

This means that Motivation is a significant predictor or SGI Propensity, for every 1-unit increase in SGI Propensity = 0.14 increase in SGI Propensity

The Interaction: (both Motivation and Gender simultaneously)
b = .002, t (524) = .179

Y (TSGIP) = .508 + .003 (Gender) + .014 (HCI) -.002 (Motivation* Gender)

Conditional effects of X on Y (Motivation predicting SGI Propensity at each level (male or female) of Gender)

Y (ARP) = Constant -.492 (0, or female) -.508 (1, or male)

Females (0): b = -.492, t(524) = -2.085, p <0.05
Males (0): b = -.508, t (433524 = -3.401, p <0.05

It can be concluded that for females, there is a relationship between HCI and SGI Propensity; for every 1-unit increase in Motivation, SGI Propensity increases by. 492. For males; there is also a relationship between Motivation and SGI Propensity. For every 1-unit increase in Motivation, SGI Propensity increases by .508. The null hypothesis is rejected at the .05 level of significance; gender does moderate the relationship between Motivation and SGI Propensity.

4.7.5. Hypothesis B5: Gender moderates the relationship between HCI and ARP

Outcome: TARP in PROCESS output

Model Summary: F(3, 433) = 68.499, p <0.05, R^2 = 0.325

This means that the overall model is significant and HCI and Gender account for 32.5% of the variance in ARP.

Model:
Gender: b = .091, t(433) = 2.070, p <0.05

This means Gender is a significant predictor of ARP, for every 1 (male) = .091 increase in ARP

SGI Propensity: b = .031, t (433) = 12.831, p <0.05

This means that HCI is a significant predictor or ARP, for every 1-unit increase in HCI = 0.31 increase in ARP

The Interaction: (both HCI and Gender simultaneously)
b = -.008, t (433) = -1.720, p > 0.05

This means that the interactive effect of HCI and Gender on ARP is not significant.

Thus, it can be concluded that gender does not moderate the relationship between HCI and ARP. There is sufficient evidence to fail to reject the null hypothesis at the .05 level of significance.

4.8.6. Hypothesis C1: Field of Study moderates the relationship between SGI Propensity and ARP

Outcome: TARP in PROCESS output

Model Summary: $F(5, 432) = 9.209$, $p < 0.05$, $R^2 = 0.083$

This means that the overall model is significant and SGI Propensity and Field account for 8.3% of the variance in ARP.

Model:
Field1: $b = .181$, $t(432) = 3.096$, $p < 0.05$

This means Field1 is a significant predictor of ARP.

SGIPROP: $b = -.231$, $t(432) = -3.929$, $p < 0.05$

This means that SGI Propensity is a significant predictor of ARP, for every 1-unit increase in SGI Propensity = -.231 decrease in ARP.

Interaction 1: (both SGI propensity and Field1 simultaneously)
$b = .283$, $t(432) = 2.126$, $p < 0.05$

This means that the interactive effect of SGI Propensity and Field1 is a significant predictor of ARP

Field3:
$B = .189$, $t(432) = 2.647$, $p < 0.05$

This means that Field3 is a significant predictor of ARP

Interaction 2: (both SGI Propensity and Field3 simultaneously)
$B = -.019$, $t(432) = -.120$, $p > .0.05$

This means that the interactive effect of SGI Propensity and Field3 is not a significant predictor of ARP.

Y (TARP) = .1.071 + .181 (Field1) - .231 (SGI Propensity) + .283 (SGI Propensity*Field1) + .189(Field3) - .019(SGI Propensity*Field3).

It can be concluded that Field1 does moderate the relationship between SGI Propensity and ARP. For respondents that are not Field1 (0); for every 1 unit increase in SGI Propensity, ARP decreases -.358, for those respondents that are in Field1, for every 1-unit increase in SGI Propensity, ARP increases .642.

Field 3 also moderates the relationship between SGI Propensity and ARP. For respondents that are not Field3 (0); for every 1 unit increase in SGI Propensity, ARP decreases -.217, for those respondents that are in Field3, for every 1-unit increase in SGI Propensity, ARP increases .783.

The null hypothesis is rejected at the .05 level of significance; field of study does moderate the relationship between SGI Propensity and ARP.

4.7.7. Hypothesis C2: Field of Study moderates the relationship between HCI and SGI Propensity

Outcome: SGIP in PROCESS output

Model Summary: $F(5, 523) = 4.056$, $p < 0.05$, $R^2 = 0.204$

This means that the overall model is significant and HCI and Field account for 20.4% of the variance in SGI Propensity.

Model:
Field1: $b = .000$, $t(523) = 191.986$, $p < 0.05$

This means Field1 is a significant predictor of SGI Propensity.

HCI: $b = -.001$, $t(523) = -3.842$, $p < 0.05$

This means that HCI is a significant predictor of SGI Propensity, for every 1-unit increase in HCI= -.001 decrease in SGI Propesnity.

Interaction 1: (both HCI and Field1 simultaneously)
$b = .000$, $t(523) = -.148$, $p > 0.05$

This means that the interactive effect of SGI Propensity and Field1 is not a significant predictor of ARP

Field3:
$B = -.011$, $t(523) = -1.524$, $p > 0.05$

This means that Field3 is not a significant predictor of SGI Propensity

Interaction 2: (both HCI and Field3 simultaneously)
$B = .000$, $t(523) = .224$, $p < 0.05$

This means that the interactive effect of SGI Propensity and Field3 is not a significant predictor of ARP.

Y (TSGIP) = .507 + .000 (Field1) - .001 (HCI) + .000 (HCI*Field1) -.011(Field3) - .000(HCI*Field3).

It can be concluded that Field1 does moderate the relationship between HCI and SGI Propensity. For respondents that are not Field1 (0); for every 1-unit increase in HCI (1 year of experience), SGI Propensity decreases -.342, for those respondents that are in Field1, for every 1-unit increase in HCI (1 year of experience), SGI Propensity increases .658.

Field 3 does not significantly moderate the relationship between HCI and SGI Propensity.

The null hypothesis is rejected at the .05 level of significance; field of study does moderate the relationship between SGI Propensity and ARP, but only for respondents belonging to Field1, not Field 3.

4.7.8. Hypothesis C3: Field of Study moderates the relationship between Personality and SGI Propensity

Outcome: SGIP in PROCESS output

Model Summary: $F(5, 523) = 1.049$, $p><0.05$, $R^2 = 0.010$

This means that the overall model is not significant. It can be concluded that Field of Study does not moderate the relationship between Personality and SGI Propensity. There is sufficient evidence to fail to reject the null hypothesis at the .05 level of significance.

4.7.9. Hypothesis C4: Field of Study moderates the relationship between Motivation and SGI Propensity

Outcome: SGIP in PROCESS output

Model Summary: $F(5, 523) = 2.588$, $p <0.05$, $R^2 = 0.164$

This means that the overall model is significant and Motivation and Field account for 16.4% of the variance in SGI Propensity.

Model:
Field1: $b = .003$, $t(523) = 191.169$, $p >0.05$

This means Field1 is not a significant predictor of SGI Propensity.

Motivation: $b = .013$, $t (523) = .462$, $p <0.05$

This means that Motivation is a significant predictor of SGI Propensity. For every 1-unit increase in Motivation = .013 increase in SGI Propensity.

Interaction 1: (both Motivation and Field1 simultaneously)
$b = -.017$, $t (523) = -1.571$, $p > 0.05$

This means that the interactive effect of Motivation and Field1 is not a significant predictor of ARP.

Field3:
$B = -.010$, $t(523) = -1.524$, $p >0.05$

This means that Field3 is not a significant predictor of ARP

Interaction 2: (both Motivation and Field3 simultaneously)
$B = .000$, $t(523) = -1.431$, $p >0.05$

This means that the interactive effect of Motivation and Field3 is not a significant predictor of ARP.

Y (TSGI) = .507 + .003 (Field1) + .013 (Motivation) - .017 (HCI*Field1) - .010(Field3) - .000(HCI*Field3).

It can be concluded that both Field1 and Field2 do not significantly moderate the relationship between Motivation and SGI Propensity. There is sufficient evidence to fail to reject the null hypothesis all levels of significance.

4.7. 10. Hypothesis C5: Field of Study moderate the relationship between HCI and ARP

The following is the PROCESS output for Hypothesis C5, with Transformed ARP as the dependent variable

Outcome: TARP in PROCESS output

Model Summary: $F(5, 432) = 45.371$, $p < 0.05$, $R^2 = 0.359$

This means that the overall model is significant and HCI and Field account for 35.9% of the variance in ARP.

Model:
Field1: $b = .252$, $t(432) = 4.653$, $p < 0.05$

This means Field1 is a significant predictor of ARP.

HCI: $b = .032$, $t (432) = 13.674$, $p < 0.05$

This means that HCI is a significant predictor of ARP. For every 1-unit increase in HCI = .032 increase in ARP.

Interaction 1: (both HCI and Field1 simultaneously)
$b = .011$, $t (432) = 2.027$, $p < 0.05$

This means that the interactive effect of HCI and Field1 is a significant predictor of ARP.

Field3:
$B = .190$, $t(523) = 3.194$, $p < 0.05$

This means that Field3 is a significant predictor of ARP

Interaction 2: (both HCI and Field3 simultaneously)
$B = .009$, $t(523) = 1.395$, $p > 0.05$

This means that the interactive effect of HCI and Field3 is not a significant predictor of ARP.

Y (TARP) = 1.074 + .252 (Field1) + .032 (HCI) + .011 (HCI*Field1) +.190(Field3) + .009(HCI*Field3).

It can be concluded that Field1 does moderate the relationship between HCI and ARP. For respondents that are not Field1 (0); for every 1-unit increase in HCI (1 year of experience), ARP decreases -.358, for those respondents that are in Field1 (1), for every 1-unit increase in HCI (1 year of experience), ARP increases .642.

For respondents that are not Field 3 (0), for every 1-unit increase in HCI (1 year of experience), ARP decreases -.217, for those respondents that are in Field3 (1), for every 1-unit increase in HCI (1 year of experience), ARP increases .783. The null hypothesis is rejected at the .05 level of significance; field of study does moderate the relationship between HCI and ARP.

Table 90: Summary of the Results of the Tests of Moderation

Hypothesis	Relationship	Effect size (R^2)	Finding	H_0	H_1
Gender					
HB1	SGI-ARP	.840	Females: no moderation Males: Increase in SGI = decrease in ARP	Reject	Accept
HB2	HCI-SGI	.350	Females: Increase in HCI = decrease in SGI Males: Increase in HCI = decrease in SGI	Reject	Accept
HB3	Personality-SGI	.010	No moderation	Accept	Reject
HB4	Motivation-SGI	.016	Females: Increase in Motivation=decrease in SGI Males: Increase in Motivation = decrease in SGI	Reject	Accept
HB5	HCI-ARP	.325	No moderation	Accept	Reject
Field of Study					
HC1	SGI-ARP	.083	Field1: Increase in SGI – Increase in ARP Field3: Increase in SGI = Increase in ARP	Reject	Accept
HC2	HCI-SGI	.041	Field1: Increase in HCI = Increase in SGI Field3: no moderation	Reject	Accept
HC3	Personality - SGI	.010	No moderation	Accept	Reject
HC4	Motivation-SGI	.164	No moderation	Accept	Reject
HC5	HCI-ARP	.359	Field1: Increase in HCI = Increase in ARP	Reject	Accept

Hypothesis	Relationship	Effect size (R^2)	Finding	H_0	H_1
			Field3: Increase in HCI = Increase in ARP		

4.8. Conclusion

The quantitative results chapter is now concluded. Discussion of univariate descriptive statistics and frequencies was provided for the biographical questions included in the questionnaire research instrument. The procedure followed in handling missing data was provided as was the procedure pertaining to the selection of covariate factors to be used in later regression testing. Thereafter, the results of the exploratory factor analyses, for the reduced NEO-FFI personality scale, the SGI propensity scale and the WEIMS scale were provided. Reliability statistics, based on measurement of Cronbach's Alpha scores to determine internal scale consistency was also provided.

Thereafter, each hypothesis was tested, using different statistical analyses. For all sub-hypotheses relating to hypotheses A1 and A2, tests of bivariate correlation and tests of hierarchical multiple regression were conducted and the results provided in tabular form. Scatterplots and Normal P-P plots were provided for each regression. The findings of the tests of correlation and multiple hierarchical regressions were summarised in tables.

The final section of this chapter related to hypotheses B and C, which were analysed using tests of moderation and mediation, as per the methods prescribed by Baron and Kenny (1986). The results of these tests were also summarised in tables. Full discussion of the results provided in this chapter, in relation to the literature, the theoretical model and qualitative results is included in Chapter 6. The qualitative results chapter follows.

CHAPTER 5

QUALITATIVE RESULTS

5.1 Introduction

The qualitative results are used to evaluate and verify the findings of the quantitative research. The following section relates the qualitative findings to constructs that make up the theoretical model on which this research is based. In this section the relationship between theoretical constructs, derived research questions, hypotheses and the qualitative Interviews are investigated.

The overarching research question of this study is: *what is the relationship between SGI propensity and personality, motivation and academic research performance (ARP)?* From this core research question, specific sub-ordinate research questions and hypotheses were derived. The constructs ARP, SGI propensity, personality, motivation, gender and field of study were all investigated in both the quantitative and the qualitative portions of the research.

It is important to note that prior to the commencement of the interview, the interviewer was careful to point out that some of the questions to be asked may not have direct bearing or be directly related to the respondent's research or field of study. The following was related to each respondent, prior to each interview:

"You may feel that some of the questions I ask may not apply particularly to your research, but I would still like to hear your thought process in regard to some of the issues raised."

Full interview transcripts are contained in the appendix.

Table 91: Summary of Qualitative Respondents

	NRF-Rating	Field	Field category	Gender
Resp1	**C**	Cognitive psychology, cognitive developmental psychology, developmental psychology, psychological assessment (cognitive)	Field4	Female
Resp2	**A**	Geochemistry, Petrology, Mineralogy, Tectonics	Field3	Male
Resp3	**A**	Ecology, Savannah ecology, wildlife ecology, herbivore ecology, population ecology, behavioural ecology, movement ecology	Field1	Male
Resp4	**A**	Gas dynamics, shock waves, flow visualisation	Field3	Male
Resp5	**A**	Postcolonial literary studies	Field4	Female
Resp6	**A**	Lie symmetry methods, differential geometry, computational fluid dynamics	Field3	Male
Resp7	**A**	Evolutionary ecology, conservation planning, paleobotany, restoration ecology	Field1	Male
Resp8	**A**	Microbial ecology, meta-genomics, microbial enzymes	Field1	Male
Resp9	**B**	Community development, community based research, policing studies,	Field4	Female

	NRF-Rating	Field	Field category	Gender
		security management, ethnography, community engagement, urban studies		
Resp10	**A**	Ethical theory (Africa and Kantian), political philosophy, meaning in life, jurisprudence	Field4	Male
Resp11	**A**	Karoo biostratigraphy, basin analysis, Karoo sedimentology, Permo-Triassic theraspids, vertebrate palaeontology	Field1	Male
Resp12	**A**	Anti-tuberculosis drugs, molecular mycobacteriology, mycobacterial genetics, mycobacterial physiology	Field3	Female
Resp13	**A**	Exercise science, nutrition	Field1	Male
Resp14	**A**	Respiration	Field1	Male
Resp15	**A**	Bioinorganic chemistry, inorganic chemistry, kinetics, computational chemistry	Field3	Male
Resp16	**A**	Experimental economics, economics methodology, philosophy of science, cognitive science	Field2	Male
Resp17	**A**	Shelley studies, romanticism, cultural studies, myth in literature, literature – social aspects, religion and literature, comparative literature, Italian literature, history in literature	Field4	Male
Resp18	**C**	Vaccinology, molecular diagnostics	Field1	Male
Resp19	**A**	Brain evolution, evolutionary neuroanatomy	Field1	Male
Resp20	**A**	Bioinformatics, virology	Field1	Male
Resp21	**A**	HIV (viruses), breast feeding, food security, health, weight management, organisational wellness, internet technology, employee health, non-communicable disease of lifestyle, health promotion and disease prevention	Field1	Female
Resp22	**C**	Research: electron transport in bacteria, multidrug resistant tuberculosis, mycobacterium tuberculosis, dormancy, mutation, clinical latency, tuberculosis, DNA repair, antituburculosis drugs, anaerobic bacterial metabolism	Field1	Male
Resp23	**C**	Fish parasitology, water quality, fish parasitic monogenea, water metal pollution, crustacean ecology, crustacean morphology	Field1	Female
Resp24	**C**	Neuropathy, neuropathic pain, viral pain	Field1	Male
Resp25	**C**	High energy theory, gravity	Field3	Male
Resp26	**C**	Experimental nuclear physics, experimental nuclear structure, theoretical nuclear physics, applied radiation physics	Field3	Male
Resp27	**A**	Hepatology, molecular biology,	Field1	Male

	NRF-Rating	Field	Field category	Gender
		virology, carcinogenesis		
Resp28	**C**	Theoretical computer science, automata, formal languages, natural language processing	Field3	Female
Resp29	**C**	Public international law, racism, land rights, socio-economic rights	Field2	Male
Resp30	**C**	Condensed matter physics, density functional theory, formalism and applications	Field3	Male

Due to the wide range of respondents' research areas it was deemed necessary to collate this area into more accessible and organised 'fields of study', or 'field category' (as in Table 91) The following classification was used:

Field1: Medicine & Biology
Respondents: 3, 7, 8, 11, 13, 14, 18, 19, 20, 21, 22, 23, 24 and 27

Field2: Commerce & Law
Respondents: 16 and 29

Field3: Mathematics & Science
Respondents: 2, 4, 6, 12, 15, 25, 26, 28 and 30

Field4: Humanities
Respondents: 1, 5, 9, 10 and 17

In total, there were 7 female respondents and 23 male respondents. There were 10 C-Rated respondents, 1 B-Rated respondent and 19 A-Rated respondents. Discussion on the differentiation between these categories of respondents follows later in this chapter. Each of the questions contained in the interviews is now discussed in relation to transcribed responses. It is important to note that each respondent is referred to by a code in the following segment of the research. For example, Resp1CF4 refers to Respondent 1, who is C-Rated and is categorised into 'Field Category 4', as defined above.

5.2. Question 1: Innovative Research

In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

The first question of the interview asked respondents to describe factors they felt contributed to the creation of innovative research. In the context of this research, the term 'innovative research' is defined as research that "breaks new grounds or challenges the status quo." Respondents were made aware of this terminology, prior to answering the question. This question relates to SGI propensity in that it aims to build a framework of 'innovative factors' in academic research, which could potentially form the foundation of SGI propensity amongst respondents. Thus, the responses to this question contribute to investigating the variable 'SGI Propensity'.

Additionally, this question is phrased in order to give the respondents a broad conception of the research at hand and at a more foundational level, to relate their own research and research experience to innovation, as defined in the context of the study. The purpose of the question is to extricate factors that contribute to and are instrumental in the generation of innovative research, as defined in the question.

Responses to the question varied slightly but generally followed a similar pattern. Several respondents commented on the nature of the question, alleging "*all research is innovative because all research is new"* (Resp19AF1). Essentially, respondents recognised that the question related specifically to the "*philosophy of innovation*" (Resp10AF4), and to "*fundamental questions that are unresolved*." (Resp6AF3).

A fundamental dichotomy in the perception of innovative research was revealed. Most respondents agreed that "*research should be innovative at the beginning, otherwise it's not research, it's just study*." (Resp11AF1), although some remarked, "*to do ground-breaking research is… not something that happens every day*" (Resp19AF1).

Another interesting concept brought forth was the distinction between "*innovative research leading to a marketable product and innovative research leading to advancement of knowledge and understanding the world around us, not necessarily marketable*." (Resp26CF3).

In total, 10 dominant themes were discovered in the transcriptions pertaining to innovative research. These include the following.

Table 92: Question 1: Innovative Research (Dominant Themes)

Number	Theme Title	Key words	Respondents
1	Collaboration	Networking, teams, groups, research groups, communication, colleagues	Resp1CF4 Resp4AF3 Resp7AF1
2	Cross-Pollination of Knowledge	Knowledge, ideas, skills, expertise, talking, communication, exchange, questions, understanding	Resp5AF4 Resp20AF1
3	Human Capital Investments	Education, training, knowledge	Resp30CF3 Resp25CF3 Resp11AF1 Resp29CF2
4	New Technologies	The Internet, computers, technology, cutting edge, open access, information	Resp3AF1 Resp17AF4 Resp6AF3
5	Innovative Thinking	Challenging, conventional, bias, freedom	Resp12AF3 Resp10AF4 Resp20AF1 Resp13AF1 Resp26CF3
6	Opportunity	Gaps in knowledge, gaps in	Resp4AF3

	Exploitation	literature, opportunity, location, relevance	Resp24CF1 Resp29CF2 Resp20AF1
7	Internal Factors	Personality, curiosity, creativity, motivation, comfort, reward, prestige	Resp5AF4 Resp12AF3 Resp28CF3 Resp13AF1 Resp1CF4
8	Resources	Funding, time, knowledge, administration,	Resp23CF1 Resp20AF1 Resp6AF3 Resp16AF2 Resp4AF3

Themes identified in answers to Question 1 related very closely to the literature on innovation and knowledge management. Respondents emphasised the importance knowledge, resources, collaboration and technology in attaining and sustaining innovation in academic research. Each of the themes identified in the interviews is now related to the pertinent literature and discussed below. Many of the themes identified in Question 1 were closely related to the subsequent questions in the interview. As such, themes identified in Question 1 are discussed only briefly with full discussions on some of these concepts following later in the chapter.

5.2.1. Theme 1: Collaboration

One of the most prominent key terms revealed from the transcriptions was the importance of collaboration, networking, teams and groups. The importance of belonging to research groups and network development was prominently articulated, as were the detrimental consequences of "*working in isolation*" (Resp1CF4). The link between the generation of innovative research and collaboration with "*people who are innovative*" (Resp4AF3) was mentioned on several occasions.

An important link between Theme 1, Theme 2, Theme 3 and Theme 4 was immediately evident. References to new technologies (predominantly the Internet) were often made, particularly the use of the Internet for networking and collaboration as well as for cross-pollination and dissemination of knowledge, skills and expertise.

The importance of the development of "*teams… who are intrigued by that same question and come from different backgrounds*" (Resp7AF1) in order to attain cutting-edge synergistic processes of innovation clearly depicts this association. Reference to the importance of the management of research groups was also made. This corroborates the importance of management as a scientific discipline in studying innovation and knowledge (Smith, 2010). Several respondents were careful to point out the dangers of teamwork and collaboration, specifically the potential ego and personality clashes that could come to fruition, if not managed correctly. These responses linked closely to Question 5, on personality and are further discussed later in this chapter.

5.2.2. Theme 2: Cross-Pollination of Knowledge

Cross-pollination refers to the synergistic effects of collaboration as well as the importance of the reliance on previous knowledge and expertise. In essence, cross-pollination has a two-fold meaning; firstly involving the exchange of ideas, knowledge and information through collaboration and secondly involving the interaction of individual-level knowledge, skills and expertise.

Fundamentally, the theme of cross-pollination of knowledge forms the foundation of innovation, as per Drucker's (1988) 'new organisation'. It also describes the importance of knowledge and specialised 'knowledge workers' as well as Nonaka's (1994) description of knowledge as the 'fuel for innovation'.

Existence of prior knowledge was deemed of utmost importance. Reference to the importance of education was often made, both prior education and "*a constant process of education*." (Resp5AF4). Once again, the links between Theme 1, Theme 2 and Theme 3 were evident. The advents of globalisation and trans-nationalism were mentioned as factors contributing to attaining improved levels of collaboration, particularly due to increased usage of the Internet in order to be able to "*talk to the right people to stimulate ways of thinking*" (Resp20AF1).

5.2.3. Theme 3: Human Capital Investment

Many respondents cited the significance of prior education in different fields as important antecedents to innovative success in their current field of study. Prior knowledge and education were described as resources that have significant bearing on innovative research generation through "*understanding the field in which you work*" (Resp30CF3). Theory pertaining to human capital investments (Becker, 1962) seemed to emerge in this theme. The importance of education, experience and training was mentioned frequently. Becker's terminology (1962: 11) that defines human capital investments as "activities that influence future real income through the embedding of resources in people," associates closely with the concept of education and training, as instruments necessary in attaining 'return on investment' (Becker, 1962, Blundel, et al., 1999). In this case, such 'return on investment' refers to improved research performance, or productivity. Hence, it can be concluded that respondents considered 'knowledge', as a resource that was vital in improving productivity and innovation in academia.

The formulation of a research question was held as an important contributing factor to innovative research by "*asking good questions*" (Resp25CF3) in order to make "*ground-breaking discoveries… find a missing link… in a certain field that you didn't expect to find*" (Resp11AF1). It was noted that research questions should be "*cutting edge*" in order to "*do something that is bold and ambitious intellectually*." (Resp29CF2).

5.2.4. Theme 4: New Technology

As previously mentioned, Theme 4 (New Technology) links very closely with Theme 1 (Collaboration), Theme 2 (Cross-Pollination) and Theme 3 (Human Capital Investments). Primarily, references to new technology included discussion on the Internet.

The phrase ‘cutting edge’ was used multiple times in reference to new technology. The importance of the researcher’s preparedness to maintain an awareness of, and to engage with cutting edge technology was described as good research practice and a potential generator of innovative research questions. This theme links directly to the SGI propensity construct under study and forms an important precursor to SGI adoption. It is suggested that respondents that are more likely to positively acknowledge and make use of the Internet, may be more prone to incorporating crowdsourcing and other SGI-based techniques in their research.

Through the Internet, respondents described the benefits of being “*linked into colleagues*” (Resp3AF1) and easy access to information and important articles. “*Innovative research has to do with. It now has become the norm for research*” (Resp17AF4). The occurrence of the phrase ‘open access’ in relation to the use of the Internet appears again later in Question 3.

Not all references to the Internet were positive, however. It is noted that this may reflect the proposed inherent non-innovativeness of academia (Lindquist, 1975, Dewald, et al., 1986). Interviewer probing revealed several negative connotations associated with Internet usage in academia. One respondent conceded the importance of, and reliance on the Internet in the modern landscape of academia but also noted, “*we must also be careful not to solely rely on modern computing*.” (Resp6AF3). Others displayed distaste for the “*very quick summaries*” (Resp3AF1) available on the “Wikipedia”, which were described as profoundly inferior to more in-depth scientific articles and which may hold the “*danger of false information*”. (Resp3AF1).

While these negative assertions relating to the Internet may indicate a lack of innovativeness, or being non-innovative, it is important to note that these objections are valid. As previously noted, SGI does pose certain challenges (Callaghan, 2014a, Torr-Brown, 2013). These challenges particularly relate to the use of crowdsourced input and the problems associated with quality control and validity.

5.2.5. Theme 5: Innovative Thinking

Innovative thinking, described as “*challenging old ways of thinking*” (Resp12AF3) was a significantly visible trend described in order to stimulate innovative research,

Several respondents provided similar descriptions of “*challenging traditions in terms of theory, practice and policy and trying to come out with new ways of doing… that generates interest and cooperation between different types of people*.” (Resp12AF3) and “*the ability to look at pervading dogma, and essentially to test widely held hypotheses. It’s to conceptualise experiments that essentially overturn the prevailing views*.” (Resp10AF4).

Through “*moving away from the beaten path*,” (Resp16AF2) researchers are able to defy the institutions of orthodoxy present in academia, more specifically by “*revisiting some of the accepted principles and trying to view them from a*

different paradigm." (Resp20AF1)

Reference to conventional bias was made as a potential detractor of innovation. Respondents made reference to having "*no conventional training, so I had no conventional biases… so I had to work it out for myself*." (Resp13AF1).

It is interesting to note that mention of innovative thinking was closely related to "*freedom*", described as "*academic freedom to pursue ideas that are somewhat off the beaten track and time to think and explore*" (Resp12AF3) or "*work outside the box*" (Resp26CF3).

Essentially, this theme encapsulates the concept of technological limits (Foster, 1986), in terms of research paradigms. References to innovative thinking, as a theme or concept can be linked to Question 4, which asks respondents about the current state of academia, particularly with reference to research paradigms, with the intent of uncovering respondents' views on technological limits. While mentions of innovative thinking, in the context of innovative research were generally positive in Question 1, responses were not as positive in Question 4, where some respondents referred to the importance of maintaining paradigms and even resisting paradigmatic change.

5.2.6. Theme 6: Opportunity Exploitation

The ability to search for, recognise and thereafter to exploit available opportunities was revealed to be an important contributor to innovation generation. Opportunities were described as "*gaps in the literature*" (Resp4AF3, Resp24CF1) that were in "*close proximity*" (Resp29CF2) to the researcher's field of study. Interestingly, respondents in medical fields of research mentioned opportunity exploitation most often.

Two respondents from nutritional sciences also mentioned the importance of environment and location, with South African populations being an important global nexus for nutritional research. Other medical researchers cited the importance of HIV and tuberculosis research in Southern Africa, with the term "*relevance*" being used to describe opportunity exploitation. One respondent described, "*marrying [the South African context] with a research focus, to make a lot of good innovative research*" (Resp20AF1).

Environmental factors (particularly geographical location) were strongly associated with research focus and the interaction of these two factors was described as a "*perfect breeding ground*" for innovative research. Once more, the importance of diversity in attaining innovation is evident (Smith, 2010).

5.2.7. Theme 7: Internal Factors (Personality and Motivation)

Many respondents referred to personality as an important factor contributing to innovative research. Personality characteristics that were commonly mentioned included diligence, creativity, open-mindedness, persistence and curiosity.

Interestingly, mentions of '*comfort zones'* were made from different viewpoints. The importance of "*being prepared to move beyond a comfort zone*" was noted

(Resp12AF3, Resp5AF4) while other respondents claimed "*it's best to keep people in their area of expertise, keep them comfortable*." (Resp28CF3)

Respondents made references to both internal and external motivational factors in generating innovative research. Internal motivational factors were mentioned far more often than external factors. Internal factors related mainly to curiosity and passion for research.

In terms of external factors, respondents made references to research that is "*high prestige*" (Resp1CF4) and provide opportunities for "*high levels of reward*" (Resp13AF1) as incentives for generating innovative research outputs.

Further discussion of both personality and motivation as separate constructs are included later in this chapter, in relation to Questions 5 and 6.

5.2.8. Theme 8: Resources (Funding, Time and Knowledge)

Several respondents alluded to the importance of research funding in order to engage in research that could be considered innovative, citing lack of funding and budget constraints as severe limitations to innovative output. Reference to funding often linked closely to mention of 'time' as a resource limitation. Time as a resource is often constrained by "*writing applications*," (Resp23CF1), "*administrative tasks and duties*" (Resp20AF1) and the ability to "*multi-task*" and balance family life (Resp6AF3).

Contrarily, some respondents also described time as a non-essential resource. Both Resp3 and Resp4AF3 described the importance of allowing the natural progression of research over time, allowing for free flowing analysis. Another respondent claimed, "*innovation is about drawing unusual links between things so innovative research cannot be done quickly*" (Resp16AF2). "*We don't go for turnaround, we go for results*" (Resp4AF3).

Theme 6 (Resources) also links very closely to Theme 2 (Cross-Pollination) and the importance of prior education and knowledge as a resource that feeds innovation.

5.3. Question 2: Budget Constraints/Alternate Funding Sources

A lot of research faces budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

The purpose of question 2 was to discover underlying SGI propensity of respondents, particularly in regard to the use of crowdfunding, or enlisting the use of web-based platforms to raise funds for research projects. Hence, this question is also used to investigate SGI propensity. More specifically, this question investigates *Crowdfunding Propensity*.

Responses to Question 2 were erratic and consisted of a wide range of different answers. Most respondents struggled to list alternative methods of research funding outside of traditional funding vehicles such as the NRF (National Research Fund) without being further probed. This may be further evidence of the

non-innovative nature of academia (Kuhn, 1970). Many expressed exasperation, particularly with regard to the bureaucratic procedures associated with research funding. Some respondents admitted that difficulties in obtaining research funding has significantly hampered the progress of research in their respective fields and consequently, research processes have had to be designed around available funds, resulting in a lot of critical research suffering severe setbacks.

One respondent observed that a lot of researchers are required to "*cut your cloth to suit your size*." Essentially, the budget is decided prior to the commencement of research and "*one adapts naturally. I dare say there are also some techniques we cannot afford to use, that we might like to but don't*." (Resp8AF1). Other respondents explained that research often must take a backseat, in order to deal with limited funding, "*generally you will fall short financially but then you just cut out part of the research you were going to do*." (Resp11AF1). "*So if it's possible you want to do research on something that doesn't need a lot of money*" (Resp27AF1).

These quotes show the counteractive effects of limited funding available for academic research, in some fields. Considering the significant and exponential growth of crowdfunding (Barnett, 2015), as previously discussed, these quotes also serve to show the potential of the probabilistic mechanism in generating funds.

Most respondents however, agreed that the association between research and funding depends largely on the type of research at hand. The following handful of quotes corroborate this underlying shared assumption:

"*It varies enormously from discipline to discipline*" – Resp5AF4

"*It depends on where you're looking for funding from*." – Resp9BF4

"*There are always different permutations of research funding. Because the funders want to be quite sure that they're investing money on the right people, on the right ideas*. " - Resp14AF1

"*It depends on what kind of work you're doing. If you're trying to cure AIDS or whatever, then people are willing to give money for that. If I'm trying to understand the brain of an African wild dog, then most people don't really give a rat's ass about that, you know what I mean? You know, so it depends what you do*." - Resp19AF1

The above quote (Resp19AF1) shows a potential difficulty that may arise in the use of crowdfunding for academic research projects. The failure of crowdfunding is well documented and the potential issue of crowdfunding failure is imminent (Salman, 2016). In this case, it is important to consider marketability of research projects. In crowdfunding, higher levels of marketability will invariably lead to more 'backers' willing to contribute funds (Walker, 2011). The difficulties in marketing research projects to the crowd are noted and are suggested as an area for further research.

An interesting contrast arises between respondents that felt that research funding is generally constrained and those that believed the opposite.

Respondents that regarded the research funding process as "*wasteful*" (Resp24CF1) generally arrived at similar conclusions. "*Everybody's research faces budget constraints of course; no one has an infinite amount of resources*" (Resp16AF2). Many South African respondents pointed to limited resource funding as a research constraint – "*incredibly bureaucratic here compared to other countries*."(Resp25CF3) and "*funds are very limited in this part of the world* (Resp27AF1).

However, a foreign respondent related, "*South Africa's one of the only countries in the world where the department of higher education and training provides a pay-out for each article and book chapter I produce… I don't really have any complaints and the system works reasonably well, it favours those people who are productive, it doesn't favour those who are unproductive. There's no other country in the world I know of that does it*." (Resp10AF4).

Interestingly, other respondents had a more positive outlook on research funding, stating that "*I've got enough money that I can manage*" (Resp1CF4), and that funding from the NRF has "*been more than sufficient* (Resp6AF3).

Several respondents pointed out that "*not all research needs funding… often people tend to do research without funding… not always a prerequisite for doing research*" (Resp9BF4). "*There another way of doing research though, entirely, where you don't even have to rely on the money. I don't need money to do research, and nor does anyone else. So a lot of scientists don't actually realise that and the problem isn't with the funding agencies, it's with the universities they don't even realise that they can actually have scientists that cost them nothing that actually make them money from their research*" (Resp20AF1).

Other respondents were careful to express that research funding is by no means a binary issue. Others commented on the difficulties associated with funding through a university that relies on research funding to fund its own infrastructure.

"*I wouldn't make it a win or lose game because you know, in funding today it's about incentives. People who receive rewards for research are only those who are successful at it. So your big issue is not so much to grow… to expand those who are actually successful, your big issue or challenge is how to get others who are less successful to do so with a certain degree of ease and probably to be funded for the mistakes that they make, but eventually who stumble upon an answer*." (Resp29CF2)

"*Scientists that work in university atmospheres are a bit dis-incentivised from seeking resources from unorthodox sources and the main reason is that… universities depend for a large part of their income on government agencies that fund research; also lavishly funding the university infrastructure as part of the research funding so therefore the universities don't like it when researchers find their own innovative sources of funding, because they tend to support only the research and not the university infrastructure. So I think that's actually the single*

biggest barrier at the moment… Universities have become dependent on their researchers seeking funds from the standard sources because the standard sources pay for the university infrastructure." (Resp16AF2)

This last quote (Resp16AF2) shows further potential difficulties that may arise in the use of crowdfunding for academic research. The potential of bureaucracy in the university environment may dampen the opportunity for crowdfunding. Crowdfunding, as it currently stands is a poorly regulated process (Ho, 2014). It is to be expected that universities may be hesitant to engage in crowdfunding for academic research projects, despite the will of the academic themselves.

In identifying alternate funding mechanisms, 5 dominant themes areas were identified, as follows:

Table 93: Question 2: Alternate Funding (Dominant Themes)

Number	Theme	Key Words	Respondents
1	The NRF	NRF, bureaucratic	Resp1CF4 Resp20AF1 Resp14AF1 Resp17AF4
2	The Private Sector	Industry, private, business	Resp9BF4 Resp30CF3 Resp6AF3 Resp21AF1 Resp13AF1 Resp23CF1 Resp27AF1
3	International	Overseas, collaborate, competition	Resp7AF1 Resp15AF3 Resp21AF1 Resp7AF1
4	Government	NGO's, resources, government, public	Resp14AF1 Resp20AF1 Resp26CF3 Resp23CF1 Resp4AF3 Resp9BF4 Resp12AF3 Resp15AF3 Resp26CF3
5	Crowdfunding	The Internet, Crowdsourcing, crowdfunding, public resources	Resp18CF1 Resp16AF2 Resp24CF1

5.3.1. Theme 1: The National Research Foundation (NRF)

The NRF is the principle funding agency for academic researchers in South Africa. Almost all respondents mentioned the NRF as the primary source of research funding, but most researchers also viewed the NRF in a negative light, described as "*cumbersome and bureaucratic… a nightmare*" (Resp1CF4) and as

"*bureaucratic bullshit*" (Resp20AF1).

Some respondents were more confident in the abilities of the NRF as a funding mechanism, even praising the availability of "*reasonable funding*" (Resp14AF1) and the fact that the NRF provides "*many ways in which you can access funds*" (Resp17AF4).

Ultimately however, most respondents agreed that NRF funds were insufficient for "*larger projects*" (Resp28CF3) and that different funding agencies and/or sources of funding, in conjunction with NRF funding would provide for a more stable level of research fund income. This shows a general trend of willingness to engage in alternate methods of research funding, potentially a sign of crowdfunding propensity.

5.3.2. Theme 2: The Private Sector

When confronted with the question of obtaining funds from alternate sources, most respondents made reference to the private sector (or 'industry'), as a primary alternative to the NRF, although these were often described to "*come with a whole string of conditions*" (Resp9BF4).

Industries ranging from "*mathematics*" (Resp6AF3) to "*chemical manufacturing and pharmaceuticals"* (Resp30CF3) and "*food companies*" (Resp21AF1) were mentioned as private sector players that were commonly associated with research funding.

Ethical issues remain a severe limitation in obtaining industry funding. Quotes such as "*we do have a code of ethics that in other words we would not accept funding from coca cola, put it that way*." (Resp21AF1) and "*Once you get industry involved, you're promoting a particular drug company and particular drugs which is not really what we would want to*" (Resp9BF4) shows the difficulties associated with industry funding. Once again, respondents were careful to point out that industry funding (like NRF-funding) is limited, depending significantly on the type of scope of research to be funded. Research projects often need to be built around funding, prior to commencement. Hence, the importance of "*[finding] funders who were independent of the outcomes*" (Resp13AF1) was made evident, owing to the fact that "*once you have a funder who depends on the outcome, your research is shot, and you'll only find what they want you to find*." (Resp13AF1).

Several respondents emphasised the dangers of collaborating with industry, particularly with regard to those who "*are not really interested in research at all, rather just in the business of industry innovations*" (Resp23CF1). Others pointed out that applying for research grants from the private sector was highly competitive, and often a fruitless endeavour. Predominantly however, most respondents agreed that industry funding depended largely on the type of research at hand. The importance of being "*able to persuade the people who have money that your research is important and that you will do a good job of it*." (Resp27AF1)

5.3.3. Theme 3: International

Many respondents had favourable stances on international collaboration as a means of obtaining research funding, particularly from the USA, the UK and Europe. As previously mentioned, respondents commonly made reference to "*the South African situation [being] not particularly easy*" (Resp7AF1) and thus, looking to international collaborators as an alternative.

"*Generally speaking scientists are very open and welcoming to collaborative experiments. I think that's the way of science, collaboration across laboratories and the exchange of ideas and sharing of information, I think that's the only way that science can progress. To provide everyone with everything they need, it's just not affordable*." (Resp15AF3).

Once again, the issue of competitiveness was raised – "*then we're competing with people from all over the world*" (Resp21AF1). In response, the importance of "*interesting topics… something that's going to fire them up*" (Resp7AF1) to attract such funding was raised often, particularly with regard to medical research. Institutions such as the Gates Foundation, the CDC (Centre for Disease Control and Prevention) and the NIH (National Institute of Health) were mentioned frequently as potential sources, willing to fund clinical trials in South Africa.

5.3.4. Theme 4: Government

References to the DST (Department of Science and Technology) were frequent (Resp14AF1, Resp20AF1 Resp26CF3). Other government institutions mentioned included the Department of Defence (Resp4AF3) and the Department of Water and Sanitation (Resp23CF1).

Many respondents expressed distaste for government funding and government in general, citing dealing with government agencies as "*complicated to manage*", resulting in being "*grossly under-resourced*" (Resp12AF3). Once more, objective alignment remains an issue in research funding – "*if government doesn't see this as a priority area… that's not going to happen*" (Resp9BF4).

In spite of this, some respondents claimed that government needs to be stringent in deciding which projects to fund because "*in order to justify the spending of that public money would seek some kind of return on investment*" (Resp15AF3) and so researchers would be required to "*play the political game*" (Resp15AF3).

Generally, respondents agreed that increased government expenditure of research funding, if apportioned appropriately, might in the future result in "*South Africa [having] a more global presence and recognition*." (Resp26CF3)

5.3.5. Theme 5: The Internet (Crowdfunding)

As previously stated, the ultimate objective of Question 2 was to reveal any underlying interest in and knowledge of Crowdfunding and to hear respondent's thoughts on obtaining research funds via the crowd. Most respondents failed to mention Crowdfunding, or even had any prior knowledge of Crowdfunding. Some respondents gave indication of preliminary awareness of distributed fund attainment through "*public donors… [raising] money… which is then used for research*," emphasising "*public interest*" and "*awareness*" (Resp18CF1).

Respondents that indicated awareness of the potential of distributed funding systems were probed further with: "*have you heard of crowdfunding? Do you think it has any potential in funding academic research?*"

Very few respondents responded by mentioning Crowdfunding directly, although those that did showed positive interest in the possibility.

"*There are some sexy new ways in which people are trying to find resources… there's crowd-funding, crowdsourcing. Put a research problem out on the web and try to get a whole bunch of people to work on it just out of their own intrinsic motivation, you don't have to pay them… you could use the Internet to try and raise money for your research… there have been some labs that have been successful at that.*" (Resp16AF2).

Reference to popular online crowdfunding platform KickStarter was made: "*if you've got an innovative idea, seeing if you can publicly fund. And when I say publicly I mean the general public, not through the taxpayer's money… It is another way of approaching it, doing a KickStarter type approach to funding*." (Resp24CF1).

Another respondent expressed interest in crowdfunding but recognised the inherent constraints of such a funding mechanism. Using the example of "*trying to solve HIV*", the respondent described that one "*can look at HIV from so many different levels. At the basic level…we should be promoting education and that's where the money should go. If you want to take it a step further you could say well, this money should go towards lobbying government and improving the distribution and the use of anti-retrovirals. And then… the next level… looking at new drugs or drugs that are less likely to cause resistance. So it depends*." (Resp18CF1)

Another concern raised by the same respondent was that public funders (the crowd) might have difficulty in understanding scientific research "*in terms of HIV… fundamentals of how the system works… benefit[s] potentially only 20, 30, 40 years down the line… people who throw personal money at this want to see results*."

5.4. Question 3: Global Catastrophe

Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

The purpose of Question 3 was to identify sources of information and data that could be used as proponents to solving scientific research problems (i.e. to discover an underlying SGI propensity, or more specifically, a *crowdsourcing propensity*). Most respondents expressed difficulty in answering the question; some were unable to respond, asking to move to the next question.

"*Well you know, there's hardly likely to be a general answer to that*

question."(Resp16AF2)

"*Oh that is a hard question. {Laughs} that's every researchers headache! Everyone likes to be able to find a timeous solution, that's what scientists want; it's the timing of the result. But I'm afraid life doesn't quite work that way. And research sometimes has a nasty habit of imitating life."* (Resp29CF2)

Respondents that indicated awareness of the potential of distributed knowledge systems or open source knowledge platforms were probed further with: "*have you heard of crowdsourcing? Do you think it has any potential in funding academic research?*" or "*do you think the Internet could be used to solve a catastrophic problem of this nature?"*

Most respondents were quick to understand that the primary resource required to solving a catastrophic event was information or data. As was expected, medical researchers were quickest to suggest open source strategies. This further supports Callaghan's (2014a) assumption that the probabilistic mechanism of SGI may be an ideal match for medical and pharmaceutical research.

Examples of catastrophic events mentioned included Ebola, TB, SARS, Swine flu Kudu migration, animal extinction, nutrition in Africa, IED's in the Middle East, policing, drug usage, natural disasters (Japan earthquake, Haiti flood, South-East Asia tsunami), The Marikana Massacre, civil unrest, climate change and rhino poaching.

In discovering potential methods in which to solve 'catastrophic' problems, 6 different themes or categories of solution were revealed.

Table 94: Question 3: Global Catastrophe (Dominant Themes)

Number	Theme	Key Words	Respondents
1	Networks	Teams, groups, expert, knowledge, assemble, communication	Resp1CF4 Resp7AF1 Resp22CF1 Resp16AF2 Resp8AF1 Resp10AF4
2	Crowdsourcing	Open source, open access, The Internet, social networking, public, communication, information, knowledge, smart phones	Resp2AF3 Resp6AF3 Resp15AF3 Resp12AF3 Resp17AF4 Resp25CF3 Resp28CF3 Resp22CF1 Resp16AF2 Resp29CF2 Resp22CF1 Resp26CF3 Resp30CF3
3	Benchmarking	Models, experiments, information,	Resp1CF4 Resp3AF1

Number	Theme	Key Words	Respondents
			Resp24CF1 Resp6AF3
4	Classic Scientific Response	Science, simulations, research, models, experiments,	Resp6AF3 Resp7AF1 Resp22CF1
5	Funding	Funding, money, budgets	Resp8AF1 Resp27AF1 Resp11AF1
6	Public Awareness	Society, public, communication, awareness	Resp13AF1 Resp14AF1 Resp18CF1

5.4.1. Theme 1: Networks

The first two and most prominent themes, Theme 1: Networks and Theme 2: Crowdsourcing were revealed to be closely related constructs extracted from the transcriptions. Most respondents agreed, "*using networks of experts and drawing on their expertise*" (Resp1CF4) or "*to assemble teams of really clever people… to get… perspectives… from a wide range of people*" (Resp7AF1) would be a good starting point in addressing a catastrophic event. The importance of "*expert knowledge and people who are trained in the area*" (Resp22CF1) was made clear. This shows respondents' awareness of the importance of knowledge (Drucker, 1988), which is decentralised (Hayek, 1945). However, it does not yet show how respondents would respond to the problem of 'stickiness' (von Hippel, 1976).

Respondents also agreed that the nature of the catastrophe at hand would subsequently determine the composition of said network. In the case of Ebola, which was the example used in posing the question, some respondents spoke to assembling teams consisting of "*subset[s] of the medical research community that has every thought about responses to public health emergencies of that sort*" (Resp16AF2). Interestingly, reference was also made to self-assembling networks of experts and scientists that form in response to a crisis. This has important bearing on crowdsourcing propensity, as it shows interest in the use of 'flash teams', which is a potential method of crowdsourcing (Callaghan, 2015a). The importance of communication amongst team or group members both within the network and outside of the network was made clear, in order to disseminate information as quickly as possible. Respondents may not have mentioned 'the wisdom of crowds (Surowiecki, 2044) directly but the same underlying principles apply in the use of networking in response to a catastrophe.

The concept of network formation applied not only to individual experts and researchers, but to organisations and institutions as well, in terms of "*those organisations specifically designed to deal with things like Ebola or national health laboratories which shift internal resources even more quickly*" (Resp8AF1). Emphasis was placed on the importance of "*compiling a list of grassroots organisations and NGOs… that have the most information available. And they're also the best networks, the ones in those positions who distribute the solution, as it were. So I think before these kinds of disasters start, ideally you*

want a list of contacts that you can draw upon, to help distribute solutions or devise plans" (Resp10AF4). These quotes show a high proclivity for openly distributed knowledge solutions and the importance of expert input (Torr-Brown, 2013).

5.4.2. Theme 2: Crowdsourcing

Respondents that seemed to be aware of the potential benefit of SGI-related research techniques and methodologies were further probed to find out thoughts on the potential of crowdsourcing and the impact of the Internet on managing catastrophic events (Aadhir & Vohra, 2003). Several respondents were already aware of the potential benefits of such methodologies as a means of gathering information in real time to contribute to solution generation, despite not mentioning the terms 'crowdsourcing' or 'open access'. Respondents noted the importance of "*communicating your findings to the public… we want the public to be interested*" (Resp2AF3). The use of Google, Wikipedia and other online research communities (such as Research Gate) to gather information as quickly as possible were cited several times by a number of different respondents. Respondents also made mention of social networking and e-mail as a means of highly efficient communication amongst fellow researchers and scientists. Ultimately, the impact of the Internet on academic research was evident (Howe 2006).

"*In this modern world today we have the Internet, with this connectedness and one can do huge amounts of work compared to when I was a student when it wasn't possible like it is today*" (Resp6AF3). Generally, most respondents agreed that "*the free flow of information*" (Resp15AF3) was imperative in addressing a catastrophic event and that failure of the scientific community to provide free flowing information was a potential detractor in finding solutions. Essentially, this is a description of open innovation, as defined by Chesbrough (2003a). The importance of "*open sharing of information which… in the field of disease outbreaks it's certainly gaining traction*" (Resp12AF3) directly links to the fundamental theory of SGI (Callaghan, 2014a).

The Internet was described in mostly a positive light as being a vehicle for "*different ways of accessing information and knowledge… layers of information which can be accessed at the same time in a kind of three dimensional space. I think there's a lot of potential for that… to break new grounds and we have to explore beyond our paradigms, otherwise there's no point in research"* (Resp17AF4)

Here, Callaghan's (2014a) proposition is raised once more; that R&D is fundamentally constrained by dyadic links between knowledge provider and knowledge seeker due to the need to keep information and knowledge proprietary. Hence, in 'collapsing' this dyadic link by feeding knowledge and information back into the crowd, a *three-dimensional* space of knowledge creation could become enabled, which may significantly improve the rate at which innovation occurs (Callaghan, 2014c). This is the key benefit and significance of the implementation of SGI.

"*The internet was invented …to share information as quickly as possible… research is done in real time… information is shared directly from the experiment to a system of computers and internet connections. So I mean the Internet itself was designed to solve these sorts of problems. So I guess taking advantage of the connectivity of the world would be the best way to approach these sorts of things, or let's say to 'prepare' for such things*". (Resp25CF3)

Once again, the above quote displays extremely high levels of SGI and crowdsourcing propensity. The respondent firmly grasps the capacity of the Internet in solving problems and more importantly, displays understanding of the probabilistic mechanism – that information and knowledge is exponentially improved through the use of the Internet.

However, some respondents also alluded to the potential negative impact of the Internet on academic research, specifically in terms of information overload and having "*too many variables… which only compounds the problem and makes it more difficult*" (Resp6AF3) or "*information overload… people may not know what to filter out*" (Resp28CF3). Other respondents were aware of crowdsourcing but were suspicious as to its regulation and viability. Such concerns have been raised often in the literature (Wang, et al., 2011).

"*I just don't know how one would filter that type of information to find something that's useful. You know the best way to get as far away from the solution as possible is to put 5 scientists on it, so they'll never reach consensus*." (Resp22CF1). Furthermore, respondents were deeply concerned about the issue of quality control in crowdsourcing and open access.

"*If it's a medical situation, or a breach of containment of disease, then… I would unequivocally say I would not involve a crowd because… there's a herd-mentality… it's very difficult to find the truth and so… I would turn to expert consultation*" (Resp22CF1).

"*Of course those things can be useful but one needs to be pretty careful, using technologies like that. I mean, a disorganised response to a catastrophe, that is in the sense that there isn't much control over the response but it spontaneously emerges from multiple, along multiple channels, that will typically have a bunch of good properties but it will typically also have a bunch of bad properties. I'll give you an example; within 24 hours of the Tsunami in Indonesia, in Thailand, within 24 hours there a bunch of sites online, soliciting donations. But a significant proportion of those sites and the ones that were up fastest were fraudulent. So a lot of money was raised but quite a lot of money was stolen as well*." (Resp16AF2)

"*I think the Internet has a role to play, but to place all our hope in the Internet would take away from the research enquiry*." (Resp29CF2)

The above quotes show a lower SGI or crowdsourcing propensity, but the concerns raised are certainly not unfounded. Issues relating to quality control, regulation and validation are widespread in the literature (Wang, et al., 2011, Callaghan, 2014b, Torr-Brown, 2013). The issue of the 'herd mentality' is a serious negative possibility

in crowdsourcing (Surowiecki, 20014), the same herd mentality has lead to destructive riots.

Here, however, it is important to point out Surowiecki's definition of a 'wise' crowd: "*certain prerequisites exist, namely the need for it to be diverse, to have independence, and to be decentralised* (Surowiecki, 2004: xix).

In other words, if individuals in the crowd are diverse, they are more likely to think and act independently. This issue does raise a potential area for further research inquiry.

However, the potential benefits of crowdsourcing information were still evident from interview responses.

"*But let's say for example after we've contained the situation and we want to understand what the socio-economic and socio-political impacts of the disease… after there's no longer any threat to human life, I would open it up to a more broadly consultative platform.*" (Resp22CF1).

Resp12AF3 made direct reference to open-access as a way of combatting catastrophic events in real-time, specifically outbreaks of disease, once again linking directly to the assertions of Callaghan (2014a), Chesbrough (2003a) and Torr-Brown (2013).

"*Real time solutions are coming from open access… where researchers are working across the world have been making available in real-time the sequences of Ebola virus strains. So the sharing, creation of virtual networks for surveillance has turned out to be an extremely important tool for the management of outbreaks. The key here is to combine the availability of open sharing of information. It's important to have the technology available which is the laboratory technology plus the IT infrastructure so that we can participate in these kinds of networks. And certainly in South Africa, that's not an issue at all*" (Resp12AF3).

Reference to the use of mobile and smart phones as well as social media were also made on multiple occasions, as predicted by Thompson (2014).

"*Now it is taken for granted that you get your information really at the drop of a hat anywhere in the world with satellite communication and you know even cell phone communication at any time*." (Resp26CF3)

"*African countries have completely skipped the landline, and most people regardless of how poor they are, have cell phones of some type or other. So in some situations the only thing you really can do is to use your smartphone if you have one and get onto the Internet and get information*." (Resp28CF3).

"*If something like social media still exists, of course you could use that to try contact as many people who have some understanding or some information to try to pull it in some way*" (Resp30CF3).

5.4.3. Theme 3: Benchmarking

The notion of benchmarking was strongly represented in respondent answers through "*looking at past other similar types of problems that have developed in the past, past models that have worked and then working out how to apply those models to this particular problem*" (Resp1CF4).

The need for benchmarking was defined as the "*lacking the baseline information*" (Resp3AF1) and the need to "*[get] as much information as possible and analysing it in order to try and reduce the uncertainties*." (Resp3AF1).

The use of models, simulations and lab experiments used in order to reduce uncertainty was mentioned frequently.

"*You need to extrapolate and model by using not the experiments, but your mind simulations and your mind experiments. If you look at Einstein for example, you can do that as a mathematician and you can come very close to those solutions and then of course, once certain things are available more, then you can actually test them. So basically you have these benchmark solutions that sometimes may look silly and stupid. A lot of these models are simple – they do not mimic the real situations but without them you wouldn't be able to get to the real solution*." (Resp6AF3).

The use of "*reconstruction… to try and see what would be a better way of dealing with in that situation*" (Resp9BF4) and the use of preparation tactics (such as case studies) in order to improve outcomes were mentioned repeatedly. As such, "*the advantage of history comes into play*." (Resp24CF1).

"*You'll have models from others types of diseases… you do have some history in terms of public data, a lot of data, big data on disease spread, the profiles, what actions are taken to curb that… implement plans to these curves or try to follow the curve based on historical evidence; how the disease or whatever, the process of that happening, how to try mitigate, while you muster your troops to start investigating the particular problem. So you have generalist approach and then while you're mounting the generalist approach, you also in the background start doing the specific approach at the same time*." (Resp24CF1)

5.4.4. Theme 4: Classic Scientific Response

In a similar vein to Theme 3 (Benchmarking), respondents recurrently described the use of classic scientific approaches to help solve catastrophic problems. Respondents held the notion that such problems should be approached methodically and scientifically in order to understand the problem at hand and deal with it in a timely and appropriate fashion.

Once again, simulations, models and experiments were mentioned frequently although references to these were often vague. "*Try to refine the problem, slowly getting closer and closer to the solution*." (Resp6AF3) and "*throw whatever research techniques you have*" (Resp7AF1).

Other respondents described more methodical approaches – "*I would take a multi-pronged approach of containment versus intervention, in terms of intervention… so lets take Ebola again, it's a very good example. The first thing I would do is to make sure that there's no further transmission of infection or further deterioration in the communities that are infected and keep them contained. And then I would call on the global scientific community to say this is a problem we need to fix. What is the global consensus? I would seek out international aid in terms of funding, expertise, hands on the ground and try to contain the sort of political fallout of the situation. And then finally introduce an intervention of the global confrontation, but if it were a catastrophe; I would give it 24 hours, that's it. What I don't receive within 24 hours is not considered and then I would deal with the problem at hand. After a few days I would evaluate if it is working, I wouldn't go longer than 3 days if it's an infectious disease. And if it's not working I would go back to the consultative route to see what suggestions are there; but if it is working I would scale it up*." (Resp22CF1).

The methodical approach suggested also strengthens the argument for the need for knowledge and information in addressing a catastrophe. Both Theme 3 (Benchmarking) and Theme 4 (Classic Scientific Response) magnify the importance of 'expert knowledge' in solving catastrophic problems. Here, discussion on Becker's (1962) human capital investment theory becomes relevant. Becker (1962) describes the importance of knowledge, expertise, skills and values that cannot be separated from the individual (Blundel, et al. 19999). In other words, this is 'tacit' knowledge (von Hippel, 1976). Both Callaghan (2014b) and Surowiecki (2004) note that expert knowledge is a vital component of crowd wisdom, or the probabilistic mechanism. The combination of both expert knowledge and outsider knowledge makes for diverse input, which is a vital ingredient in the generation of innovation (Smith, 2010).

At the same time, references to expert knowledge link very closely to von Hippel's (2005) notion of user-generated innovation. If academics are in a sense, the 'users' of the knowledge product, their input in creating knowledge makes for open innovation (Chesbrough, 2003a). This, in turn, substantiates the assumption made in this research, that SGI propensity is a function of absorptive capacity, as defined by Cohen and Levinthal (1990). If absorptive capacity is defined as "the ability… to recognise the value of new information, assimilate it and apply it to commercial ends" (Cohen & Levinthal, 1990: 128) as a function of prior related knowledge, then academic researchers (being in the business of knowledge creation) should have a strong foundation upon which an SGI propensity can be developed (Rubin, 2014).

5.4.5. Theme 5: Funding

Several respondents recognised the importance of funding in the case of a global catastrophe, linking back to Question 2. In the case of an outbreak of an infectious disease, "*the first thing you have to think of is funding*" (Resp11AF1), "*you can't do research without reasonable sums of money, it's not possible*" (Resp27AF1) and for "*medical research and other funding councils [to] shift budgets*" (Resp8AF1). Other respondents noted, "*There's a lot of money wasted*" in the case of global catastrophes and that more stringent assessment and funding processes

were required. References to money were generally made in conjunction with networking (Theme 1).

5.4.6. Theme 6: Public Awareness

The notion of public awareness was raised on several occasions by a few different respondents, particularly with regard to outbreaks of disease and problems relating to nutrition (such as obesity). This follows logically, as those affected by catastrophes should be aware of the problem at hand in order to formulate coping mechanisms. The importance of producing a "*change in society*" (Resp13AF1) to prevent further outbreaks or worsening the problem at hand was mentioned several times. Respondents noted that the general public often follows the advice of scientific professionals and the dangers of false information could have dire consequences in the case of catastrophes. In order to minimise risks, it was deemed important to "*enhance people's understanding of problems that materialise out of some cultural habits like eating raw meat from certain animals and that kind of thing*" (Resp14AF1). The after-effects of the Ebola outbreak, that "*preparation has improved drastically, especially compared to what it was before*," was cited as proof of this concept. One of the key requirements listed in order to raise public awareness was "*better lines of communication*" (Resp18CF1), which is often dependent on pre-existing infrastructure.

5.5. Question 4: State of Academia

Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

In phrasing this question, the interviewer aimed to illicit respondent views on academic research paradigms. The stance taken in this research is that academia has long been resistant to paradigmatic change and as a result academic innovation has been stifled. These views are supported in the literature. Kuhn (1970) asserts that the non-innovativeness of academia can be ascribed to convergence theory and that paradigms are innovation constraining. SGI theory mirrors these assertions (Callaghan, 2014a).

The convergence of best practice may have resulted in paradigms that are fundamentally fixed and very difficult to change. This relates closely to Joy's Law on tacit knowledge (Lakhani & Panetta, 2007). The knowledge that exists in academic research, can be seen to be tacit and very difficult to move. The same can be said of academic research paradigms. The more experienced the academic researcher, the less willing they may be to incorporate crowd-based SGI processes into their research (Rubin, 2014). Hence, SGI may represent a new iteration of Schumpeterian creative destruction in the academic research context, and hence it is to be expected that resistance may be present (Smith, 2010). Historically, academic research has often been considered non-innovative. Others have echoed the assertions of Kuhn (1970) as mentioned above. It is suggested that the academic research environment may actually slow innovation, rather than accelerate it (Welsh, 2013). As a result, it is argued that respondents that viewed the state of academia in a positive light are said to have a low SGI propensity, as they are not acting as proponents for paradigmatic change. Contrarily, respondents that viewed the state of academia in a negative light

are essentially supporting the assumption of this study and are said to have a higher SGI propensity.

Responses to Question 4 generally fell within 2 categories. Respondents either agreed or disagreed that academic research is constrained by paradigms, although some respondents remained undecided.

"*Both scenarios probably do exist simultaneously*." (Resp30CF3)

Those respondents that felt that academic research is indeed constrained non-innovative and by paradigms were vehement in their arguments.

"*Oh yes absolutely. No question*." (Resp9BF4)

"*It still absolutely is and it's worse than ever*" (Resp13AF1)

Others commented on the difficulties of changing substantiated paradigms that have become "*ingrained*" (Resp13AF1) and the difficulties associated with "*getting enough information to reverse them*" (Resp3AF1). The problem was often viewed as very difficult to solve because "*that's what paradigms do… they constrain you and it becomes a comfort zone*" (Resp5AF4). In response, respondents described "finding links" between different paradigms and ways of thinking in order to generate more innovative research.

Respondents made reference to industry's association with innovation constriction, particularly the pharmaceutical industry, which has provided researchers and the public with "*brainwashed falsehoods*" (Resp13AF1).

Another respondent agreed that in the past, academic research has been constrained but that "*things are changing*" (Resp6AF3) due to the fact that "*you can apply mathematical research in problems that are facing us… to get… solutions that actually are very relevant*" (Resp6AF3)

"*In South Africa to a large extent, we've relied on this non-innovative aspect for a long time. That has changed now; people are getting more together, networking. Things are changing*." (Resp6AF3)

The differentiation between academic research funded by private sector entities was brought forth. Those researchers without access to funds, tend to research slower and more conservatively, "*in a bad way… encourages them to work on problems the granting panel will be familiar with so they get the grant*" (Resp16AF2). On the other hand, while researchers with access to funds from private entities may be able to work more constructively and innovatively, it was noted, "*private sector entities tend to monopolise the knowledge*" (Resp16AF2) and so a balance of both types of research funding would be ideal. Another respondent supported this ideal, claiming, "*If you're in industry, unless the research turns an immediate profit, you're not going to cut it. Whereas a lot of academic funding allows you to dabble in things which have secondary benefits which would actually amount to something significant*" (Resp18CF1)

Funding was revealed to be a fundamental issue for responses to Question 4. References to academics applying "*for funding not because they want to solve the problem but because they want to be promoted*," (Resp23CF1) indicated a link between funding and innovation, as was uncovered in previous questions. It was revealed that this issue might lead to a "*paradigm trap, where new ideas aren't as robustly supported financially because the reviewers of the grant might have their own personal biases against the new theory or have built up a reputation based on an existing theory or paradigm*" (Resp24CF1) and that "*Some research is funded by agencies that require that the research is done in a certain field, and they're looking for specific answers*" (Resp30CF3). "*Funders are really pushing people to think out of the box*" (Resp22CF1)

Other respondents agreed that academic research is constrained by paradigms but for a good reason. "*It's important to be constrained by paradigms… research that is not constrained by paradigms tends to devolve into speculation. If people just feel free to reinvent the world anew every time they walk into the lab, they may have never learned anything because they're not really leveraging the accumulated wisdom of all their peers.*" (Resp16AF2).

"*If it's not innovative then it's not really research, that's just people studying*" (Resp25CF3),

"*I don't understand how one can actually do research that's not innovative*" (Resp28CF3)

"*Actual research is open. It is not informed by specific preconceived notions*" (Resp30CF3)

A large percentage of respondents disagreed, claiming that academic research is not constrained by paradigms and is in fact, very innovative. Several respondents reacted emotionally, claiming that the question is "*a gross generalisation… makes absolutely no sense… an insulting and ludicrous statement*." (Resp12AF3). Others claimed the question was "*sweeping and naïve… poorly represents the nature of research*" and is "*bloody stupid*" (Resp8AF1).

Common responses held to the view that "*the role of science is to challenge paradigms all the time*" (Resp7AF1), despite the fact that paradigm-breaking research is rare. The importance of both incremental and radical research was noted, both being described as equally valuable. Mention of "*standing on the shoulders of giants*" (Resp12AF3) and "*element of research where you need to build on what has been done before you*" (Resp25CF3) were commonly made.

More specifically, "*the nature of research is by its nature incremental and from time to time leads to the realisation that a paradigm is inappropriate and a new one is needed.*" (Resp8AF1) Most respondents recognised " *the need to be prepared to move with the changing wave of evidence*." (Resp8AF1) and commented on the "*very complex, multi-dimensional*" nature of academic research.

"*The only way to develop is to have a paradigm, and over time people pick at it*

and find weaknesses and counterexamples and then you develop a new paradigm on the basis of those" (Resp10AF4). One respondent succinctly described the process of innovation, as defined by Smith (2010), remarking on punctuated equilibrium and innovation progression. *"But it does work like that you know, there are periods of stasis and it requires some sort of trigger often to then have a change in mindset, which then triggers other new bursts of activity and then settles down again and then another burst*." (Resp24CF1)

Some respondents claimed that it is impossible for academic research to be driven by paradigms as "*if your research is based on an established paradigm or dogma*," (Resp22CF1) there is very little chance of being published. As a result most academic research is free from by paradigmatic restrictions.

One respondent made reference to "*Kuhn's analysis of the progress of science*" (Resp15AF3) and the "*ability to suddenly realise or stumble across something that no one's ever thought of and to look at things from a different angle*." (Resp15AF3).

New technologies (specifically, the Internet) were once again mentioned frequently. "*It's become more innovative as we move into this information age. You know, sharing information. Information becomes more widely available you get different people from different fields integrating new knowledge from other fields and you see these spurts of activity*." (Resp17AF4)

5.6. Question 4.1: Journal Publication

Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Question 4.1 is a follow up question to Question 4, intended to expand responses to Question 4, in terms of journal publication. This question relates specifically to the issue of 'academic failure', defined as the 'market failure' of academia to innovate and create knowledge (Dewald, et al., 1986).

An important aspect of academic failure is the peer-review process, which has been described as a constraint to innovation (Bornmann, 2010). Concerns related to the "adequacy and fairness of modern peer-review practices in publication and funding and about "reliability, accountability, reviewer bias, and competence" has been raised several times (Peters & Ceci, 1982). Mahoney (1977: 161) concludes that confirmatory bias (or "the tendency to… confirm their beliefs") is commonly present in journal publications. For Callaghan (2015a), the literature indicates that there are also serious issues related to the resistance of academics themselves to scientific discovery.

Camparino (2009:550) discusses the "resistance to scientific discovery," in regard to innovative articles that are not published because they do not conform to the orthodox viewpoints of reviewers nor fit within accepted paradigms. This "raises important questions about current policies which govern the dissemination of new information" (Camparino, 2009: 558).

Once more, responses varied widely, generally falling along a continuum from 'journals do not promote innovation' to 'journals do promote innovation'.

There was a strong trend of respondents referring to the wide range of quality of journal publications. And the importance of both 'bad' and 'good' journals as a mechanism for "*getting important new ideas through the system. Because sometimes a top journal won't want to publish something new and novel and risky. That's where the lower rated journals come in – they'll publish more risky research and if it's good enough, that research will make its way up the ladder to the top journals although "it does force people to turn out quantity rather than quality*" (Resp19AF1)

"*You get very good journals and very bad journals*" (Resp5AF4)

"*It depends on where you publish… shifts all the time*" (Resp9BF4)

"*They range in quality*". (Resp18CF1)

"*Within the next 20 years I believe the landscape is going to change again tremendously*." (Resp26CF3)

"*There are some internationally recognised journals that only publish innovative content and the more detailed and deeper sort of research in terms of expanding what has already been measured to different systems or different areas of the same sort of content go in the more standard journals. Without the journals dedicated to new types of findings then the awareness in the scientific community would be very much less*." (Resp26CF3)

It was noted that new discoveries often have publishing obstacles at first, due to the restrictive nature of article publication.

"*One of the challenges in science is to actually generate something, which is genuinely ground-breaking and then actually to get other people to appreciate what you've found*" (Resp3AF1).

"*The better-established journals… criteria for accepting articles… insist that they have to be novel*." (Resp30CF3)

However, most respondents agreed that the stringency of the publication process is a positive:

"*While it's true that the highest prestige journals in any given field tend to be quite hard to get into with new ideas, on the other hand when a new idea does get into those journals, you know then that's a really important one*." (Resp16AF2)

In addition, respondents pointed out that the wide range of journals available meant that work that is new and novel as well as work that is just 'turning the handle' or better understanding an already well-researched field can both be published and made available.

Some respondents made reference to the gradual decline of the journal publication model – "*[most] journal articles are read by apparently 5 to 6 people… unsustainable in the long run.*" (Resp5AF4) and "*clearly it's an imperfect process*" (Resp6AF3).

"*Typically… if the paper challenges existing or prevailing popular views, you sometimes might find it difficult to get that work published. In that respect, the science establishment as it were, does tend to fight against innovative research.*" (Resp15AF3)

Some respondents felt positively about the quality of journal publications: "*one of the requirements for publication in these higher status journals is that there has to be a level of novelty… if it's not taking the subject forward in some way, breaking a bit of new ground*" (Resp8AF1). However, other respondents pointed out the difficulties of publishing in a largely Westernised culture of journal publications: "*the deep problem, is that there's a certain professional standardised norms that you've got to learn, in order to package the work in way that will be of interest to the people who control the journals. And once you can master that stuff you can get published.*" (Resp10AF4).

"*The point is if you make a convincing enough case, then generally, in my opinion at least these contrary views do get aired. They then become the subject of intense debate and then eventually the situation will clear and it gets settled one way or another. "I am… prepared to trust a paper which is published in an imminent journal which I know has a good strict editorial policy and a refereeing policy."* (Resp15AF3)

Many respondents commented on the process of peer reviewing, which was viewed both positively and negatively.

"*I think that peer reviewing is a very important part of it. Its obviously got problems and the problems might arise from minor and petty jealousies that the reviewer doesn't like you, your particular research because it goes against his research, but I think that generally the peer review approach works quite well and I think that it does allow progress to remain in science."* (Resp11AF1).

"*Getting 'peer-reviewed' is a little bit of a status symbol. But the peer-reviewing process is not perfect. Most of the people who do referring such as myself, it's on a purely voluntary basis and it's done anonymously so quality control is a bit questionable. And it always seems to be at the discretion of who the editor is so some journals I'll avoid because the editor is a dickhead. But other places, you know that they're interested in this kind of work so actively try and publish there first. So I mean I think, there's probably a few ways to do it, whether you have a certain review system that's not anonymous, which might make the reviewers a little more careful. And I think trying to make things a little more open source to open up that free exchange of ideas, instead of worrying about the money making machine, focusing on the actual research instead of getting more subscriptions.*" (Resp25CF3)

"*A lot of it comes down to the editor and chief of the journal… The biggest*

problems I think is that ' all done anonymously. So if I get a paper from someone to review, I can screw them over and make sure they don't get published. You know, so the anonymity of the peer review process is a real problem. That I think is blowing things up quite a bit. But you have to play the political game, that's the problem. And we're in a field that actually shouldn't be political." (Resp19AF1)

On the other hand, "*the journal editor can only work with what they receive. It depends on what's being sent to them in the end. And you've got these academics and students that have to publish a certain number of times a year so they're sending in whatever they can. It's a complex situation*." (Resp23CF1)

Extremely negative responses were also recorded (these are both from nutritional scientists):

"*I cant even bother to read the medical journals because they're an extension of the pharmaceutical industry and so they publish these long diatribes on drug trials which, when are the drugs are relatively ineffective and they're not treating the real cause of the problem. So you have this multi-billion dollar industry, which is not innovative, it's only protecting the industry. Lets say the pharmaceutical industry produces a new drug. Who will have researched it? Who will have been the primary driver? Will it have been the professors of medicine or surgery or pharmacology? Who will become the main spokesperson for that drug? It will be the professor. And the professor will tell his students that this is the most famous drug ever. And that doesn't matter what the outcome of this drug is, the benefits or otherwise. Once the company has their profitable model, the industry plans it and promotes it. And we just fall for it*." (Resp13AF1)

"*There's no funding incentive to do that research. So there's an incredible skewing of information by journals in terms of quantity. The more articles on a subject, would suggest that the research is more robust but that's not necessarily true because it's skewed by the amount of funding which is pushed into it."* (Resp18CF1)

"*Journal publications promote research that I think is perceived to be topical in the field. And that's not necessarily innovative. It's very subjective, it is what the editor feels is interesting and sometimes the editor doesn't even know the reality of a disease on the ground and so… I don't think journal articles are a good measure of anything."* (Resp22CF1)

Comments on the iterative and incremental nature of academic research, linking to points made from Question 4.

"*If you are working on a specific problem, obviously the first thing you do, is you go and look if it's available, what everybody else has done. And obviously don't repeat exactly what they do, but it gives you an idea of how you can take the whole thing further. So I think in a sense, it is small little steps that each research project grows a little bit more and find out a little bit more and so on. So we keep learning from that and build on that*." (Resp21AF1)

"*I think people nowadays are not pushed to work in circles but they're pushed to*

work in very small steps." (Resp28CF3)

Respondents also pointed out the important link between funding and journal article publication.

"*I think publication practices have change dramatically and there is definitely a push towards selling one's research in a way that one has a big story, a big punch attached to it so you can get into the top scientific journals."* (Resp12AF3)

"*I think that the academic endeavour is undervalued by… [an] entrepreneurial view. That's not realistic. I think research for the sake of research is fundamentally important. The value we get from it, we'll leave that to the people who do the accounting to work out, but I think research is important because it's important."* (Resp29CF2)

Most interestingly, Question 4.1 elicited several responses, which included mention of open access, with regard to journal publication.

Due to the "*dramatic changes that have taken place in the field of journal publication*" (Resp12AF3), including the newfound importance of publication metrics systems, the sharing of information on social media and the Internet "*where everything is far more open and people are trying to promote themselves*" (Resp12AF3).

Views on open access publication were very mixed; some respondents viewed it positively, despite the potential negative effect on quality of research output:

"*I am strongly supportive of the idea of putting information out there… open access, it's very expensive to publish open access but it's important to give your research visibility, to make it accessible to as many places and people in the world who can actually read it. What's it doing to the quality of science I don't know, there's still outstanding science that's being done, there's still bad science that's being done. But again if you're properly trained and educated you ought to be able to distinguish those 2 classes of publications*." (Resp12AF3)

"*A lot of new information is available immediately whereas before it wasn't possible*" (Resp17AF4)

"*I think one of the hurdles [in the past] was people guarding their data rather than making the data open to anybody to access, which is possible nowadays*." (Resp24CF1)

"*I think trying to make things a little more open source to open up that free exchange of ideas, instead of worrying about the money making machine, focusing on the actual research instead of getting more subscriptions*." (Resp25CF3)

The dangers of 'predatory' open access journals was raised several times:

"*One has to be very careful. I mean some of these journals to be quite honest are just there to make money. Thy make money from what they charge for*

publications, publication fees. So as a researcher, having invested the time and effort into doing research, one has to be very careful on where in fact you publish. And being the common goal of most researchers is to get as much exposure as possible. So as I say again, some journals yes, others not quite and us researchers have to be careful." (Resp14AF1)

"*There are many so called 'predator' journals springing up all over the place trying to get the basic research through and also to see how that basic research can deliver a marketable product*. " (Resp26CF3)

The issue of 'overload' was also raised:

"*The only problem here is that too much has been written, much of it is actually useless. But it probably happens in all fields, a lot of stuff is just wasted but the rest is good and the system works like that, so you have to be a good enough researcher to know what's rubbish and know what to concentrate on. It's a skill, a lot depends on the people conducting the research*" (Resp17AF4)

On the other hand, some viewed open access publication negatively, the issue of quality control being the major contributing factor:

"*I'm not one of these people who advocate for example, the publication of open source material which undergoes very, very scant reviewing if any reviewing at all. I mean, I just don't have any confidence in the quality of the papers published in there. Now there are some very good open source journals but there are a lot of predatory journals. There's the sort of journals that you can email every day saying give us your paper, we'll publish it within 2 weeks in exchange for which, you pay us 500 dollars. And that is just feeding on this obsession that academia has with numbers of publications. Irrespective of quality. I am much more prepared to trust a paper which is published in an eminent journal which I know has a good strict editorial policy and a refereeing policy.*" (Resp15AF3)

5.7. Question 5: Personality

In your experience, which personality factors do you think contribute to innovative research?

Question 5 was asked with the intention of uncovering the underlying personality factors of innovative academic researchers. Responses fell within a set of 7 themes. Many respondents commented on the importance of finding a balance between all of these elements, also that personality depends largely on the area of research at hand. Hence, all 7 themes can be considered as interlinking.

"*I think in terms of personality... you need to have a balance*" (Resp1CF4)

Table 95: Question 5: Personality (Dominant Themes)

Number	Theme	Key Words	Respondents
1	Conscientiousness	Perseverance, persistence, patience, stubbornness, hard	Resp14AF1 Resp16AF2 Resp2AF3

Number	Theme	Key Words	Respondents
		work	Resp2AF3 Resp22CF1 Resp29CF2 Resp23CF1 Resp25CF3 Resp30CF3
2	Open-Mindedness	Flexibility, imagination, risk tolerance, change	Resp1CF4 Resp8AF1 Resp12AF3 Resp16AF2 Resp19AF1 Resp24CF1
3	Curiosity	Curiosity, inquisitiveness	Resp5AF4 Resp18CF1 Resp29CF2 Resp8AF1
4	Extraversion	Sociable skills, networking, teamwork, communication, collaboration, leadership	Resp6AF3 Resp3AF1 Resp11AF1 Resp7AF1 Resp15AF3 Resp24CF1
5	Humbleness	Humility, humbleness	Resp5AF4 Resp9BF4 Resp13AF1 Resp26CF3
6	Confidence	Authority, belief, attitude, driven	Resp13AF1 Resp6AF3 Resp12AF3 Resp10AF4 Resp2AF3 Resp1CF4
7	Enthusiasm	Passion, energy, drive	Resp8AF1 Resp27AF1 Resp14AF1

5.7.1. Theme 1: Conscientiousness

"*Most academics are nerds*" (Resp2AF3)

A general consensus amongst respondents was that researchers require a high degree of conscientiousness in conducting research.

"Well conscientiousness, a researcher who is not extremely diligent and painstaking is going to make a lot of mistakes" (Resp16AF2). Similar linking characteristics of the diligent or conscientious research were that of patience" (Resp2AF3), "*perseverance*" (Resp14AF1) and "*persistence*" (Resp22CF1, Resp14AF1).

Perseverance and persistence in particular were mentioned frequently, associated highly with mentions of "*hard work*" (Resp25CF3) and "*stubbornness*" (Resp23CF1). *"It's about being dogged in wanting to answer a question that interests you*." (Resp29CF2)

"You have to be stubborn enough to believe that something that everyone thinks is going to fail, you have to be stubborn enough to force it through." (Resp23CF1)

This characteristic can be linked closely to Theme 7 (Confidence).

Mentions of hard work and diligence occurred frequently, especially in reference to linking intelligence and "*great light bulb moment[s]"* (Resp25CF3) to actual productive output through "*a lot of hard work... to realise it into something useful*" (Resp25CF3). As such, "*probably the main factor is dedication*." (Resp30CF3)

5.7.2. Theme 2: Open-Mindedness

The importance of being "*flexible and open minded*" (Resp1CF4) points to a significant emphasis on "*imagination*" (Resp8AF1) and "a *sense of being intrepid – in other words going into places that are not always necessarily safe or comfortable, that's really important. Being prepared to be challenged and corrected where you may not necessarily understand something. And I think being open to taking risks is also another important factor."* (Resp12AF3)

Reference to tolerance of risk was also made on several occasions. *"A very risk averse researcher is unlikely to accomplish anything meaningful."* (Resp16AF2).

Generally, open-mindedness refers to being "*accepting… being a person that's open to change."* (Resp19AF1) as well the "*willingness to entertain alternative ideas. And you have to hold the current ideas and play with them in the concepts of the new ideas to see if they can work*." (Resp24CF1)

5.7.3. Theme 3: Curiosity

The theme 'curiosity' was mentioned very frequently amongst respondents, as a key personality characteristic.

References to researchers who are "*driven by curiosity*" (Resp5AF4) and "*slightly off-the-wall thinkers*" (Resp18CF1) were cited as traits that would contribute to innovation in the research context. The terms "inquisitiveness" (Resp8AF1) and "*think[ing] outside the box*" (Resp29CF2) also related closely to curiosity in research.

"*I think curiosity is a big part. You know, I think it takes a certain type of personality to think outside the box in other words, someone who's not boxed in by the hegemonies… because if you are then you're in the wrong business.*" (Resp29CF2)

5.7.4. Theme 4: Extraversion

Extraversion, or the ability to act in a sociable manner was referred to as a

characteristic of high importance in research personality. Many respondents referred to the importance of collaboration and networking in research. Hence, the ability to act in an extroverted manner is imperative, despite the general consent that academics tend to be introverted by nature, as "*research cannot be done in isolation.*" (Resp6AF3)

"*Collaboration… You get certain people in science who are antagonistic towards each other and the challenge is finding people who can openly collaborate. Also you require a lot of empathy and teamwork and getting people to feel like they're part of a team.*" (Resp3AF1)

"*One achieves more if you collaborate with people.*" (Resp11AF1)

Teamwork as a personality characteristic was strongly emphasised, though its link to "*emotional intelligence*" (Resp7AF1) was also mentioned. In terms of emotional intelligence, "*diplomacy… tact*" and "*the ability to be interested and to be able to talk to people and convince them, is an extremely important aspect of science*" (Resp15AF3)

"*These days, especially in biomedical research nobody has all the skills, the toolset to drive innovation anymore. It relies heavily on collaboration and that collaboration, often if it is… interdisciplinary, that definitely stimulates innovation because people can feed off each other especially if you've got a good working relationship between your collaborators."* (Resp24CF1)

5.7.5. Theme 5: Humbleness

Reference to "humility" (Resp5AF4), being "grounded" (Resp9BF4) and having an "absence of hubris" (Resp13AF1) associated with 'humbleness', as a personality trait.

"*It's normally the academic who is generally of a humble nature. We do get some very flamboyant academics who want to have their name recognised internationally, want to be seen as leaders and actually take other people's work and put it forward as their own. These more aggressive academics. There are very many academics who are very humble who do ground-breaking work perhaps don't get the recognition internationally, than they might deserve on the world stage. So, he's a very humble person, he's a thinker and he looks to try and discover what is behind a problem that perhaps other people have not realised."* (Resp26CF3)

5.7.6. Theme 6: Confidence

In contrast to humbleness, some respondents referred to the importance of confidence as a personality trait. More specifically, "*the belief in you that you can do it… the right attitude*" (Resp6AF3) combined with "*a strong scepticism of authority… actually a disrespect for authority.*" (Resp13AF1).

Confidence was associated with "*courage… to do what you think you should be doing instead of what you're told to be doing.*" (Resp29CF2) and "*fearless[ness]… People*

who are quite sure of themselves and have, you know… Innate confidence, and that's to be distinguished from arrogance" (Resp12AF3)

This characteristic seemed to link closely to Theme 1 (Conscientiousness), in the requirement of "*being driven… you need to have sense that the work you're doing is important and you've got to be able to withstand rejection and to put the time in, these things don't happen overnight… determination*." (Resp10AF4)

Some respondents made reference to the innate difficulty of being courageous and confident in academic research, due to the academic being perceived as a "*nerd*" (Resp2AF3).

"*You need to be fairly confident to be able to question dominant paradigms, as it were. And that doesn't come easily, especially when you're starting out*." (Resp1CF4)

5.7.7. Theme 7: Enthusiasm

Most respondents agreed on the importance of enthusiasm, "energy" (Resp8AF1) and being "passionate about what you're researching" (Resp27AF1).

"One has also got to be interested in what they are doing. If you don't have interest then you're wasting your time, your persistence won't last very long." (Resp14AF1)

5.8. Question 6: Motivation

Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Question 5 was asked with the intention of uncovering the underlying motivational factors of innovative academic researchers. Responses fell within the following set of Themes. Respondents often made mention that each person is different; motivational factors depends on the person and the type of research. Still, all of these elements are closely linked together.

"*The perfect researcher would be a perfect match between the internal and external factors*." (Resp23CF1).

Table 96: Question 6: Motivation (Dominant Themes)

Number	Theme	Key Words	Respondents
1	Passion	Enthusiasm, passion, love, enjoyment	Resp10AF4 Resp12AF3 Resp4AF3 Resp26CF3 Resp1CF4 Resp5AF4 Resp8AF1 Resp15AF3

Number	Theme	Key Words	Respondents
2	Creating Value	Value, ownership, society, narcissism	Resp1CF4 Resp14AF1 Resp9BF4 Resp15AF3 Resp16AF2
3	Money	Money, salary, funding	Resp13AF1 Resp23CF1 Resp18CF1
4	Achieving Objectives	Progress, goals, objectives, challenges	Resp20AF1 Resp3AF1
5	Curiosity	Curiosity, inquisitiveness, truth, interest	Resp11AF1 Resp24CF1 Resp12AF3
6	Ego	Ego, glory, narcissism	Resp24CF1 Resp15AF3 Resp21AF1 Resp2AF3 Resp18CF1

5.8.1. Theme 1: Passion

A vast majority of respondents made reference to "*internal motivation*" (Resp1CF4), or "*an intrinsic desire to want to discover something*" (Resp10AF4). Evidence of passion, or enthusiasm for the profession of academic research was abundantly evident; "*you need to love what you're doing*" (Resp12AF3)

"*There's a famous saying by Confucius, I think… is that if you love what you do, you'll never work a day in your life*." (Resp4AF3)

Respondents emphasised a natural tendency or inclination to research as being a prime motivational factor, defining academia as a "*lifestyle*" (Resp12AF3), rather than a 'job. The drive of the research question and accompanying curiosity were cited as characteristics of passion for research. The following quotes corroborate these suggestions:

"*I don't have a job, I have a way of life*" (Resp26CF3)

"*Conceptualising research projects and then carrying them out is what I really enjoy the most. So what I enjoy about the fact that you see a project through from an idea that you had and then investigated and did a review and you actually see it take shape into something meaningful like a research project that answers a particular question. So to me that's very rewarding*" (Resp1CF4)

"*It's very much a huge privilege because you're doing this work that you love and it's very hard often to find that. Because most people just hate their jobs. I mean I work a huge amount of after hours work but it's a pleasure. You're paid to be curious, it's wonderful.*" (Resp5AF4)

"*I'm excited by research… I get a buzz out of it*" (Resp8AF1)

Other respondents described the excitement and generation of passion from "*that eureka moment… It's that excitement that really drives scientists"* (Resp15AF3)

5.8.2. Theme 2: Creating value

Several respondents made mention of "making contributions… [To know] that your research has value" (Resp1CF4). This theme was strong amongst respondents, indicating a passion for creativity and pride emanating from value creation, specifically the ability to "*take ownership of your project*" (Resp14AF1).

"*For me the motivational factors translate into something actionable. When I do get to write up what I've been researching, it does have its own sense of energy, to be able to create stories of the stuff that I'm trying to make sense of."* (Resp9BF4)

Respondents commonly remarked that the immediate external rewards associated with academia were "*not very many*" (Resp1CF4), and hence the importance of "*making a difference to society at large that drives a lot of science*." (Resp15AF3).

Respondents linked the importance of value creation to "*a certain kind of narcissism… you have to be motivated by the thought that people are still going to be paying attention to your contributions after you're gone. Because the returns to truly innovative research typically don't take the form of money or high status, except within your community; so you go to a modest grave but you go thinking that maybe you will have built something that maybe will last for a long time*" (Resp16AF2)

5.8.3. Theme 3: Money

References to money or funding were made frequently, as an external motivational factor, although these references were mostly related in a negative sense. Respondents claimed that there exists a component of academic researchers who "*want to make money in research, they normally come up with an idea and they push that idea and they sell it off and they've got much better marketing skills and much better people skills*" (Resp18CF1). For the most part however, respondents agreed that money/salary were not efficient nor sufficient motivational factors.

"*Truth. Not in it for money, just in it to find the truth*." (Resp13AF1)

"*There's only a certain point up to which you can pay a person and then they'll tell you I'm not interested, I won't do it. And you can put money on the table and they won't do it because it's just not about the money. Most professors will tell you they're not here for the money because otherwise they'd be out in private practice."* (Resp23CF1)

5.8.4. Theme 4: Achieving Objectives:

Respondents described the achievement of objectives as a strong motivational force.

Resp20AF1 makes an interesting analogy, comparing the academic endeavour to a "computer game":

"Like a computer game, where what motivates you to try harder is failing but not failing so badly that you realise that you have no chance of progressing. You can identify another possible avenue that you can take, again and again. And you make slow progress. It's like 'levelling up'. You've accumulated progress, some bit of knowledge, or whatever it is… So what I'm getting at is that those are the things that motivate you, the day-to-day challenges, not the grand overarching challenges." (Resp20AF1)

The motivational factor linked to objective achievement the fulfilment of a predetermined goal.

"You must perceive a particular mission that you want to achieve… You must have a goal that you're working towards. And the challenge of course is to get the opportunities so you can't guarantee will come. What you need to do is position yourself so that when the opportunity is open you can jump in and take advantage of it." (Resp3AF1)

5.8.5. Theme 5: Curiosity

"*Now my wife gets very cross with me because she says I always question everything, but I think that's what a scientist does*" (Resp11AF1)

Curiosity emerged as a prevalent theme amongst respondents, closely related to Theme 1 (Passion). Respondents described the importance of "*an enquiring mind*" (Resp11AF1). Repeated mentions of key words such as 'curiosity' 'inquisitiveness' and 'interest' were recorded frequently. Respondents also made mention of addressing "*gaps in knowledge*" (Resp24CF1) and the desire to uncover "*the extraordinariness of the world*" (Resp11AF1).

"*It's an inquisitiveness. And it's not in a critical way but it's to try and understand your observations. And I guess that what motivates us all the time is that when we have a good scientific question – a why – we go out into the field, you find the specimens that can solve that problem and you answer the question, which usually will bring up another 10 questions that need answering as well. And so I think that's what drives innovative research and discovery*. (Resp11AF1)

"Top researchers are consumed by what they do; you have to be constantly burning in your head to want to answer a key question" (Resp12AF3)

"*Unless you're internally motivated, you won't do research. And internal motivation is just a curiosity. The sort of bottom line is trying to figure out why we're here, how we got here; the existential questions are what drive us."* (Resp11AF1)

5.8.6. Theme 6: Ego

A large number of respondents admitted the strong motivational force of being "*driven by the desire for glory*" (Resp24CF1). Once more, the term 'narcissism'

was used to describe this motivational force. Mention of the term 'ego' was most used most frequently.

"*Pure ego. If you show something that no one has ever shown, and everyone says gee that looks good, that sort of feeding of the ego is enormously important for many scientists that I know*." (Resp15AF3)

"*Well you know I think academics to a certain degree have got very big egos, they like to see their names on publications*." (Resp21AF1)

The aforementioned "*nerd*" (Resp2AF3) description of the stereotypical academic researcher was mentioned again:

"*A lot of it is ego. I will admit that egos actually quite important, you know there's a small little nerd who's been beaten up most of his life gets an opportunity to show the world that he's actually a hell of a lot smarter than everybody thought*. (Resp18CF1)

5.9 Conclusion to the Qualitative Results

Results of the qualitative research are used in this study to provide a test of validity of the theoretical model derived from the literature and to support and verify the findings of the quantitative study. All questions, for all 30 respondents, included in the interview schedule were transcribed and analysed. For question 1, relating to innovative research, 8 dominant themes emerged. For question 2, relating to alternative methods of research funding, 5 dominant themes emerged, most notably the theme of using the Internet, or crowdfunding to obtain funding for research projects. For Question 3, relating to solving a potential global catastrophe, 6 dominant themes emerged, most notably crowdsourcing, or using the Internet to obtain knowledge and information inputs that may be useful in solving said global catastrophe. Questions 4 and 4.1 related to the state of academia and journal publications, respectively. Responses varied widely along a continuum from low to high SGI propensities. Question 5, relating to personality revealed 7 dominant themes while Question 6, relating to motivation revealed 6 dominant themes. Each of the dominant themes is discussed in relation to the theoretical model derived from the literature, in the following chapter. The results of the quantitative study are also compared to the results of the qualitative study in the next chapter. Having discussed both the quantitative and qualitative results of this study, the results chapter of this research is now concluded. The discussion chapter follows.

CHAPTER 6

DISCUSSION

6.1. Discussion of Quantitative Results

The findings of the quantitative analyses are now compared with the theoretical model. Each of the hypotheses and sub-hypotheses derived from the literature is discussed in relation to the findings of the quantitative study.

6.1.1. Discussion of Univariate Statistics

The univariate analysis provided interesting insight on the descriptive statistics of the sample. While a total of 674 questionnaires were collected in total, only 529 questionnaires were deemed satisfactorily completed for the purposes of data analysis. Missing data within those 529 completed questionnaires was minimal and was replaced with mean values, as seen necessary.

The mean respondent's age is 44.12, with 13.71 years of work experience, as an academic researcher. The sample comprised almost equally of males and females, with slightly more females (50.7%) than males (49.1%). This provides for a very stable prediction of results based on gender, which is covered in the section on moderation, later in this chapter.

The majority of respondents were native English speakers, accounting for 44.8% of the sample, with the remainder made up of native Afrikaans speakers at 28%, Xhosa at 2.1%, Zulu at 1.7% and other official South African languages (which include Ndebele, Northern Sotho, Sotho, Swazi, Tsonga and Venda) accounting for 11.2% of the total sample. Approximately 10% of the sample was made up of foreign language speakers, or respondents that did not speak any of the eleven official South African languages as their native language.

In terms of nationality, the majority of the sample was South African at 73.2% of the sample. Respondents hailing from other African countries accounted for 13.4% of the sample, while Europeans (9.1%) and respondents from other parts of the world (outside of Africa and Europe) accounted for 4.1% of the sample.

The majority of respondents – 42.5% of the sample – had attained PhDs, a further 30.6% were professors and only 10.4% were associate/adjunct professors. Those with a master's degree (or lower) accounted for 26.5% of the sample. Education levels were further tested by descriptive statistics pertaining to level of education categorised into four levels, from Primary School education (1-7 years), high school education (8-12 years), undergraduate/honours-level education (13-16 years) and Masters/PhD-level education (17-20 years). Most of the sample has obtained a Masters or PhD degree at 94.7%. Only 3.2% of the sample were undergraduate/honours graduates and the small remainder had at least a high school education. These respondents represent an error in the sampling protocol, and were excluded from further analysis.

According to Becker (1962), parental levels of education can be considered a form of human capital investment (HCI), as an intangible individual-level investment that should produce a return on investment, over time. As such, data on both mother's and father's educating levels was collected and analysed, with the majority of respondent's fathers having at least a high school education at 36.7% or an

undergraduate/honours degree at 30.6%. Of the total sample, 19.5% of the sample's fathers were educated at a Masters/PhD level. Only 5.7% of the sample's mothers have obtained a Masters/PhD degree, a much smaller percentage in contrast to Father's education. The majority of the samples' mothers have received a high school education at 43.1% while 35.2% have received at least an undergraduate/honours degree.

In measuring the impact of familial life as a potential spillover effect on research productivity, the majority of respondents – 65.6% were married; the other 34.4% were not married. Additionally, most respondents in the sample – 56.5% supported at least one child in their family (with a maximum of six children supported), while the remainder – 43.5%, did not support any children. These questions were asked with the intention of uncovering the potential spillover effect of family life and research productivity.

The sample was widespread across South African universities. The University of Witwatersrand accounted for 23.3% of the sample. The University of Cape Town accounted for 20.5% of the sample. In total, 26.4% of the respondents did not indicate their university affiliation. The remainder of the sample were affiliated with The University of Pretoria, The Nelson Mandela Metropolitan University and The University of Kwa-Zulu Natal.

Respondents were also grouped by faculty, or 'field of study', which was measured categorically as one of four 'fields' including Field 1: Medicine and Biology at 35.1%, Field, 2: Business, Commerce and Law at 17.2%, Field 3: Mathematics and Science at 20.2% and Field 4: Humanities at 27.5%.

In measuring total ARP (academic research productivity scores), an aggregate total of both internationally published (ISI/IBSS) journal articles and locally published (DOHET) journal articles was used. The mean ARP score was calculated at 22.44, with the average international (ISI/IBSS) journal article publications amounting to 8.13 and a locally (DOHET) journal article publication mean total of 14.31.

The results of the bivariate and multivariate analyses, in reference to the research hypotheses are now provided.

6.1.2. Hypothesis A1: SGI propensity is significantly associated with Academic Research Productivity (ARP)

The underlying research question of this study asks *what is the relationship between SGI Propensity and ARP?* The objective of this study is to examine South African academic researchers' propensity to engage with and their levels of interest in SGI, in relation to their academic research output, in order to assess the potential applicability of SGI in the academic research context. In the context of innovation and knowledge management, Second Generation Innovation, as defined by Callaghan (2014a, 2014b, 2014c, 2015) is a probabilistic paradigm of innovation, knowledge, innovation and R&D management and value creation, made possible through distributed knowledge systems, such as crowdsourcing. SGI theory rests on the notion of the 'stickiness' of knowledge (von Hippel, 1976).

Journal article publications were used as a measure of ARP because journal article publications represent a true reflection of productivity, in the context of academia. The notion of the inherent non-innovativeness of academia is well chronicled (Kuhn, 1970; Lindquist, 1975; Camparino, 2009; Welsh, 2013). According to these perspectives, academia may be innovation-constrained and innovation-resistant because of over-reliance on paradigms, which are inherently resistant to change. The peer-review process of journal article publication has been described as both overly stringent and inflexible (Welsh, 2013), and a mirror image of the non-innovative state of academia itself. For this reason, the measurement of ARP, using journal article publications is justified.

It is hypothesised that an academic researcher with a high SGI propensity would, in turn, have a low FGI propensity. This means that such an academic would be averse to the constraints of 'First Generation' academia or, academia that is non-innovative and constrained by paradigms. Such an academic would also be more prone to engage in innovative, paradigm-breaking methods of knowledge creation or innovation, such as crowdsourcing, or open source production. The relationship between this proposed SGI propensity and ARP, as a measure of journal article publications forms the basis of this study. If academia is truly non-innovative, then academics with a high SGI propensity would be expected to have a lower level of ARP and those with low levels of SGI propensity would be expected to have a higher level of ARP. In other words, these two variables are expected to have an inverse relationship.

However, the opposite may also be true. It may also be possible that academics with high levels of research output (ARP) have high levels of ARP *because* they have high levels of SGI propensity, meaning that the inclination to be innovative and adaptive to paradigmatic change would result in higher research productivity. In other words, these two variables may also have a direct relationship. If this is true, then researchers that produce more research output are also more innovative and would have higher SGI propensities.

The bivariate test between SGI Propensity and ARP produced a negative correlation, with a Spearman's Rho of -.16, $p < 0.05$, confirming the alternative hypothesis. As SGI Propensity increases, research productivity decreases and vice versa. Academics that have published more journal articles generally have lower SGI propensities, across different fields.

The results of the hierarchical multiple regression however, produced mixed results. When controlling for gender, university affiliation, field of study, language, nationality and title, SGI propensity and ARP were found to have a direct relationship. SGI propensity makes a significant contribution to the variance in the outcome, ARP, although the percentage of variance was small, R^2 Change = .014, $p < 0.05$. This means that, prior to outlier removal, the direct relationship between SGI propensity and ARP held true. Academics that were more inclined to believe that FG (first generation) academia is flawed (or, those who had higher SGI propensities) and tended towards innovative research processes such as crowdsourcing had higher levels of research output.

It must also be noted that gender (.103, $p<.05$), language (.142, $p<.05$), title (.697, $p<.05$) and field of study (211, $p<.05$) as covariate factors also made significant

contributions to the model; more so than the independent variable SGI propensity, as theory predicts (Becker, 1962; Callaghan, 2014a).

Most notably, field of study made the greatest contribution to the variance in the outcome ARP (.697, p<.05). The tables of correlation (included in the appendix) show that respondents belonging to Field 1 (defined as areas of research most closely related to medical and biological research) correlate significantly with ARP.

Upon removal of outliers however, the results differ. With outliers removed from the sample, R^2 Change for SGI propensity = .006, p >0.05, meaning that SGI propensity is not significantly associated with ARP. It also interesting to note that 'South African', as a covariate (used as indication of nationality), correlated negatively with ARP. This result may be attributable to Lotka's Law (Egghe, 2005), which predicts that the number of authors making x contributions in a given period is a fraction of the number making a single contribution, and as a result, research productivity may be skewed. Inspection of the collected data shows that the respondents identified as outliers are more productive, which supports the assumption underlying Lotka's Law (Egghe, 2005). It is acknowledged that the removal of outliers may provide an unrealistic representation of the sample, but per Lotka's Law, it may be possible that only a few academic researchers produce the majority of research output.

The removal of outliers gives a clearer indication as to the true relationship between these two variables, and essentially confirms the results of the bivariate correlation between SGI propensity and ARP. Excluding respondents that do not conform to the normality of the sample. Academic researchers that produce higher levels of research output, in the form of journal article publication do not have higher levels of SGI propensity. Essentially, these academics prefer to conform to academic standards and norms and are less inclined to believe in the failure of academic innovation, or to engage in SGI research processes such as crowdsourcing, which was measured by the SGI propensity scale.

With outliers removed, language (.131, p<.05), title (.704, p<.05), field (.174, p<.05) and university affiliation (.127, p<.05), all contributed significantly to the outcome ARP. As in the case of the previous test, 'South African', as an indication of nationality and Field 1 both produced similar correlations.

In conclusion, when controlling for gender, university affiliation, field of study, language, nationality and title the null hypothesis is rejected at the 5% level of significance. When SGI propensity increases, ARP decreases, and vice versa. These two variables have an inverse relationship. This finding may support the assertions of Kuhn (1970) and Callaghan (2014a) and the existence of paradigmatic stagnancy. Academia may indeed be constrained by paradigms, and the system of journal publication, which is one of the foremost measures of academic success, productivity and knowledge creation (Welsh, 2013) is itself constrained and resistant to innovation. If this is true, these findings do not bode well for the future of academic research and the potential cataclysmic potential of catastrophic events and societal problems, which require real-time and innovative solutions. It is stressed once more that these findings are not causal and can only suggest and test theory and arguments.

It is difficult to relate these findings to the absorptive capacity (Cohen & Levinthal, 1990) of academic researchers. As previously discussed, academics – in the business of knowledge creation, should in essence have high levels of absorptive capacity, or knowledge creation as a function of prior-related knowledge. This research does not answer the question as to academic researchers' levels of absorptive capacity. Indeed, some academics may have high absorptive capacity but are constrained by the closed system of academia and thus, are not able to extricate the full benefits of their individual-level absorptive capacity. This presents an interesting area for further study.

6.2.2. Hypothesis A1b: HCI are significantly associated with SGI Propensity

Becker (1962) introduces the notion of human capital investments (HCI) as intangible individual-level investments, such as education, training and experience. Using experience, in the form of 'number of years of academic research experience as an indication of HCI provides clarity to the amount of exposure an academic researcher has had to the system of academia. Once again, the issue of the inherently non-innovative system of academia, as described by Kuhn (1970), becomes important in this regard and links directly to ARP as a measure of productivity. The relationship between HCI and ARP is discussed in Hypothesis A3.

In this case however, the relationship between HCI and SGI propensity is investigated. The objective of testing this hypothesis is to discover the prolonged effects of exposure to an inherently non-innovative academic system, in terms of SGI propensity. If the state of academia is taken to be non-innovative and constrained by paradigms as a result of 'academic failure (Camparino, 2009), then academic researchers that have become vested in said academic system by investing time (experience, or HCI), may have themselves, become non-innovative, or alternatively have bowed to the pressures of the system to be non-innovative. In other words, if these assumptions are made, the relationship between HCI and SGI Propensity is also expected to be inverse. That is, as academic researchers invest more time into academia, their propensity to engage in innovative and potentially paradigm-breaking processes, such as those associated with SGI may decrease. On the other hand, academic researchers that are new to academia and have not yet become accustomed to the standard culture of non-innovativeness are expected to be more innovative, or to have higher SGI propensities.

As per the theory put forth by Becker (1962), the opposite could also be true, in the case of a direct relationship between HCI and SGI propensity. It may be possible that with prolonged experience, academics could become more innovative. Becker (1962) lists knowledge as one of the intangible assets, which provides for a return on investment. Termed 'productive knowledge (de la Fuente, 2011), this individual-level accumulation of experience should theoretically provide impetus for innovativeness, a catalyst for increased SGI propensity. As an academic becomes more acquainted with the system of academia – whether it be innovative or not – aggregated productive knowledge should provide the foundation for innovative research output, as is the fundamental objective of academia.

Thus, it is to be expected that greater levels of experience ultimately results in increased innovativeness, as a function of improved understanding and higher

knowledge inputs. At the same time however, it is possible that the proposed non-innovativeness of academia may become transposed onto the academic researcher as time progresses. Essentially, this hypothesis aims to test the effect of HCI, in the form of years of experience on SGI propensity.

The bivariate test between HCI and SGI propensity determines that these two variables are negatively correlated, with a Spearman's Rho of -.168, $p < 0.05$. As academic researchers gain experience, their belief in the failure of academia and propensity to engage in new and innovative research techniques decreases, confirming the proposed inverse relationship between HCI and SGI propensity.

In testing this relationship using hierarchical multiple regression, while controlling for gender, university affiliation, field of study, language, nationality and title the results of the test for correlation was confirmed. HCI significantly accounted for 1.4% of the variance of SGI Propensity, confirming the association between HCI and SGI Propensity, albeit to a relatively small extent, R^2 Change = .014, $p < .05$). As such, prior to outlier removal, the inverse relationship between HCI and SGI Propensity held true. Academics with more experience tended towards lower SGI propensities. It is stressed once more that sample outliers were primarily highly productive researchers, further supporting the assertions of Lotka's Law (Egghe, 2005).

From the covariate factors included in the model, only language (-.011, $p < .05$) proved to be a significant contribution to variance in the outcome SGI propensity. The correlation between English (used as an indication of language) and SGI Propensity produced a correlation coefficient of .112, $p < .05$.

The results remained constant with the removal of outliers, further confirming the inverse relationship between HCI and SGI Propensity. Once again, language proved to be the only covariate factor with significant variance contribution.

In conclusion, the null hypothesis is rejected the .05 level of significance. These findings support the assertions of Becker (1962), in the sense that experience may constitute an individual level intangible investment that over time produces a return on investment. However, in the sense of academia, this return on investment may not be one that is constructive. Instead, in the case of the sample at hand, as academic researchers become more experienced and gain more knowledge over time, SGI propensity, or the proclivity to engage in SGI research techniques and the belief in academic failure decreases. A possible interpretation of these results may indicate that prolonged exposure to the proposed non-innovative academic system may result in the transference of non-innovativeness. The longer an academic spends within a constrained system, the more accustomed and accepting said academic becomes to change resistance and reliance on closed paradigms. Such academics are also most likely less inclined to engage in SGI research techniques and as a result, have lower SGI propensities. On the other hand, academics with less experience, who may have not yet succumbed to the conventions of the closed system have higher SGI propensities and may be more innovative, if the link between SGI and innovativeness is true (Callaghan, 2014a).

It remains to be seen whether this inverse relationship is a direct result of HCI (or, more experience) or whether it can be attributed to generational cultural differences

(Kuhn, 1970). It is argued that respondents with more experience belong to an older generation, with different instilled cultural values than those that are younger, with less experience (Thompson & McHugh, 2009). The potentially detrimental effects of collectivism cannot be ruled out as a detractor to innovation and SGI Propensity. This introduces another area of potential further study.

6.2.3. Hypothesis A1c: Personality is significantly associated with SGI Propensity

In considering personality from the perspective of Costa and McCrae (1989, 1990, 1992) in their seminal work on the 'big five' personality traits, it becomes clear that personality is an important consideration in the measurement of SGI propensity. To be 'innovative', is a function of numerous different individual-level characteristics that are difficult to pinpoint precisely. Langston and Sykes (1997) cite personality as a variable that is proximal to the individual, and thus justified for use in the measurement of SGI propensity.

For Costa and McCrae (1989), personality as a construct, can be sub-divided into 'the big five', or five broad components of personality, each of which measures a certain personality trait, or characteristics. These five constructs of personality include agreeableness, conscientiousness, neuroticism, openness to experience and extraversion. Each of these constructs can be further deconstructed into sub-scales, or specific personality traits that combined, make up one of the big five. For example, extraversion as a construct can be measured by questions relating to warmth, gregariousness and assertiveness, amongst others.

The linkage between personality and SGI propensity becomes especially evident in consideration of the 'openness to experience' construct of the big five, also commonly referred to simply as 'openness'. An individual with a high SGI propensity is one that is essentially open, resistant to collective group-mentality and culture with a high proclivity for experiencing the new and novel. In the context of academia, such an individual refutes the institutional ideals based on closed paradigms and is instead open to new ways of doing things (Costa & McCrae, 1990).

The SGI propensity scale, which was derived from the seminal literature on SGI (Callaghan, 2014a) and open innovation (Chesbrough, 2003a), amongst others uses 'open orientation' as one of its four measures of SGI propensity, along with crowdsourcing propensity, crowdfunding propensity and SGI propensity itself. Here, the linkage between SGI propensity and personality becomes clear. It is hypothesised that an individual that is open to new experience, as a measure of personality should be one with a high SGI propensity, as the two concepts are invariably interrelated in this sense.

The results of the hierarchical multiple regression, while controlling for gender, university affiliation, field of study, language, nationality and title found no significant association between the constructs of personality and SGI propensity. Language (English) and title (Professor) however, proved to contribute significantly to the variance in the outcome SGI propensity, both correlating negatively with the dependant variable – language (-.096, $p<.05$) and title (-.149, $p<.05$).

The removal of outliers corroborated the findings of the previous tests, no significant association between personality and SGI propensity was found, while language and title continue to negatively correlate with SGI propensity.

The test for correlation between each of the five personality constructs with SGI propensity provided interesting results. Of the five personality constructs, only openness to experience (or, openness) correlated significantly and positively with SGI propensity (Rho= .128, $p<.05$), while all four other constructs (conscientiousness, extraversion, agreeableness and neuroticism) did not correlate significantly. It can be concluded that while the constructs of personality that comprise the big five, as defined by Costa and McCrae (1989), do not significantly associate with SGI propensity, openness, as a measure of personality does associate significantly with SGI propensity. This suggests that openness, as a measurement of personality is tantamount to a justifiable component in the measurement of SGI propensity. Academic researchers that are open to experience, or who are "artistic, curious, imaginative, insightful, original [and have] wide interests" (Costa &McCrae, 1990: 178) are more likely to have a high SGI propensity.

It is noted here that the reduction of the NEO-FFI scale to 20-items for the purposes of this study may have hindered precise measurement of personality, as the scale derived by Costa and McCrae (1989), consisting of 240 items, and later of 60 items (Costa & McCrae, 2004) was deemed to long for the purposes of this research. This presents an interesting opportunity for further research, using the full NEO-FFI scale, as defined by Costa and McCrae (1989; 2004) in relation to studies on SGI.

6.2.4. Hypothesis A1d: Motivation is significantly associated with SGI Propensity

In examining work motivation as a measurement, it is useful to consider self-determination theory (Ryan & Deci, 2000), which sub-divides motivation into a number of constructs along a continuum, ranging from amotivation to extrinsic motivation to pure intrinsic (or, internal) motivation. Extrinsic motivation can be further subdivided into different levels of regulation, or the extent to which one internalises their profession, including external regulation, Introjected regulation, identified regulation and integrated regulation. As one proceeds along the continuum, motivation becomes more internalised until pure intrinsic motivation is reached. Moving in the opposite direction along the continuum shows less internalisation; motivation that is influenced by external influences.

The WEIMS (Work Extrinsic-Intrinsic Motivation Scale) (Tremblay, et al., 2009) was deemed appropriate for use in the measurement of work motivation amongst academic researchers as it aptly measures all six of the components along the self-determination continuum. The WEIMS scale is specifically designed to measure work motivation, defined as "a set of energetic forces that originates both within as well as beyond an individual's being, to initiate work-related behaviour, and to determine its form, direction, intensity and duration" (Pinder, 1998: 11). In asking respondents 'why do you do your job?' it was hoped to uncover the underlying motivational factors that drive academic researchers to perform and to innovate, which is one of the fundamental objectives in producing academic output.

In examining SGI propensity, the extent to which academic researchers are motivated to work, plays a role in determining the combined effects of HCI (Experience), openness and productivity, in relation to SGI propensity. Intrinsic motivation can be considered an individual-level intangible investment that is contiguous to the individual; in other words, a more reliable indication of SGI propensity than personality, which is only proximal to the individual (Langston & Sykes, 1997). An intrinsically motivated academic researcher is one who has internalised his or her profession and thus can be considered a powerful driving force of human capital investment.

In this sense, it is hypothesised that the intrinsically motivated academic researcher should have a higher SGI propensity, since such an academic researcher would be internally motivated to produce innovative output and be willing to experiment with novel research techniques in order to improve innovative output. It is expected therefore, that motivation and SGI propensity should have a direct relationship.

While controlling for gender, university affiliation, field of study, language, nationality and title, the constructs of motivation were found to contribute 1.3% of the variance in the dependant variable SGI propensity and once again correlated positively and significantly with SGI propensity, confirming the results of the initial test for correlation. Only title, as a covariate factor was found to contribute significantly to variance in the outcome, SGI propensity, with a negative correlation.

The removal of outliers produced similar results; motivation accounting for a significantly increased 6.1% of total variance in the outcome SGI propensity, while title (Professor) and language (English) significantly contributed to variance and both correlated negatively with SGI propensity.

It can be concluded then that the null hypothesis is rejected; motivation is a significant predictor and is significantly associated with SGI propensity. It can also be concluded that the direct relationship between motivation and SGI propensity, as hypothesises proved to be true.

The test for correlations between each construct along the Self-Determination continuum with SGI propensity showed that internal motivation (.165, $p<.05$) correlated most highly with SGI propensity. This means that intrinsically motivated academic researchers are perhaps more likely to experiment with new and untested research techniques and are more likely to maintain similar views as to ‘academic failure’. It must be noted however, that the components of extrinsic motivation as well as amotivation, as a separate individual construct also correlated positively with SGI propensity, although not to the same extent as intrinsic motivation.

While these results speak to the relationship between SGI propensity and motivation, showing that the two variables relate directly, they do not indicate the actual productivity of the academic researchers in question. The question of the relationship of motivation in relation to the overall theoretical model is examined once more in discussion of Hypothesis A2 and its sub-hypotheses, which is discussed next.

6.2.5. Hypothesis 5A: Motivation mediates the relationship between SGI Propensity and ARP.

In order to further delineate the extent to which motivation impacts the theoretical model, it is important to consider the potential mediating effect of motivation on the relationship between SGI propensity and ARP.

While the constructs of motivation along the self-determination continuum are associated with SGI propensity, as discussed above, the holistic nature of the effect of motivation on the theoretical model has yet to be determined. Since ARP is used to determine the extent of SGI propensity and motivation is used to determine the extent to which academic researchers internalise their work, the relationship between the three variables – SGI propensity, ARP and motivation must be examined carefully.

The test for association between SGI propensity and ARP produced a result that indicated that these two variables are inversely related; as ARP increases, SGI propensity decreases and vice versa. This relationship can be explained from the point of Kuhn (1970), in that closed models of innovation and the stagnation of paradigmatic academic research has precipitated inertia in the academic research innovation pipeline, essentially supports the theory of 'academic failure' (Camparino, 2009). Additionally, the test between HCI and SGI propensity further supports this assumption. As academics gain more experience, they might become accustomed to the non-innovativeness of the academic system of knowledge production and over time, begin to conform to standards of stagnation and non-innovativeness. Combined, the results of these two tests show that academic research may indeed be non-innovative and constrained by paradigms. However these tests do not consider the individual-level variations in academic researchers that impact this inverse relationship.

While the test between personality and SGI propensity shows that openness, as an aspect of personality contributes significantly to higher SGI propensities, the test between motivation and SGI propensity might shows the true extent of individual-level variance, since motivation can be considered contiguous to the individual and this warrants further examination.

In order to do so, each of the six constructs of motivation along the self-determination continuum is tested as a potential mediator on the relationship between SGI propensity and ARP. Mediation, if found to be present, would imply that motivation is associated significantly with SGI propensity and additionally, is itself significantly associated with ARP. That is, instead of SGI Propensity directly associating with ARP, SGI propensity associates with motivation, and motivation, in turn associates with ARP. This would indicate a mediated relationship, rather than a direct relationship. Using the method prescribed by Baron and Kenny's (1986), the following hypotheses were tested.

6.2.5.1. Hypothesis A2a: Amotivation mediates the relationship between SGI Propesnity and ARP

Amotivation exists at the low-end of the self-determination continuum, and represents individuals that either "lack the intention to act or act passively" (Tremblay, et al., 2009: 214).

The results of the test of mediation showed that Amotivation does mediate the relationship between SGI propensity and ARP. The test confirmed the inverse relationship between SGI propensity and ARP, with a coefficient of .253, but with the inclusion of the mediator, amotivation, this coefficient was found to increase slightly to -.236, making the indirect effect of SGI propensity on ARP, *while controlling for amotivation* to be -.017.

This means that amotivation does mediate the relationship between SGI propensity and ARP, but to a very small extent. Academic researchers who are not motivated to work, or who experience feelings of being overwhelmed and helplessness with regard to academic research, have a slightly stronger indirect relationship between SGI propensity and ARP, meaning that the more work they produce (in the form of journal article publications), the less proclivity for SGI they have. Again, it is noted that the change in relationship propagated by the mediator is very small. The effect size, as measured by Kappa-Squared ($K^2 =$ .014), is also small. These results can perhaps be attributed to the fact that amotivation in academic researchers may link to despondency, in a sense 'giving up' and bowing to the pressures of the academic system to conform to standards. The effect may be small, but it remains significant and so the null hypothesis is rejected.

6.2.5.2. Hypothesis A2b: External Regulation mediates the relationship between SGI Propesnity and ARP

Moving along the Self-Determination continuum, the middle stage between amotivation and pure intrinsic motivation is entitled 'extrinsic motivation', a construct which is sub-divided into four separate sub-componenets of external motivation, or motivation which is influenced by external factors to varying degrees of internalisation. The first of these four subcomponenets is external regulation, which is defined as "doing an activity only to obtain a reward" Tremblay, et al., 2009: 214). This component represents pure external motivation; such as performing strictly in the objective of obtaining a salary.

Once again, the test of mediation supports the inverse relationship between SGI propensity and ARP (-.253) but also showed that with the mediator (external regulation) present that the correlation coefficient increased very slightly to -.253. It was shown that SGI propensity does not predict external regulation but that SGI propensity does predict ARP, while controlling for external regulation. This can be seen as an example of partial mediation. The effect size ($K^2 =$ .004) is small but still significant, meaning that the null hypothesis is rejected.

Externally regulated academic researchers are slightly more likely to have lower SGI propensities as their academic research output increases. Similar to amotivation, this result may also be explained by despondency and lack of interest in academic research. One who is externally regulated (motivated by money or other external motivators) is perhaps less likely to wish to innovate or change existent paradigms.

6.2.5.3. Hypothesis A2c: Introjected Regulation mediates the relationship between SGI Propesnity and ARP

Introjected Regulation is defined as the regulation of behaviour through self-worth contingencies, such as self-esteem or guilt (Tremblay, et al., 2009). This can be seen as motivation that is 'somewhat external' and therefore better interpreted as slightly more internal than external regulation. An example would be performing academic research strictly for recognition amongst peers.

In the relationship between SGI propensity and ARP, introjected regulation was shown to have similar effects to amotivation and external regulation; causing a slight increase in the coefficient (-.242) between dependent and independent variables in the model, with an effect size, $K^2 = .009$. The null hypothesis is rejected.

6.2.5.4. Hypothesis A2d: Identified Regulation mediates the relationship between SGI Propesnity and ARP

Identified Regulation refers to an individual that partakes in an activity that has value or meaning to the individual (Tremblay, et al., 2009), such as attainment of career goals and is thus considered 'somewhat internal'.

Identified regulation was found to significantly mediate the relationship between SGI propensity and ARP with the strongest effect size of the components of motivation ($K^2 = .016$). This is still a small effect but is significant because it is through identified regulation that the relationship between SGI propensity and ARP changes most. Academic researchers that experience identified regulation are more likely than any other respondents to have lower SGI propensities in relation to higher research output. It would seem identified regulation represents an optimal point of mediation between the dependant and independent variables, perhaps attributable to the fact that identified regulation lies directly in the centre of the self-determination continuum, mid-way between amotivation and pure intrinsic motivation.

This is a significant and important finding because it shows the mean significance of motivation does indeed mediate the relationship between SGI propensity and ARP. If identified regulation is taken to represent the 'average' academic researcher in the sample (because of its position in the continuum), then it follows that the average academic researcher is slightly less likely to have a high SGI propensity, as academic research productivity increases. The null hypothesis is rejected.

6.2.5.5. Hypothesis A2e: Integrated Regulation mediates the relationship between SGI Propesnity and ARP

The final component of extrinsic motivation is integrated regulation which Tremblay, et al. (2009: 214) define as "identifying with the value of an activity to the point that it becomes part of the individual's sense of self and is considered 'internal'. This is the form of extrinsic motivation that is most fully internalised and hence, is said to be autonomous."

Integrated regulation was found to mediate the relationship between SGI propensity and ARP, once again with a small effect size ($K^2 = .007$). However, in moving along the continuum, closer towards pure intrinsic motivation, the effect of the mediator on

the relationship between the dependent and independent variable *decreased* very slightly, from -.253 to -.261, with the indirect effect of SGI propensity on ARP =. 009. This means that for academic researchers who are motivated by integrated regulation, the inverse association between SGI propensity and ARP decreases; as the academic researcher's research output increases, his or her SGI propensity will still decrease, but to a lesser extent than other academic researchers. The null hypothesis is rejected.

6.2.5.6. Hypothesis A2f: Intrinsic Motivation mediates the relationship between SGI Propesnity and ARP

The final component on the Self-Determination continuum is intrinsic motivation, which refers to pure intrinsic motivation, or an individual whose behaviour is self-motivated and self-determined, rather than extrinsically motivated. Respondents that fall under this category may partake in academic research to satisfy personal curiosity or purely because of passion for academia and the deriving of pleasure and satisfaction through working as an academic researcher.

The null hypothesis was rejected, with a small effect size (K^2 = .013), but the introduction of the mediator intrinsic motivation also caused a slight decrease in the relationship between SGI propensity and ARP, from -.253 to -.267, with the indirect effect of SGI propensity on ARP being .015. Like integrated regulation, intrinsically motivated academic researchers experience less severity in the inverse association between SGI propensity and ARP.

Thus, it can be concluded that intrinsically motivated academic researchers do still experience the inverse relationship between SGI propensity and ARP but to a lesser extent than other academic researchers, who are not intrinsically motivated. On the other hand, academic researchers who are extrinsically motivated, or not motivated at all to perform their jobs (amotivation) are more likely to experience a strong inverse relationship between SGI propensity and ARP, perhaps due to despondency and uncaringness. This means that individuals who are intrinsically motivated might be slightly less likely to be at the mercy of the phenomenon of 'academic failure' (Camparino, 2009). Once an academic researcher has internalised their profession, is curious, passionate and experiences great satisfaction or deriving of pleasure from their profession, then SGI propensity and ARP are slightly less inverse. This represents an important finding in the context of this study.

6.2.6. Hypothesis A3: HCI is significantly associated with ARP

Becker (1962) ascribes investments in human capital (such as experience) as the primary driver of performance, in this case ARP. If HCI is represented by years of experience as an academic researcher, then it is hypothesised that ARP, as a measure of research output (in the form of number of journal article publications) would increase, parallel to increases in HCI. In other words, these two variables are expected to have a direct relationship. However, what HCI also measures is the amount of exposure an academic researcher has had to a proposed system of non-innovativeness and suppression that can be attributed to reliance on closed paradigms (Callaghan, 2014a) and the advent of the 'academic failure' phenomenon (Camparino, 2009), over time. If this is true, then while ARP is expected to increase over time, the level of innovativeness is expected to decrease. This is discussed in Hypothesis A1b,

which revealed that SGI propensity (or, innovativeness) does decrease as HCI increases. Essentially, over time, exposure to non-innovativeness resulted in lower SGI propensities and academic researchers that become increasingly closed in their research methodologies and technique usage.

As a result, while ARP may increase over time, this output may actually be less innovative, as the constraints of academia gradually take hold over the same period of time.

The test for correlation between HCI and ARP indicate that these two variables correlate positively and highly, Rho = .649, $p<.05$. While controlling for gender, university affiliation, field of study, language, nationality and title in a test of hierarchical multiple regression, the result of the bivariate correlation was confirmed, with HCI as an independent variable accounting for 9.4% (R^2 Change = .094, $p <.05$) of the variance in the outcome, ARP. With outliers removed, HCI remained a significant predictor ARP (R^2 Change = .115, $p <.05$). Language, title, field of study and university affiliation also all contributed significantly to variance in ARP, correlating positively with the dependent variable as well.

In conclusion, the null hypothesis is rejected; HCI and ARP are significantly associated, as hypothesised. The results of this test however must be considered in combination with the results of the test for Hypothesis2A and Hypothesis 3A, which examines the relationship between SGI propensity and ARP and HCI and SGI propensity, respectively. While it is clear that HCI and ARP are directly related, both HCI and ARP are significantly associated with SGI propensity.

In order to further investigate the relationship between these three main variables under study, an additional post-hoc analysis, testing to see if SGI propensity mediates the relationship between HCI and ARP was also conducted. It is expected that academic researchers with a higher SGI propensity will have a stronger relationship between HCI and ARP. If this is the case, then SGI propensity can be seen to be a causal channel that might transmit years of experience onto ARP, since the relationship between SGI propensity and HCI is inverse.

The results of the post-hoc analysis concluded that SGI propensity does significantly mediate the relationship between HCI and ARP but to a very small extent ($K^2 = .025$).

From this, it can be determined that academic researchers who have a higher SGI propensity may have a stronger relationship between HCI and ARP. In other words, being open to experimenting with new research techniques, particularly in the case of open source research techniques, such as crowdsourcing should to some extent alleviate the negative influence of prolonged exposure to a non-innovative system of academia while at the same time improving research output. This means more output and more importantly, more *innovative* output.

6.2.7. Hypothesis B: The interactive effect of Gender

In order to gauge the interactive effect of gender on the relationships established in the theoretical, tests of moderation were conducted, using gender as the moderating variable. Test of moderation were conducted on five separate occasions, testing the

interactive effect of gender on each of the hypotheses that have been discussed above. While it is expected that optimal innovation will occur at an diverse combination of male and females (Boyd, 2013), the actual effect of gender in relation to SGI propensity is unknown. It is to be expected that in general terms, females will have lower levels of ARP as a result of the impact 'family life', such as maternal leave and spending more time, on average, raising children, as well as differences in specialisation, as women tend to specialise to a lesser extent than men (Leahey, 2006). This may also apply in the context of HCI, as women are in general, considered more likely to spend time on 'family life', which introduce a spillover effect on research productivity (Leahey, 2006). As a result, women may inadvertently have less experience than men (Boyd, 2013). However, it is noted that this theory is considered contentious (Leahy, 2006).

In terms of personality, particularly in the case of measurements of the NEO-FFI (agreeableness, extraversion, neuroticism, conscientiousness and openness) females have been found to score highly in the traits of neuroticism and agreeableness (Chapman, 2007), while males tended towards openness, extraversion and conscientiousness (Chapman, 2007). In contrast, studies on the relationship between gender and self-determination theory based motivation determined near-zero effect sizes, representing negligible differences between males and females in terms of motivation (Fortier, 2012). If these theoretical assumptions hold true, similar results are expected in this sample.

6.2.7.1 Hypothesis B1: Gender moderates the relationship between SGI propensity and ARP

For males, it was found that the relationship between SGI propensity and ARP remains inverse, for every 1-unit increase in SGI propensity, ARP decreased by .373, $p < .05$. While it was found that females also experience an inverse relationship between SGI propensity and ARP, the moderating effect was not significant. It is possible that a larger sample may have produced a significant result, seeing as the difference is significant in males. Overall however, it is clear that gender does moderate the relationship between SGI propensity and ARP, with males being more at risk of producing less output if SGI propensities are high. The null hypothesis is rejected.

6.2.7.2. Hypothesis B2: Gender moderates the relationship between HCI and SGI propensity

It is hypothesised that increases in HCI (experience) would result in decreases in SGI propensity, as the causal effect of HCI, or prolonged exposure to non-innovative academic environment, would result in lower levels of SGI propensity, or innovation. For both males and females, the results of the test of moderation confirmed this hypothesis. For females, there is a relationship between HCI and SGI Propensity; for every 1-unit increase in HCI (1 year of experience), SGI Propensity decreases by. -492. For males, for every 1-unit increase in HCI (1 year of experience), SGI Propensity decreases by -.508. The null hypothesis is rejected.

6.2.7.3. Hypothesis B3: Gender moderates the relationship between Personality and SGI Propensity

With the overall model being insignificant, it is not possible to determine the interactive effect of gender on the relationship between personality and SGI propensity. However, it is likely that had the result been significant, males who tend to score more highly on 'openness to experience' (Chapman, 2007), would more likely have higher SGI propensities. This is because openness to experience was found to associate positively with SGI propensity, as was discovered in testing Hypothesis A1c. However in this case, there is sufficient evidence to fail to reject the null hypothesis as no significant results were uncovered.

6.2.7.4. Hypothesis B4: Gender moderates the relationship between Motivation and SGI propensity

Gender was found to significantly moderate the relationship between motivation and SGI propensity, despite the theoretical assertion that gender should count for negligible differences in motivation (Fortier, 2012). For females, for every 1-unit increase in Motivation, SGI Propensity increases by .492. For males, for every 1-unit increase in Motivation, SGI Propensity increases by .508. The null hypothesis is rejected; both males and females have higher levels of SGI propensity when intrinsically motivated, since higher motivation scores represents academic researchers with higher levels of intrinsic motivation. This supports the findings of Hypothesis A1d.

6.2.7.5. Hypothesis B5: Gender moderates the relationship between HCI and ARP

The interactive effect of gender on the relationship between HCI and ARP was found to be non-significant. It would seem that while HCI (experience) and ARP increase in tandem, as discovered in testing Hypothesis A3, differences in gender do not change this relationship and both males and females experience the same relationship. There is sufficient evidence to fail to reject the null hypothesis.

5.2.8. Hypothesis C: The Interactive Effect of Field of Study

In order to gauge the potential interactive effect of field of study on the relationships established in the theoretical model, tests of moderation, as per the method prescribed by Baron and Kenny (1986) were conducted on five separate occasions, testing the same five relationships as previously (for Gender). For the purposes of this study, Field of study, as a variable was categorised into five separate broad areas of research focus including the following: Field 1: Medicine and biology, Field2: Business and Commerce, Field3: Mathematics and Science and Field 4: Humanities. In testing for the moderating effect of field of study, Field2: Business and commerce was excluded as a reference variable, in dummy coding the categories of field of study, as to avoid heterogeneity bias which may be present as business and commerce as an area of research is very broad. Additionally, Field 4: humanities were excluded from the analysis as the PROCESS syntax for SPSS (Hayes, 2013) only allows for entry of 2 categorical variables into a test of moderation. Essentially, these tests aimed to see if respondent belonging to Field 1: Medicine and Biology and Field 2: Mathematics and Science had different associations between HCI, ARP, SGI Propensity, Personality and Motivation.

6.2.8.1 Hypothesis C1: Field of Study moderates the relationship between SGI propensity and ARP

In testing the interactive effect of field of study on the relationship between SGI propensity and ARP, it would be expected that respondents with fields of study relating to medical and biological research would have higher SGI propensities, and hence lower levels of ARP. This is because respondents categorised as belonging to Field 1 and Field 3 are expected to be closer to the issue of academic failure and the theoretical principles that govern SGI. Indeed, medical research has already begun to make use of SGI. Crowdsourcing and open source production has become widespread practice in a broad array of medical and biological research fields (Brabham, 2008, Callaghan, 2014c). Developments in natural science research such as physics, chemistry and engineering have also begun to make use of SGI research techniques (Callaghan, 2014a). By contrast, respondents are categorised as not belonging to Field 1 or Field 3 are expected to have lower SGI propensities, as these fields of study are commonly associated with academic failure and reliance of closed models of innovation (Lindquist, 1975).

The results of the test of moderation indicate that field of study significantly moderates the relationship between SGI propensity and ARP. For respondents belong to Field 1, for every 1-unit increase in SGI Propensity, ARP increases .642, while respondents that do not classify as Field 1, for every 1 unit increase in SGI Propensity, ARP decreases -.358.

The same results hold for respondents belonging to Field 3, For respondents that are not Field3 (0); for every 1 unit increase in SGI Propensity, ARP decreases -.217, for those respondents that are in Field 3, for every 1-unit increase in SGI Propensity, ARP increases .783.

Thus, the null hypothesis is rejected. Respondents belonging to both Field1 and Field2 have a weaker relationship between SGI propensity and ARP. As SGI propensity increases, levels of ARP increase while for respondents that do not belong to either Field 1 or Field 3, the same inverse relationship between SGI propensity and ARP holds.

6.2.8.2. Hypothesis C2: Field of Study moderates the relationship between HCI and SGI propensity

It would be expected that respondents with higher HCI (more experience) would have lower SGI propensities, as was confirmed by testing Hypothesis A1b. Therefore, it would also be expected that respondents belonging to Field 1 and Field 3, would be more likely to have higher SGI propensities and thus, less HCI.

For respondents that are not Field1 (0); for every 1-unit increase in HCI (1 year of experience), SGI Propensity decreases -.342, for those respondents that are in Field1, for every 1-unit increase in HCI (1 year of experience), SGI Propensity increases .658. The results of the test for moderation using Field 3 were non-significant. However, this still confirms the alternative hypothesis, Respondents that research in fields outside of medicine and biology experience the same inverse relationship between HCI and SGI propensity, as is to be expected. However, for respondents that do

conduct research in the areas of medicine and biology, SGI propensity actually increases over time, as they gain more experience, despite the potentially counteractive effects of the closed and non-innovative academic environment. The null hypothesis is rejected.

6.2.8.3. Hypothesis C3: Field of Study moderates the relationship between Personality and SGI Propensity

The overall model in testing the moderating effect of field of study on the relationship between personality and SGI propensity was non-significant, meaning that no conclusions can be drawn as field of study's interactive effect on this relationship. There is sufficient evidence to fail to reject the null hypothesis.

6.2.8.4. Hypothesis C4: Field of Study moderates the relationship between Motivation and SGI propensity

While the tests of moderation for both Field 1 and Field 3 proved to be significant overall, the results of the test indicated that both fields do not moderate the relationship between motivation and SGI propensity. This can perhaps be attributable to the fact that motivation, along the self-determination continuum is widely spread amongst the sample – ranging from amotivation to pure intrinsic motivation. It would be expected that intrinsically motivated individuals would be more likely to have higher SGI propensities, but it would seem that field of study does not impact this relationship. There is sufficient evidence to fail to reject the null hypothesis.

5.2.8.5. Hypothesis C5: Field of Study moderates the relationship between HCI and ARP

HCI and ARP are expected to have a direct relationship. As HCI increases, so does ARP, and vice versa. The test for moderation using field of study confirmed this; for respondents belonging to Field1 for every 1-unit increase in HCI (1 year of experience), ARP increases .642. However, respondents not in Field 1 experience a decrease in this relationship (-.358). The same results were obtained using Field 3 as the mediator, those belonging to field 3 experiencing a simultaneous increase in HCI and ARP, while those outside of Field 3 experienced a decrease.

These results show that while HCI and ARP do have a positive relationship in the case of respondents belonging to Field 1 and 3, they have an inverse relationship for respondents in other fields. This may be because respondents in Fields 1 and 3 have higher SGI propensities, as discovered in Hypothesis D1. Respondents that have lower SGI propensities on the other hand, would have higher levels of ARP, as discovered in Hypothesis A1. Respondents with higher SGI propensities, or those belonging to Fields 1 and 3, are less inclined to be shaped by the constrictive academic context and thus, the inverse relationship between SGI Propensity and ARP may actually be reversed. However, for respondents in other fields, who are more inclined to have lower SGI propensities, research output may actually decrease as experience increases, potentially attributable to lower SGI propensities.

The null hypothesis is rejected; field of study is found to moderate the relationship between HCI and ARP.

6.2.9. Conclusion

Discussion pertaining to the quantitative results of this study is now concluded. Each of the 5 hypotheses was discussed in detail, in relation to both the theoretical model and the results of the statistical tests. It was discovered that the main relationship under study – between SGI propensity and ARP does indeed exist, but inversely, with the effect of HCI playing a large role in this relationship. This means that as academic researchers gain more experience and produce more output, their levels of SGI propensity decrease. According to theory (Camparino 2009, Welsh, 2013), this may be a result of an inherently non-innovative academic research environment, which champions the 'tried and tested', rather than new and novel academic research. Essentially this confirms a state of academic failure', in a similar vein to the 'innovation failure', proposed by Callaghan (2014a).

Additionally, it was found that personality, as a whole does not have a significant effect of SGI propensity, but openness, as a construct of personality does. Researchers who are more open to experience, are more likely to have higher SGI propensities and as a result might have lower levels of ARP.

Motivation, in terms of self-determination theory was also found to have a significant impact on the model, specifically on the relationship between SGI propensity and ARP. In testing for mediation, it was found that different stages along the Self-determination continuum – from amotivation to pure intrinsic motivation – affect this relationship in different ways. Those academic researchers that are unmotivated or have strong extrinsic motivation have a stronger relationship between SGI propensity and ARP, while the opposite holds for those who are intrinsically motivated.

Finally, the moderating effects of gender and field of study were investigated. It was found that gender does indeed moderate the relationships between SGI propensity and ARP, the relationship between HCI and SGI propensity, the relationship between motivation and SGI propensity and the relationship between HCI and ARP. However, gender was not found to be significant as a moderator in the relationship between personality and SGI propensity.

Field of study was found to be a significant moderator in the relationship between SGI propensity and ARP, the relationship between HCI and SGI propensity and the relationship between HCI and ARP. However, field of study was found to be non-significant as a moderator in the relationship between personality and SGI propensity as well as in the relationship between motivation and SGI propensity.

6.3. Discussion of Qualitative Results

The findings of the qualitative interviews are now compared with the theoretical model. Discussion on the primary relationship between SGI propensity and ARP that forms the foundation of this research is discussed, as are the other important variables in the theoretical model. These other important variables include personality, motivation, human capital investments, gender and field of study.

6.3.1. The Dependent and Independent Variables (ARP and SGI Propensity)

Research question 1 asks; *"What is the relationship between SGI propensity and ARP?"* In this research question, the primary dependent and independent variables of this research are introduced. The dependent variable is ARP. The independent variable is defined as SGI Propensity, or the willingness of academic researchers to engage in SGI-based research practices such as crowdsourcing. It is important to note this chapter does not attempt to test the hypotheses of this study, rather that the results of the qualitative portion of this research are used to support the quantitative findings and to help draw conclusions and make recommendations.

6.3.1.1. Academic Research Productivity (ARP)

The ARP of qualitative respondents was determined by NRF-rating.

An official NRF rating serves as an indicator of a high level of research productivity. The NRF rating system is defined, by the NRF (2015) as follows:

"The NRF Rating system is…. A tool for benchmarking the quality of… researchers. NRF ratings are allocated based on a researcher's recent research outputs and impact as perceived by international peer reviewers. The rating of individuals is based on the quality and impact of their research outputs over the past eight years, taking into consideration the evaluation made by local and international peers. It identifies researchers who count among the leaders in their fields of expertise and gives recognition to those who constantly produced high quality research outputs." (NRF, 2015:1).

The NRF-Rating system is as follows (NRS, 2015: 1)

A-Rating: Leading International Researchers
B-Rating: Internationally Acclaimed Researchers
C-Rating: Established Researchers
P – Prestigious Awards
Y – Promising Young Researchers

From the official definition and rating system, it follows that A-Rated researchers are considered more research productive than B-Rated researchers, while B-Rated researchers are considered more productive than C-Rated researchers. It is important to note that P and Y-Rated researchers were excluded from the qualitative portion of this research.

From the 30 qualitative respondents, there were 10 C-Rated respondents, 1 B-Rated respondent and 19 A-Rated respondents.

While it is acknowledge that all NRF-rated researchers are highly research productive, in the context of this research, these 3 categories fall under 3 measures of ARP, in terms of international impact.

Thus A-Rated respondents (Respondents 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21 and 27) are considered to be highly internationally impactful. The single B-Rated respondents (Respondent 9) is considered to be moderately internationally impactful) and the C-rated respondents (1, 18, 22, 23, 24, 25, 26, 28,

29 and 30) are considered to be lower internationally impactful. Again, it is stressed that this measure of productivity is relative and applies to this sample of 30 respondents *only*.

6.3.1.2. SGI Propensity

SGI Propensity was investigated through the use of 4 interlinking questions in the interviewing process. Questions 1, 2, 3 and 4 were all used to investigate SGI Propensity. The reason that SGI propensity was so deeply investigated is because the primary intention of this research is to unveil academic researcher's awareness of and proclivity to engage in SGI, as defined by Callaghan (2014a) in his seminal work on SGI. The potential of SGI was thoroughly reviewed in the Literature Review section of this study. A brief review of the fundamental SGI theory relevant to the qualitative research follows.

It is argued that conventional methods of academic research have reached their natural technological limit, or 'S-Curve' (Foster, 1986) and as a result, innovation in academia has become stagnant. This stagnancy in academia can be attributed to several other factors as well, including lack of sufficient funding and "bloated publication processes" (Welsh, 2013: 1) as well as the 'Death Valley' phenomenon (Koyayashi, et al., 2007), which is the divide between academic research and actual implementation by practitioners. Collectively, these phenomena are termed 'academic failure'. However, the introduction of SGI into academia may hold the potential to overcome academic failure. Callaghan (2014a) argues that SGI could be implemented in the pharmaceutical industry in order to overcome similar problems related to the failure of the pharmaceutical 'innovation pipeline' (Callaghan, 2014a, McKenna, 2014). It is argued in this study, that SGI may provide the same benefits in academia, which also experiences innovative inertia. At its core, SGI relies on a 'probabilistic mechanism', which would essentially propagate exponential knowledge creation through the use of modern telecommunications technology, such as the Internet. Callaghan (2014a) states that the probabilistic mechanism is attainable through the use of crowdsourcing.

From the above discussion and analysis of the transcripts, it is clear that the general trend extricated from the qualitative interviews is one towards a moderate SGI propensity. In Question 1 on the components of innovative research, interview transcripts generated themes relating to collaboration, cross-pollination of knowledge, human capital investments, new technologies and innovative thinking; all of which indicate high SGI propensities. It is noted that mention of these themes was not evenly spread amongst researcher productivity levels, with only 5 C-Rated (lower productivity) respondents making reference to these themes. On the other hand, these emerged much more strongly from A-Rated respondents (high productivity), with 13 occurrences of respondents making mention of 1 of these 5 themes, related to SGI propensity.

In Question 2, the dominant theme linking most closely to SGI propensity was that of 'Crowdfunding' or the use of the Internet to generate funding for research projects. While only 6 respondents contributed to the crowdfunding theme, 4 respondents were A-Rated, 2 were C-Rated. From the other, more conventional themes pertaining to

research funding, such as approaching the private sector or government institutions, the split between A-Rated and C-Rated respondents was relatively equal.

In Question 3, theme 2 (crowdsourcing, or the use of the internet to gain access to knowledge and information in real time) is most closely linked to SGI Propensity. However, mentions of 'public awareness' show a keen awareness amongst respondents of the potential of the public to contribute to solving catastrophic problems. The theme 'Networking' also shows the sample's understanding of the importance of the interaction of knowledge in solving complex problems as well as the importance of 'expert knowledge'.

In Questions 4 and 4.1, no dominant themes emerged, as responses were mostly binary in nature – relating to positive or negative outlooks on the state of academia and journal publications. The spread of both positive and negative views on these issues was relatively even across high and low-productive respondents.

In summary, the qualitative research seems to indicate the relationship between SGI Propensity and ARP amongst South African academic researchers. It is noted once more that all NRF-rated researchers are generally considered highly productive and the measure of A-Rated versus C-Rated researchers is not considered a truly reliable measure of productivity. Despite this, awareness of SGI, crowdsourcing, open access, open innovation and crowdfunding seems to be widespread across the sample. Also, the propensity or proclivity to engage in SGI practices such as crowdsourcing or crowdfunding does exist amongst the sample. However, it must be noted that negative views on SGI were recorded on multiple occasions. Many respondents made reference to the dangers of crowdsourcing, particularly with reference to quality control and regulatory procedures.

Thus, it is suggested that in answering research question 1: *what is the relationship between SGI propensity and academic research productivity?* No definite conclusion can be drawn from the qualitative portion of this research. It is safe to assume that this relationship does indeed exist, although its extent is difficult to determine from the data collected in this research. Further research in this area is recommended.

6.3.2 Personality, Motivation, HCI, Gender and Field of Study

Other variables included in the qualitative study included Personality, Motivation, gender and Field of Study, each of which is now discussed in relation to the qualitative findings of this research.

6.3.2.1. Personality

Costa and McCrae (1989) refer to the Five Factor Model (FFM) of personality as a hierarchical organisation of personality traits, applicable across observers and cultures. The FFM provides a "common language for psychologists from different traditions, a basic phenomenon for personality theorists to explain, a natural framework for organising research, and a guide to the comprehensive assessment of individuals" (Costa & McCrae, 1989: 177).

While Costa and McCrae (1989) identify five components of personality, 7 personality components emerged from the results of the qualitative research,

including: conscientiousness, open-mindedness, curiosity, extraversion, humbleness, confidence and enthusiasm. Although these emergent personality themes are strictly related to the context of academic research, they do link very closely to the typology developed by Costa and McCrae (1989).

Table 97: Dominant Themes relating to Personality

Number	Theme	Key Words	Respondents
1	Conscientiousness	Perseverance, persistence, patience, stubbornness, hard work	Resp14AF1 Resp16AF2 Resp2AF3 Resp2AF3 Resp22CF1 Resp29CF2 Resp23CF1 Resp25CF3 Resp30CF3
2	Open-Mindedness	Flexibility, imagination, risk tolerance, change	Resp1CF4 Resp8AF1 Resp12AF3 Resp16AF2 Resp19AF1 Resp24CF1
3	Curiosity	Curiosity, inquisitiveness	Resp5AF4 Resp18CF1 Resp29CF2 Resp8AF1
4	Extraversion	Sociable skills, networking, teamwork, communication, collaboration, leadership	Resp6AF3 Resp3AF1 Resp11AF1 Resp7AF1 Resp15AF3 Resp24CF1
5	Humbleness	Humility, humbleness,	Resp5AF4 Resp9BF4 Resp13AF1 Resp26CF3
6	Confidence	Authority, belief, attitude, driven	Resp13AF1 Resp6AF3 Resp12AF3 Resp10AF4 Resp2AF3 Resp1CF4
7	Enthusiasm	Passion, energy, drive	Resp8AF1 Resp27AF1 Resp14AF1

For Costa and McCrae (19189), Conscientiousness refers to individuals who are efficient, organised, reliable, responsible and thorough, or " a dimension that holds impulsive behaviour in check" (Costa &McCrae, 1990: 197). 8 respondents made reference to conscientiousness by mentioning key characteristics generally associated

with ‘industriousness and orderliness’. Key terms from the transcriptions included perseverance, persistence, patience, stubbornness and hard work.

Two themes identified from transcriptions – Open-Mindedness and Curiosity can be seen to be similar to Costa and McCrae’s definition of ‘Openness’ as dimension of personality. In being open-minded, respondents referred to traits such as flexibility, imagination, risk tolerance and embracing change. Similarly, curiosity was defined as individuals who portrayed traits such as curiosity and inquisitiveness. Both these themes link very closely to Costa and McCrae’s (1989) definition of openness, which is defined as inventiveness and curiousness and is said to reflect the degree of individual-level intellectual curiosity, creativity, independence, imaginativeness and a preference of variety and novelty (Atkinson, et al, 2014).

Clearly, openness is the personality trait that is assumed to be most closely correlated to SGI propensity, as uptake of SGI practices such as crowdsourcing would require a certain degree of inventiveness, curiosity and openness.

A third personality trait identified by Costa and McCrae’s FFM is Extraversion, a theme that emerged strongly from the transcripts. Extraverted researchers were described as sociable, having a strong emphasis on networking, teamwork, communication, collaboration and leadership. Two other similar themes also emerged, confidence and enthusiasm, which can be likened to Extraversion as defined in the FFM model. Traits such as authority, belief, strong attitude and drive were used to describe confident researchers; while enthusiastic researchers were described as being passionate and energetic. It is clear that the combination of these traits forms an important part of the successful, innovative and productive researcher, despite many respondents describing academic researchers as introverted and ‘nerds’ by nature. Evidently, Neuroticism, as defined in the FFM model was not referenced as a personality trait of a productive or innovative academic researcher.

The 7th identified theme in personality was that of humility, which might be likened to the FFM’s ‘Agreeableness’, although this is not a very close comparison. For the FFM, the agreeable individual is one who is appreciative, forgiving, generous, kind, sympathetic and trusting, while the humble academic researcher is one who is modest and shows humility. In fact, most respondents seem to agree that agreeableness is probably not a trait of a productive academic researcher, since agreeableness could potentially be linked to close-mindedness; individuals with extremely high agreeableness may even be perceived as naive or submissive (Costa & McCrae, 1989), which would not associate with productivity or innovativeness.

In general terms, the personality traits discovered from the qualitative research seem to mirror those to be found in the literature on the Five Factor Model (Costa & McCrae, 1989, 1990, 1992, Atkinson, et al., 2014). It would seem that the productive and innovative academic researcher, is one that is primarily conscientious, open-minded and curious, while traits such as extraversion, confidence, enthusiasm and humility also contribute significantly.

6.3.2.2. Motivation

In compiling thematic concepts from interview transcriptions, 6 motivational themes emerged, including passion, creating value, money, achieving objectives, curiosity and ego. The measurement of motivation in this study is through the use of Self-Determination Theory (Deci & Ryan, 200). The Self-Determination Continuum shows motivational factors on a scale from pure amotivation to pure intrinsic motivation, with external motivational factors lying between these two extremes.

The continuum is depicted below:

Table 98: The Self-Determination Continuum (Adapted from Ryan & Deci, 2000)

Behaviour	Non-self determined	Self determined				
Type of Motivation	Amotivation	Extrinsic Motivation				Intrinsic Motivation
Type of Regulation	Non-Regulation	External Regulation	Introjected Regulation	Identified Regulation	Integrated Regulation	Intrinsic Regulation
		External	Somewhat External	Somewhat Internal	Internal	
Locus of Causality	Impersonal					Internal

It is suggested that the 6 motivational factors identified in the qualitative data fall directly into the categories described by Ryan and Deci (2000) along the SD continuum.

Table 99: Dominant Themes relating to Motivation

Number	Theme	Key Words	Respondents
1	Passion	Enthusiasm, passion, love, enjoyment	Resp10AF4 Resp12AF3 Resp4AF3 Resp26CF3 Resp1CF4 Resp5AF4 Resp8AF1 Resp15AF3
2	Creating Value	Value, ownership, society, narcissism	Resp1CF4 Resp14AF1 Resp9BF4 Resp15AF3 Resp16AF2
3	Money	Money, salary, funding	Resp13AF1 Resp23CF1 Resp18CF1
4	Achieving Objectives	Progress, goals, objectives, challenges	Resp20AF1 Resp3AF1

Number	Theme	Key Words	Respondents
5	Curiosity	Curiosity, inquisitiveness, truth, interest	Resp11AF1 Resp24CF1 Resp12AF3
6	Ego	Ego, glory, narcissism	Resp24CF1 Resp15AF3 Resp21AF1 Resp2AF3 Resp18CF1

The most prominent theme that emerged in describing the motivational factors of a productive and innovative academic researcher was that of passion; described as enthusiasm, love, enjoyment and excitement. Academic researchers that possess these qualities can be said to fall into the category of pure intrinsic motivation, or intrinsic regulation, on the extreme end of the SD continuum.

On the opposite end of the spectrum, no mentions of amotivation were made, as was expected. However, the existence of extrinsic motivational factors in academic research was uncovered. On the lower end of the extrinsic motivation continuum is external regulation, which refers to "doing an activity only to obtain a reward" Tremblay, et al., 2009: 214) and represents pure external motivation. Respondents referenced the theme of money as an external motivational factor. However respondents that did make mention of money were also careful to note such factors are generally not prime motivators, rather, they are of a secondary motivational nature.

Moving further along the SD continuum, Introjected Regulation is defined as the regulation of behaviour through self-worth contingencies, such as self-esteem or guilt (Tremblay, et al., 2009). This component can be linked directly to the theme of 'Ego', with traits such as self-esteem and narcissism being frequently mentioned. One quote in particular stands out in this regard: "*A lot of it is ego. I will admit that egos actually quite important, you know there's a small little nerd who's been beaten up most of his life gets an opportunity to show the world that he's actually a hell of a lot smarter than everybody thought*. (Resp18CF1). This theme emerged relatively strongly, only second to Passion.

Achieving objective can also be seen as a factor of introjected regulation. The satisfaction that emanates from achieving objectives through progress, meeting goals or overcoming challenges can be seen as a self-worth contingency.

Identified Regulation refers to an individual that partakes in an activity that has value or meaning to the individual (Tremblay, et al., 2009), moving closer along the continuum towards intrinsic motivation. 'Curiosity' is a theme that falls under this term. Curiosity, or inquisitiveness and interest would fall under the same category, as a motivational factor that has value or meaning to an individual, but perhaps not yet fully internalised. One may be curious, but to act on that curiosity would require further motivation.

On the extreme end of extrinsic motivation lies integrated regulation. Tremblay, et al. (2009: 214) define this as "identifying with the value of an activity to the point that it becomes part of the individual's sense of self. This is the form of extrinsic motivation that is most fully internalised and hence, is said to be autonomous." In the theme of

'creating value', respondents used terms such as 'value, ownership, helping society and narcissism' to describe the motivation that stems from taking ownership of value created through academic research.

The following quote encapsulates the theme of creating value: "*For me the motivational factors translate into something actionable. When I do get to write up what I've been researching, it does have its own sense of energy. To be able to create stories of the stuff that I'm trying to make sense of.*" (Resp9BF4)

In general terms, the motivational factors discovered from the qualitative research seem to mirror those to be found in the literature on self-determination theory (Ryan & Deci, 2000) and the WEIMS scale (Tremblay, et al., 2009) It would seem that the productive and innovative academic researcher is one that is primarily driven by passion, or pure intrinsic motivation. This was the theme that emerged most strongly from the data. However, it is also important to take into account all forms from extrinsic motivation along the continuum, as these seem to contribute quite significantly to motivation as well.

6.3.2.3. Human Capital Investments

Human Capital Investments (HCI) emerged as a theme, described as an important contributing factor to the production of innovative research. Specifically, respondents cited the significance of prior education, prior knowledge and experience as factors that are imperative in improving academic research productivity.

Becker's (1962: 11) terminology, which defines human capital investments as "activities that influence future real income through the embedding of resources in people," associates closely to the concept of education and training, as instruments necessary in attaining 'return on investment' (Becker, 1962, Blundel, et al., 1999). In this case, such 'return on investment' refers to improved research performance, or productivity. So, it can be concluded that respondents considered 'knowledge', as a resource that was vital in improving productivity and innovation in academia.

6.3.2.4. Gender

The sample of 30 qualitative respondents was heavily skewed in favour of male respondents, who accounted for 76.6% of the total sample, while female respondents made up the remainder. Because of this, it is difficult to make reliable assumptions pertaining to the impact of gender on research productivity. There was no indication of specific themes or categories that linked solely to male or female respondents. As such, comments on the impact of gender on academic research productivity are left to the quantitative portion of this research.

6.3.2.5. Field of Study

To re-iterate, due to the wide range of respondents' research areas, it was deemed necessary to collate this area into more accessible and organised 'fields of study', or 'field category'. The following classification was used:

Field1: Medicine & Biology
Respondents: 3, 7, 8, 11, 13, 14, 18, 19, 20, 21, 22, 23, 24 and 27

Field2: Commerce & Law
Respondents: 16 and 29

Field3: Mathematics & Science
Respondents: 2, 4, 6, 12, 15, 25, 26, 28 and 30

Field4: Humanities
Respondents: 1, 5, 9, 10 and 17

As per the predictions of SGI theory (Callaghan, 2014a), respondents that fell under 'Field 1: Medicine & Biology' had the highest SGI propensity, and also consisted of the most A-Rated researchers (compared to the composition of the other Field categories), which may indicate a higher level of academic research productivity. Respondents under this category most frequently made mention of open access, the use of new technologies such as the Internet, social media and smart phones. While respondents in this category did seem to endorse crowdfunding (such as KickStarter) in order to fund research projects, many of these same respondents emphasised caution in crowdsourcing information in the case of catastrophic events. This may be attributable to the fact that the medical and pharmaceutical research fields are dependent on exact data and information and issues relating to quality control and validity of crowdsourced data may still be too problematic for use and implementation. In relation to the state of academia and journal publications, the general trend of respondents in this category was towards a consensus that academic research is inherently constrained by paradigms and that the journal publication process is flawed. This may show a higher SGI propensity, although, it must be noted that those who disagreed with this viewpoint, tended to disagree very strongly.

Field 3 (mathematics and science) contained the most respondents after Field 1 and also mostly consisted of A-Rated researchers. Respondents in the Field 3 category showed strong support for using crowdsourcing to obtain data in the case of catastrophic events, and a strong support for crowdfunding also emerged, showing a high level of SGI propensity. In terms of Question 4 and 4.1 (State of Academia and Journal Publication) responses varied broadly. Some respondents claimed that academia requires paradigms to function others referenced the importance of embracing paradigmatic change. Reponses to the question on journal publication seemed to indicate a slightly higher SGI propensity.

Both Fields 2 and 4 consisted of only a few respondents (7 in total). One respondent from field 2 showed extremely high levels of SGI propensity, suggesting and applauding the use of open access, crowdsourcing and crowdfunding in solving problems, while several Field 4 respondents showed high interest in open access, especially in terms of obtaining data from the Internet and positive views to open access journal publications.

In general terms, respondents across all four fields seemed to show relatively high SGI propensity, although those with lower propensities were extremely low.

6.4. Conclusion

It seems the awareness of open source, crowdsourcing and crowdfunding is still in its infancy amongst South African academic researchers, but signs of development of these concepts are present. The interviews indicate that the use of SGI-based processes is already in motion, especially in the case of confronting catastrophic events and the importance of widely distributed knowledge is widely accepted and acknowledged amongst the sample. Respondents indicate high levels of interest in using crowdfunding to fund research projects. Many respondents however acknowledge and made frequent reference to problems with SGI, associated with quality control, validity, reliability and fraud.

Respondents are generally aware of the importance of the Internet and other new technologies such as social media and smart devices, as well as the significant change that is expected in academia in the near future as a result of the introduction of these technologies. As academic researchers, many seem to be uncertain as to what the future holds, particularly in terms of new technologies. However, the general consensus is that change is to be expected.

Respondents were split on the issue of paradigmatic change, some advocating it, others denying its existence entirely. Two interview quotes clearly capture this dichotomy.

"Research that is not constrained by paradigms tends to devolve into speculation" (Resp16AF2)

*"That's what paradigms do… they constrain you (*Resp5AF4)

The effects of the predicted academic paradigm shift, attributed to SGI still remain to be seen. It is clear however, that SGI does indeed exist in academia and its presence is steadily growing and causing change.

Discussion on motivation shows that Ryan and Deci's (2000) model of self-determination theory is an effective measure of motivation in academic research. Themes drawn from interview transcripts translate well into the themes of extrinsic and intrinsic motivation as defined in the self-determination continuum. The same applies in discussion on personality in academic research and the comparison of themes that emerged from interview transcripts and Costa and McCrae's (1989) FFM of personality. Mentions of each of the five defined personality characteristics were common amongst the sample, including Extraversion, Agreeableness, Neuroticism, Openness and especially Conscientiousness.

The discussion of results of the quantitative and qualitative studies is now concluded. The concluding chapter of this dissertation follows.

CHAPTER 7

CONCLUSIONS & RECOMMENDATIONS

7.1. Introduction

In this section, the study is concluded with a summary of the research objectives, methodologies, results and conclusions. The theoretical model, derived from the literature is discussed in relation to the findings of the quantitative and qualitative components of this research. Each of the research questions, presented in the introduction chapter of this research is answered, in conjunction with the findings of the quantitative and qualitative findings. Conclusions are then drawn and recommendations are made.

7.2. The Research Problem and the Literature

In a world of an exponentially increasing free-flow of knowledge and information made possible by the advent of the Internet and the flood of accompanying information communication technologies, a fundamental problem has become evident. Despite this free-flow of knowledge and information readily available to millions, perhaps billions around the world, the innovation 'pipeline', or flow of knowledge and innovative products, services and processes has become dangerously idle. It has been purported that in the case of pharmaceutical innovation, the innovation pipeline, or supply of knowledge is in fact, inherently flawed and nearly broken (McKenna, 2014). The reason for this 'failure of innovation' can be attributed to a global system of closed innovation where investments in innovation are characteristically linked to profit-driven incentives, and innovation that is not inherently profitable is not pursued because financial incentives are tethered to the need to generate profitable returns (Martin & Scott, 2000; Callaghan, 2014). Consequently, research and innovation focused on with societal problem solving has suffered severe obstacles.

Essentially, a closed model, or closed paradigm of knowledge and innovation has emerged. This creates the adverse circumstance where such closed models of innovation are "fundamentally adverse to the requirements of R&D management" (Callaghan, 2014a: 2070). As a result, the global innovation pipeline has become congested with product and service innovations that are "coupled to the dictates of the market mechanism which disproportionally allocates resources" (Callaghan, 2014a: 2070). An era of 'innovation failure' has dawned (McKenna, 2014) as reliance on closed paradigms of innovation and resistance to radical innovation becomes the norm.

This is the research problem that forms the foundation of this research. The aggregation and interaction of knowledge and information is the catalyst for innovation (Walsh, 2013). But, despite the advents of the information age, the Internet and the flood of information and communication technology that has followed (Aadir & Vohra, 2003; Metz, 2015), which should, in theory allow for exponentially improved levels of global innovation, modern innovation has failed dramatically on numerous occasions (Callaghan, 2014). This is particularly evident in the face of potential 'global catastrophes', such as the outbreak of widespread disease or the onset of microbial antibiotic resistance (Callaghan, 2014a), problems that are predicted to exponentially increase in danger and frequency as the world becomes more globalised (Maher, 2013, D'onfro, 2015).

"The Fourth Industrial Revolution, which includes developments in previously disjointed fields such as artificial intelligence and machine-learning, robotics,

nanotechnology, 3-D printing, and genetics and biotechnology, will cause widespread disruption… over the next five years, with enormous change predicted in the skill sets needed to thrive in the new landscape." (WEF, 2016:1)

Management as a scientific discipline is imperative in the context of scientific advancement, as management holds the potential to solve interdisciplinary problems through the implementation of precise scientific measurements, quality control and improvement. It is argued that management theory can be used as an instrument to ensure progress in any field of enquiry and provide the tools needed to deal with the problems of innovation failure.

At the root of the problem of innovation failure, is the difficulty of managing knowledge. Knowledge as an economic resource is by its very nature, inherently constrained. Knowledge is proprietary (firm specific) (Forbes & Wield, 2002), is unevenly distributed at the macro level (Hayek, 1945) and thus can be said to be decentralised. As such, knowledge is 'sticky', it resides within the individual, rather than within organisations, in other words, it is tacit. This makes knowledge is very difficult and costly to move from where it originated (von Hippel, 1976). The combined effect of these attributes of knowledge is known as the problem of knowledge aggregation (Smith, 2010) and represents a severe obstacle to knowledge creation and hence, to innovation.

Furthermore, the combination of the problem of knowledge aggregation, coupled with the issues relating to innovation failure and the failure of the innovation pipeline can be seen as a threshold point in the innovation paradigm. In innovation theory the S-Curve represents the natural limit of the lifespan of a certain technology (Foster, 1986). Callaghan (2015a: 13) argues that in much the same way, the natural limit, or S-curve associated with closed models of innovation "reflects the inability of the system to produce new [innovation]. This constraint is conceptualised as an innovation 'threshold', or 'constraint threshold'."

In order to overcome the issues associated with the knowledge and innovation threshold, Callaghan (2014a) introduces the notion of Second Generation Innovation, or innovation that is fundamentally different from 'First Generation' (or, contemporary) innovation (FGI). The difference between FGI and SGI, as proposed by Callaghan (2014a) is the introduction of the 'probabilistic mechanism' in knowledge and innovation creation, which could allow for exponential and innovation creation, as should be attainable with available technology such as the Internet, which is not being attained because of the overt presence of profit-driven incentives and restrictive market forces.

Callaghan (2014a) builds on the notion of open innovation (Chesbrough, 2003a), where the boundaries between organisations become more permeable through a process of leveraging external knowledge. SGI however, takes open innovation a step further in introducing the probabilistic mechanism, which is the use of crowdsourcing in sourcing knowledge. Crowdsourcing "represents the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call" (Howe, 2006) and represents the underlying mechanism through SGI functions. Crowdsourcing allows for the leveraging of distributed knowledge through the Internet, knowledge

which is tacit and which can be used to solve some of society's most pressing problems. By harnessing the power of collective intelligence (Surowiecki, 2004), the problem space becomes eroded at exponential rates, essentially overcoming issues associated with closed models of innovation.

Proof of the concept of crowdsourcing, crowdfunding and open source production are widespread in the literature. From disaster management to cancer research, sociological studies and even garment design, "*crowdsourcing is an idea whose time has come"* (Torr-Brown, 2013:1).

It is argued in this research that the philosophy that governs SGI can be extended to the context of academic research. Academia is primarily concerned with knowledge creation and thus, represents a prime candidate for testing the assumptions of SGI theory. In order to do so, this research has aimed at discovering the applicability and the potential of SGI in knowledge creation.

The comparison between innovation in general and academia is justified by considering theory relating to innovation failure, as discussed above. Academia has been subject to very similar obstacles. The primary requirement of academia is knowledge creation and subsequent innovation, especially with recent advancement in telecommunications technology; the phenomenon of 'academic failure' is still eminent. Academia has been described as "bloated" (Welsh, 2013:1), "resistant to scientific discovery" (Camparino, 2009) and unreliable and prone to bias (Peters & Ceci, 1982). The process of journal article publication is a particular area of concern (Bornman, 2010), with the 'Death Valley' phenomenon (Koyayashi, 1986), relating to the divide between academic research and the actual implementation by practitioners as a serious point of alarm.

The initial suggestion that academia may be non-innovative was first recorded by Kuhn (1970). Lindquist (1975) echoed these assertions. The underlying theme of these initial suggestions are based on the convergence of best practice, as described by Kuhn (1970), which has essentially resulted in closed paradigms of academic innovation that have become commonplace. More recently, Changizi (2012) and Welsh (2013) have reiterated the issue of non-innovativeness in academia, specifically with reference to the inhospitable nature of academia to 'big discovery' (Changizi, 2012) and the potentially stifling effect of academia on true innovation (Welsh, 2013). Callaghan (2016a; 2016b; 2016c) stresses the potentially detrimental effect of academic 'stagnation', which results from overreliance on closed paradigms of innovation, particularly in the case of academic research.

This research aimed to answer the question as to the potential of SGI in the academic context by investigating the propensity of academic researchers in South African universities to engage in SGI; to find out whether these academic researchers are willing to go beyond the norm; to experiment with distributed knowledge research techniques, such as crowdsourcing and most importantly, to find out if these academic researchers are even aware of the problems and disadvantages associated with FGI, or contemporary academic research practice that currently prevails. Such research may be associated with the same paradigmatic constraints as those that limit the world's supply of innovation that solves pressing societal problems.

However, these measurements of 'SGI propensity' are baseless without a reference point. The theoretical model is built around the SGI Propensity construct, but relates most directly to academic research productivity, termed ARP, which is the cumulative total of academic journal article publications of academic researchers. It is proposed that academic researchers with high levels of SGI propensity will inadvertently experience lower levels of ARP. If the system of academic journal article publication is indeed flawed, closed and susceptible to publishing research that is non-innovative, then it follows that innovative research is bound to be rejected, thus decreasing the productivity of the innovative academic researcher. This means that the literature predicts an inverse relationship between SGI propensity and ARP.

Furthermore, in constructing a theoretical model to test the relationships surrounding SGI propensity, it is imperative to consider individual-level variances, such as differences in personality and motivation, which may significantly impact on SGI propensities and levels of productivity. A vital component of individual difference was measured through human capital investments (HCI), defined by Becker (1962) as individual-level intangible investments such as experience, education and training that generates a return on investment, in the form of performance, or productivity. In measuring academic researcher experience, it is assumed that more experience would equate to a greater inclination to conform to academic research standards and hence, a decrease in levels of SGI propensity, or overall innovativeness. In essence, it is assumed that the academic research context shapes the individual, over time. Moreover, a prolonged exposure to a system, or environment of non-innovative academia could transpose onto the academic researcher, resulting in lower levels of SGI propensity. On the other hand, the opposite should also hold true. For academic researchers with little experience, perhaps not yet shaped by the constrictive academic environment, levels of SGI propensity and innovation are expected to be high.

The combination of measurements of HCI, ARP and SGI propensities forms a second level to the foundation of this research. From the investigation of these three interlinking variables, a clear picture of the situation pertaining to academia in South African universities will begin to emerge. However, the theoretical model is still not complete, as there are further individual-level differences to take into consideration.

In measuring individual-level differences in personality, Costa and McCrae's (1989) seminal 'big five' model was used. The 'big five' model of personality deconstructs personality into five distinct personality constructs, including agreeableness, neuroticism, conscientiousness, extraversion and openness to experience. It is expected that the construct 'openness to experience' is most likely to correspond with high levels of SGI propensity, since a high SGI propensity would require an individual who is willing to experiment with new research techniques and to be more accepting of ideas and concepts that may seem extraordinary. At the same time, measurement of personality gives a clearer indication to the relationship between SGI propensity and ARP, contributing to the increasingly robust theoretical model under study.

Additionally, measurement of individual-level motivation is required in order to determine the relationship between SGI propensity and ARP. Ryan and Deci's (2000) self-determination continuum, which measures levels of motivation along a continuum from amotivation to pure intrinsic motivation is used as it suitably

describes the effects of motivational factors in the context of the workplace, where academic research is generally conducted. It is assumed here that academic researchers with high levels of intrinsic motivation will be more likely to have higher levels of SGI propensity since such individuals should be less likely to succumb to the pressures of the contemporary academic cultural norms and standards.

Moreover, the effect of gender differences is included in the model provides an interesting differentiation in males and females in the context of academic research. As a general trend, women are expected to be slightly less productive than men, as a result of cultural trends pertaining to maternity leave and the time commonly invested in looking after children (Leahey, 2006).

Furthermore, it is expected that academic researchers that conduct research in different areas of academia will have different relationships between SGI propensity and ARP. As per the fundamental theory pertaining to SGI, it is hypothesised that academic researchers who conduct research in highly innovative fields such as medicine and biology are expected to have higher levels of SGI. These fields are expected to be associated, to some extent, with SGI since open and crowdsourced research techniques are gradually becoming more commonplace, particularly in pharmaceutical research (Brabham, 2008). This trend is gaining traction at a rapid pace (Metz, 2015) and is expected to increase drastically in the future (Callaghan, 2015a). It is assumed that academic researchers associated with these highly innovative fields of inquiry are likely to be more familiar with SGI-related research processes and techniques and therefore, may to some extent be more willing to adopt them in their own research, resulting in higher SGI propensities.

At this point, the theoretical model is complete. In order to fully understand the potential of SGI in the academic context in South African universities, the relationship between SGI propensity and ARP needs to be investigated. However, since the study is conducted at the individual-level, with data collected from individual academic researchers, it is important to control for individual-level differences. Human Capital Investments, or HCI, measured in the form of years of experience adds that individual-level context in the most simplistic form, while simultaneously complementing the three-dimensional relationship required to understand SGI propensity. Personality and motivation are added in as well, to account for further individual-level variance and gender and field of study are included as final tests of differentiation, and different areas of research inquiry, respectively. With the theoretical model composed and fully described, a brief recapitulation of the methodology that was employed over the course of this research is reviewed.

7.3. Methodology and Analysis

The underlying research question was answered by way of deriving and thereafter testing five separate hypotheses. The objective of these tests was to find the answer to the ultimate question that underpins this research – *what is relationship between SGI propensity and ARP*?

In answering this fundamental research question, the aim is to uncover the underlying applicability of a Second Generation of Innovation (Callaghan, 2014a) within the

context of academic research in South African universities. Essentially, this aim can be interpreted as the investigations into the interrelationships between SGI-based innovative practices, academic productivity, human capital investments, personality and motivation in order to provide insight into the potential acceleration of academic research and innovation. The overarching objective of the research is therefore to test theory that relates SGI practices to ARP, as discussed above.

Two separate but interlinking studies were conducted, one quantitative and one qualitative, using a mixed methods research design (Wagner, et al., 2012). After developing a theoretical model from the literature, quantitative data collection and analysis was conducted in order to test these hypothesised associations. During this phase of research, the assumptions of post-positivism associated with critical realism (Trochim, 2002) were applied in order to avoid problematic concerns relating to potential observation errors (Wagner, et al. 2012).

After concluding the quantitative portion of the research used to test the relationships in the developed theoretical model, a second phase of inquiry commenced in qualitative research. Techniques were employed to test the validity of the findings of the quantitative study. During the qualitative portion of the research however, the research paradigm shifted into interpretivism, which is considered better suited to qualitative research since interpretivism lends itself to the interpretation of reality as being social constructed (Creswell, et al., 2003) and subjective (Wagner, et al., 2012).

Using comprehensive purposive sampling, academic researchers from different universities across South Africa were surveyed in order to collect quantitative data. Research permissions from The University of Witwatersrand, The University of Pretoria, The University of Kwa-Zulu Natal, The University of Cape Town and Nelson Mandela Metropolitan University were obtained. A questionnaire, containing short one-word answers and Likert scales was used to collect quantitative data. The data collection process spanned a course of eight months from August 2015 to March 2016 and was administered through the use of SurveyMonkey.com, a reputed online survey hosting website. The quantitative sample ultimately comprised of 529 full-time academic researchers.

Using the maximum heterogeneity sampling technique, qualitative data was collected simultaneously, with the use of 15-minute telephonic or face-to-face interview, with academic researchers from different South African universities. This qualitative sample comprised of 30 NRF-rated academic researchers from across South Africa and spanned over the same period of time as the quantitative research. Both the quantitative and qualitative research instruments were specifically designed to test the theoretical model derived from the literature.

The analysis of quantitative data, involved the use of a number of statistical tests, which were administered with the use of SPSS 22.0 software for Mac. Firstly, aggregate data was analysed using Univariate descriptive statistics in order to uncover the sample distribution and frequencies. Thereafter, the Likert scales contained in the questionnaire were explored using exploratory factor analyses and their reliability confirmed in calculating Cronbach's Alpha scores. Once the Likert scales were confirmed to be reliable, bivariate correlations between the major variables under study was conducted and a series of multivariate tests was performed. Hierarchical

multiple regressions were used to test the derived hypotheses, as were tests of mediation and moderation, using Andre Hayes' (2013) PROCESS syntax, designed for SPSS.

In the analysis of collected qualitative data, a method of transcript coding and theme development, as prescribed by Miles and Huberman (1994) was employed. In developing dominant themes that emerged from qualitative interview transcripts, the results of the quantitative analyses were further validated, in relation to the theoretical model. Thereafter both the quantitative and qualitative results were discussed, in conjunction with the hypotheses derived from the theoretical model. Further discussion of these results, in relation to the theoretical model and the derived hypotheses is now provided. The following discussion aims to provide answers to the research questions that underpin this study and to conclude this dissertation.

7.4. Answers to the Research Questions

Each of the research questions proposed in the introductory chapter of this research are introduced in chronological order, in relation to the theoretical model. Drawing on the results from both the quantitative and qualitative studies, the research questions are now answered, conclusions are drawn and recommendations are made.

7.4.1 Research Question A: What is the association between SGI Propensity, HCI, Motivation, Personality and ARP?

Theoretically, confirmation of the inverse relationship between SGI Propensity and ARP would confirm the alternative hypothesis, in that as academic researchers become more research productive, they become inherently less innovative and less likely to be SGI-inclined. This would confirm the assertions of Kuhn (1970), Callaghan (2014a), McKenna (2014) and Camparino (2009), signifying that the innovation pipeline is indeed flawed and nearly broken and furthermore confirms the underlying assumption of this research, that academia has fallen victim to the innovation failure epidemic that has engulfed the world in the form of academic failure. The impact of HCI, or years of experience on this relationship would serve to further prove this theory, as the effects of prolonged exposure to non-innovativeness permeates deeper into academia, amplifying the cycle of innovation failure.

At the individual level, differences in personality and motivation would give clearer indication as to the symptomatic causes of innovation and academic failure. Academic researchers with open personalities may be less prone to such a risk, as would academic researchers that are intrinsically motivated to perform. On the other hand, academic researchers with closed personalities and those that are unmotivated, or even extrinsically motivated to perform, should be more likely to capitulate to the non-innovative pressure inherent in the academic system.

The five separate research questions that encapsulate this overarching research question are discussed in relation to the results of both the qualitative and quantitative results of this study, as follows.

7.4.1.1 Research Question A1a: What is the relationship between SGI propensity and ARP?

The results of both the quantitative and qualitative studies confirmed the existence of a relationship between SGI propensity and ARP. However it was discovered that this relationship is inverse, as academic researchers produce more output, in the form of journal article publications, their proclivity to engage in experimental research techniques such as crowdsourcing, crowdfunding and open source production decreases. A decrease in SGI propensity also indicates a difference in the respondent's research philosophies or beliefs regarding the academic system, specifically relating to innovation in the academic context.

In the quantitative study, the aggregate measurements of ARP and SGI propensity were tested by way of a bivariate correlation. This produced a significantly negative correlation between the two variables, confirming the alterative hypothesis, that SGI propensity and ARP are related, but inversely. While controlling for covariate factors including gender, language, title, nationality, field of study and university affiliation, two separate tests of multiple hierarchical regression confirmed the findings of the bivariate correlation. However, it must be noted that the first test of hierarchical multiple regression, which was conducted prior to outlier removal produced insignificant results. With outliers removed, however, the results were significant. This provides indication of the powerful impact that can be attributed to outliers in the sample and reinforces the importance of their removal in testing the hypotheses.

Qualitatively, the relationship between SGI propensity and ARP was shown to exist. However, the relationship between these two variables differed. Amongst qualitative respondents, all of whom are highly rated academic researchers with NRF-Ratings no less than C-Rated, were all found to have a positive relationship between ARP and SGI propensity. Academic researchers that had higher levels of research productivity, also had higher SGI propensities, commonly making references to open source innovation and belief in the failure of academic innovation. However, it must be noted that the results of the qualitative research vary widely, many highly productive, or A-Rated respondents displayed the same relationship between SGI propensity and ARP as those in the quantitative sample. The general trend however, seemed to incline towards a positive relationship between the two variables. This may be attributable to the fact that those sampled in the qualitative study do not conform to the normality of the quantitative sample, which represents an average of academic researchers across South Africa. Those respondents that comprised the qualitative study are amongst the leading researchers in their field in South Africa. Indeed some were amongst the leading international researchers in their respective fields. It is evident that such respondents are far from what could be considered 'normal' and thus, it is expected that results would differ.

It is proposed here that the qualitative sample of this research collectively represent a state of academia that theoretically *should* be the norm. As per the results of the quantitative study, it would seem that the mean, or average trend in South African academia is one of a constrictive academic environment that promotes non-innovativeness and discourages both innovation and paradigmatic change. It would seem that academic failure, as defined by Camparino (2009) is indeed a cause for concern. The proverbial 'innovation pipeline' that should supply a free flow of knowledge, information and innovation is in fact filtering out truly innovative performance, in the form of journal articles. This supports McKenna's (2014) prediction of a nearly broken innovation pipeline, in the context of academia.

However, in a 'perfect' scenario, as is the case of internationally acclaimed academic researchers in the qualitative sample, this problem does not exist. The highest rated and most acclaimed researchers in South Africa, although few are indeed innovative and simultaneously produce high levels of ARP. It is perhaps because of the high status these academic researchers have attained, that they are able to overcome the boundaries, or critical point of innovation of contemporary academia. As a result, the work of these academic researchers is more likely to be published, despite potentially being 'too innovative', or antithetical to a system of academic non-innovativeness.

In answering Research Question A by combining the results of both the qualitative and quantitative studies, it can be concluded that relationship does indeed exist between SGI propensity and ARP, but that these results differ in considering the relationship at the 'normal' level of academia and at the high-end level of academia. It would seem that restrictive practices in academic innovation have precipitated a system and an ingrained culture of non-innovativeness that may only be avoided through extremely high levels of productivity.

7.4.1.2. Research Question A1b: What is the relationship between HCI and SGI Propensity?

The relationship between SGI propensity and HCI adds a contextual layer to the relationship between SGI propensity and ARP. The results of the tests pertaining to this research question provided similar results to those of the previous research question.

Becker's (1962: 11) terminology, which defines human capital investments as "activities that influence future real income through the embedding of resources in people," associates closely with the concept of education and training, as instruments necessary in attaining 'return on investment' (Becker, 1962, Blundel, et al., 1999).

The analysis of quantitative data found a negative, or inverse association between SGI propensity and HCI. A test of correlation proved a negative relationship, while tests of hierarchical multiple regressions showed that while controlling for gender, title, language, nationality, university affiliation and field of study, these two variables were indeed inversely related. In the case of the qualitative study, HCI emerged as a dominant theme seen to be imperative as a contributing factor to the production of innovative research. In other words, in attaining higher levels of SGI. Specifically, respondents cited the significance of prior education, prior knowledge and experience as factors that are crucial in improving innovative academic research productivity.

The inverse relationship discovered in the quantitative sample, indicates evidence of a restrictive academic environment, in which innovative research productivity (or, journal article publications) is generally eschewed, in favour of productivity, or journal article publications that adhere to the culturally normal and standard, non-innovative criteria. Again, this may provide proof of Camparino's (2009) notion of academic failure and to a broader extent, perhaps proof of failure of the innovation pipeline (McKenna, 2014).

Indeed, this does serve as proof of Becker's (1962) notion of human capital, where prolonged exposure, or accumulated experience does provide academic researchers with a return on investment, albeit one that is not productive. Instead, the more experience accumulated by academic researchers in the academic research context results in decreased levels of SGI propensity. These academic researchers are less inclined to experiment with open source and crowdsourced research techniques and are more likely to hold the belief that academia is not flawed, nor are any changes required to the existing academic research paradigm. Essentially, Kuhn's (1970) conception of cultural convergence is amplified, over time. Because of this, it may be possible that SGI, as defined by Callaghan (2014a) represents a radical innovation and one that is expected to face resistance (Smith, 2010).

The results of the qualitative research support the findings of the quantitative study to some extent. Many highly rated (A-Rated) respondents ascribed poor levels of innovative output to an inherently non innovative journal article publication system, some making particular reference to the inefficiency of the peer-review process, echoing the assertions of Welsh (2013).

Again, the difference between the qualitative and quantitative samples remained an important differentiator in answering Research Question A2. If the quantitative sample represents a normalised cross-section of South African academic researchers, then the results pertaining to the quantitative study would show the general trend in the relationship between SGI propensity and HCI. On the other hand, the qualitative sample, comprising only highly rated researchers, some even internationally acclaimed academic researchers. This sample shows only a small segment of South African academic researchers and the results of the qualitative study cannot be said to be generalisable. Indeed, as levels of HCI, or experience amongst the qualitative sample increased, so did SGI propensity. Those A-Rated academic researchers, who were mostly very well experienced, simultaneously showed high levels of SGI propensity. Awareness of the importance of cross-pollination of knowledge, collaboration, open source production, crowdsourcing and even crowdfunding, were all mentioned frequently amongst these respondents. Many also expressed concerns about non-innovative academic standards, particularly the journal article publication process.

These differences in the sample show once again the discrepancy amongst South African academic researchers; encapsulated by a differentiation between the academic 'elite' (the qualitative sample), who are not at the mercy of non-innovative academia, perhaps because of their high status versus the standard level (the quantitative sample) of academia, or those academic researchers who become less innovative over time.

In conclusion, the answer to Research Question A2 is complex, but points to a general trend of decreased innovation as experience, or HCI increases. However, these differences may be mitigated in the case of extremely productive academic researchers.

7.4.1.3. Research Question A1c: What is the relationship between Personality and SGI Propensity?

Costa and McCrae's (1989) seminal 'big five' theory pertaining to personality was used in this research. The 'big five' refers to five broad personality traits that can be further sub-divided into certain personality characteristics or, sub-scales. The big five personality traits include agreeableness, extraversion, neuroticism, conscientiousness and openness to experience, each of which was measured quantitatively by the use of a reduced version of the NEO-FFI scale (Costa & McCrae, 1994).

It is assumed that a high level of openness to experience, as a construct of personality would be a strong predictor of a personality that is associated with high SGI propensity, since SGI propensity is strengthened by personalities that are open, willing to experiment and curious about new and untested research techniques and methods.

In the quantitative sample, no significant relationship was found between personality, as a whole and SGI propensity. However, a test for correlation did show strong positive correlation between openness to experience and SGI propensity, as was hypothesised, while none of the other personality traits significantly correlated with SGI propensity at all.

Qualitatively, in determining personality characteristics that associated with high levels of innovativeness, or SGI propensity in academic research, seven different dominant themes, relating to personality were uncovered. The strongest theme that emerged was that of conscientiousness, which surprisingly did not correlate to SGI propensity in the quantitative study. This could perhaps be linked to Research Question A1 and A2, in that if conscientiousness represents the act of an academic researcher being efficient, responsible and reliable (Costa & McCrae, 1989), then it follows that such an academic researcher would also be one that adheres to the rules, or conforms to normality. Costa and McCrae (1989) define sub-scales of conscientiousness as 'competence' and 'dutifulness', which would indicate a respondent who is bound to rules and regulations; potentially someone that does not actively seek to innovate. And would therefore be associated with low SGI propensity.

As was expected, openness emerged as another strong theme amongst qualitative respondents. This mirrors the findings of the quantitative study. Respondents made reference to key terms such as flexibility, imaginativeness and risk tolerance in describing the academic researcher who is open and thus, more likely to be innovative or have a high level of SGI propensity. Another theme, that of 'curiosity' emerged relatively strongly and can be seen as being closely linked to openness. Costa and McCrae (1989) specifically cite curiosity as a defining trait of the openness to experience personality construct, and if openness was determined to correlate strongly and positively with SGI propensity, this then serves as further evidence of the relationship between SGI propensity and openness.

Extraversion was another personality trait deemed necessary in attaining innovative levels of research output, amongst the qualitative sample. While extraversion did not associate quantitatively with SGI propensity, the high level of importance placed on

of social skills, collaboration and communication in attaining innovation, as defined by the qualitative sample is clear.

Other personality traits that emerged from the qualitative research included humbleness, confidence and enthusiasm, all of which can perhaps be seen as having secondary importance to openness and curiosity. The attainment of these personality traits were cited primarily as ancillary characteristics that propel levels of openness in the attainment of SGI propensity, or innovative research output.

Neuroticism and agreeableness were two of the 'big five' personality traits not mentioned. It is expected that these characteristics would associate negatively with innovation and output, as they would only serve to diminish ARP and SGI propensity. It is interesting to note however, that these items, when measured quantitatively did not associate at all with SGI propensity. It is suggested that this result may be due to a reluctance of quantitative respondents to admit to such personality traits.

In conclusion, in answering Research Question A3, no direct association between personality and SGI propensity was discovered, however, upon further investigation, the importance of openness to experience, as construct of personality, becomes abundantly evident. Academic researchers who are open to experience, who are curious, risk-tolerant and adaptable are more likely to have higher SGI propensities, as they are more likely to want to innovate and experiment with new and untested research techniques and methods.

7.4.1.4. Research Question A1d: What is the relationship between Motivation and SGI Propensity?

Ryan and Deci's (2000) seminal work relating to self-determination theory was used in assessing academic researchers' levels of motivation in conducting academic research in order to further test the extent of SGI propensity. It is argued that academic researchers that are intrinsically motivated, rather than extrinsically motivated will be apt to have higher SGI propensities, since the internalising of one's work is expected to result in improved performance (Tremblay, et al., 2009). In this case, improved innovative performance.

The self-determination continuum (Ryan & Deci, 2000) defines motivation as existing along a continuum, with three distinct stages, including amotivation, extrinsic motivation and intrinsic motivation. While amotivation and intrinsic motivation exist on the continuum as pure forms of zero-level motivation and 'pure' intrinsic motivation, respectively, extrinsic motivation can be further subdivided into smaller components, which range in terms of 'regulation', or the extent to which an individual has internalised certain activities or tasks. These components of extrinsic motivation include external regulation, introjected regulation, identified regulation and integrated regulation; each of which describes extrinsic motivation as a function of the extent of internalisation.

The results of the quantitative study indicated that motivation and SGI propensity associate positively. That is, respondents that were intrinsically motivated tended to have higher SGI propensities since a high motivation score indicates a respondent that is intrinsically motivated, as per the WEIMS scale, used to determine motivation

(Tremblay, et al., 2009). Tests of hierarchical multiple regressions confirmed this association.

In the qualitative study respondents made frequent reference to motivational factors that are inherently associated with intrinsic motivation, further validating the findings of the quantitative study. When prompted to describe motivational factors that enhance or accelerate innovative academic research, responses generally revolved around several interlinking themes, including passion, value creation, objective achievement and curiosity; all of which link directly to intrinsic motivation.

It is interesting to note that mention of external motivational factors also emerged from the qualitative research. Reference to money, or financial objectives as well as ego were also noted as potential motivators in academic research, although these themes were substantially less common than those relating to intrinsic motivation. On the self-determination continuum, money or the attainment of financial objectives can be seen as a form of external regulation, where one "[does] an activity only to obtain a reward" (Tremblay, et al., 2009: 214). Ego, on the other hand is slightly closer to the intrinsic motivation, yet still falls under the extrinsic motivation domain, most closely associated with introjected regulation, or the regulation of behaviour through self-worth contingencies, such as self-esteem or guilt (Tremblay, et al., 2009).

In conclusion, Research Question A4 is answered in that motivation and SGI propensity are indeed associated. More importantly, it is the attainment of intrinsic, or internal motivation that is imperative in attaining high levels of SGI propensity, or innovative research output. However, these findings do not provide a holistic perspective of the issue of motivation. Research Question 5A, builds on research Question 4A, in delving further into the potential interaction effect of motivation on the theoretical model.

7.4.1.5. Research Question A1e: What is the mediating effect of motivation on the relationship between SGI Propensity and ARP?

While personality can be considered a variable that is proximal, or 'nearby' to the individual, motivation can be seen as a variable that is contiguous, or 'embedded' within the individual (Langston & Sykes, 1997). This warrants further examination of motivation, in investigating individual-level differences in the relationship between SGI propensity and ARP. As such, the extent of the mediating effect of the items of the self-determination continuum on the relationship between SGI propensity and motivation were tested.

Clearly, as per the result of the qualitative study in which respondents represent a 'high-end' cross section of academia in the South African context, SGI Propensities, levels of ARP and intrinsic motivation are all expected to be highly correlated. This was proved true, as per the results of Question 6, where high performance and highly innovative respondents all made common reference to intrinsic motivational factors such as passion, curiosity, value creation and objective achievement as the primary motivational contributors to innovative research productivity and performance. Only a small proportion of the qualitative sample made reference to externally motivating factors such as ego and financial gains, and these were mentioned only in reference to academia in general.

The quantitative study, which directly measured each of the constructs of motivation along the self-determination continuum with the use of the WEIMS scale (Tremblay, et al., 2009) allowed for further analysis, particularly with regard to the relationship between SGI propensity and ARP. In order to do so, six hypotheses were derived, correlating to the six levels of motivation along the self-determination continuum, each investigated by way of a test of mediation (Baron & Kenny, 1986).

The tests of mediation pertaining to the quantitative sample, where the relationship between SGI propensity and ARP are expected to be inverse, produced interesting results. Whilst it was discovered that all respondents in the quantitative sample experience the inverse relationship between SGI propensity and ARP, this relationship is indeed mediated according to the respondents' position along the self-determination continuum, indicating that motivation does indeed mediate the relationship between SGI propensity and ARP. Those respondents that were strongly extrinsically motivated, or entirely unmotivated (amotivation) were found to experience a strong inverse relationship between SGI propensity and ARP. On the other hand, as respondents' inclined towards intrinsic motivation, or moved further along the continuum, the same inverse relationship remained, but this relationship was significantly weaker. This finding confirms that academic researchers who are intrinsically motivated, are less likely to accede to the widespread standard of academic failure or low innovativeness. Once an academic researcher has internalised their profession and becomes curious, passionate and experiences great satisfaction or deriving of pleasure from their profession, then SGI propensity and ARP become *less* inverse.

This result represents an important finding in this study as it suggests that perhaps a key solution to the problem of academic failure (Camparino, 2009) is the identification of motivational factors that may impede the advancement of innovation in academia.

Together with the findings of Research Question A3, on personality, it is suggested here that the shaping of individual-level variances in personality and motivation in the academic context, are extremely important in solving the dilemma of academic failure.

7.4.1.6. Research Question A2: What is the relationship between HCI and ARP?

Research Question B considers two of the three major variables under study in this research, without the confounding influence of SGI propensity. Per the results of testing Research Question A1 and A2, it would seem that both ARP and HCI have negative influences of levels of SGI propensity. This would indicate a potential lack of innovation and innovative thinking amongst academic researchers, although this result differs when considering only the extreme level of research productive academic researchers.

In measuring the association between HCI and ARP, two variables which seem to generally decrease SGI propensity, it is hoped to gain further understanding of the elements that lead to decreased innovativeness. It is assumed these two variables will be directly related. As an academic researcher gains experience, it is expected that

levels of research output would increase, discounting the level of innovation inherent in said academic research output.

The results of the quantitative study confirmed this assumption; high levels of ARP were positively and strongly correlated with HCI. The same results held when testing for hierarchical multiple regression and controlling for gender, field of study, language nationality, title and university affiliation, both with and without sample outliers.

In terms of the qualitative study, it is taken that the respondents, all being highly rated academic researchers, have high levels of ARP as well as high levels of HCI, since the NRF rating system provides official ratings only to those academic researchers that have consistently produced high levels of high quality research output, over time (NRF, 2015). This would validate the findings of the quantitative study, in concluding that HCI and ARP are indeed significantly positively associated. As academic researchers gain experience, their levels of ARP increase. Again, it is important to note that the interaction between HCI and ARP does not take into account the level of innovativeness, or SGI propensity inherent to the ARP in question.

Thus, in answering Research Question A3, it is clear that HCI and ARP are indeed positively associated and experience a direct relationship, amongst academic researchers in South African universities. These findings can be used to strengthen the findings of Research Questions A1 and A2, in that if ARP and HCI are intrinsically related, their interaction with SGI propensity is bound to be similar.

7.4.1.7. Research Question B: What is the interactive effect of Gender on the relationship between SGI Propensity and ARP?

If ARP, or levels of performance are expected to differ in males and females (Leahey, 2006), then it would also be expected that gender differences would have a significant impact on the relationship between SGI Propensity and ARP.

Leahey (2006) suggests that the disparity in research productivity amongst males and females can be ascribed to societal or cultural familial roles, such as maternity leave, as well as the notion that females tend to specialise less than males (Leahey, 2006). In general, males tend to have higher levels of academic research productivity than women (Leahey, 2006), as the spillover effect of additional duties commonly associated with females impacts performance levels.

In terms of personality, particularly in the case of measurements of the NEO-FFI (agreeableness, extraversion, neuroticism, conscientiousness and openness) females have been found to score highly in the traits of neuroticism and agreeableness (Chapman, 2007), while males tended towards openness, extraversion and conscientiousness (Chapman, 2007). By contrast, studies on the relationship between gender and motivation based on self-determination theory determined near-zero effect sizes, or negligible differences between males and females in terms of motivation (Fortier, 2012). If these theoretical assumptions hold true, similar results are expected in this sample.

The interactive effect of gender on five different hypothesised relationships was tested, using tests of moderation, as prescribed by Baron and Kenny (1986). In the relationship between ARP and SGI propensity, males were shown to be more susceptible to the negative influence of increased ARP, while the difference in female respondents was not significant. These findings support the findings of Research Question A1 and gender theory, which predicts the same effect (Leahey, 2006; Chapman, 2007).

A similar result was found in testing the moderating effect of gender on the relationship between HCI and SGI propensity. Also expected to be inverse, as a result of prolonged exposure to a non-innovativeness academic environment, females were found to be slightly less susceptible to the negative influence of accumulated experience on SGI propensity, although for both males and females the relationship remained an inverse one.

While the results of the test of moderation that investigated the effect of gender on the relationship between personality and SGI propensity proved inconclusive, this does provide an interesting area for further study. For Chapman (2007), females are expected to associate positively with personality traits such as agreeableness and neuroticism, which should theoretically link to lower SGI propensities. On the other hand males, expected to be more prone to openness, are expected to have higher SGI propensities.

Gender was also found to moderate the relationship between motivation and SGI propensity. Males were more likely to be intrinsically motivated and thus, more inclined to have higher SGI propensities while females were also likely experience the same relationship but to a slightly lesser extent. While this difference may have been significant, it was also very small which perhaps confirms Fortier's (2012) assertion of negligible differences in motivation amongst males and females.

In testing the moderating effect of gender on the relationship between HCI and ARP, a non-significant effect showed the relative non-difference between males and females in this regard. The findings of Research Question B; that these two variables increase or decrease concurrently still holds and it now becomes evident that gender differences do not alter this relationship.

As indicated in the discussion chapter, the qualitative sample was heavily skewed in favour of male respondents and there was no indication of specific themes or categories that linked solely to male or female respondents. As such, it is difficult to discern any immediate differences in males and females from the qualitative portion of this research. However, this does indicate that highly rated academic researchers, as per NRF rankings, are potentially skewed in favour of males, perhaps a validation of Leahey's (2006) theory on gender differences in research productivity. This introduces another interesting area for further research.

In conclusion to answer Research Question C, gender differences do account for variances in certain relationships in the theoretical model. As per the assertions of Leahey (2006), the potential spillover effect of family life generally attributable to females does seem, to some extent, to impact on research productivity. Gender

differences in personality and motivation, in relation to SGI propensity and ARP are suggested as areas for further research.

7.4.1.8. Research Question C: What is the interactive effect of Field of Study on the relationship between SGI Propensity and ARP?

The interactive effect of field of study was also investigated using tests of moderation (Baron & Kenny, 1986) in conjunction with consideration of the findings of the qualitative study. In sub-dividing respondent areas of research into 'fields of study', four separate categories were created. It is acknowledged that these categories are broadly generalised but the differentiation does provide for interesting insight into the the relationship between SGI propensity and ARP.

Field 1: Medicine and Biology: SGI theory pertains primarily to the field of health sciences, particularly virology, pharmaceuticals production and cancer and AIDS-related research (Callaghan, 2014a, 2014b, 2014c) as well as the study of biological systems, such as swarm theory, evolution and the collective mechanism (Callaghan, 2015). It is expected that respondents that fall under this category would have high levels of SGI propensity, as crowdsourcing has in recent times becomes exponentially more popular in these areas of study.

Field 2: Business, Commerce and Law: respondents belonging to this Field category are those that conduct academic research relating primarily to management and economic sciences, as well as research pertaining to law. While evidence of SGI does exist in these areas, it is not as abundant as in the spheres of medicine and biology. As a result, it is expected that respondents in these areas of research would have low SGI propensities.

Field 3: Mathematics and Science: respondents that conduct research in areas such as engineering, physics, chemistry, statistics, computer science and mathematics belong to Field 3, expected to have high SGI propensities. These areas of research investigate natural and abstract occurring phenomena through the use of complex mathematical methods and processes, all of which are susceptible to SGI. Computer science, software engineering and complex mathematical algorithm design have long been at the forefront of crowdsourcing and open source production, the open-source development of software, such as in the case of Linux (Brabham, 2008) and the success of Google's search engine (Metz, 2015). Both have proven to be significantly successful models.

Field 4: Humanities: comprises of areas of study related to the study of people, such as psychology, history, sociology, art and language. Again, while progress in crowdsourcing and other SGI-related research techniques has infiltrated these areas of study, SGI propensities are expected be lower than for those respondents belonging to Fields 1 and 2.

In summary, the four field categories can be split into two broader categories – those that are expected to have high SGI propensities because of their close association to recent trends and advancements in crowdsourcing and SGI (Fields 1 and3) and those that are expected to have low SGI propensities (Fields 2 and 4), because of the lesser extent to which these fields are related to SGI and crowdsourcing. This differentiation

is loosely based on Thornhill's (2005) typology of high and low-technology industries.

In the quantitative study, Field 1 and Field 3, the 'high-technology' categories were used to test the moderating effect on the relationships in the theoretical model. The reasoning for including only these two categories is because results from the tests of moderation show the moderating effect of respondents belonging to these categories *and* respondents that do not belong to these categories, giving a clear indication as to the interactive effect of field of study for the entire sample. Testing the moderating effect of field of study on the relationship between SGI propensity and ARP showed that respondents belonging to the 'high-technology fields' experience a positive relationship between SGI propesnity and ARP, in that ARP and SGI propensity increase and decrease concurrently, contrary to the general trend of the sample. Similar results were discovered when testing the moderating effect of field of study on the relationship between HCI and SGI propensity, which is also expected to be inverse. While the test for Field 3 proved to be insignificant, respondents in Field1 also showed a direct, positive relationship, this time between HCI and SGI propensity.

These findings show respondents that belong to Fields 1 and 3 do indeed have high SGI propensities and moreso that as they gain experience, their SGI propensities increase in conjunction with increases in ARP. On the other hand, the results of both of the abovementioned tests showed that those respondents that do *not* belong to Field 1 or Field 3, or those respondents that belonged to Field 2 or 4 did experience the expected inverse relationships between SGI propensity and ARP and HCI and SGI propensity, respectively. The respondents in the 'low-technology' fields of study are prone to the negative consequences of academic failure, while 'high-technology' respondents, are not.

These results show that in 'high-technology' fields of research, the problem of academic failure is already becoming mitigated by the introduction of SGI. This provides for exciting new potentialities in combatting innovation failure in general and signals perhaps a turning point, in solving the problem of convergence in academia (Kuhn, 1970, Callaghan, 2014a). Indeed, the proposed SGI revolution may already be underway.

Testing the moderating effect of field of study on the relationship between personality and SGI propensity yielded no significant results, nor did the test for the moderating effect of field of study on the relationship between motivation and SGI propensity. These are both suggested as potential areas for further study.

When testing the moderating effect of field of study on the relationship between HCI and ARP, it was found that respondents belonging to Field 1 and 3 (high-technology) do have a direct relationship between HCI and ARP; as one increases or decreases, so does the other (as per the findings pertaining to Research Question B). However, for respondents not belonging to Field 1 or 3 (respondents in Field 2 and 4), the relationship between HCI and ARP becomes inverse; as these academic researchers gain experience, or become more familiar with the convergent academic views of conformity and non-innovativeness, their research productivity decreases. Again, this provides insight into the impact that the introduction of SGI in academic research has had, in the brief space of time it has existed. Those academic researchers that research

in fields that are gradually implementing SGI and crowd-based research techniques can be seen to be moving away from the dominant paradigm of academic failure associated with non-innovativeness, while those in other areas of research, remain left behind.

The results of the qualitative study validated and to a large extent, confirmed the findings of the quantitative study. Qualitative respondents belonging to Fields 1 and 3 (primarily consisting of A-Rated researchers) made the most frequent references to SGI, including open source software or open access production, the use of new technologies such as the Internet, social media and smartphone technology as well crowdfunding in relation to improving ARP, or levels of innovativeness in academic research. These same respondents also generally agreed on the non-innovative nature of academia and the problematic issue of reliance on closed academic paradigms.

While this may show a high SGI propensity amongst Field 1, 3 and A-Rated respondents it must be noted that many respondents in these categories also provided contrary responses to the general trend. Some emphasised caution in the use of crowdsourcing, highlighting issues related to validity and quality control, especially in situations relating to catastrophic events. Other respondents in these categories also disagreed with the notion of academic failure, claiming that lack of innovation in academia is impossible, as academia is inherently innovative.

Fields 2 and 4 consisted of only a small percentage of the total sample but these respondents generally shared the views of respondents belonging to Fields 1 and 3. In general terms, respondents across all four fields seemed to show relatively high SGI propensity, although those with lower propensities were extremely low.

The results of the qualitative study do not provide a clear indication of the fundamental dichotomy in SGI propensities amongst different fields of research as the results of the quantitative study, but similar conclusions can be drawn. Essentially, the divide between ‘high’ and ‘low’ technology fields of study does suggest that SGI and SGI-based research techniques and methodologies are already beginning to infiltrate into academia in South Africa. As a result, those in fields of study that are prone to high SGI propensities, are already beginning to see the associated benefits of SGI; the effects of academic failure are slowly becoming mitigated over time. At the same time, the awareness of SGI in the context of academia is widespread amongst the South African academic ‘elite’ (the qualitative sample), but views and opinions on SGI are still divided, some remain uncertain and even unconvinced of the potential of SGI.

To answer Research Question D, the results of both qualitative and quantitative studies seem to indicate that field of study does indeed significantly moderate the relationship between SGI propensity and ARP.

7.5. Recommendations

Recommendations for stakeholders and for potential further research are now briefly discussed. If SGI does indeed hold the potential to accelerate the rate at which academic innovation occurs, then it is recommended that gradual procedural change be implemented to allow for the incorporation of SGI into certain areas of academia.

The potential benefits of essentially dissolving the problem of knowledge aggregation (Hayek, 1945) may provide academic researchers with the capabilities to solve problems previously thought unsolvable (Callaghan, 2014a). Furthermore, if SGI has indeed already become prevalent in academia, then as per the fundamentals of Moore's Law, it is recommended that innovation and change in the academic context be anticipated, predicted and managed correctly and ultimately harnessed to guide long-term planning and set targets for research and development (Disco & Barend, 1998). Additionally, the potential for the application and implementation of SGI-based research practice may expand beyond academia into commercial research. This provides an interesting opportunity for further study.

The potential application of SGI in the global academic innovation context is also, recommended as an area for further study, as the findings of this research are taken to generalisable in the South African context only.

7.6. Conclusion

The objective of this chapter was to summarise the results of the process of hypothesis testing in relation to the research problem and research questions, to provide a discussion of the implications of the research for theory and practice and to make recommendations for stakeholders and for further research. The research questions that provided the rationale and structure for the research were outlined. A summary of the research objectives was provided. A summary of the findings was provided, together with recommendations. The following are the primary conclusions from this research.

This study was undertaken in order to understand the potential applicability and potential of SGI in the academic context. It is argued that academia can be seen as a cross-section of the state of innovation as a whole, since the two are intrinsically linked in knowledge creation, research and development (Dewald, et al., 1986). However, the convergence of best practice (Kuhn, 1970) may have resulted in an academic research paradigm that is fundamentally fixed and very difficult to change, representing a string of serious problems for the future of innovation in academia and academia in general. This relates closely to Joy's Law on tacit knowledge (Lakhani & Panetta, 2007) in that the knowledge that exists in academia is tacit and very difficult to move. The same can be said of academic research paradigms, which seem to remain static and resistant to change. It would seem that the problems relating to the stagnation of the innovation pipeline (McKenna, 2014) have been transposed on contemporary practice in academia.

It is also argued that Callaghan's (2014a) suggestion of the implementation of SGI in order to combat these problems is also applicable in the case of academia. This study was undertaken to assess this proposed applicability of SGI in the context of academia.

In investigating the relationship between SGI propensity and ARP, the results of this study find that academic researchers that produce more output are less inclined to have high SGI propensities. This inverse relationship points to a fundamental inconsistency in academia, which should in theory be a "breeding ground" for innovation (Christensen, 1997) and essentially proves Callaghan's (2014a) notion of

innovation failure, or the inadequacy of 'first generation' innovation, in academia. Additionally, it was discovered that the more experienced the academic researcher, the less willing they may be to incorporate crowd-based and open-sourced SGI processes into their research, as a result of prolonged exposure to a non-innovative environment. Becker's (1962) theory on human capital investment holds true. However the return on investment (with the investment being years of experience) is negative.

As such, it is suggested that SGI may represent a new iteration of Schumpeterian creative destruction in the academic research context and thus, it is to be expected that resistance may be present (Smith, 2010). By considering the seminal typology of innovation developed by Henderson and Clark (1990), which still holds today, SGI can be considered a radical innovation in the context of academia, and one that will bring with it untold disruption in the current state of equilibrium (Smith, 2010).

However, once this state of non-innovative equilibrium is punctuated through the gradual adoption of SGI, it is expected that a much faster and more open adoption of crowd-based and open-source SGI practices will occur. The findings of this research seem to indicate that this process of SGI seeping into academia has in fact already begun. It is expected that through a process of 'natural selection', analogous to that of evolutionary theory (Teece, 1998), the academic research paradigms associated with non-innovativeness and convergence will gradually become extinct, being replaced with more adaptable and flexible research paradigms. While this procedure may be highly disruptive, academia should in the long run see untold benefits. The impact of individual-level motivation and personality should also be taken into account in assessing SGI in the academic context. In general, fostering intrinsic motivation and personalities associated with openness in academia, may lessen the abrasiveness of SGI as it punctures the current state of equilibrium.

The empirical findings of this research are taken to be generalisable to the South African context, in that most academic researchers that undertook this study displayed similar relationships between the variables under study. Generalisability to the global context however, may not be viable. The study of SGI in the global academic innovation context is recommended as an area for further study. This research has provided empirical evidence in a South-African specific context in the form of certain statistical associations that either supported or contested theory, and the research questions were answered through an analysis of these results.

It is argued that this research is significant for the following reasons. Firstly, the theoretical principles that govern innovation and knowledge management theory are uniquely suited to investigating the potential and applicability of SGI in the context of academic research. This is particularly valid in light of the phenomenon of academic failure, or the proverbial 'market failure' of academia to produce innovative output (McKenna, 2014; Camaprino, 2009). This study offers a useful perspective on the innovative capability of academia in South Africa.

Secondly, this research offers a solution to the problem of lack of knowledge surrounding the issue of SGI in South African academia. While the era of SGI may indeed have already started, the transition from the contemporary state of non-innovation will likely not be smooth. This research points to evidence of strong

resistance to the world of open source and crowd-based research techniques and methodologies. As previously discussed, it is important to remember that SGI is not suggested as a replacement to contemporary or 'first generation' innovation in academia, rather that it is suggested as a mechanism that can be used to improve innovation in academia (Callaghan, 2015a).

Thirdly, this research provides a theoretical framework for the further development and application of SGI, in the broader academic context. If SGI has indeed already become prevalent in academia, then as per the fundamentals of Moore's Law, it is recommended that innovation and change in the academic context be anticipated, predicted and managed correctly and ultimately harnessed to guide long-term planning and set targets for research and development (Disco & Barend, 1998).

It is therefore argued in this research, that the consequences of a lack of knowledge of how to transcend the constraints of academic failure represent significantly problematic potential future outcomes for academia internationally. Non-adoption of SGI in academia may result in substandard innovative research output, with potentially dire consequences for the state of academia as a whole. It is also argued that processes, techniques and methodologies relating to the incorporation of SGI in academia requires extensive testing and development in order to smooth the forthcoming transition that into the "fourth industrial revolution" (WEF, 2015: 1), that is expected with the emergence of SGI in academia.

REFERENCES

Abernathy, W. J., & Utterback, J. M. (1978). Patterns of industrial innovation.*Technology Review*, 64(7), 254-228.

Abramo, G., D'Angelo, C. A., & Di Costa, F. (2014). Investigating returns to scope of research fields in universities. *Higher Education*, 68(1), 69-85.

Ackerman, P. L., & Cianciolo, A. T. (2000). Cognitive, perceptual-speed, and psychomotor determinants of individual differences during skill acquisition. *Journal of Experimental Psychology: Applied*, 6(4), 259.

Adair, J.G., & Vohra, N. (2003). The Explosion of Knowledge, References, and Citations. *American Psychologist*, 58(1), 15-23.

Afuah, A., & Tucci, C. L. (2012). Crowdsourcing as a solution to distant search. *Academy of Management Review*, 37(3), 355-375.

Altbach, P. (2015). The costs and benefits of world-class universities. *International Higher Education*, 1(33), 5-8.

Anderson, N. L., & Anderson, N. G. (1998). Proteome and proteomics: new technologies, new concepts, and new words. *Electrophoresis*, 19(11), 1853-1861.

Anderson, P., & Tushman, M. L. (1990). Technological discontinuities and dominant designs: A cyclical model of technological change. *Administrative Science Quarterly*, 1(1), 604-633.

Averett, N. (2013). With Funding Tight, Researchers Tap the Public. *BioScience*. *63*(11), 908-908.

Atkinson, Hilgard, Nolen-Hoeksema, S., Fredrickson, B. L., Loftus, G. R., & Lutz, C. (2014). *Introduction to Psychology*. Cengage Learning EMEA.

Balicer, R. D. (2007). Modeling infectious diseases dissemination through online role-playing games. *Epidemiology*, *18*(2), 260-261.

Barnett, C (2015) Trends Show Crowdfunding to Surpass VC in 2016. *Forbes* Available at: http://www.forbes.com/sites/chancebarnett/2015/06/09/trends-show-crowdfunding-to-surpass-vc-in-2016/#31303295444b [Accessed: 19 February 2016]

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173.

Barrick, M. R., Stewart, G. L., Neubert, M. J., & Mount, M. K. (1998). Relating member ability and personality to work-team processes and team effectiveness. *Journal of Applied Psychology*, 83(3), 377.

Basalla, G. (1988). *The Evolution of Technology*. Cambridge University Press.
Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *The Journal of Political Economy*, 1(1), 9-49.

Bers, J. A., Dismukes, J. P., Mehserle, D., Rowe, C. (2011). Extending the Stage-Gate-System Model to Radical Innovation: The Accelerated Radical Innovation Model. *Technology Management in the Energy Smart World (PICMET), 2011 Proceedings of PICMET'11*, 1-17.

Bers, J., Dismukes, J., Miller, L., Dubrovensky, A. (2009). Accelerated Radical Innovation: Theory and Application. *Technological Forecasting and Social Change*, 76(1), 165 – 177.

Besley, T. J., & Ghatak, M. (2003). Competition and incentives with motivated agents. *LSE STICERD Research Paper No. TE465*. 2003.

Black, S. E., & Lynch, L. M. (2001). How to compete: the impact of workplace practices and information technology on productivity. *Review of Economics and Statistics*, 83(3), 434-445.

Blake, M. K., & Hanson, S. (2005). Rethinking innovation: context and gender. *Environment and Planning*, 37(4), 681-701.

Blundell, R., Dearden, L., Meghir, C., & Sianesi, B. (1999). Human capital investment: the returns from education and training to the individual, the firm and the economy. *Fiscal Studies*, 20(1), 1-23.

Bornmann, L., Leydesdorff, L., & Van den Besselaar, P. (2010). A meta-evaluation of scientific research proposals: Different ways of comparing rejected to awarded applications. *Journal of Informetrics*, 4(3), 211-220.

Bosma, N., Van Praag, M., Thurik, R., & De Wit, G. (2004). The value of human and social capital investments for the business performance of startups. *Small Business Economics*, 23(3), 227-236.

Boyd, D. (2013) The Role of Gender in Innovation. *Psychology Today.* Available At: https://www.psychologytoday.com/blog/inside-the-box/201306/the-role-gender-in-innovation [Accessed: 19 April, 2015].

Boyle, G. J. (2008). Critique of the five-factor model of personality. *The SAGE Handbook of Personality Theory and Assessment, 1(1),* 295-312.

Boynton, R. (2004). The Tyranny of Copyright? *The New York Times*, 25 January 2004. (25-26)

Brabham, D. (2008). Crowdsourcing as a Model for Problem Solving: An Introduction and Cases. Convergence. *The International Journal of Research into New Media Technologies*, 14(1), 75-90.

Brabham, D. (2008). Crowdsourcing as a Model for Problem Solving: An Introduction and Cases. *The International Journal of Research into New Media Technologies*, 14(1), 75-90.

Brown, E. (2012). *Working the Crowd: Social Media Marketing for Business*. BCS, The Chartered Institute, 2012.

Bryman, A. (2004). *Social Research Methods*. New York: Oxford University Press, 2004.

Buecheler, T., Sieg, J. H., Füchslin, R. M., & Pfeifer, R. (2010). Crowdsourcing, Open Innovation and Collective Intelligence in the Scientific Method-A Research Agenda and Operational Framework. *ALIFE*, 1(1), 679-686.

Bunting, I. (2015). Research Universities in Africa: An empirical overview of eight flagship universities. *Knowledge Production and Contradictory Functions in African Higher Education*, 1(1), 18.

Buré, C. (2007). Gender in/and Science, Technology and Innovation Policy: An overview of current literature and findings. *Comissioned Paper.*

Burrell, G., & Morgan, G. (1979). *Sociological Paradigms and Organisational Analysis*. London: Heinemann, 1979.

Callaghan, C. W. (2014a). A New Probabilistic Problem-Solving Paradigm: A Conceptual Critical Reflection. *Mediterranean Journal of Social Sciences, 5*(23), 2070.

Callaghan, C. W. (2014b). Solving Ebola, HIV, Antibiotic Resistance And Other Challenges: The New Paradigm Of Probabilistic Innovation. *American Journal of Health Sciences (AJHS), 5*(2), 165-178.

Callaghan, C. W. (2014c). R&D failure and second generation R&D: New potentialities. *Mediterranean Journal of Social Sciences, 5*(3), 11.

Callaghan, C. W. (2015a). Crowdsourced 'R&D'and medical research. *British Medical Bulletin*, 115(1) 67-76.

Callaghan, C.W. (2015b). Stigmergy and the Crowd: Swarm Intelligence, Knowledge Management Theory and Societal Problem Solving in Real Time. *Unpublished*.

Callaghan, C.W. (2016a). Disaster Management, Crowdsourced R&D and Probabilistic Innovation Theory: Toward Real Time Disaster Response Capability. *International Journal of Disaster Risk Reduction*, 17, 238-250.

Callaghan, C.W. (2016b). A New Paradigm of Knowledge Management: Crowdsourcing as Emergent Research and Development. *Southern African Business Review*, 20, 1-28.l

Callaghan, C.W. (2016c). Capital-centric versus knowledge centric paradigms of human resource management: A historical perspective. *Acta Comercii*, 16(1), 1-11.

Callison-Burch, C., Dredze, M. (2010) Creating Speech and Language Data With Amazon's Mechanical Turk. *Proceedings of the NAACL HLT 2010 Workshop on Creating Speech and Language Data with Amazon's Mechanical Turk*, 1-12.

Campanario, J.M. (2009). Rejecting and resisting Nobel class discoveries: accounts by Nobel Laureates. *Scientometrics*, 81(2): 549-565.

Campbell-Kelly, M. (2004). Not All Bad: A Historical Perspective on Software Patents. *Mich. Telecomm. & Tech. L. Rev*, 1(1), *11*-191.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, 56(1), 81-105.

Centers for Disease Control and Prevention (CDC) (2013). Update: Severe respiratory illness associated with Middle East Respiratory Syndrome Coronavirus (MERS-CoV)--worldwide, 2012-2013. *MMWR. Morbidity and Mortality Weekly Report*, *62*(23), 480.

Chan, L., Kirsop, B., & Arunachalam, S. (2011). Towards open and equitable access to research and knowledge for development. *PLoS Medicine*, *8*(3), 100-116.

Chapman, B. P. (2007). Gender differences in Five Factor Model personality traits in an elderly cohort. *Personality and Individual Differences*, 43(6), 1594-1603.

Chaves, M. (1996). Ordaining women: The diffusion of an organizational innovation. *American Journal of Sociology*, 1(1), 840-873.

Chesbrough, H. (2003a). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business Press, 2003.

Chesbrough, H. (2006). Open innovation: a new paradigm for understanding industrial innovation. *Open innovation: Researching a New Paradigm*, 1(1), 1-12.

Chesbrough, H. (2007). Business model innovation: it's not just about technology anymore. *Strategy & Leadership*, *35*(6), 12-17.

Chesbrough, H., & Crowther, A. K. (2006). Beyond high tech: early adopters of open innovation in other industries. *R&D Management*, *36*(3), 229-236.

Christensen, C. M. (1997). *The Innovator's Dilemma: The Revolutionary Book that Will Change the Way You Do Business*. Collins Business Essentials, 1997.

Christensen, L. B., Johnson, B., & Turner, L. A. (2011). *Research Methods, Design, and Analysis*. Allyn & Bacon, 2011.

Clark, P. B., & Wilson, J. Q. (1961). Incentive systems: A theory of organizations. *Administrative Science Quarterly*, 1(1), 129-166.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2013). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. Routledge, 2013.

Cohen, W. & Levinthal, D. (1990) Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, 128(35), 128-52.

Collier, N., Son, N. T., & Nguyen, N. M. (2011). OMG U got flu? Analysis of shared health messages for bio-surveillance. *Journal of Biomedical Semantics*, *2*(5), 1-10.

Colombelli, A., Krafft, J., & Quatraro, F. (2013). Properties of knowledge base and firm survival: Evidence from a sample of French manufacturing firms. *Technological Forecasting and Social Change*, *80*(8), 1469-1483.

Costa, P. T. & McCrae, R. R. (1989). Reinterpreting the Myers‐Briggs type indicator from the perspective of the five‐factor model of personality. *Journal of Personality*, 57(1), 17-40.

Costa, P. T., & McCrae, R. R. (1990). Personality disorders and the five-factor model of personality. *Journal of Personality Disorders*, 4(4), 362-371.

Costa, P. T., & McCrae, R. R. (1995). Domains and facets: Hierarchical personality assessment using the Revised NEO Personality Inventory. *Journal of Personality Assessment*, 64(1), 21-50.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. *Handbook of Mixed Methods in Social and Behavioral Research*, 1(2), 209-240

D'onfro, J. (2015) Bill Gates: The world's next epidemic could be much worse than Ebola, and here's what we need to invest in to stop it. *Business Insider*. Available At: http://www.businessinsider.com/bill-gates-on-the-next-big-epidemic-2015-3 [Accessed 16 September 2015]

Danilda, I., & Granat Thorslund, J. (2011). *Innovation and Gender*. Stockholm: Vinnova, 2011.

Debackere, K. (2000). Managing academic R&D as a business at KU Leuven: context, structure and process. *R&D Management*, 30(4), 323-328.

de La Fuente, A. (2011). Human capital and productivity. *Nordic Economic Policy Review*, 2(2), 103-132.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*, 18(1), 105-110.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125(6), 627-630.

Derényi, I., & Vicsek, T. (1995). Cooperative transport of Brownian particles. *Physical Review Letters*, *75*(3), 374-380.

Devaux, A., & Paparoditis, N. (2010). Increasing interactivity in street view web navigation systems. *Proceedings of the 18th ACM International Conference on Multimedia*, 903-906.

Dewald, W. G., Thursby, J. G., & Anderson, R. G. (1986). Replication in empirical economics: The journal of money, credit and banking project. *The American Economic Review*, 1(1), 587-603.

DeYoung, C. G., Quilty, L. C., & Peterson, J. B. (2007). Between facets and domains: 10 aspects of the Big Five. *Journal of Personality and Social Psychology*, 93(5), 870-880.

Dhillon, R, Glatter, R., Srikishna, D (2016). To Fight the Zika Pandemic, Learn From Ebola, *Harvard Business Review.* Available at: https://hbr.org/2016/02/to-fight-the-zika-pandemic-learn-from-ebola. [Accessed: 14 January, 2016].

Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology*, 41(1), 417-440.

Disco, C., Barend, M. (1998) Getting New Technologies Together. *New York: Walter de Gruyter*, 206-207.

Dismukes, J. (2004) Accelerated Radical Innovation. *Res-Technology Management,* 47(1), 2-4.

Doloi, H. K. (2011). Understanding stakeholders' perspective of cost estimation in project management. *International Journal of Project Management*, 29(5), 622-636.

Dong, Y., & Peng, C. Y. J. (2013). Principled missing data methods for researchers. *SpringerPlus*, 2(1), 1-17.

Dosi, G. (1982). Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change. *Research Policy*, 11(3), 147-162.

Drucker, P. F. (1988). The Coming of the New Organization. *Harvard Business Review*, 1(1), 45-53.

Drucker, P.F. (1994). The Age of Social Transformation. *The Atlantic Monthly,* 94(11), 11-94.

Dustdar, S., Bertino E., Motari-Nezhad, H., Ignjatovik, A., Bentallah, B., Allahbakhsh, M. (2013). Quality Control in Crowdsourcing Systems, Scale Workflow. *IEEE Computer Society*,17(2), 76-81.

Edwards, A. W. F. (1984). *Likelihood*. CUP Archive, 1984.

Egghe, L. (2005). Relations between the continuous and the discrete Lotka power function. *Journal of the American Society for Information Science and Technology*, 56(7), 664-668.

Eshel, B. (2013). Learning about Bacteria from Natural Information Processing. *Annals of the New York Academy of Sciences*, 1178(1), 78-90.

Eysenck, H. J. (1967). Intelligence assessment: a theoretical and experimental approach. *British Journal of Educational Psychology*, 37(1), 81-98.

Field, A. (2012) *Discovering Statistics using IBM SPSS Statistics*. London: Sage, 2012.

Finley, K (2015) Open source is going even more open, because it has to, *Wired Magazine*. Available at*:* http://www.wired.com/2015/07/open-source-going-even-openbecause/ [Accessed: 23 December 2015]

Forbes, N., & Wield, D. (2002). From followers to leaders: managing technology and innovation in newly industrializing countries, *Psychology Press*, 2002.

Fortier, M. (2012). A meta-analysis of the influence of gender on self-determination theory's motivational regulations for physical activity. *Canadian Psychology/Psychologie Canadienne*, 53(4), 291.

Garnier, S., Gautrais, J., & Theraulaz, G. (2007). The biological principles of swarm intelligence. *Swarm Intelligence*, 1(1), 3-31.

Ghuari, P. & Gronhaug, K. (2010). *Research Methods in Business Studies: A Practical Guide.* (Fourth Edition ed.) FT-Pearson, 2010.

Gillet, N., Vallerand, R. J., & Lafrenière, M. A. K. (2012). Intrinsic and extrinsic school motivation as a function of age. The mediating role of autonomy support. *Social Psychology of Education*, 15(1), 77-95.

Glaser, B. G., & Strauss, A. L. (1967). *The Discovery of Grounded Theory: strategies for qualitative research*. London: New Brunswick, 1967.

Goneos-Malka, A., Grobler, A., & Strasheim, A. (2013). Suggesting new communication tactics using digital media to optimise postmodern traits in marketing. *Communicatio*n, 39(1), 122-143.

Grant, R. M. (1996). Toward a Knowledge-Based Theory of the Firm. *Strategic Management Journal*, 17(2), 109-122.

Greenberg, J (2015) How Google Became Alphabet, From A to Z, *Wired Magazine*. Available at: http://www.wired.com/2015/08/how-google-became-alphabet/ [Accessed on: 23 December, 2015]

Guba, E. G. (1981). Criteria for Assessing the Trustworthiness of Naturalistic Inquiries. ERIC/ECTJ Annual Review. *Educational Communication and Technology*, 29(2), 75-91.

Gujarati, D. N., & Porter, D. (2009). *Basic Econometrics*. Mc Graw-Hill International Edition. 2009.

Hagel, J., & Brown, J. S. (2011). Creation nets: harnessing the potential of open innovation. *Journal of Service Science (JSS)*, 1(2), 27-40.

Halifax, Justine, (2013), Superbugs immune to antibiotics a threat to humans as big as terrorism or climate change. *Birmingham Mail*. Available at: http://www.birminghammail.co.uk/lifestyle/health/superbugs-immune-antibiotics-bigger-threat-3410907. [Accessed 30 May 30 2015]

Hanson, R. (1995). Could Gambling Save Science. *MIT*. Available at: http://li.mit.edu/Stuff/CNSE/Paper/Hanson90.pdf [Accessed 1 December 2015]

Hayek, F. A. (1945). The use of knowledge in society. *The American Economic Review*, 35(4), 519-530.

Henderson, R. M., & Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, 1(1), 9-30.

Hertel, G., Niedner, S., & Herrmann, S. (2003). Motivation of software developers in Open Source projects: an Internet-based survey of contributors to the Linux kernel. *Research Policy*, 32(7), 1159-1177.

Hilbert, M., Lopez, P. (2011) The World's Technological Capacity to Store, Communicate and Compute Information. *Science Magazine*, 332 (6025), 60 – 65.

Ho, U. (2014) Crowdscience: Technology and the Masses. *IOL*. Available at: http://www.iol.co.za/scitech/science/news/crowd-science-technology-and-the-masses-1.1751765 [Accessed 22 March, 2015.]

Howe, J., (2006) The Rise of Crowdsourcing, *Wired Magazine.* Available at: http://www.wired.com/wired/archive/14.06/crowds_pr.html [Accessed: 16 March 2015.]

Huang, H. C. (2009). Designing a knowledge-based system for strategic planning: A balanced scorecard perspective. *Expert Systems with Applications*, 36(1), 209-218.

Humbert, M. (2007). Technology and Workforce: Comparison Between the Information Revolution and The Industrial Revolution. *University of California, 2013.*

Huotari, K., & Hamari, J. (2012). Defining gamification: a service marketing perspective. *Proceeding of the 16th International Academic MindTrek Conference.* ACM, 17-22.

Ipeirotis, P (2013). Project Troia: Quality Assurance in Crowdsourcing , A Computer Scientist in a Business School. *Behind the Enemy Lines.* Available at: http://www.behind-the-enemy-lines.com/2013/06/project-troia-quality-assurance-in.html [Accessed 12 March 2015]

Irwin, A. (1995). *Citizen science: A study of people, expertise and sustainable development*. Psychology Press, 1995.

Jackall, R. (1988). Moral mazes: The world of corporate managers. *International Journal of Politics, Culture, and Society*, 1(4), 598-614.

Jackson, K. M., & Trochim, W. M. (2002). Concept mapping as an alternative approach for the analysis of open-ended survey responses. *Organizational Research Methods*, 5(4), 307-336.

Jain, A., Raj, S., Misra, R., & Baveja, B. M. (2015, April). Road congestion sensing via crowdsourcing and MapReduce. *Proceedings of the 14th International Conference on Information Processing in Sensor Networks*. ACM, 356-357.

Jakobwitz, S., & Egan, V. (2006). The dark triad and normal personality traits. *Personality and Individual Differences*, 40(2), 331-339.

Johnson, N. P., & Mueller, J. (2002). Updating the accounts: global mortality of the 1918-1920" Spanish" influenza pandemic. *Bulletin of the History of Medicine*, 76(1), 105-115.

Kerr, C., Harbison, F. H., Dunlop, J. T., & Myers, C. A. (1960). Industrialism and industrial man. *International Lab. Review*, 1(1), *82* - 236.

Keyes, R (2006) The Impact of Moore's Law. *Solid State Circuits Newsletter, 3(20), 25-27.*

Kirkham, D. (2016). Drug companies vow to work more closely with governments to combat antimicrobial resistance. *BMJ*, 1(1), *352*-410.

Kittur, A., Chi, E., Suh, B. (2008). Crowdsourcing for Usability: Using Micro-Task Markets for Rapid, Remote, and Low-cost User Measurements. *Proc. CHI,* 2008.

Kobayashi, T., Nakamori, Y., & Wierzbicki, A. P. (2007). Management of technology in academic research. *Creative Environments*. Springer Berlin Heidelberg, 353-368.

Kochugovindan, S., & Vriend, N. J. (1998). Is the Study of Complex Adaptive Systems Going to Solve the Mystery of Adam Smith's" Invisible Hand"?.*Independent Review-Oakland, 1(3), 53-66.*

Kondratiev, N. D. (1925). The major economic cycles. *Voprosy Konjunktury*, *1*(1), 28-79.

Kopetz, H. (2011). *Real-time systems: design principles for distributed embedded.* Springer Science and Business Media, 2011.

Krommenhoek, R., Galpin, J. (2014). Statistical Research Design and Analysis, *University of Witwatersrand*. Johannesburg, 2014.

Kuhn, T. S. (1970). *The Structure of Scientific Revolutions. 2nd Edition*. Chicago: University of Chicago Press, 1970.

Lakhani, K. , Wolf, R. (2005). Why Hackers Do What They Do: Understanding Motivation And Effort In Free/Open Source Software Projects. *Perspectives On Free And Open Source Software*, 1(1), 3-22.

Lakhani, K., Jeppeson, L., Lohse, P., Panttea, J. (2007). The Value of Openness in Scientific Problem Solving, *Working Paper*, 2007.

Lakhani, K., Panetta, J. (2007) The Principles of Distributed Innovation. *Innovations: Technology, Governance, Globalization*, 2(3), 97-12.

Lakoff, A. (2015). Two states of emergency: Ebola 2014. *Limn 5: Ebola's Ecologies*, 2015.

Langston, C. A., & Sykes, W. E. (1997). Beliefs and the Big Five: Cognitive bases of broad individual differences in personality. *Journal of Research in Personality*, 31(2), 141-165.

Larsen, R. J., & Buss, D. M. (2010). *Personality psychology: Domains of knowledge about human nature* (4th Edition). New York: McGraw-Hill, 2010.

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, 27(2), 131-150.

Leahey, E. (2006). Gender differences in productivity research specialization as a missing link. *Gender & Society*, 20(6), 754-780.

Lin, Y. D., Hwang, R. H., Baker, F. (2012) Computer Networks: an Open Source Approach. *McGraw-Hill*, 2012.

Lindquist, J. (1975). *Implementing Contract Learning Innovation Process in Higher Education.* ERIC, 1975.

Loch, C. H., & Huberman, B. A. (1999). A punctuated-equilibrium model of technology diffusion. *Management Science*, 45(2), 160-177.

Lynch, L. M., & Black, S. E. (1995). *Beyond the incidence of training: evidence from a national employers survey* (No. w5231). National Bureau of Economic Research. 1995.

MacKinnon, D. P. (2008). Mediation analysis. *The Encyclopedia of Clinical Psychology*, 2008.

Maher, K, (2013). The Drugs Don't Work. *Time Magazine*. Available at http://www.bbc.co.uk/news/health-22649922. [Accessed on May 30, 2015].

Mahoney, M. J. (1977). Publication prejudices: An experimental study of confirmatory bias in the peer review system. *Cognitive Therapy and Research*, 1(2), 161-175.

Martin, S., & Scott, J. T. (2000). The nature of innovation market failure and the design of public support for private innovation. *Research Policy*, 29(4), 437-447.

Marvel, M. R., & Lee, I. H. (2011). Gender and the innovation activity of entrepreneurs: a multilevel analysis. *Frontiers of Entrepreneurship Research*, 31(8), 1.
Marwell, G. (1975). Why ascription? Parts of a more or less formal theory of the functions and dysfunctions of sex roles. *American Sociological Review*, 72(1), 445-455.

McAdam, M., & Marlow, S. (2008). A preliminary investigation into networking activities within the university incubator. *International Journal of Entrepreneurial Behavior & Research*, 14(4), 219-241.

McCrae, R. R. (2001). Trait psychology and culture: Exploring intercultural comparisons. *Journal of personality*, 69(6), 819-846.

McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of personality and social psychology*, 52(1), 81.

McCrae, R. R., & Costa Jr, P. T. (1999). A five-factor theory of personality.*Handbook of personality: Theory and research*, 2(1), 139-153.

McCrae, R. R., & John, O. P. (1992). An introduction to the five‐factor model and its applications. *Journal of personality*, 60(2), 175-215.

McKenna, M. (2014). Sneak Peek: What the White House is Thinking About Antibiotic Resistance, *Wired Magazine.* Available at: http://www.wired.com/2014/04/pcast-resistance/ [Accessed 6 April 2014].

Mell, P., & Grance, T. (2010). The NIST definition of cloud computing.*Communications of the ACM*, *53*(6), 50.

Metz, C (2015). Microsoft: An Open Source Windows Is Definitely Possible. *Wired Magazine*. Available at: (http://www.wired.com/2015/04/microsoft-open-source-windows-definitely-possible/)[Accessed on 5 April 2015]

Metz, C (2016). AI Is transforming Google Search, the Rest of the Web is Next, *Wired Magazine*. Available at: http://www.wired.com/2016/02/ai-is-changing-the-technology-behind-google-searches/?mbid=social_twitter [Accessed 27 January 2016]

Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis, 2nd ed*. Thousand Oaks: Sage, 1994.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2013). *Qualitative data analysis: A methods sourcebook.* SAGE Publications, Incorporated, 2013.

Millward, L. J., & Freeman, H. (2002). Role expectations as constraints to innovation: The case of female managers. *Communication Research Journal*, 14(1), 93-109.

Mitchell, M., & Taylor, C. E. (1999). Evolutionary computation: an overview. *Annual Review of Ecology and Systematics*, 30(1), 593-616.

Morgeson, F. P., Campion, M. A., Dipboye, R. L., Hollenbeck, J. R., Murphy, K., & Schmitt, N. (2007). Reconsidering the use of personality tests in personnel selection contexts. *Personnel psychology*, 60(3), 683-729.

Murphy, K. R., & Davidshofer, C.O. (2005). *Psychological Testing.* 6th Ed. New Jersey: Pearson Education, 2005.

Nonaka, I. (1991). The knowledge-creating company. *Harvard business review*, 69(6), 96-104.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization science*, 5(1), 14-37.

Nordström, K., & Biström, M. (2002). Emergence of a dominant design in probiotic functional food development. *British Food Journal*, 104(9), 713-723.

NRF (National Research Foundation) (2016) Available at: http://www.nrf.ac.za/ [Accessed 12 January 2016]

Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools*, 13(1), 48-63.

Ozer, D. J., & Benet-Martinez, V. (2006). Personality and the prediction of consequential outcomes. *Annu. Rev. Psychol.*, 57(1), 401-421.

Pearson, M (2016). Zika Virus Spreads Public Health Emergency, *CNN*. Available at: http://edition.cnn.com/2016/02/01/health/zika-virus-public-health-emergency/index.html. [Accessed 16 January 2016]

Perkman, M, Walsh, K. (2007). University-industry relationships and open innovation : towards a research agenda. *International Journal of Management Reviews*, 9(4), 259–280.

Peters, D. P., & Ceci, S. J. (1982). Peer-review practices of psychological journals: The fate of published articles, submitted again. *Behavioral and Brain Sciences*, 5(2), 187-195.

Petersen, E. E. (2016). Interim guidelines for pregnant women during a Zika virus outbreak—United States, 2016. *MMWR. Morbidity and mortality weekly report*, 65(1).

Pieterse, J. N. (2009). *Globalization and culture: Global mélange*. Rowman & Littlefield Publishers, 2009.

Pinder, C. C. (1998). *Work motivation in organizational behavior.* Upper Saddle River, NJ: Prentice Hall, 1998.

Podsakoff, P. M., & Schriesheim, C. A. (1985). Field Studies of French and Raven's Bases of Power: Critique, Reanalysis, and Suggestions for Future Research. *Psychological Bulletin*, 97(3), 387-411.

Polanyi, M. (1973). Personal Knowledge: Toward a Post-Critical Philosophy. London. Routledge & Kegan Paul, 1973.

Popper, K. R. (1959). The Propensity Interpretation of Probability. *The British Journal for the Philosophy of Science*, 10(37), 25-42.

Popper, K. R. (1963). *Science: Conjectures and Refutations: The Growth of Scientific Knowledge*. London: Routledge, 1963.

Powell, W., Snellman K. (2014). The Knolwedge Economy. *Stanford University Press. Product Innovation Management*, 29(2), 245-256.

Pugliesi, K. (1995). Work and well-being: Gender differences in the psychological consequences of employment. *Journal of Health and Social Behavior*, 1(1) 57-71.

Radoff, J. (2016). Gamification, Behaviorism and Bullshit. *Jon Radoff's Internet Wonderland,* 2016.

Redding, S. (1996). The low-skill, low-quality trap: Strategic complementarities between human capital and R & D. *The Economic Journal*, 1(1), 458-470.

Reed, R., Storrud-Barnes, S., & Jessup, L. (2012). How open innovation affects the drivers of competitive advantage: Trading the benefits of IP creation and ownership for free invention. *Management Decision*, 50(1), 58-73.

Reskin, B. F., & Visher, C. A. (1986). The impacts of evidence and extralegal factors in jurors' decisions. *Law and Society Review*, 1(1), 423-438.

Ritzer, G. (1993). The McDonalidization of Society. *Reference and Research Book News. Portland*: May 2004, 19(2). 1993.

Rosa, P., & Dawson, A. (2006). Gender and the commercialization of university science: academic founders of spinout companies.*Entrepreneurship and Regional Development*, 18(4), 341-366.

Rosenkopf, L., & Nerkar, A. (2001). Beyond local search: boundary‐spanning, exploration, and impact in the optical disk industry. *Strategic Management Journal*, 22(4), 287-306.

Rothwell, R. (1992). Successful industrial innovation: critical factors for the 1990s. *R&D Management*, 22(3), 221-240.

Rothwell, R., & Gardiner, P. (1989). The strategic management of re-innovation. *R&D Management*, 19(2), 147-160.

Rubin, A. (2014). The Potential of A Second Generation of R&D Paradigm Applied to Academic Entrepreneurial Innovation. Conference Proceeding From South African Institute of Management Sciences, September 2014. *SAIMS 10(1). Johannesburg. 2014.*

Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: examining reasons for acting in two domains. *Journal of personality and social psychology*, 57(5), 749.

Ryan, R., Deci, E (2000). Self-determination theory and the facilitation of intrinsic motivation, social development and well-being, *American Psychologist*, 55(1) 68-78.

Rynes, S. L., Bartunek, J. M., & Daft, R. L. (2001). Across the great divide: Knowledge creation and transfer between practitioners and academics.*Academy of management Journal*, 44(2), 340-355.

Sakkab, N. Y. (2002). Connect & develop complements research & develop at P&G. *Research-Technology Management*, 45(2), 38-45.

Salmann, S (2016). The Global Crowdfunding Industry Raised $34.4 Billion In 2015, And Could Surpass VC In 2016. *Dazeinfo*. Available at: http://dazeinfo.com/2016/01/12/crowdfunding-industry-34-4-billion-surpass-vc-2016/ [Accessed: January 7, 2016].

Samson, A (2006). Gender and Science, Technology and Innovation. *IDRC Innovation, Policy and Science Program Area, Strategic Commissioned Paper*. April 2006.

Saporito, B. (2013). The conspiracy to end cancer. *Time*, *181*(12), 6-30.

Scholz, N. (2015). Empirical Research Results: Description, Analysis and Synthesis. *The Relevance of Crowdfunding*, 1(1), 45-63.

Schumpeter, J. (1942) *Capitalism, Socialism and Democracy*, 1942.

Sciaca, N (2016). The Internet Crowdsourced an Entirely New Kind of Facewash, *Mashable*. Available At: http://mashable.com/2016/01/24/milky-jelly-face-wash/#H2UnTzzQXaq3 [Accessed 16 January 2016]

Semmelweis, Ignaz; Carter, K. Codell (translator, extensive foreword) (September 15, 1983) [1861], *Etiology, Concept and Prophylaxis of Childbed Fever*, University of Wisconsin Press, 1983.

Sharma, R. S., Soe, K. M. Y., & Balasubramaniam, D. (2014). Case studies on the exploitation of crowd-sourcing with Web 2.0 functionalities. *International Journal of Electronic Business*, 11(4), 384-408.

Smith, A. (1776). *An inquiry into the nature and causes of the wealth of nations: Volume One*.

Smith, D (2010). Exploring Innovation, Second Edition, McGraw-Hill, London, 2010.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological methodology*, 13(2), 290-312.

Soumitra, D. (2012). The Global Innovation Index 2012: Stronger Innovation linkages for Global Growth. *INSEAD, 2012*.

Spradley, J. P. (1979). The ethnographic interview. *New York: Holt, Rinehart and Winston*, 1979.

St. Laurent, A. (2008) Understanding Open Source and Free Software Licensing. *O'Reilly Media.* 2008.

Stieger, D., Matzler, K., Chatterjee, S., & Ladstaetter-Fussenegger, F. (2012). Democratizing Strategy. *California Management Review*, 54(4), 44-68.

Stockton, N (2015) The US is finally taking action on antibiotic resistance, *Wired Magazine* ,Available at: http://www.wired.com/2015/09/us-finally-taking-action-antibiotic-resistance/. [Accessed: 16 January 2016].

Surowiecki, J. (2004). *The Wisdom of Crowds*. London: Little, Brown. 2004.

Suits, D. B. (1957). Use of dummy variables in regression equations. *Journal of the American Statistical Association*, 52(280), 548-551.

Susman, G. I., & Evered, R. D. (1978). An assessment of the scientific merits of action research. *Administrative science quarterly*, 1(1), 582-603.

Swan, M. (2012). Sensor mania! the internet of things, wearable computing, objective metrics, and the quantified self 2.0. *Journal of Sensor and Actuator Networks*, 1(3), 217-253.

Teece, D. J. (1980). Economies of scope and the scope of the enterprise.*Journal of economic behavior & organization*, 1(3), 223-247.

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research policy*, 15(6), 285-305.

Thompson, L. (2014). Is Crowdfunding Really a Capital Raising Boon? Boards & Shareholders . *Compliance Week*, 1(1), 56-57.

Thompson, P & McHugh, D (2009). *Work Organisations – A Critical Approach*, Palgrave Macmillan, New York, 2009.

Tidd, J., Pavitt, K., & Bessant, J. (2001). *Managing innovation*, 1(3), 10-17.

Torr-Brown, S. (2013). Crowdsourcing for science and medicine: progress and challenges. *The Journal of OncoPathology*, 1(2), 75-81.

Tremblay, M. A., Blanchard, C. M., Taylor, S., Pelletier, L. G., & Villeneuve, M. (2009). Work Extrinsic and Intrinsic Motivation Scale: Its value for organizational psychology research. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, 41(4), 213.

Twigg, G. (1984). *The black death: a biological reappraisal*. Batsford Academic and Educational. 1984.

Vallerand, R. J., & Reid, G. (1984). On the causal effects of perceived competence on intrinsic motivation: A test of cognitive evaluation theory. *Journal of Sport Psychology*, *6*(1), 94-102.

Von Ahn, L., Maurer, B., McMillen, C., Abraham, D., & Blum, M. (2008). recaptcha: Human-based character recognition via web security measures. *Science*, *321*(5895), 1465-1468.

von Hippel, E. (1976). The dominant role of users in the scientific instrument innovation process. *Research policy*, 5(3), 212-239.

von Hippel, E. (1994). "Sticky information" and the locus of problem solving: implications for innovation. *Management science*, 40(4), 429-439.

von Hippel, E. (2005). Democratizing innovation: The evolving phenomenon of user innovation. *Journal für Betriebswirtschaft*, 55(1), 63-78.

Vukovic, M. (2009, July) Crowdsourcing for Enterprises. *Services-I, 2009 World Conference on IEEE*. 686-692.

Wagner, C., Kawulich, B., Garner, M. (2013). Doing Social Research: A Global Context*MCGraw-Hill Higher Education. 2013.*

Wang, J., Ipeirotis, P. G., Provost, F. (2011) Managing Crowdsourcing Workers. *The 2011 Winter Conference on Business Intelligence*, 10-12.

Wang, Z., & Wang, N. (2012). Knowledge sharing, innovation and firm performance. *Expert systems with applications*, 39(10), 8899-8908.

Wasik, B (2011) #Riot: Self organized hyper networked revolts – coming to a city near you, *Wired Magazine*. Available at: http://www.wired.com/2011/12/ff_riots/ [Accessed 16 January 2016].

Watson, D., & Clark, L. A. (1984). Negative affectivity: the disposition to experience aversive emotional states. *Psychological bulletin*, 96(3), 465.

Wheeler, D. A. (2005). Why open source software/free software (OSS/FS, FLOSS, or FOSS)? Look at the numbers! 2005.

Widiger, Thomas A. (1995). Conoley, Jane Close; Impara, James C., eds. Review of the Revised NEO Personality Inventory. The Twelfth Mental Measurements Yearbook (Lincoln, NE: Buros Institute of Mental Measurements). 1995.

Wigfield, A.; Guthrie, J. T.; Tonks, S.; Perencevich, K. C. (2004). Children's motivation for reading: Domain specificity and instructional influences. *Journal of Educational Research,* 97(1), 299–309.

Williams, D., Ducheneaut, N., Xiong, L., Zhang, Y., Yee, N., & Nickell, E. (2006). From tree house to barracks the social life of guilds in world of warcraft. *Games and culture*, 1(4), 338-361.

World Health Organization. (2003). Consensus document on the epidemiology of severe acute respiratory syndrome (SARS). 2003.

Wright, R., & Keith, L. (2014). Wearable Technology: If the Tech Fits, Wear It. *Journal of Electronic Resources in Medical Libraries*, *11*(4), 204-216.

Yong, E (2013) How the Science of Swarms Can Help Us Fight Cancer and Predict the Future, *Wired Magazine*. Available at: http://www.wired.com/2013/03/powers-of-swarms/ (Accessed 16 January 2016].

Yu, L., & Nickerson, J. V. (2011). Cooks or cobblers?: crowd creativity through combination. *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, 1393-1402.

Zaidan, O., Callison-Burch, C. (2011). Crowdsourcing Translation: Professional Quality from Non-Professionals. *Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics*, 19(24), 1220-1229.

Zelenika, I., & Pearce, J. M. (2013). The Internet and other ICTs as tools and catalysts for sustainable development: innovation for 21st century. *Information Development*. 29(3), 217-232.

APPENDIX

9.1. Appendix A: Questionnaire

9.1.1. Questionnaire Sample Participation Form



University of the Witwatersrand
School of Economic and Business Sciences

Date: _____

Good Day

My name is Asaf Rubin; I am a Masters student at the School of Economics and Business Science at the University of the Witwatersrand, Johannesburg. I am conducting research on academic research productivity in South African universities. As an academic researcher, you are invited to take part in this research. The purpose of this research is to assess the potential of a 'second generation' of innovation in academic research, which could potentially improve levels of research output.

Your response is important and there are no right or wrong answers. This survey is both confidential and anonymous. Anonymity and confidentiality are guaranteed by not needing to enter your name on the questionnaire (you may sign with an 'x' if you wish to remain anonymous). Your participation is completely voluntary and involves no risk, penalty, or loss of benefits whether or not you participate. You may withdraw from the survey at any stage.

The survey comprises of a number one word answers and scale questions, which should take no longer than 20 minutes to complete.

Thank you for considering participating. Should you have any questions, or should you wish to obtain a copy of the results of the survey, please contact me:

Contact number: 076 6266244
Email: rubinsav@gmail.com

My supervisor's contact details: (Professor. Chris Callaghan)
Email: Chris.Callaghan@wits.ac.za

Kind regards

Asaf Rubin
Honours Student: Division of Management
School of Economic and Business Sciences
University of the Witwatersrand, Johannesburg

9.1.2. Consent form for Questionnaire

Title of research project: Second Generation Innovation and Academic Research Productivity in South African Universities
Name of principal researcher: Asaf Rubin
Department/research group address: School of Economic and Business Science
Telephone: 076 626 6244
Email: rubinsav@gmail.com

I acknowledge the following:

- I agree to participate in this research project.
- I have read this consent form and the information it contains and had the opportunity to ask questions about them.
- I agree to my responses being used for education and research on condition that my privacy is respected, subject to the following:
  - I understand that my personal details will be used in aggregate form only, so that I will not be personally identifiable.
  - I understand that I am under no obligation to take part in this project.
  - I understand I have the right to withdraw from this project at any stage.

Signature of participant (you may sign with an 'x' if you wish to remain anonymous):

_____

Date: _____

Signature of Researcher: Asaf Rubin



9.1.3. Questionnaire (Adapted from SurveyMonkey version)

9.1.3.1. Section A

SECTION A

The following are several questions about you, your background, and the place where you work. These questions are important because they help us to see if different types of people respond to the questions on the questionnaire in different ways. They are NOT used to identify any individual.

1. What is your age?

   _____

2. What is your gender?

   _____

3. What country were you born in?

   _____

4. What is your first language?

   _____

5. How many years have you been a researcher?

   _____

6. What is your title? (Tick appropriate block)
   - ❑ Mr/Mrs/Ms
   - ❑Dr
   - ❑ Associate/Adjunct Professor
   - ❑ Professor

7. Are you married? (Tick appropriate block)
   - ❑ Yes
   - ❑ No

8. How many children do you support in your family?

   _____

9. In what field(s) do you primarily research?

   _____

10. How many years of education have you received (in years)? (Tick appropriate)
    - ❑ Primary (0-7 years)
    - ❑ High School (8-12 years)
    - ❑ Undergraduate/Honours (13-16 years)
    - ❑ Masters/PHD (17-20 years)

- ❑ Prefer not to say

11. What is the highest level of education your father has received (in years)? (Tick appropriate block)
    - ❑ Primary (0-7 years)
    - ❑ High School (8-12 years)
    - ❑ Undergraduate/Honours (13-16 years)
    - ❑ Masters/PHD (17-20 years)
    - ❑ Prefer not to say

12. What is the highest level of education your mother has received (in years)? (Tick appropriate block)
    - ❑ Primary (0-7 years)
    - ❑ High School (8-12 years)
    - ❑ Undergraduate/Honours (13-16 years)
    - ❑ Masters/PHD (17-20 years)
    - ❑ Prefer not to say

9.1.3.2. Section B

SECTION B

The following are several questions about your work as an academic researcher. These questions are important because they help to see if different types of people respond to the questions in the questionnaire in different ways, They are NOT used to identify any individual.

1. How many (completed) Masters students have you supervised?

   _____
   _____

2. How may (completed) PhD students have you supervised?

   _____
   _____

3. How many South African Department of Higher Education and Training (DOHET) Local (South African but not ISI/IBSS) accredited journal articles (in total) have you had published? (including those accepted for publication)

   _____
   _____

4. How many ISI/IBSS indexed (or internationally accredited journal articles have you had published? (including those accepted for publication)

   _____
   _____

5. How many of your published Department of Higher Education and Training accredited Local or ISI/IBSS accredited journal articles (including those accepted for publication) have been co-authored with another researcher or other researchers?

   _____
   _____

6. How many times has your work been published (including those accepted for publication) in peer reviewed conference proceedings?

   _____
   _____

7. How many presentations have you made at peer reviewed Conferences?

   _____
   _____

8. How many academic research books (not text/prescribed) have you had published?

   _____
   _____

9. How many textbooks (educational/prescribed) have you had published?

   _____
   _____

10. How many academic research books (not text/prescribed books) have you contributed book chapters to?

    _____
    _____

11. How many textbooks (educational/prescribed) have you contributed book chapters to?

    _____
    _____

12. Do you (on average) prefer quantitative, qualitative or mixed methods in your research?

    _____
    _____

9.1.3.3. Page 3: Section C

SECTION C

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please mark you answers with an 'X' in the appropriate block.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	I often feel inferior to others.					
2	Once I find the right way to do something, I stick to it.					
3	I often get into arguments with my family and co-workers.					
4	I'm pretty good about pacing myself so as to get things done on time.					
5	When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.					
6	I don't consider myself especially "light-hearted".					
7	I tend to be cynical and skeptical of others' intentions.					
8	Sometimes I feel completely worthless.					
9	I believe that most people will take advantage of you if you let them.					
10	I waste a lot of time before settling down to work.					
11	I seldom notice the moods or feelings that different environments produce.					
12	I am a cheerful, high-spirited person.					
13	Too often, when things go wrong, I get discouraged and feel like giving up.					
14	I am not a cheerful optimist.					
15	Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.					
16	Sometimes I'm not as dependable or reliable as I should be.					
17	I generally try to be thoughtful and considerate.					
18	I never seem to be able to get organised.					
19	I would rather go my own way than be a leader of others.					
20	I believe we should look to our religious authorities for decisions on moral issues.					

9.1.3.4. Section D

SECTION D

A few important definitions:

- **Crowdsourcing:** the use of 'the Crowd' (any and all people with access to the internet) all contributing to find innovative solutions to problems or to complete projects (for example: Wikipedia)
- **Crowdfunding:** obtaining funds from the crowd (usually via the internet). People contribute small amounts in order to reach a monetary goal (e.g. Kickstarter)

To what extent do you agree/disagree with the following statements? Please tick the appropriate block.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Contemporary research methods are often not useful for solving practical problem					
2	My research requires problems to be solved in 'real time' (as the problem occurs)					
3	My research does not have potential to help solve societal problems					
4	I believe contemporary research practices are flawed					
5	I often pursue research projects that are high risk					
6	External knowledge is essential in building new knowledge					
7	My research would benefit from perspectives from people from different fields of expertise					
8	Smaller teams would be more adept at solving problems rather than large numbers of people					
9	External sources of knowledge (non-academic) would help improve my research productivity					
10	Collaboration would not particularly help improve my research productivity					
11	I would use crowd-funding (obtaining funds from a large undefined network of people to reach a monetary goal, e.g. KickStarter) to obtain research funds					
12	My research does not face budget/funding constraints					
13	People around the world would not be interested in funding my research					
14	I am open to using alternate methods of research funding					
15	Access to more funds would greatly enhance my research productivity					
16	I would make use of 'crowdsourcing' (obtaining inputs from a large undefined network of people) to help solve research problems					
17	I would make use of 'crowdsourcing' to help complete smaller research tasks					
18	Crowdsourcing would not improve my research productivity					
19	Crowdsourcing probably will not improve the quality of solutions to research problems					
20	I am concerned about quality control and validity issues of crowdsourcing					

9.1.3.5. Section E

SECTION E

The following questions concern your beliefs about your job.

Why do you do your job?

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Because this is the type of work I chose to do to attain a certain lifestyle.					
2	For the income it provides me.					
3	I ask myself this question; I don't seem to be able to important tasks related to this work.					
4	Because I derive much pleasure from learning new things					
5	Because it has become a fundamental part of who I am					
6	Because I want to succeed at this job					
7	Because I chose this type of work to attain my career goals					
8	From the satisfaction I experience from taking on interesting challenges					
9	Because it allows me to earn money					
10	Because it is part of the way in which I have chosen to liv life.					
11	Because I want to be very good at this work					
12	I am provided with unrealistic working conditions.					
13	Because I want to be a "winner" in life.					
14	Because it is the type of work I have chosen to attain certa important objectives.					
15	For the satisfaction I experience when I am successful at do difficult tasks					
16	Because this type of work provides me with security.					
17	I don't know, too much is expected of us.					
18	Because this job is a part of my life.					

9.1.3.6. Section F

SECTION F

To what extent do you agree/disagree with each of the following statements? Please mark your answer with an 'X'.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Most of the satisfaction I get from my job comes primarily from teaching					
2	Most of the satisfaction I get from my job comes primarily from administrative work					
3	Most of the satisfaction I get from my job comes primarily from conducting academic research					

~END~

Thank you for participating in this study. Your contribution is appreciated and is invaluable to the research.

9.2. Appendix B: Interview

9.2.1. Interview Sample Participation Form



University of the Witwatersrand
School of Economic and Business Sciences

Date: _____

Good Day

My name is Asaf Rubin; I am a Masters student at the School of Economics and Business Science at the University of the Witwatersrand, Johannesburg. I am conducting research on academic research productivity in South African universities. As an academic researcher, you are invited to take part in this research. The purpose of this research is to assess the potential of a 'second generation' of innovation in academic research, which could potentially improve levels of research output.

Your response is important and there are no right or wrong answers. This research is both confidential and anonymous. Anonymity and confidentiality are guaranteed by not needing to provide your name (you may sign with an 'x' if you wish to remain anonymous). Your participation is completely voluntary and involves no risk, penalty, or loss of benefits whether or not you participate. You may withdraw from the research at any stage.

The research will take place in the form of a thirty-minute interview, consisting of open-ended questions. Your answers, should you agree to participate, will be recorded and thereafter transcribed.

Thank you for considering participating. Should you have any questions or concerns please contact me:

Contact number: 076 6266244
Email: rubinsav@gmail.com

My supervisor's contact details: (Professor. Chris Callaghan)
Email: Chris.Callaghan@wits.ac.za

Kind regards

Asaf Rubin
Masters Student: Division of Management
School of Economic and Business Sciences
University of the Witwatersrand, Johannesburg

9.2.2. Interview Consent Form

Title of research project: Second Generation Innovation and Academic Research Productivity in South African Universities
Name of principal researcher: Asaf Rubin
Department/research group address: School of Economic and Business Science
Telephone: 076 626 6244
Email: rubinsav@gmail.com

I acknowledge the following:

- I agree to participate in this research project.
- I have read this consent form and the information it contains and had the opportunity to ask questions about them.
- I give my consent for this interview to be recorded
- I agree to my responses being used for education and research on condition that my privacy is respected, subject to the following:
  - I understand that my personal details will be used in aggregate form only, so that I will not be personally identifiable.
  - I understand that I am under no obligation to take part in this project.
  - I understand I have the right to withdraw from this project at any stage.

Signature of participant (you may sign with an 'x' if you wish to remain anonymous)

_____

Date: _____

Signature of Researcher: Asaf Rubin



9.2.3. Interview Schedule

Introductory question: please briefly describe your area(s) of research

Questions relating to Innovation and SGI (Open-ended Questions [Estimated time allocations are included in parentheses]

Question 1: In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research? (±5 minutes)

Question 2: A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Question 2.1. (Probe) Have you heard of crowdfunding?

Question 3: Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution? (±5 minutes).

Question 3.1. (Probe) – have you heard of crowdsourcing?

Question 4: Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you agree? (±5 minutes)

a) Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Questions relating to Personality and Motivation (Open-ended Questions) [Estimated time allocations are included in parentheses]

a) In your experience, which personality factors do you think contribute to innovative research? (± 5 minutes)

b) Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you? (±5 minutes)

Final Thoughts
Are there any final thoughts you would like to share?

Thank you for your participation.

9.3. Appendix C: Research Plan

Research Plan 2015			
Task	**Start**	**End**	**Financial Budget**
Pre-Thesis tasks			
Literature Review	1st Jan	28th Feb 2015	
Thesis outline	18th Feb	28th Feb 2015	
Proposal preparation	15th Feb	11th April 2015	
Prepare ethics pack		18th April 2015	
Hand in 1st draft to Supervisor for checking		19th April 2015	
Make changes to proposal	29th March	20th April 2015	
Supervisor checks second draft		1st May 2015	
Final changes to proposal		10th May 2015	
Submit ethics and defense milestone	**15th May**		
Ethics approval		1st July 2015	
Prepare pilot candidates		2nd July 2015	
Present defense		7th July 2015	
Run Pilot test		15th July 2015	
Run pilot test stats and modify tests		23rd July 2015	
Qualitative Data Collection			
Print questions and approval sheets		25th July 2015	
Collect data + record, type – Qual	Early August	Finalise Qual	
Collect Data Quant + capture	Mid August		
Data collection milestone	**End July 2015**		
Stats processing			
Interpret Qual data	Aug		
Run Quant SPSS	Sep		
Combine data	Oct		
Stats milestone	**End Sep 2015**		
Write up first draft of report		1st Dec 2015	
Supervisor to check first draft		1st Feb 2016	
Write up second draft + fixes		15th Feb 2016	
Proof read		20th Feb 2016	
Print, bind, hand in		30th March 2016	1000
Complete		**30th March 2016**	**R1000**

9.4. Appendix D: Consistency Matrix

Research Questions	Hypotheses	Theory	Analysis
RQA1: What is the relationship between SGI propensity and ARP?	**HA1**: SGI Propensity is significantly associated with ARP	SGI (Second Generation Innovation) is a proposed now paradigm of problem solving through the use of distributed knowledge systems, resting on the probabilistic mechanism, which may be attainable through the use of crowdsourcing (Callaghan, 2014a). SGI Propensity is the proclivity of an individual to engage in SGI-based research techniques and methodologies in order to improve productivity and innovative output. SGI propensity is also associated with a belief relating to the 'failure' of 'First Generation' (or contemporary) innovation practice (Callaghan, 2014a) ARP (Academic Research Productivity) is a measure research output measured by an aggregate total of journal article publications.	Quantitative: bivariate correlation, hierarchical multiple regression (Field, 2012) Qualitative: thematic coding and analysis of interviews (Miles & Huberman, 1994)

Research Questions	Hypotheses	Theory	Analysis
RQA2: What is the relationship between HCI and SGI Propensity?	**HA2**: Human Capital Investments (HCI) is significantly associated with SGI Propensity	HCI (Human Capital Investment): individual-level intangible investments such as experience, education and training that results in a return on investment, over time in the form of improved performance (Becker, 1962). SGI Propensity: as above	Quantitative: bivariate correlation, hierarchical multiple regression (Field, 2012) Qualitative: thematic coding and analysis of interviews (Miles & Huberman, 1994)
RQA3: What is the relationship between personality and SGI propensity?	**HA3**: Personality is significantly associated with SGI Propensity	Personality: a psychological construct which measures individual-level differences in terms of five different personality characteristics, including agreeableness, conscientiousness, neuroticism, extraversion and openness to experience (Costa & McCrae, 1990). SGI Propensity: as above	Quantitative: bivariate correlation, hierarchical multiple regression (Field, 2012) Qualitative: thematic coding and analysis of interviews (Miles & Huberman, 1994)
RQA4: What is the relationship between motivation and SGI	**HA4**: Motivation is significantly associated with SGI Propensity	Motivation: a psychological construct which measures motivation. Self-determination theory (Ryan & Deci, 2000)	Quantitative: bivariate correlation, hierarchical multiple regression (Field, 2012)

Research Questions	Hypotheses	Theory	Analysis
propensity?		was used to determine motivation, measuring motivation on a continuum from amotivation, to extrinsic motivation to intrinsic motivation (Tremblay, et al., 2009). SGI Propensity: as above	Qualitative: thematic coding and analysis of interviews (Miles & Huberman, 1994)
RQA5: What is the mediating effect of motivation on the relationship between SGI propensity and ARP?	**HA5:** Motivation mediates the relationship between SGI Propensity and ARP **HA5i:** Amotivation mediates the relationship between SGI Propensity and ARP **HA5ii:** External Regulation mediates the relationship between SGI Propensity and ARP **HA5iii:** Introjected Regulation mediates the relationship between SGI Propensity and ARP **HA5iv:** Identified Regulation mediates the relationship between SGI Propensity and ARP **HA5v:** Integrated Regulation mediates the relationship between SGI Propensity and ARP	The different constructs of motivation along the Self-Determination continuum are expected to interact with SGI propensity at difference levels of significance.	Quantitative: test of mediation (Baron & Kenny, 1986) Qualitative: thematic coding and analysis of interviews (Miles & Huberman, 1994)

Research Questions	Hypotheses	Theory	Analysis
	HA5vi: Intrinsic Motivation mediates the relationship between SGI Propensity and ARP		
RQB: What is the relationship between HCI and ARP?	**HB**: HCI is significantly associated with ARP	HCI: as above ARP: as above	Quantitative: bivariate correlation, hierarchical multiple regression (Field, 2012) Qualitative: thematic coding and analysis of interviews (Miles & Huberman, 1994)
RQC: What is the moderating effect of gender on the theoretical model?	**HC1**: Gender moderates the relationship between SGI Propensity and ARP **HC2**: Gender moderates the relationship between HCI and SGI Propensity **HC3**: Gender moderates the relationship between Personality and SGI Propensity **HC4**: Gender moderates the relationship between Motivation and SGI Propensity **HC5**: Gender moderates the relationship between HCI and ARP	Gender is used to measure the difference between males and females in the relationships in the theoretical model.	Quantitative: test of moderation (Baron & Kenny, 1986) Qualitative: thematic coding and analysis of interviews (Miles & Huberman, 1994)

Research Questions	Hypotheses	Theory	Analysis
RQD: What is the moderating effect of field of study on the theoretical model?	**HC1**: Field of Study moderates the relationship between SGI Propensity and ARP **HC2**: Field of Study moderates the relationship between HCI and SGI Propensity **HC3**: Field of Study moderates the relationship between Personality and SGI Propensity **HC4**: Field of Study moderates the relationship between Motivation and SGI Propensity **HC5**: Field of Study moderates the relationship between HCI and ARP	Field of study is sub-divided into four categories, each associating with the general area of study. It is expected that respondents in different fields of study will experience different relationships in the theoretical model.	Quantitative: test of moderation (Baron & Kenny, 1986) Qualitative: thematic coding and analysis of interviews (Miles & Huberman, 1994)

9.5. Appendix E: SPSS Output

Author's note: SPSS Output has been modified to fit within document margins.

9.5.1. EFA for Personality

Descriptive Statistics

	Mean	Std. Deviation	Analysis N	Missing N
N1	2.319	1.0843	523	6
N2	2.747	1.1241	526	3
N3	2.044	1.0986	523	6
N4	2.307	1.0302	522	7
O1	2.358	.9675	528	1
O2	2.368	1.0254	524	5
O3	2.490	1.2784	527	2
O4	3.535	1.0508	525	4
A1	3.91	.985	523	6
A2	2.75	1.075	524	5
A3	3.07	1.162	526	3
A4	4.18	.792	525	4
C1	2.235	.9807	528	1
C2	2.599	1.0940	526	3
C3	2.394	1.1393	528	1
C4	2.132	.9999	523	6
E1	2.848	1.0725	526	3

E2	2.315	.9478	523	6
E3	2.338	1.0961	523	6
E4	3.222	1.0856	528	1

Correlation Matrix[a]

		N1	N2	N3	N4	O1	O2	O3	O4	A1	A2	A3	A4	C1	C2	C3	C4	E1	E2	E3	E4
Correlation	N1	1.000	.239	.468	.363	.028	-.022	-.107	.032	-.081	.194	-.042	-.059	.133	.181	.175	.228	.084	.197	.192	-.231
	N2	.239	1.000	.341	.413	.025	.031	-.040	.050	-.250	.246	-.163	-.019	.198	.298	.255	.254	.114	.171	.255	-.120
	N3	.468	.341	1.000	.480	.057	.030	-.071	-.002	-.235	.263	-.223	-.094	.195	.194	.260	.293	.143	.302	.331	-.292
	N4	.363	.413	.480	1.000	.053	.051	-.011	-.062	-.212	.267	-.223	-.147	.238	.280	.375	.360	.157	.192	.300	-.257
	O1	.028	.025	.057	.053	1.000	-.118	-.170	.024	-.073	-.029	.234	-.106	.193	.004	.155	.044	-.177	.013	-.021	-.061
	O2	-.022	.031	.030	.051	-.118	1.000	.097	-.213	-.124	.059	-.136	-.102	-.031	.085	.137	.080	.177	.098	.151	-.006
	O3	-.107	-.040	-.071	-.011	-.170	.097	1.000	-.024	-.029	-.025	-.112	-.068	-.129	-.109	-.023	-.049	.139	-.080	-.019	.039
	O4	.032	.050	-.002	-.062	.024	-.213	-.024	1.000	.040	-.061	.056	.189	-.100	-.025	-.076	.016	.003	-.097	-.172	-.008
	A1	-.081	-.250	-.235	-.212	-.073	-.124	-.029	.040	1.000	-.316	.190	.168	-.045	-.139	-.195	-.073	-.110	-.130	-.178	.052
	A2	.194	.246	.263	.267	-.029	.059	-.025	-.061	-.316	1.000	-.296	.018	.117	.206	.169	.094	.151	.246	.275	-.131
	A3	-.042	-.163	-.223	-.223	.234	-.136	-.112	.056	.190	-.296	1.000	-.058	-.045	-.125	-.053	-.121	-.177	-.098	-.202	.004
	A4	-.059	-.019	-.094	-.147	-.106	-.102	-.068	.189	.168	.018	-.058	1.000	-.098	-.005	-.189	-.184	-.035	-.184	-.191	.059
	C1	.133	.198	.195	.238	.193	-.031	-.129	-.100	-.045	.117	-.045	-.098	1.000	.412	.275	.444	-.025	.130	.186	-.159
	C2	.181	.298	.194	.280	.004	.085	-.109	-.025	-.139	.206	-.125	-.005	.412	1.000	.283	.446	.073	.080	.169	-.179
	C3	.175	.255	.260	.375	.155	.137	-.023	-.076	-.195	.169	-.053	-.189	.275	.283	1.000	.362	.056	.063	.206	-.147
	C4	.228	.254	.293	.360	.044	.080	-.049	.016	-.073	.094	-.121	-.184	.444	.446	.362	1.000	.083	.087	.162	-.193

	E1	.084	.114	.143	.157	-.177	.177	.139	.003	-.110	.151	-.177	-.035	-.025	.073	.056	.083	1.000	.307	.289	-.079
	E2	.197	.171	.302	.192	.013	.098	-.080	-.097	-.130	.246	-.098	-.184	.130	.080	.063	.087	.307	1.000	.476	-.252
	E3	.192	.255	.331	.300	-.021	.151	-.019	-.172	-.178	.275	-.202	-.191	.186	.169	.206	.162	.289	.476	1.000	-.234
	E4	-.231	-.120	-.292	-.257	-.061	-.006	.039	-.008	.052	-.131	.004	.059	-.159	-.179	-.147	-.193	-.079	-.252	-.234	1.000
Sig. (1-tailed)	N1		.000	.000	.000	.264	.311	.007	.231	.034	.000	.168	.090	.001	.000	.000	.000	.028	.000	.000	.000
	N2	.000		.000	.000	.287	.238	.183	.124	.000	.000	.000	.329	.000	.000	.000	.000	.005	.000	.000	.003
	N3	.000	.000		.000	.096	.250	.054	.486	.000	.000	.000	.016	.000	.000	.000	.000	.001	.000	.000	.000
	N4	.000	.000	.000		.112	.123	.404	.079	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	O1	.264	.287	.096	.112		.003	.000	.289	.048	.257	.000	.008	.000	.464	.000	.158	.000	.387	.320	.082
	O2	.311	.238	.250	.123	.003		.013	.000	.002	.089	.001	.010	.240	.026	.001	.035	.000	.013	.000	.448
	O3	.007	.183	.054	.404	.000	.013		.293	.255	.287	.005	.059	.001	.006	.302	.133	.001	.033	.333	.184
	O4	.231	.124	.486	.079	.289	.000	.293		.180	.083	.101	.000	.011	.280	.042	.359	.474	.013	.000	.429
	A1	.034	.000	.000	.000	.048	.002	.255	.180		.000	.000	.000	.154	.001	.000	.049	.006	.002	.000	.120
	A2	.000	.000	.000	.000	.257	.089	.287	.083	.000		.000	.339	.004	.000	.000	.016	.000	.000	.000	.001
	A3	.168	.000	.000	.000	.000	.001	.005	.101	.000	.000		.091	.153	.002	.114	.003	.000	.013	.000	.463
	A4	.090	.329	.016	.000	.008	.010	.059	.000	.000	.339	.091		.012	.454	.000	.000	.214	.000	.000	.087
	C1	.001	.000	.000	.000	.000	.240	.001	.011	.154	.004	.153	.012		.000	.000	.000	.283	.001	.000	.000
	C2	.000	.000	.000	.000	.464	.026	.006	.280	.001	.000	.002	.454	.000		.000	.000	.046	.035	.000	.000
	C3	.000	.000	.000	.000	.000	.001	.302	.042	.000	.000	.114	.000	.000	.000		.000	.100	.074	.000	.000
	C4	.000	.000	.000	.000	.158	.035	.133	.359	.049	.016	.003	.000	.000	.000	.000		.029	.025	.000	.000
	E1	.028	.005	.001	.000	.000	.000	.001	.474	.006	.000	.000	.214	.283	.046	.100	.029		.000	.000	.035
	E2	.000	.000	.000	.000	.387	.013	.033	.013	.002	.000	.013	.000	.001	.035	.074	.025	.000		.000	.000
	E3	.000	.000	.000	.000	.320	.000	.333	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000

E4	.000	.003	.000	.000	.082	.448	.184	.429	.120	.001	.463	.087	.000	.000	.000	.000	.035	.000	.000	

a. Determinant = .023

Inverse of Correlation Matrix

	N1	N2	N3	N4	O1	O2	O3	O4	A1	A2	A3	A4	C1	C2	C3	C4	E1	E2	E3	E4
N1	1.382	-.048	-.486	-.214	.045	.041	.083	-.044	-.077	-.103	-.131	.012	.045	-.054	.004	-.072	-.002	-.053	.007	.078
N2	-.048	1.378	-.134	-.324	.013	.021	-.002	-.119	.174	-.062	.006	-.095	-.034	-.186	-.078	-.046	.010	-.048	-.131	-.080
N3	-.486	-.134	1.720	-.347	-.058	.033	.044	-.040	.158	-.019	.198	-.036	-.015	.099	-.065	-.145	.013	-.185	-.136	.170
N4	-.214	-.324	-.347	1.692	-.047	.058	-.042	.085	.015	-.083	.161	.090	-.007	-.042	-.262	-.182	-.084	.062	-.071	.138
O1	.045	.013	-.058	-.047	1.209	.083	.134	-.047	.123	.013	-.257	.074	-.222	.095	-.152	.059	.154	-.030	.032	.026
O2	.041	.021	.033	.058	.083	1.154	-.055	.218	.090	.038	.080	.032	.128	-.077	-.141	-.077	-.128	-.042	-.065	-.015
O3	.083	-.002	.044	-.042	.134	-.055	1.110	.004	.027	.018	.101	.113	.060	.108	-.017	.005	-.155	.132	.020	.032
O4	-.044	-.119	-.040	.085	-.047	.218	.004	1.147	.024	.043	-.027	-.179	.148	.010	.029	-.142	-.093	.030	.154	.047
A1	-.077	.174	.158	.015	.123	.090	.027	.024	1.261	.287	-.116	-.204	-.078	.084	.087	-.104	.036	-.020	-.001	.038
A2	-.103	-.062	-.019	-.083	.013	.038	.018	.043	.287	1.338	.249	-.133	-.020	-.119	-.075	.100	-.018	-.164	-.111	.025
A3	-.131	.006	.198	.161	-.257	.080	.101	-.027	-.116	.249	1.299	.131	.018	.014	-.082	.089	.051	-.039	.113	.107
A4	.012	-.095	-.036	.090	.074	.032	.113	-.179	-.204	-.133	.131	1.224	-.009	-.125	.114	.232	-.052	.184	.133	.034
C1	.045	-.034	-.015	-.007	-.222	.128	.060	.148	-.078	-.020	.018	-.009	1.480	-.364	-.097	-.437	.093	-.088	-.100	.021
C2	-.054	-.186	.099	-.042	.095	-.077	.108	.010	.084	-.119	.014	-.125	-.364	1.486	-.103	-.397	-.029	.066	-.016	.099
C3	.004	-.078	-.065	-.262	-.152	-.141	-.017	.029	.087	-.075	-.082	.114	-.097	-.103	1.377	-.231	.000	.143	-.092	.014
C4	-.072	-.046	-.145	-.182	.059	-.077	.005	-.142	-.104	.100	.089	.232	-.437	-.397	-.231	1.634	-.057	.075	.059	.064
E1	-.002	.010	.013	-.084	.154	-.128	-.155	-.093	.036	-.018	.051	-.052	.093	-.029	.000	-.057	1.251	-.298	-.195	-.027
E2	-.053	-.048	-.185	.062	-.030	-.042	.132	.030	-.020	-.164	-.039	.184	-.088	.066	.143	.075	-.298	1.503	-.475	.183
E3	.007	-.131	-.136	-.071	.032	-.065	.020	.154	-.001	-.111	.113	.133	-.100	-.016	-.092	.059	-.195	-.475	1.554	.114
E4	.078	-.080	.170	.138	.026	-.015	.032	.047	.038	.025	.107	.034	.021	.099	.014	.064	-.027	.183	.114	1.200

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.803
Bartlett's Test of Sphericity	Approx. Chi-Square	1919.878
	df	190
	Sig.	.000

Anti-image Matrices

		N1	N2	N3	N4	O1	O2	O3	O4	A1	A2	A3	A4	C1	C2	C3	C4	E1	E2	E3	E4
Anti-image Covariance	N1	.723	-.025	-.205	-.092	.027	.026	.054	-.027	-.044	-.056	-.073	.007	.022	-.026	.002	-.032	-.001	-.025	.003	.047
	N2	-.025	.725	-.056	-.139	.008	.013	-.001	-.075	.100	-.034	.003	-.056	-.017	-.091	-.041	-.021	.006	-.023	-.061	-.049
	N3	-.205	-.056	.581	-.119	-.028	.017	.023	-.020	.073	-.008	.089	-.017	-.006	.039	-.028	-.052	.006	-.072	-.051	.083
	N4	-.092	-.139	-.119	.591	-.023	.029	-.022	.044	.007	-.037	.073	.044	-.003	-.017	-.113	-.066	-.039	.024	-.027	.068
	O1	.027	.008	-.028	-.023	.827	.060	.100	-.034	.081	.008	-.164	.050	-.124	.053	-.091	.030	.102	-.017	.017	.018
	O2	.026	.013	.017	.029	.060	.867	-.043	.165	.062	.025	.053	.023	.075	-.045	-.089	-.041	-.089	-.024	-.036	-.011
	O3	.054	-.001	.023	-.022	.100	-.043	.901	.003	.019	.012	.070	.083	.036	.065	-.011	.003	-.112	.079	.011	.024
	O4	-.027	-.075	-.020	.044	-.034	.165	.003	.872	.017	.028	-.018	-.128	.087	.006	.018	-.076	-.065	.017	.087	.034
	A1	-.044	.100	.073	.007	.081	.062	.019	.017	.793	.170	-.071	-.132	-.042	.045	.050	-.051	.023	-.011	-.001	.025
	A2	-.056	-.034	-.008	-.037	.008	.025	.012	.028	.170	.748	.143	-.081	-.010	-.060	-.040	.046	-.011	-.082	-.053	.016
	A3	-.073	.003	.089	.073	-.164	.053	.070	-.018	-.071	.143	.770	.083	.009	.007	-.046	.042	.031	-.020	.056	.069
	A4	.007	-.056	-.017	.044	.050	.023	.083	-.128	-.132	-.081	.083	.817	-.005	-.069	.068	.116	-.034	.100	.070	.023

	C1	.022	-.017	-.006	-.003	-.124	.075	.036	.087	-.042	-.010	.009	-.005	.676	-.165	-.048	-.181	.050	-.040	-.044	.012
	C2	-.026	-.091	.039	-.017	.053	-.045	.065	.006	.045	-.060	.007	-.069	-.165	.673	-.050	-.164	-.015	.030	-.007	.055
	C3	.002	-.041	-.028	-.113	-.091	-.089	-.011	.018	.050	-.040	-.046	.068	-.048	-.050	.726	-.103	.000	.069	-.043	.009
	C4	-.032	-.021	-.052	-.066	.030	-.041	.003	-.076	-.051	.046	.042	.116	-.181	-.164	-.103	.612	-.028	.030	.023	.033
	E1	-.001	.006	.006	-.039	.102	-.089	-.112	-.065	.023	-.011	.031	-.034	.050	-.015	.000	-.028	.800	-.159	-.100	-.018
	E2	-.025	-.023	-.072	.024	-.017	-.024	.079	.017	-.011	-.082	-.020	.100	-.040	.030	.069	.030	-.159	.665	-.203	.102
	E3	.003	-.061	-.051	-.027	.017	-.036	.011	.087	-.001	-.053	.056	.070	-.044	-.007	-.043	.023	-.100	-.203	.644	.061
	E4	.047	-.049	.083	.068	.018	-.011	.024	.034	.025	.016	.069	.023	.012	.055	.009	.033	-.018	.102	.061	.834
Anti-image	N1	.825[a]	-.034	-.315	-.140	.035	.032	.067	-.035	-.059	-.076	-.098	.009	.032	-.038	.003	-.048	-.002	-.036	.005	.061
Correlation	N2	-.034	.878[a]	-.087	-.212	.010	.016	-.001	-.094	.132	-.046	.004	-.073	-.024	-.130	-.056	-.031	.008	-.034	-.090	-.062
	N3	-.315	-.087	.849[a]	-.203	-.041	.024	.032	-.029	.107	-.012	.133	-.025	-.009	.062	-.042	-.086	.009	-.115	-.083	.119
	N4	-.140	-.212	-.203	.877[a]	-.033	.041	-.030	.061	.010	-.055	.108	.063	-.004	-.026	-.172	-.109	-.057	.039	-.043	.097
	O1	.035	.010	-.041	-.033	.604[a]	.071	.116	-.040	.100	.010	-.205	.061	-.166	.071	-.118	.042	.125	-.022	.023	.021
	O2	.032	.016	.024	.041	.071	.681[a]	-.049	.190	.075	.031	.065	.027	.098	-.059	-.112	-.056	-.107	-.032	-.049	-.013
	O3	.067	-.001	.032	-.030	.116	-.049	.635[a]	.003	.023	.015	.084	.097	.047	.084	-.014	.004	-.131	.102	.015	.028
	O4	-.035	-.094	-.029	.061	-.040	.190	.003	.556[a]	.020	.035	-.022	-.151	.114	.007	.023	-.104	-.078	.023	.116	.040
	A1	-.059	.132	.107	.010	.100	.075	.023	.020	.762[a]	.221	-.090	-.164	-.057	.061	.066	-.073	.029	-.015	-.001	.031
	A2	-.076	-.046	-.012	-.055	.010	.031	.015	.035	.221	.831[a]	.189	-.104	-.014	-.084	-.055	.068	-.014	-.116	-.077	.020
	A3	-.098	.004	.133	.108	-.205	.065	.084	-.022	-.090	.189	.729[a]	.104	.013	.010	-.061	.061	.040	-.028	.080	.086
	A4	.009	-.073	-.025	.063	.061	.027	.097	-.151	-.164	-.104	.104	.626[a]	-.007	-.093	.088	.164	-.042	.135	.096	.028
	C1	.032	-.024	-.009	-.004	-.166	.098	.047	.114	-.057	-.014	.013	-.007	.781[a]	-.245	-.068	-.281	.068	-.059	-.066	.016
	C2	-.038	-.130	.062	-.026	.071	-.059	.084	.007	.061	-.084	.010	-.093	-.245	.813[a]	-.072	-.255	-.021	.044	-.010	.074
	C3	.003	-.056	-.042	-.172	-.118	-.112	-.014	.023	.066	-.055	-.061	.088	-.068	-.072	.864[a]	-.154	.000	.099	-.063	.011

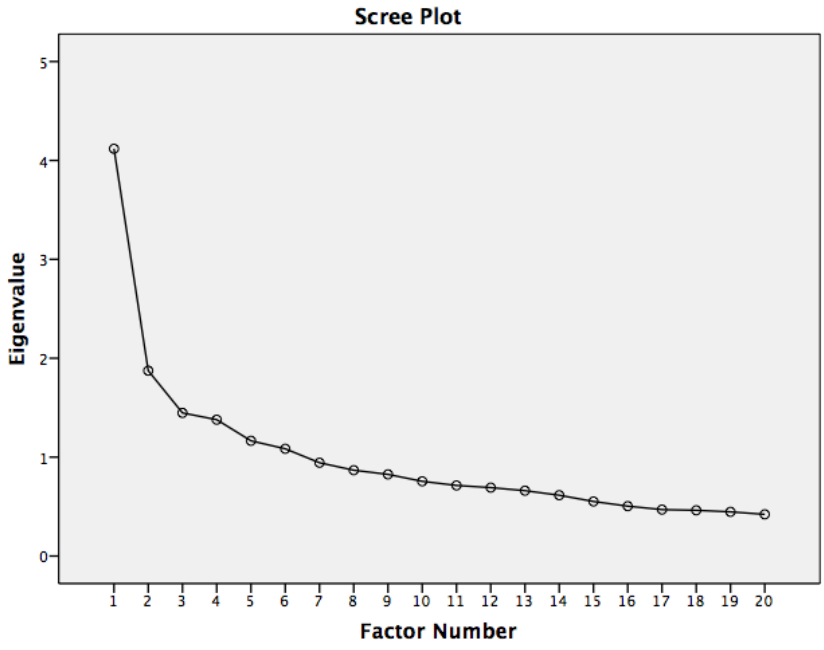
C4	-.048	-.031	-.086	-.109	.042	-.056	.004	-.104	-.073	.068	.061	.164	-.281	-.255	-.154	.799[a]	-.040	.048	.037	.046
E1	-.002	.008	.009	-.057	.125	-.107	-.131	-.078	.029	-.014	.040	-.042	.068	-.021	.000	-.040	.758[a]	-.218	-.140	-.022
E2	-.036	-.034	-.115	.039	-.022	-.032	.102	.023	-.015	-.116	-.028	.135	-.059	.044	.099	.048	-.218	.758[a]	-.311	.137
E3	.005	-.090	-.083	-.043	.023	-.049	.015	.116	-.001	-.077	.080	.096	-.066	-.010	-.063	.037	-.140	-.311	.846[a]	.084
E4	.061	-.062	.119	.097	.021	-.013	.028	.040	.031	.020	.086	.028	.016	.074	.011	.046	-.022	.137	.084	.863[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
N1	.277	.363
N2	.275	.310
N3	.419	.556
N4	.409	.510
O1	.173	.373
O2	.133	.195
O3	.099	.161
O4	.128	.141
A1	.207	.351
A2	.252	.384
A3	.230	.326
A4	.183	.351
C1	.324	.467
C2	.327	.469
C3	.274	.352
C4	.388	.551
E1	.200	.252
E2	.335	.622
E3	.356	.464
E4	.166	.192

Extraction Method: Principal Axis Factoring.



Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.118	20.592	20.592	3.557	17.783	17.783	1.762	8.811	8.811
2	1.874	9.371	29.963	1.251	6.257	24.039	1.596	7.979	16.790
3	1.447	7.236	37.199	.809	4.047	28.086	1.167	5.834	22.624
4	1.379	6.894	44.093	.756	3.781	31.867	1.106	5.530	28.154
5	1.165	5.826	49.919	.557	2.783	34.650	.915	4.574	32.728
6	1.085	5.423	55.342	.460	2.298	36.947	.844	4.219	36.947
7	.944	4.718	60.060						
8	.868	4.340	64.400						
9	.826	4.129	68.528						
10	.756	3.778	72.306						
11	.714	3.569	75.876						
12	.692	3.459	79.335						
13	.661	3.305	82.640						
14	.615	3.075	85.715						
15	.552	2.759	88.474						
16	.505	2.523	90.997						
17	.470	2.348	93.345						
18	.463	2.313	95.658						
19	.447	2.234	97.892						
20	.422	2.108	100.000						

Extraction Method: Principal Axis Factoring.

Factor Matrix[a]

	Factor					
	1	2	3	4	5	6
N1	.462					
N2	.510					
N3	.650					
N4	.663					
O1						
O2						
O3						
O4						
A1						
A2	.447					
A3						
A4						
C1	.444	.410				
C2	.496					
C3	.483					
C4	.547					
E1						
E2	.468		-.446			
E3	.552					
E4						

Extraction Method: Principal Axis Factoring.

a. 6 factors extracted. 20 iterations required.

Reproduced Correlations

		N1	N2	N3	N4	O1	O2	O3	O4	A1	A2	A3	A4	C1	C2	C3	C4	E1	E2	E3	E4
Reproduced Correlation	N1	.363[a]	.257	.431	.369	.057	-.044	-.076	.061	-.092	.159	-.076	-.045	.143	.161	.184	.235	.095	.211	.207	-.236
	N2	.257	.310[a]	.361	.367	.031	.039	-.046	.002	-.227	.282	-.197	-.033	.207	.274	.247	.264	.106	.152	.223	-.167
	N3	.431	.361	.556[a]	.497	.051	.016	-.058	.021	-.220	.285	-.173	-.102	.174	.217	.273	.287	.169	.307	.330	-.283
	N4	.369	.367	.497	.510[a]	.042	.078	-.017	-.023	-.251	.270	-.200	-.151	.238	.295	.351	.379	.150	.202	.296	-.240
	O1	.057	.031	.051	.042	.373[a]	-.123	-.176	-.004	-.064	-.022	.221	-.127	.174	.027	.132	.044	-.197	.009	-.023	-.057
	O2	-.044	.039	.016	.078	-.123	.195[a]	.125	-.139	-.114	.080	-.148	-.146	.015	.056	.096	.082	.154	.101	.164	.002
	O3	-.076	-.046	-.058	-.017	-.176	.125	.161[a]	-.054	-.024	-.027	-.101	-.048	-.152	-.087	-.023	-.046	.091	-.067	-.008	.074
	O4	.061	.002	.021	-.023	-.004	-.139	-.054	.141[a]	.088	-.036	.034	.175	-.054	-.026	-.087	-.048	-.079	-.123	-.144	.005
	A1	-.092	-.227	-.220	-.251	-.064	-.114	-.024	.088	.351[a]	-.301	.197	.122	-.062	-.112	-.212	-.063	-.089	-.121	-.207	.049
	A2	.159	.282	.285	.270	-.022	.080	-.027	-.036	-.301	.384[a]	-.272	.013	.116	.206	.155	.094	.163	.243	.282	-.112
	A3	-.076	-.197	-.173	-.200	.221	-.148	-.101	.034	.197	-.272	.326[a]	-.050	-.008	-.162	-.087	-.097	-.211	-.102	-.188	.035
	A4	-.045	-.033	-.102	-.151	-.127	-.146	-.048	.175	.122	.013	-.050	.351[a]	-.100	-.009	-.215	-.142	-.057	-.161	-.192	.078
	C1	.143	.207	.174	.238	.174	.015	-.152	-.054	-.062	.116	-.008	-.100	.467[a]	.419	.290	.428	-.010	.132	.177	-.170
	C2	.161	.274	.217	.295	.027	.056	-.087	-.026	-.112	.206	-.162	-.009	.419	.469[a]	.284	.444	.063	.085	.181	-.150
	C3	.184	.247	.273	.351	.132	.096	-.023	-.087	-.212	.155	-.087	-.215	.290	.284	.352[a]	.362	.039	.077	.190	-.141
	C4	.235	.264	.287	.379	.044	.082	-.046	-.048	-.063	.094	-.097	-.142	.428	.444	.362	.551[a]	.068	.071	.187	-.198
	E1	.095	.106	.169	.150	-.197	.154	.091	-.079	-.089	.163	-.211	-.057	-.010	.063	.039	.068	.252[a]	.274	.272	-.095
	E2	.211	.152	.307	.202	.009	.101	-.067	-.123	-.121	.243	-.102	-.161	.132	.085	.077	.071	.274	.622[a]	.492	-.249
	E3	.207	.223	.330	.296	-.023	.164	-.008	-.144	-.207	.282	-.188	-.192	.177	.181	.190	.187	.272	.492	.464[a]	-.219
	E4	-.236	-.167	-.283	-.240	-.057	.002	.074	.005	.049	-.112	.035	.078	-.170	-.150	-.141	-.198	-.095	-.249	-.219	.192[a]
Residual[b]	N1		-.018	.036	-.005	-.029	.022	-.031	-.028	.011	.035	.033	-.014	-.010	.021	-.010	-.007	-.011	-.013	-.015	.005

N2	-.018		-.020	.046	-.007	-.008	.007	.049	-.024	-.035	.034	.013	-.009	.024	.008	-.010	.008	.019	.033	.046
N3	.036	-.020		-.017	.006	.013	-.013	-.023	-.015	-.022	-.050	.008	.021	-.023	-.013	.006	-.026	-.004	.001	-.009
N4	-.005	.046	-.017		.011	-.027	.006	-.039	.039	-.003	-.023	.004	.000	-.015	.024	-.019	.007	-.009	.004	-.017
O1	-.029	-.007	.006	.011		.005	.006	.028	-.009	-.007	.013	.022	.019	-.023	.022	.000	.019	.004	.003	-.003
O2	.022	-.008	.013	-.027	.005		-.028	-.074	-.009	-.021	.012	.044	-.046	.029	.041	-.002	.023	-.003	-.013	-.008
O3	-.031	.007	-.013	.006	.006	-.028		.030	-.005	.003	-.010	-.021	.022	-.021	-4.798E-6	-.003	.048	-.013	-.011	-.035
O4	-.028	.049	-.023	-.039	.028	-.074	.030		-.048	-.024	.021	.014	-.045	.001	.012	.063	.082	.026	-.029	-.013
A1	.011	-.024	-.015	.039	-.009	-.009	-.005	-.048		-.015	-.007	.046	.018	-.028	.017	-.010	-.020	-.009	.028	.003
A2	.035	-.035	-.022	-.003	-.007	-.021	.003	-.024	-.015		-.024	.005	.001	.000	.014	-.001	-.012	.003	-.006	-.019
A3	.033	.034	-.050	-.023	.013	.012	-.010	.021	-.007	-.024		-.008	-.037	.038	.034	-.024	.034	.004	-.013	-.031
A4	-.014	.013	.008	.004	.022	.044	-.021	.014	.046	.005	-.008		.002	.004	.026	-.041	.022	-.022	.001	-.019
C1	-.010	-.009	.021	.000	.019	-.046	.022	-.045	.018	.001	-.037	.002		-.007	-.015	.016	-.015	-.002	.009	.011
C2	.021	.024	-.023	-.015	-.023	.029	-.021	.001	-.028	.000	.038	.004	-.007		.000	.002	.010	-.006	-.013	-.029
C3	-.010	.008	-.013	.024	.022	.041	-4.798E-6	.012	.017	.014	.034	.026	-.015	.000		.000	.017	-.014	.016	-.006
C4	-.007	-.010	.006	-.019	.000	-.002	-.003	.063	-.010	-.001	-.024	-.041	.016	.002	.000		.015	.015	-.024	.005
E1	-.011	.008	-.026	.007	.019	.023	.048	.082	-.020	-.012	.034	.022	-.015	.010	.017	.015		.033	.017	.016
E2	-.013	.019	-.004	-.009	.004	-.003	-.013	.026	-.009	.003	.004	-.022	-.002	-.006	-.014	.015	.033		-.016	-.004
E3	-.015	.033	.001	.004	.003	-.013	-.011	-.029	.028	-.006	-.013	.001	.009	-.013	.016	-.024	.017	-.016		-.015
E4	.005	.046	-.009	-.017	-.003	-.008	-.035	-.013	.003	-.019	-.031	-.019	.011	-.029	-.006	.005	.016	-.004	-.015	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 4 (2.0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor					
	1	2	3	4	5	6
N1	.568					
N2						
N3	.669					
N4	.586					
O1					-.586	
O2						
O3						
O4						
A1				-.537		
A2				.537		
A3					-.408	
A4						-.566
C1		.624				
C2		.643				
C3						
C4		.642				
E1						
E2			.742			
E3			.525			
E4						

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 8 iterations.

Factor Transformation Matrix

Factor	1	2	3	4	5	6
1	.627	.508	.362	.409	.062	.216
2	.092	.560	-.463	-.285	-.612	-.092
3	-.083	.321	-.547	.312	.604	-.359
4	.493	-.354	.040	.081	-.204	-.763
5	-.163	.410	.518	-.549	.275	-.400
6	.567	-.180	-.292	-.589	.375	.272

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

9.5.2. EFA for SGI Propensity

Descriptive Statistics

	Mean	Std. Deviation	Analysis N	Missing N
SGIPROP1	2.712	.9859	528	1
SGIPROP2	2.992	1.0644	527	2
SGIPROP3	3.926	.9751	527	2
SGIPROP4	2.579	.8560	525	4
SGIPROP5	2.711	.9857	526	3
OO1	4.053	.7740	526	3
OO2	4.057	.7666	529	0
OO3	3.642	.8899	528	1
OO4	3.379	1.0218	528	1
OO5	3.710	1.1547	528	1
CFP1	2.775	1.1107	528	1
CFP2	3.555	1.1279	526	3
CFP3	3.559	.9242	528	1
CFP4	3.759	.8429	528	1
CFP5	3.821	.9741	525	4
CSP1	3.123	1.0546	527	2
CSP2	3.110	1.0119	528	1
CSP3	3.059	.9799	525	4
CSP4	3.060	.9335	529	0
CSP5	2.465	.8829	529	0

Correlation Matrix[a]

		SGIPRO P1	SGIPRO P2	SGIPRO P3	SGIPRO P4	SGIPRO P5	OO1	OO2	OO3	OO4	OO5	CFP1	CFP2	CFP3	CFP4	CFP5	CSP1	CSP2	CSP3	CSP4	CSP5
Correlation	SGIPRO P1	1.000	.156	-.176	.416	-.061	.033	.019	.112	.073	-.034	.008	-.052	-.085	-.056	-.027	.050	.070	.024	.067	.030
	SGIPRO P2	.156	1.000	.075	.081	.072	.110	.117	.043	.161	.158	.036	.054	.084	.100	.123	.130	.130	.111	.104	.006
	SGIPRO P3	-.176	.075	1.000	-.156	.036	.080	.174	.014	.159	.146	.069	.109	.234	.176	.184	.157	.151	.229	.234	.025
	SGIPRO P4	.416	.081	-.156	1.000	.066	.042	-.004	.104	.148	-.058	.036	.009	-.113	-.055	-.037	.072	.084	-.057	.019	.026
	SGIPRO P5	-.061	.072	.036	.066	1.000	.078	.118	.022	-.029	-.085	.155	.037	.063	.145	.142	.074	.036	-.027	.019	-.121
	OO1	.033	.110	.080	.042	.078	1.000	.292	.138	.237	.081	.069	.057	.140	.230	.109	.116	.124	.103	.075	-.061
	OO2	.019	.117	.174	-.004	.118	.292	1.000	.126	.264	.178	.098	.039	.109	.156	.172	.212	.193	.135	.167	-.028
	OO3	.112	.043	.014	.104	.022	.138	.126	1.000	.185	-.044	-.094	-.075	.015	.113	-.008	.001	-.020	-.001	.013	-.116
	OO4	.073	.161	.159	.148	-.029	.237	.264	.185	1.000	.146	.123	.128	.133	.098	.192	.247	.215	.228	.210	.035
	OO5	-.034	.158	.146	-.058	-.085	.081	.178	-.044	.146	1.000	-.076	.208	.088	.082	.129	.067	.050	.187	.120	.009
	CFP1	.008	.036	.069	.036	.155	.069	.098	-.094	.123	-.076	1.000	.173	.113	.279	.351	.450	.435	.223	.225	.014
	CFP2	-.052	.054	.109	.009	.037	.057	.039	-.075	.128	.208	.173	1.000	.175	.198	.442	.240	.186	.223	.144	-.025
	CFP3	-.085	.084	.234	-.113	.063	.140	.109	.015	.133	.088	.113	.175	1.000	.153	.198	.116	.045	.127	.112	-.034
	CFP4	-.056	.100	.176	-.055	.145	.230	.156	.113	.098	.082	.279	.198	.153	1.000	.432	.288	.298	.201	.166	-.046
	CFP5	-.027	.123	.184	-.037	.142	.109	.172	-.008	.192	.129	.351	.442	.198	.432	1.000	.346	.306	.284	.234	-.113

	CSP1	.050	.130	.157	.072	.074	.116	.212	.001	.247	.067	.450	.240	.116	.288	.346	1.000	.749	.551	.478	.093
	CSP2	.070	.130	.151	.084	.036	.124	.193	-.020	.215	.050	.435	.186	.045	.298	.306	.749	1.000	.508	.447	.108
	CSP3	.024	.111	.229	-.057	-.027	.103	.135	-.001	.228	.187	.223	.223	.127	.201	.284	.551	.508	1.000	.633	.180
	CSP4	.067	.104	.234	.019	.019	.075	.167	.013	.210	.120	.225	.144	.112	.166	.234	.478	.447	.633	1.000	.225
	CSP5	.030	.006	.025	.026	-.121	-.061	-.028	-.116	.035	.009	.014	-.025	-.034	-.046	-.113	.093	.108	.180	.225	1.000
Sig. (1-tailed)	SGIPROP1		.000	.000	.000	.082	.228	.330	.005	.047	.217	.425	.116	.025	.101	.268	.128	.055	.291	.062	.245
	SGIPROP2	.000		.043	.032	.051	.006	.004	.160	.000	.000	.208	.110	.027	.011	.002	.001	.001	.006	.009	.447
	SGIPROP3	.000	.043		.000	.203	.034	.000	.371	.000	.000	.056	.006	.000	.000	.000	.000	.000	.000	.000	.285
	SGIPROP4	.000	.032	.000		.067	.172	.464	.009	.000	.091	.206	.417	.005	.104	.198	.051	.028	.097	.334	.275
	SGIPROP5	.082	.051	.203	.067		.037	.003	.310	.254	.026	.000	.202	.074	.000	.001	.045	.205	.269	.331	.003
	OO1	.228	.006	.034	.172	.037		.000	.001	.000	.031	.056	.098	.001	.000	.007	.004	.002	.010	.044	.081
	OO2	.330	.004	.000	.464	.003	.000		.002	.000	.000	.012	.185	.006	.000	.000	.000	.000	.001	.000	.261
	OO3	.005	.160	.371	.009	.310	.001	.002		.000	.155	.016	.044	.363	.005	.429	.493	.322	.490	.380	.004
	OO4	.047	.000	.000	.000	.254	.000	.000	.000		.000	.002	.002	.001	.012	.000	.000	.000	.000	.000	.209
	OO5	.217	.000	.000	.091	.026	.031	.000	.155	.000		.040	.000	.022	.030	.002	.063	.124	.000	.003	.416
	CFP1	.425	.208	.056	.206	.000	.056	.012	.016	.002	.040		.000	.005	.000	.000	.000	.000	.000	.000	.374
	CFP2	.116	.110	.006	.417	.202	.098	.185	.044	.002	.000	.000		.000	.000	.000	.000	.000	.000	.000	.285
	CFP3	.025	.027	.000	.005	.074	.001	.006	.363	.001	.022	.005	.000		.000	.000	.004	.149	.002	.005	.221

CFP4	.101	.011	.000	.104	.000	.000	.000	.005	.012	.030	.000	.000	.000		.000	.000	.000	.000	.000	.145
CFP5	.268	.002	.000	.198	.001	.007	.000	.429	.000	.002	.000	.000	.000	.000		.000	.000	.000	.000	.005
CSP1	.128	.001	.000	.051	.045	.004	.000	.493	.000	.063	.000	.000	.004	.000	.000		.000	.000	.000	.016
CSP2	.055	.001	.000	.028	.205	.002	.000	.322	.000	.124	.000	.000	.149	.000	.000	.000		.000	.000	.006
CSP3	.291	.006	.000	.097	.269	.010	.001	.490	.000	.000	.000	.000	.002	.000	.000	.000	.000		.000	.000
CSP4	.062	.009	.000	.334	.331	.044	.000	.380	.000	.003	.000	.000	.005	.000	.000	.000	.000	.000		.000
CSP5	.245	.447	.285	.275	.003	.081	.261	.004	.209	.416	.374	.285	.221	.145	.005	.016	.006	.000	.000	

a. Determinant = .015

Inverse of Correlation Matrix

	SGIPRO P1	SGIPRO P2	SGIPRO P3	SGIPRO P4	SGIPRO P5	OO1	OO2	OO3	OO4	OO5	CFP1	CFP2	CFP3	CFP4	CFP5	CSP1	CSP2	CSP3	CSP4	CSP5
SGIPROP1	1.298	-.175	.176	-.495	.122	-.015	-.033	-.091	.026	.028	-.010	.068	.023	.054	-.035	.032	-.036	-.044	-.087	.001
SGIPROP2	-.175	1.105	-.035	-.014	-.088	-.041	-.014	.003	-.094	-.147	.054	.036	-.052	-.030	-.062	-.032	-.063	.002	.002	-.009
SGIPROP3	.176	-.035	1.211	.099	-.012	.026	-.102	-.003	-.096	-.065	.046	.011	-.185	-.085	-.055	.050	-.054	-.080	-.164	-.001
SGIPROP4	-.495	-.014	.099	1.315	-.136	-.029	.065	-.067	-.192	.026	-.006	-.089	.099	.062	.064	-.080	-.097	.198	-.039	-.037
SGIPROP5	.122	-.088	-.012	-.136	1.114	-.036	-.123	-.001	.110	.115	-.123	.012	-.027	-.085	-.083	-.058	.097	.070	-.049	.106
OO1	-.015	-.041	.026	-.029	-.036	1.195	-.256	-.060	-.178	-.007	.010	-.008	-.099	-.222	.077	.056	-.049	-.057	.040	.058
OO2	-.033	-.014	-.102	.065	-.123	-.256	1.249	-.087	-.179	-.178	.014	.101	-.013	.011	-.088	-.126	-.073	.111	-.079	.014

OO3	-.091	.003	-.003	-.067	-.001	-.060	-.087	1.138	-.198	.100	.161	.083	-.001	-.182	.050	-.030	.080	-.018	-.029	.137
OO4	.026	-.094	-.096	-.192	.110	-.178	-.179	-.198	1.284	-.079	-.053	-.032	-.069	.107	-.116	-.099	-.010	-.085	-.034	-.040
OO5	.028	-.147	-.065	.026	.115	-.007	-.178	.100	-.079	1.182	.169	-.201	-.006	-.050	-.016	.046	.053	-.172	-.009	.024
CFP1	-.010	.054	.046	-.006	-.123	.010	.014	.161	-.053	.169	1.451	.001	-.069	-.139	-.261	-.344	-.293	.103	-.033	-.002
CFP2	.068	.036	.011	-.089	.012	-.008	.101	.083	-.032	-.201	.001	1.333	-.111	-.001	-.510	-.132	.034	-.097	.052	.002
CFP3	.023	-.052	-.185	.099	-.027	-.099	-.013	-.001	-.069	-.006	-.069	-.111	1.143	-.041	-.068	-.080	.171	-.022	-.032	.021
CFP4	.054	-.030	-.085	.062	-.085	-.222	.011	-.182	.107	-.050	-.139	-.001	-.041	1.398	-.445	-.038	-.196	.017	.027	-.019
CFP5	-.035	-.062	-.055	.064	-.083	.077	-.088	.050	-.116	-.016	-.261	-.510	-.068	-.445	1.679	-.072	-.006	-.105	-.065	.203
CSP1	.032	-.032	.050	-.080	-.058	.056	-.126	-.030	-.099	.046	-.344	-.132	-.080	-.038	-.072	2.734	-1.465	-.486	-.195	.016
CSP2	-.036	-.063	-.054	-.097	.097	-.049	-.073	.080	-.010	.053	-.293	.034	.171	-.196	-.006	-1.465	2.520	-.282	-.132	-.033
CSP3	-.044	.002	-.080	.198	.070	-.057	.111	-.018	-.085	-.172	.103	-.097	-.022	.017	-.105	-.486	-.282	2.095	-.889	-.107
CSP4	-.087	.002	-.164	-.039	-.049	.040	-.079	-.029	-.034	-.009	-.033	.052	-.032	.027	-.065	-.195	-.132	-.889	1.846	-.229
CSP5	.001	-.009	-.001	-.037	.106	.058	.014	.137	-.040	.024	-.002	.002	.021	-.019	.203	.016	-.033	-.107	-.229	1.131

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.778
Bartlett's Test of Sphericity	Approx. Chi-Square	2158.656
	df	190
	Sig.	.000

Anti-image Matrices

		SGIPRO P1	SGIPRO P2	SGIPRO P3	SGIPRO P4	SGIPRO P5	OO1	OO2	OO3	OO4	OO5	CFP1	CFP2	CFP3	CFP4	CFP5	CSP1	CSP2	CSP3	CSP4	CSP5
Anti-image Covariance	SGIPRO P1	.771	-.122	.112	-.290	.085	-.010	-.021	-.062	.016	.019	-.005	.039	.016	.030	-.016	.009	-.011	-.016	-.036	.001
	SGIPRO P2	-.122	.905	-.026	-.009	-.071	-.031	-.010	.002	-.066	-.113	.034	.024	-.041	-.020	-.033	-.011	-.023	.001	.001	-.008
	SGIPRO P3	.112	-.026	.826	.062	-.009	.018	-.067	-.002	-.062	-.046	.026	.007	-.134	-.050	-.027	.015	-.018	-.031	-.073	-.001
	SGIPRO P4	-.290	-.009	.062	.760	-.093	-.018	.040	-.045	-.114	.017	-.003	-.051	.066	.034	.029	-.022	-.029	.072	-.016	-.025
	SGIPRO P5	.085	-.071	-.009	-.093	.897	-.027	-.089	-.001	.077	.087	-.076	.008	-.022	-.055	-.044	-.019	.034	.030	-.024	.084
	OO1	-.010	-.031	.018	-.018	-.027	.837	-.172	-.044	-.116	-.005	.006	-.005	-.073	-.133	.038	.017	-.016	-.023	.018	.043
	OO2	-.021	-.010	-.067	.040	-.089	-.172	.801	-.061	-.111	-.120	.007	.060	-.009	.006	-.042	-.037	-.023	.042	-.034	.010
	OO3	-.062	.002	-.002	-.045	-.001	-.044	-.061	.879	-.136	.074	.098	.055	-.001	-.114	.026	-.010	.028	-.007	-.014	.107
	OO4	.016	-.066	-.062	-.114	.077	-.116	-.111	-.136	.779	-.052	-.029	-.019	-.047	.060	-.054	-.028	-.003	-.032	-.014	-.028
	OO5	.019	-.113	-.046	.017	.087	-.005	-.120	.074	-.052	.846	.098	-.128	-.004	-.030	-.008	.014	.018	-.069	-.004	.018
	CFP1	-.005	.034	.026	-.003	-.076	.006	.007	.098	-.029	.098	.689	.001	-.042	-.069	-.107	-.087	-.080	.034	-.012	-.001
	CFP2	.039	.024	.007	-.051	.008	-.005	.060	.055	-.019	-.128	.001	.750	-.073	-.001	-.228	-.036	.010	-.035	.021	.001
	CFP3	.016	-.041	-.134	.066	-.022	-.073	-.009	-.001	-.047	-.004	-.042	-.073	.875	-.026	-.036	-.026	.059	-.009	-.015	.016
	CFP4	.030	-.020	-.050	.034	-.055	-.133	.006	-.114	.060	-.030	-.069	-.001	-.026	.715	-.190	-.010	-.056	.006	.011	-.012
	CFP5	-.016	-.033	-.027	.029	-.044	.038	-.042	.026	-.054	-.008	-.107	-.228	-.036	-.190	.595	-.016	-.001	-.030	-.021	.107

	CSP1	.009	-.011	.015	-.022	-.019	.017	-.037	-.010	-.028	.014	-.087	-.036	-.026	-.010	-.016	.366	-.213	-.085	-.039	.005
	CSP2	-.011	-.023	-.018	-.029	.034	-.016	-.023	.028	-.003	.018	-.080	.010	.059	-.056	-.001	-.213	.397	-.053	-.028	-.012
	CSP3	-.016	.001	-.031	.072	.030	-.023	.042	-.007	-.032	-.069	.034	-.035	-.009	.006	-.030	-.085	-.053	.477	-.230	-.045
	CSP4	-.036	.001	-.073	-.016	-.024	.018	-.034	-.014	-.014	-.004	-.012	.021	-.015	.011	-.021	-.039	-.028	-.230	.542	-.110
	CSP5	.001	-.008	-.001	-.025	.084	.043	.010	.107	-.028	.018	-.001	.001	.016	-.012	.107	.005	-.012	-.045	-.110	.884
Anti-image Correlation	SGIPROP1	.569[a]	-.146	.140	-.379	.102	-.012	-.026	-.075	.020	.023	-.007	.052	.019	.040	-.024	.017	-.020	-.027	-.056	.001
	SGIPROP2	-.146	.774[a]	-.031	-.011	-.079	-.036	-.012	.003	-.079	-.129	.043	.030	-.047	-.024	-.045	-.018	-.038	.001	.002	-.008
	SGIPROP3	.140	-.031	.828[a]	.079	-.010	.021	-.083	-.003	-.077	-.055	.035	.009	-.157	-.066	-.038	.028	-.031	-.050	-.110	-.001
	SGIPROP4	-.379	-.011	.079	.554[a]	-.112	-.023	.051	-.055	-.148	.021	-.004	-.067	.081	.046	.043	-.042	-.053	.119	-.025	-.030
	SGIPROP5	.102	-.079	-.010	-.112	.590[a]	-.031	-.105	-.001	.092	.100	-.097	.010	-.024	-.068	-.061	-.034	.058	.046	-.034	.095
	OO1	-.012	-.036	.021	-.023	-.031	.742[a]	-.210	-.051	-.144	-.006	.008	-.006	-.085	-.171	.055	.031	-.028	-.036	.027	.050
	OO2	-.026	-.012	-.083	.051	-.105	-.210	.775[a]	-.073	-.141	-.146	.010	.078	-.011	.008	-.061	-.068	-.041	.069	-.052	.012
	OO3	-.075	.003	-.003	-.055	-.001	-.051	-.073	.556[a]	-.164	.086	.126	.067	-.001	-.144	.036	-.017	.047	-.011	-.020	.121
	OO4	.020	-.079	-.077	-.148	.092	-.144	-.141	-.164	.801[a]	-.064	-.039	-.024	-.057	.080	-.079	-.053	-.005	-.052	-.022	-.033
	OO5	.023	-.129	-.055	.021	.100	-.006	-.146	.086	-.064	.679[a]	.129	-.160	-.005	-.039	-.011	.026	.031	-.109	-.006	.021
	CFP1	-.007	.043	.035	-.004	-.097	.008	.010	.126	-.039	.129	.849[a]	.001	-.054	-.098	-.167	-.173	-.153	.059	-.020	-.001
	CFP2	.052	.030	.009	-.067	.010	-.006	.078	.067	-.024	-.160	.001	.754[a]	-.090	-.001	-.341	-.069	.018	-.058	.033	.002
	CFP3	.019	-.047	-.157	.081	-.024	-.085	-.011	-.001	-.057	-.005	-.054	-.090	.802[a]	-.032	-.049	-.045	.101	-.014	-.022	.019

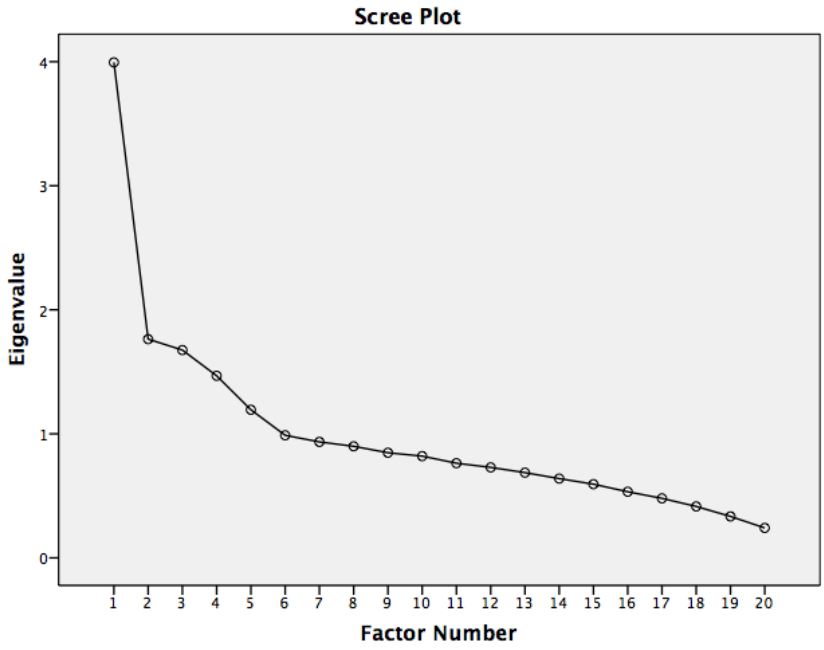
CFP4	.040	-.024	-.066	.046	-.068	-.171	.008	-.144	.080	-.039	-.098	-.001	-.032	.807[a]	-.291	-.019	-.104	.010	.017	-.015
CFP5	-.024	-.045	-.038	.043	-.061	.055	-.061	.036	-.079	-.011	-.167	-.341	-.049	-.291	.792[a]	-.034	-.003	-.056	-.037	.147
CSP1	.017	-.018	.028	-.042	-.034	.031	-.068	-.017	-.053	.026	-.173	-.069	-.045	-.019	-.034	.810[a]	-.558	-.203	-.087	.009
CSP2	-.020	-.038	-.031	-.053	.058	-.028	-.041	.047	-.005	.031	-.153	.018	.101	-.104	-.003	-.558	.803[a]	-.123	-.061	-.020
CSP3	-.027	.001	-.050	.119	.046	-.036	.069	-.011	-.052	-.109	.059	-.058	-.014	.010	-.056	-.203	-.123	.817[a]	-.452	-.070
CSP4	-.056	.002	-.110	-.025	-.034	.027	-.052	-.020	-.022	-.006	-.020	.033	-.022	.017	-.037	-.087	-.061	-.452	.820[a]	-.159
CSP5	.001	-.008	-.001	-.030	.095	.050	.012	.121	-.033	.021	-.001	.002	.019	-.015	.147	.009	-.020	-.070	-.159	.658[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
SGIPROP1	.229	.409
SGIPROP2	.095	.105
SGIPROP3	.174	.230
SGIPROP4	.240	.426
SGIPROP5	.103	.110
OO1	.163	.254
OO2	.199	.290
OO3	.121	.144
OO4	.221	.282
OO5	.154	.222
CFP1	.311	.402
CFP2	.250	.390
CFP3	.125	.145
CFP4	.285	.316
CFP5	.405	.609
CSP1	.634	.713
CSP2	.603	.671
CSP3	.523	.635
CSP4	.458	.515
CSP5	.116	.146

Extraction Method: Principal Axis Factoring.



Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.994	19.971	19.971	3.512	17.558	17.558	2.393	11.966	11.966
2	1.763	8.817	28.789	1.155	5.774	23.332	1.239	6.197	18.163
3	1.675	8.376	37.165	.990	4.950	28.282	1.183	5.916	24.079
4	1.468	7.339	44.503	.811	4.053	32.335	1.168	5.841	29.920
5	1.194	5.969	50.473	.546	2.731	35.066	1.029	5.146	35.066
6	.988	4.941	55.414						
7	.935	4.674	60.088						
8	.899	4.497	64.585						
9	.847	4.237	68.822						
10	.820	4.101	72.923						
11	.763	3.816	76.739						
12	.729	3.646	80.385						
13	.687	3.436	83.821						
14	.639	3.195	87.016						
15	.594	2.970	89.986						
16	.533	2.665	92.651						
17	.480	2.399	95.050						
18	.415	2.073	97.122						
19	.334	1.671	98.794						
20	.241	1.206	100.000						

Extraction Method: Principal Axis Factoring.

Factor Matrix[a]

	Factor				
	1	2	3	4	5
SGIPROP1		.533			
SGIPROP2					
SGIPROP3					
SGIPROP4		.517			
SGIPROP5					
OO1					
OO2					
OO3					
OO4					
OO5					
CFP1	.487				
CFP2					.408
CFP3					
CFP4	.450				
CFP5	.582				
CSP1	.785				
CSP2	.737				
CSP3	.687				
CSP4	.614				
CSP5					

Extraction Method: Principal Axis Factoring.

a. 5 factors extracted. 11 iterations required.

Reproduced Correlations

		SGIPRO P1	SGIPRO P2	SGIPRO P3	SGIPRO P4	SGIPRO P5	OO1	OO2	OO3	OO4	OO5	CFP1	CFP2	CFP3	CFP4	CFP5	CSP1	CSP2	CSP3	CSP4	CSP5
Reproduced Correlation	SGIPRO P1	.409[a]	.109	-.164	.411	-.027	.034	.012	.101	.124	-.020	-.004	-.020	-.109	-.070	-.049	.069	.081	.009	.045	.038
	SGIPRO P2	.109	.105[a]	.062	.104	.017	.122	.133	.078	.165	.098	.043	.093	.063	.092	.127	.122	.110	.127	.120	-.001
	SGIPRO P3	-.164	.062	.230[a]	-.183	.020	.131	.176	.018	.143	.159	.071	.130	.164	.167	.187	.174	.148	.248	.206	.018
	SGIPRO P4	.411	.104	-.183	.426[a]	.007	.044	.013	.108	.112	-.053	.034	-.017	-.110	-.041	-.018	.074	.087	-.037	.005	.003
	SGIPRO P5	-.027	.017	.020	.007	.110[a]	.090	.078	.042	.033	-.046	.140	.041	.050	.145	.146	.088	.084	-.044	-.038	-.093
	OO1	.034	.122	.131	.044	.090	.254[a]	.264	.163	.226	.086	.070	.034	.122	.183	.145	.132	.119	.083	.089	-.071
	OO2	.012	.133	.176	.013	.078	.264	.290[a]	.156	.255	.116	.088	.050	.143	.201	.161	.196	.179	.171	.167	-.038
	OO3	.101	.078	.018	.108	.042	.163	.156	.144[a]	.139	.021	-.028	-.065	.026	.046	-.018	-.003	-.002	-.038	-.012	-.052
	OO4	.124	.165	.143	.112	.033	.226	.255	.139	.282[a]	.155	.079	.108	.118	.164	.178	.234	.215	.245	.233	.012
	OO5	-.020	.098	.159	-.053	-.046	.086	.116	.021	.155	.222[a]	-.051	.180	.126	.071	.158	.045	.019	.200	.160	.030
	CFP1	-.004	.043	.071	.034	.140	.070	.088	-.028	.079	-.051	.402[a]	.183	.076	.279	.349	.459	.443	.241	.217	-.011
	CFP2	-.020	.093	.130	-.017	.041	.034	.050	-.065	.108	.180	.183	.390[a]	.155	.221	.444	.213	.174	.229	.167	-.026
	CFP3	-.109	.063	.164	-.110	.050	.122	.143	.026	.118	.126	.076	.155	.145[a]	.170	.221	.110	.086	.134	.103	-.040
	CFP4	-.070	.092	.167	-.041	.145	.183	.201	.046	.164	.071	.279	.221	.170	.316[a]	.388	.313	.286	.188	.158	-.081
	CFP5	-.049	.127	.187	-.018	.146	.145	.161	-.018	.178	.158	.349	.444	.221	.388	.609[a]	.372	.326	.266	.204	-.091

	CSP1	.069	.122	.174	.074	.088	.132	.196	-.003	.234	.045	.459	.213	.110	.313	.372	.713[a]	.689	.558	.515	.120
	CSP2	.081	.110	.148	.087	.084	.119	.179	-.002	.215	.019	.443	.174	.086	.286	.326	.689	.671[a]	.527	.491	.123
	CSP3	.009	.127	.248	-.037	-.044	.083	.171	-.038	.245	.200	.241	.229	.134	.188	.266	.558	.527	.635[a]	.567	.203
	CSP4	.045	.120	.206	.005	-.038	.089	.167	-.012	.233	.160	.217	.167	.103	.158	.204	.515	.491	.567	.515[a]	.189
	CSP5	.038	-.001	.018	.003	-.093	-.071	-.038	-.052	.012	.030	-.011	-.026	-.040	-.081	-.091	.120	.123	.203	.189	.146[a]
Residual[b]	SGIPROP1		.047	-.012	.006	-.034	-.002	.007	.011	-.051	-.014	.012	-.032	.023	.014	.022	-.020	-.012	.015	.022	-.008
	SGIPROP2	.047		.013	-.023	.054	-.013	-.016	-.035	-.004	.060	-.008	-.039	.021	.008	-.004	.008	.020	-.016	-.016	.007
	SGIPROP3	-.012	.013		.027	.016	-.051	-.002	-.003	.016	-.012	-.002	-.021	.069	.009	-.002	-.016	.003	-.019	.028	.007
	SGIPROP4	.006	-.023	.027		.058	-.003	-.017	-.004	.035	-.006	.001	.026	-.003	-.014	-.019	-.003	-.004	-.020	.014	.023
	SGIPROP5	-.034	.054	.016	.058		-.012	.040	-.021	-.062	-.039	.015	-.005	.014	.000	-.004	-.014	-.047	.017	.057	-.028
	OO1	-.002	-.013	-.051	-.003	-.012		.027	-.025	.011	-.004	-.001	.022	.018	.047	-.036	-.017	.005	.019	-.014	.010
	OO2	.007	-.016	-.002	-.017	.040	.027		-.030	.009	.062	.010	-.011	-.034	-.045	.011	.016	.014	-.036	.001	.011
	OO3	.011	-.035	-.003	-.004	-.021	-.025	-.030		.047	-.065	-.065	-.010	-.011	.067	.010	.004	-.019	.036	.025	-.064
	OO4	-.051	-.004	.016	.035	-.062	.011	.009	.047		-.010	.044	.020	.015	-.066	.014	.013	.000	-.016	-.023	.023
	OO5	-.014	.060	-.012	-.006	-.039	-.004	.062	-.065	-.010		-.025	.028	-.039	.011	-.029	.022	.031	-.013	-.040	-.021
	CFP1	.012	-.008	-.002	.001	.015	-.001	.010	-.065	.044	-.025		-.010	.036	.000	.002	-.008	-.008	-.018	.008	.025
	CFP2	-.032	-.039	-.021	.026	-.005	.022	-.011	-.010	.020	.028	-.010		.020	-.022	-.002	.028	.011	-.006	-.023	.001
	CFP3	.023	.021	.069	-.003	.014	.018	-.034	-.011	.015	-.039	.036	.020		-.017	-.023	.006	-.040	-.007	.010	.006

CFP4	.014	.008	.009	-.014	.000	.047	-.045	.067	-.066	.011	.000	-.022	-.017		.044	-.026	.012	.013	.008	.035
CFP5	.022	-.004	-.002	-.019	-.004	-.036	.011	.010	.014	-.029	.002	-.002	-.023	.044		-.026	-.020	.018	.030	-.022
CSP1	-.020	.008	-.016	-.003	-.014	-.017	.016	.004	.013	.022	-.008	.028	.006	-.026	-.026		.059	-.007	-.036	-.027
CSP2	-.012	.020	.003	-.004	-.047	.005	.014	-.019	.000	.031	-.008	.011	-.040	.012	-.020	.059		-.019	-.044	-.015
CSP3	.015	-.016	-.019	-.020	.017	.019	-.036	.036	-.016	-.013	-.018	-.006	-.007	.013	.018	-.007	-.019		.066	-.024
CSP4	.022	-.016	.028	.014	.057	-.014	.001	.025	-.023	-.040	.008	-.023	.010	.008	.030	-.036	-.044	.066		.036
CSP5	-.008	.007	.007	.023	-.028	.010	.011	-.064	.023	-.021	.025	.001	.006	.035	-.022	-.027	-.015	-.024	.036	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 16 (8.0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor				
	1	2	3	4	5
SGIPROP1					.621
SGIPROP2					
SGIPROP3					
SGIPROP4					.642
SGIPROP5					
OO1				.480	
OO2				.504	
OO3					
OO4				.448	
OO5					
CFP1		.533			
CFP2			.590		
CFP3					
CFP4		.416			
CFP5		.462	.602		
CSP1	.720	.401			
CSP2	.705				
CSP3	.735				
CSP4	.679				
CSP5					

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 8 iterations.

Factor Transformation Matrix

Factor	1	2	3	4	5
1	.741	.404	.417	.336	-.041
2	.398	-.189	-.424	-.027	.791
3	-.512	.241	.167	.684	.428
4	.161	-.783	.008	.548	-.246
5	-.071	-.360	.786	-.343	.359

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

9.5.3. EFA for Motivation

Descriptive Statistics

	Mean	Std. Deviation	Analysis N	Missing N
IDREG1	3.142	1.1745	529	0
IDREG2	3.788	1.0237	528	1
IDREG3	3.737	.8644	529	0
EXTREG1	2.830	1.0957	528	1
EXTREG2	3.400	1.0406	528	1
EXTREG3	3.295	.9943	529	0
AMOT1	1.970	.8531	528	1
AMOT2	2.502	1.1123	526	3
AMOT3	2.697	1.1271	528	1
INMOT1	4.354	.6898	528	1
INMOT2	4.246	.7178	529	0
INMOT3	4.047	.7758	529	0
INTREG1	4.163	.7906	529	0
INTREG2	4.013	.7964	529	0
INTREG3	3.870	.7833	529	0
INTROREG1	4.100	.7926	529	0
INTROREG2	3.741	.9610	526	3
INTROREG3	3.334	1.0620	527	2

Correlation Matrix[a]

		IDREG1	IDREG2	IDREG3	EXTREG1	EXTREG2	EXTREG3	AMOT1	AMOT2	AMOT3	INMOT1	INMOT2	INMOT3	INTREG1	INTREG2	INTREG3	INTREREG1	INTREREG2	INTREREG3
Correlation	IDREG1	1.000	.077	.091	.349	.214	.225	.040	-.026	.064	-.064	-.084	-.005	-.033	.205	.032	-.093	.018	.121
	IDREG2	.077	1.000	.505	.160	.082	.210	-.166	.021	-.156	.354	.400	.199	.312	.127	.363	.671	.497	.386
	IDREG3	.091	.505	1.000	.095	.023	.183	-.062	-.039	-.131	.216	.232	.301	.257	.272	.293	.362	.364	.461
	EXTREG1	.349	.160	.095	1.000	.546	.385	.020	.064	.009	-.052	-.048	-.053	-.119	.018	-.055	.072	.124	.162
	EXTREG2	.214	.082	.023	.546	1.000	.382	-.021	.041	.075	-.090	-.106	-.094	-.011	.109	.021	.042	.057	.064
	EXTREG3	.225	.210	.183	.385	.382	1.000	.026	.041	.110	.020	.034	.080	.110	.139	.220	.198	.169	.230
	AMOT1	.040	-.166	-.062	.020	-.021	.026	1.000	.292	.218	-.142	-.288	-.147	-.128	-.119	-.182	-.167	-.138	-.037
	AMOT2	-.026	.021	-.039	.064	.041	.041	.292	1.000	.469	.014	-.082	-.176	-.026	-.165	-.053	.102	-.016	-.008
	AMOT3	.064	-.156	-.131	.009	.075	.110	.218	.469	1.000	-.115	-.205	-.098	-.091	-.008	-.105	-.089	-.053	-.020
	INMOT1	-.064	.354	.216	-.052	-.090	.020	-.142	.014	-.115	1.000	.509	.323	.478	.147	.330	.482	.360	.150
	INMOT2	-.084	.400	.232	-.048	-.106	.034	-.288	-.082	-.205	.509	1.000	.462	.380	.243	.343	.466	.373	.194
	INMOT3	-.005	.199	.301	-.053	-.094	.080	-.147	-.176	-.098	.323	.462	1.000	.268	.315	.259	.303	.278	.196
	INTREG1	-.033	.312	.257	-.119	-.011	.110	-.128	-.026	-.091	.478	.380	.268	1.000	.418	.496	.403	.321	.105
	INTREG2	.205	.127	.272	.018	.109	.139	-.119	-.165	-.008	.147	.243	.315	.418	1.000	.394	.100	.192	.079
	INTREG3	.032	.363	.293	-.055	.021	.220	-.182	-.053	-.105	.330	.343	.259	.496	.394	1.000	.360	.344	.259
	INTREREG1	-.093	.671	.362	.072	.042	.198	-.167	.102	-.089	.482	.466	.303	.403	.100	.360	1.000	.513	.365
	INTREREG2	.018	.497	.364	.124	.057	.169	-.138	-.016	-.053	.360	.373	.278	.321	.192	.344	.513	1.000	.388

	INTROREG3	.121	.386	.461	.162	.064	.230	-.037	-.008	-.020	.150	.194	.196	.105	.079	.259	.365	.388	1.000
Sig. (1-tailed)	IDREG1		.039	.018	.000	.000	.000	.178	.273	.071	.072	.027	.452	.224	.000	.228	.017	.341	.003
	IDREG2	.039		.000	.000	.030	.000	.000	.319	.000	.000	.000	.000	.000	.002	.000	.000	.000	.000
	IDREG3	.018	.000		.015	.298	.000	.077	.186	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000
	EXTREG1	.000	.000	.015		.000	.000	.321	.072	.414	.118	.136	.112	.003	.342	.105	.049	.002	.000
	EXTREG2	.000	.030	.298	.000		.000	.312	.173	.044	.020	.007	.015	.396	.006	.316	.168	.095	.072
	EXTREG3	.000	.000	.000	.000	.000		.274	.175	.006	.326	.220	.033	.006	.001	.000	.000	.000	.000
	AMOT1	.178	.000	.077	.321	.312	.274		.000	.000	.001	.000	.000	.002	.003	.000	.000	.001	.199
	AMOT2	.273	.319	.186	.072	.173	.175	.000		.000	.375	.030	.000	.273	.000	.111	.009	.357	.429
	AMOT3	.071	.000	.001	.414	.044	.006	.000	.000		.004	.000	.012	.018	.426	.008	.020	.112	.321
	INMOT1	.072	.000	.000	.118	.020	.326	.001	.375	.004		.000	.000	.000	.000	.000	.000	.000	.000
	INMOT2	.027	.000	.000	.136	.007	.220	.000	.030	.000	.000		.000	.000	.000	.000	.000	.000	.000
	INMOT3	.452	.000	.000	.112	.015	.033	.000	.000	.012	.000	.000		.000	.000	.000	.000	.000	.000
	INTREG1	.224	.000	.000	.003	.396	.006	.002	.273	.018	.000	.000	.000		.000	.000	.000	.000	.008
	INTREG2	.000	.002	.000	.342	.006	.001	.003	.000	.426	.000	.000	.000	.000		.000	.011	.000	.035
	INTREG3	.228	.000	.000	.105	.316	.000	.000	.111	.008	.000	.000	.000	.000	.000		.000	.000	.000
	INTREG1	.017	.000	.000	.049	.168	.000	.000	.009	.020	.000	.000	.000	.000	.011	.000		.000	.000
	INTREG2	.341	.000	.000	.002	.095	.000	.001	.357	.112	.000	.000	.000	.000	.000	.000	.000		.000
	INTREG3	.003	.000	.000	.000	.072	.000	.199	.429	.321	.000	.000	.000	.008	.035	.000	.000	.000	

a. Determinant = .004

Inverse of Correlation Matrix

	IDREG1	IDREG2	IDREG3	EXTREG1	EXTREG2	EXTREG3	AMOT1	AMOT2	AMOT3	INMOT1	INMOT2	INMOT3	INTREG1	INTREG2	INTREG3	INTROREG1	INTROREG2	INTROREG3
IDREG1	1.280	-.228	.027	-.383	.030	-.111	-.025	.039	-.068	-.046	.107	-.006	.041	-.285	.005	.298	.050	-.119
IDREG2	-.228	2.394	-.644	-.118	-.019	-.016	.063	-.003	.137	.027	-.269	.272	.019	.146	-.195	-1.131	-.281	-.017
IDREG3	.027	-.644	1.695	-.010	.082	-.059	-.050	-.085	.170	-.003	.177	-.266	-.072	-.301	.027	.115	-.077	-.495
EXTREG1	-.383	-.118	-.010	1.766	-.752	-.327	-.010	-.133	.170	-.045	-.036	.024	.241	.028	.212	.005	-.150	-.081
EXTREG2	.030	-.019	.082	-.752	1.581	-.308	.101	.004	-.056	.079	.152	.115	-.073	-.182	.000	-.068	.005	.041
EXTREG3	-.111	-.016	-.059	-.327	-.308	1.416	-.087	.081	-.190	.112	.025	-.067	-.071	.034	-.258	-.168	.028	-.100
AMOT1	-.025	.063	-.050	-.010	.101	-.087	1.222	-.329	-.037	-.025	.272	-.028	-.042	.011	.122	.100	.014	-.054
AMOT2	.039	-.003	-.085	-.133	.004	.081	-.329	1.525	-.700	-.045	-.109	.241	-.040	.223	-.074	-.297	.080	.088
AMOT3	-.068	.137	.170	.170	-.056	-.190	-.037	-.700	1.453	.016	.203	-.090	.059	-.193	.109	.036	-.111	-.094
INMOT1	-.046	.027	-.003	-.045	.079	.112	-.025	-.045	.016	1.710	-.451	-.128	-.485	.164	-.084	-.367	-.131	.074
INMOT2	.107	-.269	.177	-.036	.152	.025	.272	-.109	.203	-.451	1.876	-.486	-.062	-.185	-.054	-.180	-.114	-.044
INMOT3	-.006	.272	-.266	.024	.115	-.067	-.028	.241	-.090	-.128	-.486	1.498	.058	-.248	-.003	-.235	-.066	-.032
INTREG1	.041	.019	-.072	.241	-.073	-.071	-.042	-.040	.059	-.485	-.062	.058	1.826	-.487	-.418	-.291	-.086	.170
INTREG2	-.285	.146	-.301	.028	-.182	.034	.011	.223	-.193	.164	-.185	-.248	-.487	1.598	-.360	.166	-.055	.153
INTREG3	.005	-.195	.027	.212	.000	-.258	.122	-.074	.109	-.084	-.054	-.003	-.418	-.360	1.644	.002	-.110	-.195
INTROREG1	.298	-1.131	.115	.005	-.068	-.168	.100	-.297	.036	-.367	-.180	-.235	-.291	.166	.002	2.514	-.309	-.252
INTROREG2	.050	-.281	-.077	-.150	.005	.028	.014	.080	-.111	-.131	-.114	-.066	-.086	-.055	-.110	-.309	1.624	-.266

INTRORE G3	-.119	-.017	-.495	-.081	.041	-.100	-.054	.088	-.094	.074	-.044	-.032	.170	.153	-.195	-.252	-.266	1.499

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.792
Bartlett's Test of Sphericity	Approx. Chi-Square	2839.821
	df	153
	Sig.	.000

Anti-image Matrices

		IDREG 1	IDREG 2	IDREG 3	EXTRE G1	EXTRE G2	EXTRE G3	AMOT 1	AMOT 2	AMOT 3	INMOT 1	INMOT 2	INMOT 3	INTREG 1	INTREG 2	INTREG 3	INTRORE G1	INTRORE G2	INTRORE G3
Anti-image Covariance	IDREG1	.781	-.074	.012	-.170	.015	-.061	-.016	.020	-.037	-.021	.045	-.003	.018	-.139	.002	.093	.024	-.062
	IDREG2	-.074	.418	-.159	-.028	-.005	-.005	.022	-.001	.039	.006	-.060	.076	.004	.038	-.049	-.188	-.072	-.005
	IDREG3	.012	-.159	.590	-.003	.031	-.025	-.024	-.033	.069	-.001	.056	-.105	-.023	-.111	.010	.027	-.028	-.195
	EXTREG1	-.170	-.028	-.003	.566	-.269	-.131	-.004	-.049	.066	-.015	-.011	.009	.075	.010	.073	.001	-.052	-.031
	EXTREG2	.015	-.005	.031	-.269	.632	-.138	.052	.002	-.024	.029	.051	.049	-.025	-.072	.000	-.017	.002	.017
	EXTREG3	-.061	-.005	-.025	-.131	-.138	.706	-.051	.037	-.092	.046	.009	-.031	-.027	.015	-.111	-.047	.012	-.047
	AMOT1	-.016	.022	-.024	-.004	.052	-.051	.818	-.176	-.021	-.012	.118	-.016	-.019	.006	.061	.033	.007	-.030
	AMOT2	.020	-.001	-.033	-.049	.002	.037	-.176	.656	-.316	-.017	-.038	.105	-.014	.091	-.030	-.077	.032	.038
	AMOT3	-.037	.039	.069	.066	-.024	-.092	-.021	-.316	.688	.006	.074	-.041	.022	-.083	.045	.010	-.047	-.043
	INMOT1	-.021	.006	-.001	-.015	.029	.046	-.012	-.017	.006	.585	-.141	-.050	-.155	.060	-.030	-.085	-.047	.029
	INMOT2	.045	-.060	.056	-.011	.051	.009	.118	-.038	.074	-.141	.533	-.173	-.018	-.062	-.017	-.038	-.037	-.016

	INMOT3	-.003	.076	-.105	.009	.049	-.031	-.016	.105	-.041	-.050	-.173	.668	.021	-.103	-.001	-.062	-.027	-.014
	INTREG1	.018	.004	-.023	.075	-.025	-.027	-.019	-.014	.022	-.155	-.018	.021	.548	-.167	-.139	-.063	-.029	.062
	INTREG2	-.139	.038	-.111	.010	-.072	.015	.006	.091	-.083	.060	-.062	-.103	-.167	.626	-.137	.041	-.021	.064
	INTREG3	.002	-.049	.010	.073	.000	-.111	.061	-.030	.045	-.030	-.017	-.001	-.139	-.137	.608	.000	-.041	-.079
	INTROREG1	.093	-.188	.027	.001	-.017	-.047	.033	-.077	.010	-.085	-.038	-.062	-.063	.041	.000	.398	-.076	-.067
	INTROREG2	.024	-.072	-.028	-.052	.002	.012	.007	.032	-.047	-.047	-.037	-.027	-.029	-.021	-.041	-.076	.616	-.109
	INTROREG3	-.062	-.005	-.195	-.031	.017	-.047	-.030	.038	-.043	.029	-.016	-.014	.062	.064	-.079	-.067	-.109	.667
Anti-image Correlation	IDREG1	.644[a]	-.130	.018	-.255	.021	-.082	-.020	.028	-.050	-.031	.069	-.005	.027	-.199	.003	.166	.035	-.086
	IDREG2	-.130	.813[a]	-.320	-.057	-.010	-.009	.037	-.002	.073	.013	-.127	.143	.009	.075	-.098	-.461	-.143	-.009
	IDREG3	.018	-.320	.804[a]	-.006	.050	-.038	-.035	-.053	.108	-.002	.099	-.167	-.041	-.183	.016	.055	-.046	-.310
	EXTREG1	-.255	-.057	-.006	.643[a]	-.450	-.207	-.007	-.081	.106	-.026	-.020	.015	.134	.017	.125	.002	-.089	-.050
	EXTREG2	.021	-.010	.050	-.450	.659[a]	-.206	.073	.003	-.037	.048	.088	.075	-.043	-.114	.000	-.034	.003	.027
	EXTREG3	-.082	-.009	-.038	-.207	-.206	.792[a]	-.066	.055	-.132	.072	.015	-.046	-.044	.023	-.169	-.089	.018	-.068
	AMOT1	-.020	.037	-.035	-.007	.073	-.066	.775[a]	-.241	-.028	-.017	.179	-.021	-.028	.008	.086	.057	.010	-.040
	AMOT2	.028	-.002	-.053	-.081	.003	.055	-.241	.513[a]	-.470	-.028	-.064	.159	-.024	.143	-.047	-.152	.051	.058
	AMOT3	-.050	.073	.108	.106	-.037	-.132	-.028	-.470	.569[a]	.010	.123	-.061	.036	-.127	.070	.019	-.072	-.064
	INMOT1	-.031	.013	-.002	-.026	.048	.072	-.017	-.028	.010	.865[a]	-.252	-.080	-.274	.099	-.050	-.177	-.079	.046
	INMOT2	.069	-.127	.099	-.020	.088	.015	.179	-.064	.123	-.252	.855[a]	-.290	-.034	-.107	-.031	-.083	-.065	-.026
	INMOT3	-.005	.143	-.167	.015	.075	-.046	-.021	.159	-.061	-.080	-.290	.816[a]	.035	-.160	-.002	-.121	-.042	-.022
	INTREG1	.027	.009	-.041	.134	-.043	-.044	-.028	-.024	.036	-.274	-.034	.035	.832[a]	-.285	-.241	-.136	-.050	.103

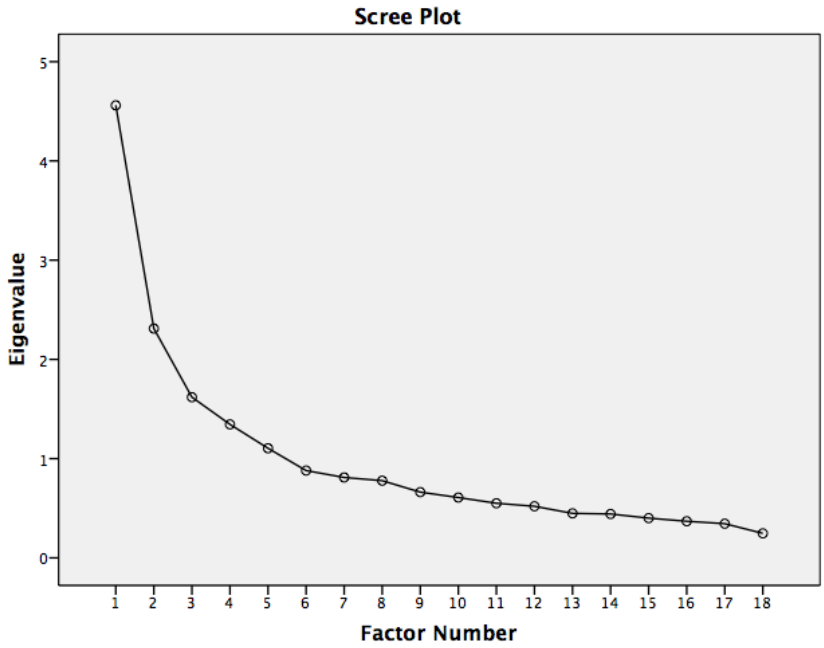
INTREG2	-.199	.075	-.183	.017	-.114	.023	.008	.143	-.127	.099	-.107	-.160	-.285	.703[a]	-.222	.083	-.034	.099
INTREG3	.003	-.098	.016	.125	.000	-.169	.086	-.047	.070	-.050	-.031	-.002	-.241	-.222	.869[a]	.001	-.068	-.124
INTRORE G1	.166	-.461	.055	.002	-.034	-.089	.057	-.152	.019	-.177	-.083	-.121	-.136	.083	.001	.829[a]	-.153	-.130
INTRORE G2	.035	-.143	-.046	-.089	.003	.018	.010	.051	-.072	-.079	-.065	-.042	-.050	-.034	-.068	-.153	.929[a]	-.171
INTRORE G3	-.086	-.009	-.310	-.050	.027	-.068	-.040	.058	-.064	.046	-.026	-.022	.103	.099	-.124	-.130	-.171	.818[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
IDREG1	.219	.224
IDREG2	.582	.610
IDREG3	.410	.521
EXTREG1	.434	.642
EXTREG2	.368	.503
EXTREG3	.294	.335
AMOT1	.182	.204
AMOT2	.344	.671
AMOT3	.312	.377
INMOT1	.415	.470
INMOT2	.467	.508
INMOT3	.332	.282
INTREG1	.452	.522
INTREG2	.374	.625
INTREG3	.392	.411
INTROREG1	.602	.707
INTROREG2	.384	.421
INTROREG3	.333	.437

Extraction Method: Principal Axis Factoring.



Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.560	25.336	25.336	4.066	22.591	22.591	2.664	14.802	14.802
2	2.311	12.838	38.174	1.787	9.931	32.522	1.648	9.156	23.958
3	1.619	8.996	47.170	1.160	6.444	38.966	1.645	9.138	33.096
4	1.345	7.473	54.643	.872	4.846	43.812	1.268	7.046	40.142
5	1.104	6.136	60.778	.584	3.243	47.055	1.244	6.914	47.055
6	.880	4.887	65.666						
7	.810	4.501	70.167						
8	.778	4.322	74.489						
9	.662	3.680	78.169						
10	.608	3.378	81.546						
11	.550	3.058	84.604						
12	.520	2.888	87.492						
13	.448	2.491	89.983						
14	.442	2.456	92.440						
15	.400	2.225	94.664						
16	.369	2.049	96.714						
17	.345	1.915	98.628						
18	.247	1.372	100.000						

Extraction Method: Principal Axis Factoring.

Factor Matrix[a]

	Factor				
	1	2	3	4	5
IDREG1					
IDREG2	.708				
IDREG3	.576				.405
EXTREG1		.734			
EXTREG2		.626			
EXTREG3		.502			
AMOT1					
AMOT2			.724		
AMOT3					
INMOT1	.585				
INMOT2	.635				
INMOT3	.481				
INTREG1	.595				
INTREG2	.423			.548	
INTREG3	.591				
INTROREG1	.746				
INTROREG2	.629				
INTROREG3	.471				

Extraction Method: Principal Axis Factoring.

a. 5 factors extracted. 24 iterations required.

Reproduced Correlations

		IDREG1	IDREG2	IDREG3	EXTREG1	EXTREG2	EXTREG3	AMOT1	AMOT2	AMOT3	INMOT1	INMOT2	INMOT3	INTREG1	INTREG2	INTREG3	INTROREG1	INTROREG2	INTROREG3
Reproduced Correlation	IDREG1	.224[a]	.036	.112	.294	.271	.232	.030	-.028	.055	-.107	-.093	-.006	-.017	.177	.050	-.054	.035	.112
	IDREG2	.036	.610[a]	.463	.180	.084	.227	-.150	.011	-.129	.384	.410	.281	.304	.115	.343	.619	.496	.441
	IDREG3	.112	.463	.521[a]	.084	.011	.199	-.078	-.070	-.088	.206	.256	.271	.236	.253	.323	.387	.393	.457
	EXTREG1	.294	.180	.084	.642[a]	.547	.400	.002	.033	.038	-.088	-.086	-.081	-.097	.012	-.007	.095	.110	.165
	EXTREG2	.271	.084	.011	.547	.503[a]	.356	.006	.045	.073	-.069	-.078	-.067	-.029	.097	.020	.029	.056	.066
	EXTREG3	.232	.227	.199	.400	.356	.335[a]	.004	.080	.077	.044	.040	.054	.099	.188	.154	.175	.191	.212
	AMOT1	.030	-.150	-.078	.002	.006	.004	.204[a]	.280	.247	-.183	-.244	-.164	-.163	-.111	-.146	-.161	-.132	-.034
	AMOT2	-.028	.011	-.070	.033	.045	.080	.280	.671[a]	.452	.016	-.129	-.157	-.014	-.171	-.061	.113	.008	.008
	AMOT3	.055	-.129	-.088	.038	.073	.077	.247	.452	.377[a]	-.110	-.211	-.150	-.051	-.024	-.071	-.096	-.093	-.046
	INMOT1	-.107	.384	.206	-.088	-.069	.044	-.183	.016	-.110	.470[a]	.472	.292	.435	.184	.352	.502	.353	.145
	INMOT2	-.093	.410	.256	-.086	-.078	.040	-.244	-.129	-.211	.472	.508[a]	.337	.442	.227	.378	.500	.374	.176
	INMOT3	-.006	.281	.271	-.081	-.067	.054	-.164	-.157	-.150	.292	.337	.282[a]	.337	.291	.319	.297	.272	.181
	INTREG1	-.017	.304	.236	-.097	-.029	.099	-.163	-.014	-.051	.435	.442	.337	.522[a]	.420	.438	.394	.325	.127
	INTREG2	.177	.115	.253	.012	.097	.188	-.111	-.171	-.024	.184	.227	.291	.420	.625[a]	.403	.083	.186	.114
	INTREG3	.050	.343	.323	-.007	.020	.154	-.146	-.061	-.071	.352	.378	.319	.438	.403	.411[a]	.372	.341	.224
	INTROREG1	-.054	.619	.387	.095	.029	.175	-.161	.113	-.096	.502	.500	.297	.394	.083	.372	.707[a]	.514	.367
	INTROREG2	.035	.496	.393	.110	.056	.191	-.132	.008	-.093	.353	.374	.272	.325	.186	.341	.514	.421[a]	.351

	INTROREG3	.112	.441	.457	.165	.066	.212	-.034	.008	-.046	.145	.176	.181	.127	.114	.224	.367	.351	.437[a]
Residual[b]	IDREG1		.041	-.021	.054	-.057	-.007	.010	.001	.009	.044	.009	.001	-.016	.028	-.018	-.039	-.017	.008
	IDREG2	.041		.042	-.019	-.002	-.017	-.016	.010	-.027	-.029	-.010	-.083	.009	.011	.019	.052	.001	-.055
	IDREG3	-.021	.042		.011	.012	-.017	.016	.031	-.043	.009	-.023	.030	.021	.019	-.030	-.025	-.028	.004
	EXTREG1	.054	-.019	.011		.000	-.015	.018	.031	-.028	.036	.039	.028	-.022	.006	-.048	-.023	.014	-.003
	EXTREG2	-.057	-.002	.012	.000		.027	-.027	-.004	.001	-.020	-.028	-.027	.018	.012	.001	.013	.001	-.002
	EXTREG3	-.007	-.017	-.017	-.015	.027		.022	-.039	.033	-.025	-.006	.026	.011	-.049	.066	.023	-.022	.018
	AMOT1	.010	-.016	.016	.018	-.027	.022		.011	-.030	.041	-.045	.017	.035	-.008	-.036	-.005	-.006	-.003
	AMOT2	.001	.010	.031	.031	-.004	-.039	.011		.017	-.002	.047	-.019	-.013	.007	.008	-.011	-.024	-.016
	AMOT3	.009	-.027	-.043	-.028	.001	.033	-.030	.017		-.004	.005	.052	-.040	.016	-.034	.007	.039	.026
	INMOT1	.044	-.029	.009	.036	-.020	-.025	.041	-.002	-.004		.037	.031	.044	-.038	-.022	-.020	.007	.004
	INMOT2	.009	-.010	-.023	.039	-.028	-.006	-.045	.047	.005	.037		.125	-.062	.016	-.035	-.034	-.001	.018
	INMOT3	.001	-.083	.030	.028	-.027	.026	.017	-.019	.052	.031	.125		-.068	.023	-.060	.006	.005	.014
	INTREG1	-.016	.009	.021	-.022	.018	.011	.035	-.013	-.040	.044	-.062	-.068		-.002	.058	.009	-.004	-.023
	INTREG2	.028	.011	.019	.006	.012	-.049	-.008	.007	.016	-.038	.016	.023	-.002		-.008	.017	.006	-.035
	INTREG3	-.018	.019	-.030	-.048	.001	.066	-.036	.008	-.034	-.022	-.035	-.060	.058	-.008		-.012	.003	.035
	INTREG1	-.039	.052	-.025	-.023	.013	.023	-.005	-.011	.007	-.020	-.034	.006	.009	.017	-.012		-.001	-.002
	INTREG2	-.017	.001	-.028	.014	.001	-.022	-.006	-.024	.039	.007	-.001	.005	-.004	.006	.003	-.001		.037
	INTREG3	.008	-.055	.004	-.003	-.002	.018	-.003	-.016	.026	.004	.018	.014	-.023	-.035	.035	-.002	.037	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 12 (7.0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor				
	1	2	3	4	5
IDREG1					
IDREG2	.534		.540		
IDREG3			.656		
EXTREG1		.783			
EXTREG2		.706			
EXTREG3		.513			
AMOT1					
AMOT2					.793
AMOT3					.593
INMOT1	.658				
INMOT2	.633				
INMOT3					
INTREG1	.552			.462	
INTREG2				.759	
INTREG3	.420			.424	
INTROREG1	.735				
INTROREG2	.473		.416		
INTROREG3			.628		

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

Factor Transformation Matrix

Factor	1	2	3	4	5
1	.754	.125	.522	.336	-.175
2	-.187	.892	.232	-.105	.323
3	.322	-.300	.127	-.393	.797
4	-.010	.017	-.355	.810	.466
5	-.541	-.313	.729	.256	.111

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

9.5.4. Regression 1

Descriptive Statistics

	Mean	Std. Deviation	N
TARP	1.0729	.55831	438
Gender	.492	.5004	528
SouthAfrican	.732	.4436	529
English	.448	.4978	529
Prof	.206	.4048	529
Field1Med&Bio	.342	.4749	529
Uni3: Wits	.231	.4216	529
SGIPROPENSITY	3.2481	.44328	529

Correlations

		TARP	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	SGIPROPENSITY
Pearson Correlation	TARP	1.000	.178	-.096	.129	.502	.098	.111	-.205
	Gender	.178	1.000	-.163	-.104	.186	-.033	-.010	-.021
	SouthAfrican	-.096	-.163	1.000	.040	-.061	.077	-.154	.030
	English	.129	-.104	.040	1.000	-.064	.168	.066	-.098
	Prof	.502	.186	-.061	-.064	1.000	-.190	.021	-.138
	Field1Med&Bio	.098	-.033	.077	.168	-.190	1.000	.069	.030
	Uni3: Wits	.111	-.010	-.154	.066	.021	.069	1.000	-.068
	SGIPROPENSITY	-.205	-.021	.030	-.098	-.138	.030	-.068	1.000

Sig. (1-tailed)	TARP	.	.000	.022	.004	.000	.020	.010	.000
	Gender	.000	.	.000	.008	.000	.225	.412	.314
	SouthAfrican	.022	.000	.	.182	.082	.038	.000	.245
	English	.004	.008	.182	.	.070	.000	.064	.012
	Prof	.000	.000	.082	.070	.	.000	.318	.001
	Field1Med&Bio	.020	.225	.038	.000	.000	.	.057	.246
	Uni3: Wits	.010	.412	.000	.064	.318	.057	.	.060
	SGIPROPENSITY	.000	.314	.245	.012	.001	.246	.060	.
N	TARP	438	437	438	438	438	438	438	438
	Gender	437	528	528	528	528	528	528	528
	SouthAfrican	438	528	529	529	529	529	529	529
	English	438	528	529	529	529	529	529	529
	Prof	438	528	529	529	529	529	529	529
	Field1Med&Bio	438	528	529	529	529	529	529	529
	Uni3: Wits	438	528	529	529	529	529	529	529
	SGIPROPENSITY	438	528	529	529	529	529	529	529

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof[b]	.	Enter
2	SGIPROPENSITY[b]	.	Enter

a. Dependent Variable: TARP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.572[a]	.327	.317	.46125	.327	34.797	6	430	.000
2	.584[b]	.341	.330	.45703	.014	8.991	1	429	.003

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, SGIPROPENSITY

c. Dependent Variable: TARP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	44.420	6	7.403	34.797	.000[b]
	Residual	91.485	430	.213		
	Total	135.905	436			

2	Regression	46.298	7	6.614	31.665	.000[c]
	Residual	89.607	429	.209		
	Total	135.905	436			

a. Dependent Variable: TARP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, SGIPROPENSITY

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.764	.060		12.792	.000					
	Gender	.103	.046	.093	2.260	.024	.178	.108	.089	.933	1.072
	SouthAfrican	-.073	.051	-.058	-1.414	.158	-.096	-.068	-.056	.942	1.062
	English	.157	.045	.140	3.461	.001	.129	.165	.137	.959	1.043
	Prof	.720	.057	.522	12.720	.000	.502	.523	.503	.930	1.075
	Field1Med&Bio	.207	.048	.176	4.294	.000	.098	.203	.170	.930	1.075
	Uni3: Wits	.093	.053	.071	1.752	.080	.111	.084	.069	.964	1.037
2	(Constant)	1.264	.177		7.143	.000					
	Gender	.103	.045	.092	2.269	.024	.178	.109	.089	.933	1.072
	SouthAfrican	-.070	.051	-.056	-1.383	.167	-.096	-.067	-.054	.942	1.062
	English	.142	.045	.127	3.152	.002	.129	.150	.124	.948	1.055
	Prof	.697	.057	.505	12.320	.000	.502	.511	.483	.913	1.095

	Field1Med&Bio	.211	.048	.179	4.404	.000	.098	.208	.173	.929	1.076
	Uni3: Wits	.084	.053	.064	1.594	.112	.111	.077	.063	.961	1.041
	SGIPROPENSITY	-.151	.050	-.120	-2.999	.003	-.205	-.143	-.118	.965	1.036

a. Dependent Variable: TARP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	SGIPROPENSITY	-.120[b]	-2.999	.003	-.143	.965	1.036	.913

a. Dependent Variable: TARP

b. Predictors in the Model: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	SGIPROPENSITY
1	1	3.825	1.000	.01	.02	.01	.02	.01	.02	.02	
	2	.943	2.014	.00	.04	.00	.04	.47	.16	.01	
	3	.744	2.267	.00	.01	.02	.01	.00	.01	.88	
	4	.530	2.687	.00	.34	.00	.45	.09	.11	.00	
	5	.469	2.855	.01	.15	.01	.04	.40	.66	.00	
	6	.393	3.120	.02	.22	.29	.38	.00	.03	.01	
	7	.096	6.306	.96	.22	.65	.07	.02	.01	.08	
2	1	4.721	1.000	.00	.01	.01	.01	.01	.01	.01	.00

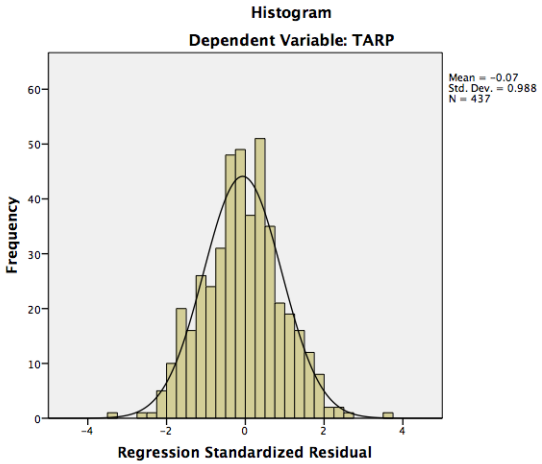
2	.943	2.238	.00	.04	.00	.03	.47	.15	.01	.00
3	.752	2.506	.00	.01	.02	.00	.00	.01	.89	.00
4	.531	2.983	.00	.33	.00	.46	.12	.07	.00	.00
5	.485	3.121	.00	.03	.02	.01	.37	.76	.01	.00
6	.411	3.388	.00	.37	.17	.42	.01	.00	.01	.00
7	.149	5.623	.02	.20	.76	.03	.00	.00	.06	.03
8	.008	23.704	.98	.01	.01	.03	.03	.00	.01	.97

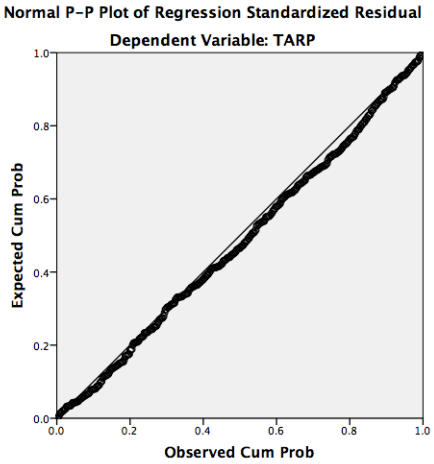
a. Dependent Variable: TARP

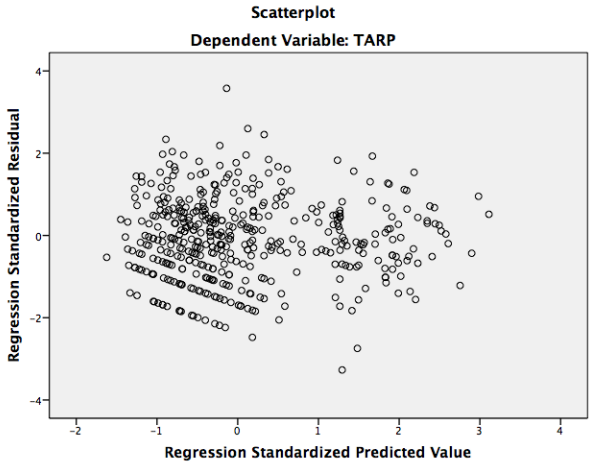
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.5441	2.0871	1.0720	.32552	528
Std. Predicted Value	-1.623	3.112	-.003	.999	528
Standard Error of Predicted Value	.044	.098	.061	.011	528
Adjusted Predicted Value	.5492	2.0791	1.1022	.33548	437
Residual	-1.49455	1.63474	-.03064	.45151	437
Std. Residual	-3.270	3.577	-.067	.988	437
Stud. Residual	-3.296	3.629	-.068	.997	437
Deleted Residual	-1.51840	1.68227	-.03107	.46015	437
Stud. Deleted Residual	-3.335	3.681	-.068	1.000	437
Mahal. Distance	2.982	19.249	6.986	2.845	528
Cook's Distance	.000	.048	.002	.004	437
Centered Leverage Value	.007	.044	.016	.007	528

a. Dependent Variable: TARP







9.5.5. Regression 1 (With outliers removed)

Descriptive Statistics

	Mean	Std. Deviation	N
TARP	1.0186	.51494	394
Gender	.483	.5002	482
SouthAfrican	.761	.4267	482
English	.436	.4964	482
Prof	.168	.3743	482
Field1Med&Bio	.326	.4691	482
Uni3: Wits	.203	.4029	482
SGIPROPENSITY	3.262750691562932	.389149456978544	482

Correlations

		TARP	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	SGIPROPENSITY
Pearson Correlation	TARP	1.000	.166	-.027	.112	.481	.052	.086	-.139
	Gender	.166	1.000	-.121	-.113	.187	-.043	-.055	-.014
	SouthAfrican	-.027	-.121	1.000	.040	.004	.088	-.116	-.026
	English	.112	-.113	.040	1.000	-.082	.157	.045	-.127
	Prof	.481	.187	.004	-.082	1.000	-.241	-.062	-.090
	Field1Med&Bio	.052	-.043	.088	.157	-.241	1.000	.067	.037
	Uni3: Wits	.086	-.055	-.116	.045	-.062	.067	1.000	-.047

	SGIPROPENSITY	-.139	-.014	-.026	-.127	-.090	.037	-.047	1.000
Sig. (1-tailed)	TARP	.	.000	.293	.013	.000	.152	.044	.003
	Gender	.000	.	.004	.006	.000	.171	.112	.380
	SouthAfrican	.293	.004	.	.189	.463	.027	.005	.285
	English	.013	.006	.189	.	.037	.000	.164	.003
	Prof	.000	.000	.463	.037	.	.000	.088	.024
	Field1Med&Bio	.152	.171	.027	.000	.000	.	.071	.206
	Uni3: Wits	.044	.112	.005	.164	.088	.071	.	.152
	SGIPROPENSITY	.003	.380	.285	.003	.024	.206	.152	.
N	TARP	394	394	394	394	394	394	394	394
	Gender	394	482	482	482	482	482	482	482
	SouthAfrican	394	482	482	482	482	482	482	482
	English	394	482	482	482	482	482	482	482
	Prof	394	482	482	482	482	482	482	482
	Field1Med&Bio	394	482	482	482	482	482	482	482
	Uni3: Wits	394	482	482	482	482	482	482	482
	SGIPROPENSITY	394	482	482	482	482	482	482	482

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method

1	Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio[b]	.	Enter
2	SGIPROPENSITY[b]	.	Enter

a. Dependent Variable: TARP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.546[a]	.298	.287	.43476	.298	27.389	6	387	.000
2	.551[b]	.304	.291	.43349	.006	3.263	1	386	.072

a. Predictors: (Constant), Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio

b. Predictors: (Constant), Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio, SGIPROPENSITY

c. Dependent Variable: TARP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	31.061	6	5.177	27.389	.000[b]
	Residual	73.148	387	.189		

	Total	104.209	393			
2	Regression	31.675	7	4.525	24.080	.000[c]
	Residual	72.535	386	.188		
	Total	104.209	393			

a. Dependent Variable: TARP

b. Predictors: (Constant), Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio

c. Predictors: (Constant), Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio, SGIPROPENSITY

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.731	.060		12.253	.000					
	Gender	.097	.045	.094	2.140	.033	.166	.108	.091	.938	1.066
	SouthAfrican	-.031	.052	-.025	-.582	.561	-.027	-.030	-.025	.960	1.042
	English	.142	.045	.137	3.153	.002	.112	.158	.134	.962	1.039
	Prof	.713	.062	.518	11.593	.000	.481	.508	.494	.907	1.103
	Field1Med&Bio	.170	.049	.155	3.475	.001	.052	.174	.148	.912	1.097
	Uni3: Wits	.133	.055	.104	2.408	.016	.086	.122	.103	.974	1.027
2	(Constant)	1.077	.200		5.370	.000					
	Gender	.095	.045	.093	2.115	.035	.166	.107	.090	.937	1.067
	SouthAfrican	-.034	.052	-.028	-.642	.521	-.027	-.033	-.027	.959	1.043

	English	.131	.045	.126	2.885	.004	.112	.145	.122	.944	1.059
	Prof	.704	.062	.511	11.423	.000	.481	.503	.485	.900	1.111
	Field1Med&Bio	.174	.049	.158	3.557	.000	.052	.178	.151	.910	1.099
	Uni3: Wits	.127	.055	.100	2.314	.021	.086	.117	.098	.971	1.030
	SGIPROPENSITY	-.103	.057	-.078	-1.806	.072	-.139	-.092	-.077	.969	1.032

a. Dependent Variable: TARP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	SGIPROPENSITY	-.078[b]	-1.806	.072	-.092	.969	1.032	.900

a. Dependent Variable: TARP

b. Predictors in the Model: (Constant), Uni3: Wits, English, Prof, SouthAfrican, Gender, Field1Med&Bio

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	SGIPROPENSITY
1	1	3.730	1.000	.01	.02	.01	.02	.01	.02	.02	
	2	1.032	1.901	.00	.04	.00	.02	.43	.12	.06	
	3	.761	2.214	.00	.00	.01	.02	.02	.06	.85	

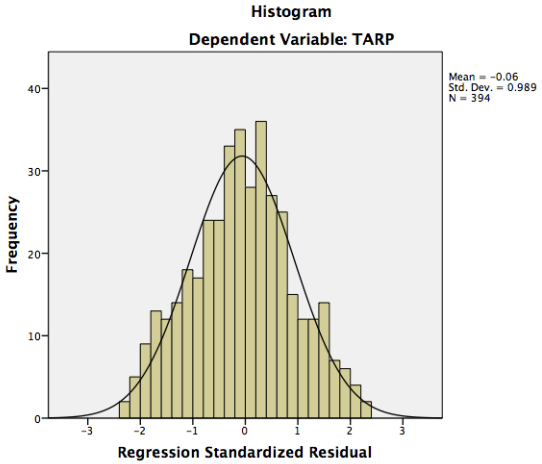
	4	.547	2.612	.00	.32	.00	.50	.07	.10	.00	
	5	.466	2.830	.00	.21	.00	.08	.42	.59	.00	
	6	.371	3.171	.03	.21	.30	.29	.04	.10	.00	
	7	.093	6.320	.96	.19	.68	.07	.01	.01	.07	
2	1	4.634	1.000	.00	.01	.01	.01	.01	.01	.01	.00
	2	1.032	2.119	.00	.04	.00	.02	.42	.13	.06	.00
	3	.763	2.464	.00	.00	.01	.01	.03	.05	.86	.00
	4	.548	2.908	.00	.30	.00	.51	.08	.07	.00	.00
	5	.474	3.127	.00	.10	.00	.04	.44	.70	.00	.00
	6	.398	3.411	.00	.38	.17	.34	.01	.04	.00	.00
	7	.143	5.683	.02	.16	.78	.03	.00	.00	.06	.02
	8	.006	26.776	.98	.01	.02	.04	.01	.00	.01	.97

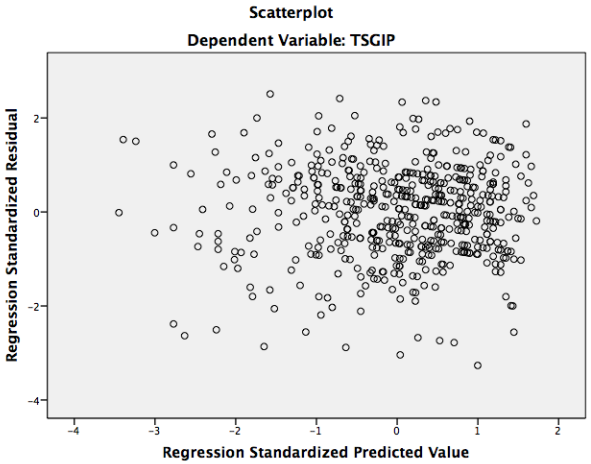
a. Dependent Variable: TARP

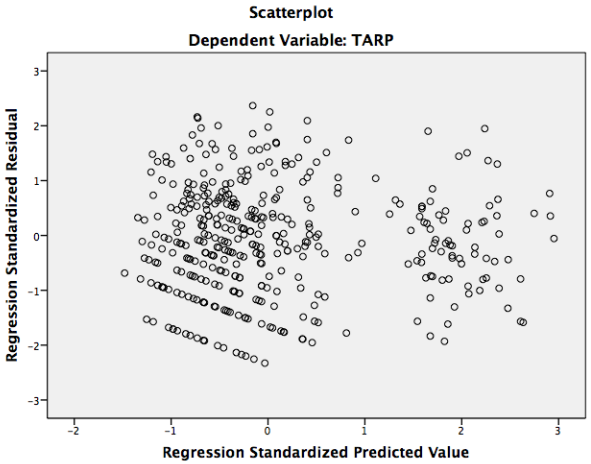
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.5984	1.8567	1.0186	.28390	482
Residual	-1.00922	1.02611	-.02604	.42854	394
Std. Predicted Value	-1.480	2.952	.000	1.000	482
Std. Residual	-2.328	2.367	-.060	.989	394

a. Dependent Variable: TARP


Histogram
Dependent Variable: TARP
Mean = -0.06
Std. Dev. = 0.989
N = 394
Frequency
Regression Standardized Residual


Scatterplot
Dependent Variable: TSGIP
Regression Standardized Residual
Regression Standardized Predicted Value


Scatterplot
Dependent Variable: TARP
Regression Standardized Residual
Regression Standardized Predicted Value

9.5.6. Regression 2

Descriptive Statistics

	Mean	Std. Deviation	N
TSGIP	.5075	.06064	529
Gender	.492	.5004	528
SouthAfrican	.732	.4436	529
English	.448	.4978	529
Prof	.206	.4048	529
Field1Med&Bio	.342	.4749	529
Uni3: Wits	.231	.4216	529
HCI	13.709	10.0411	529

Correlations

		TSGIP	Gender	SouthAfrican	English	Prof	Field1Med& Bio	Uni3: Wits	HCI
Pearson Correlation	TSGIP	1.000	-.028	.043	-.096	-.149	.033	-.069	-.191
	Gender	-.028	1.000	-.163	-.104	.186	-.033	-.010	.177
	SouthAfrican	.043	-.163	1.000	.040	-.061	.077	-.154	-.061
	English	-.096	-.104	.040	1.000	-.064	.168	.066	.069
	Prof	-.149	.186	-.061	-.064	1.000	-.190	.021	.565

	Field1Med&Bio	.033	-.033	.077	.168	-.190	1.000	.069	-.055
	Uni3: Wits	-.069	-.010	-.154	.066	.021	.069	1.000	-.022
	HCI	-.191	.177	-.061	.069	.565	-.055	-.022	1.000
Sig. (1-tailed)	TSGIP	.	.258	.164	.013	.000	.228	.056	.000
	Gender	.258	.	.000	.008	.000	.225	.412	.000
	SouthAfrican	.164	.000	.	.182	.082	.038	.000	.081
	English	.013	.008	.182	.	.070	.000	.064	.056
	Prof	.000	.000	.082	.070	.	.000	.318	.000
	Field1Med&Bio	.228	.225	.038	.000	.000	.	.057	.102
	Uni3: Wits	.056	.412	.000	.064	.318	.057	.	.309
	HCI	.000	.000	.081	.056	.000	.102	.309	.
N	TSGIP	529	528	529	529	529	529	529	529
	Gender	528	528	528	528	528	528	528	528
	SouthAfrican	529	528	529	529	529	529	529	529
	English	529	528	529	529	529	529	529	529
	Prof	529	528	529	529	529	529	529	529
	Field1Med&Bio	529	528	529	529	529	529	529	529
	Uni3: Wits	529	528	529	529	529	529	529	529
	HCI	529	528	529	529	529	529	529	529

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof[b]	.	Enter
2	HCI[b]	.	Enter

a. Dependent Variable: TSGIP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.196[a]	.038	.027	.05981	.038	3.461	6	521	.002
2	.230[b]	.053	.040	.05942	.014	7.889	1	520	.005

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

c. Dependent Variable: TSGIP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.074	6	.012	3.461	.002[b]
	Residual	1.864	521	.004		
	Total	1.938	527			
2	Regression	.102	7	.015	4.133	.000[c]
	Residual	1.836	520	.004		
	Total	1.938	527			

a. Dependent Variable: TSGIP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.517	.007		73.320	.000					
	Gender	-.001	.005	-.008	-.173	.863	-.028	-.008	-.007	.933	1.072
	SouthAfrican	.004	.006	.026	.589	.556	.043	.026	.025	.942	1.062
	English	-.013	.005	-.108	-2.460	.014	-.096	-.107	-.106	.959	1.043
	Prof	-.022	.007	-.147	-3.299	.001	-.149	-.143	-.142	.930	1.075

	Field1Med&Bio	.003	.006	.024	.546	.586	.033	.024	.023	.930	1.075
	Uni3: Wits	-.008	.006	-.057	-1.297	.195	-.069	-.057	-.056	.964	1.037
2	(Constant)	.525	.008		68.925	.000					
	Gender	.001	.005	.004	.093	.926	-.028	.004	.004	.924	1.082
	SouthAfrican	.003	.006	.022	.497	.620	.043	.022	.021	.941	1.063
	English	-.011	.005	-.092	-2.081	.038	-.096	-.091	-.089	.942	1.062
	Prof	-.010	.008	-.064	-1.194	.233	-.149	-.052	-.051	.641	1.559
	Field1Med&Bio	.004	.006	.030	.686	.493	.033	.030	.029	.928	1.078
	Uni3: Wits	-.009	.006	-.064	-1.463	.144	-.069	-.064	-.062	.961	1.041
	HCI	-.001	.000	-.148	-2.809	.005	-.191	-.122	-.120	.659	1.518

a. Dependent Variable: TSGIP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	HCI	-.148[b]	-2.809	.005	-.122	.659	1.518	.641

a. Dependent Variable: TSGIP

b. Predictors in the Model: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

Collinearity Diagnostics[a]

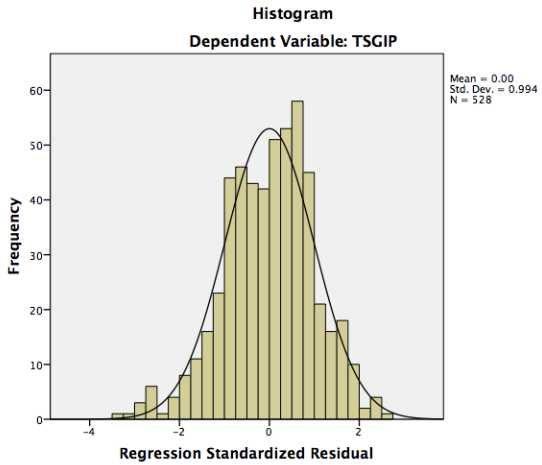
Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	HCI
1	1	3.824	1.000	.01	.02	.01	.02	.01	.02	.02	
	2	.943	2.014	.00	.04	.00	.04	.47	.16	.01	
	3	.744	2.267	.00	.01	.02	.01	.00	.01	.88	
	4	.530	2.687	.00	.34	.00	.45	.09	.11	.00	
	5	.469	2.854	.01	.15	.01	.04	.40	.66	.00	
	6	.393	3.119	.02	.22	.29	.38	.00	.03	.01	
	7	.096	6.305	.96	.22	.65	.07	.02	.01	.08	
2	1	4.545	1.000	.01	.01	.01	.01	.01	.01	.01	.01
	2	1.021	2.109	.00	.02	.00	.04	.25	.15	.03	.02
	3	.749	2.464	.00	.00	.02	.01	.01	.02	.87	.00
	4	.535	2.916	.00	.41	.00	.40	.05	.07	.00	.00
	5	.473	3.099	.01	.13	.02	.07	.20	.69	.00	.00
	6	.393	3.400	.01	.22	.29	.38	.00	.03	.01	.00
	7	.201	4.761	.01	.07	.13	.06	.46	.01	.00	.74
	8	.084	7.370	.97	.14	.53	.03	.04	.01	.08	.22

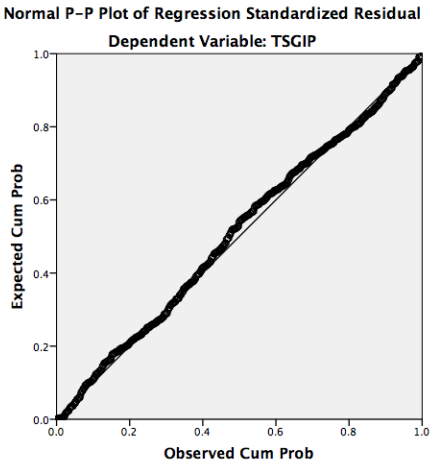
a. Dependent Variable: TSGIP

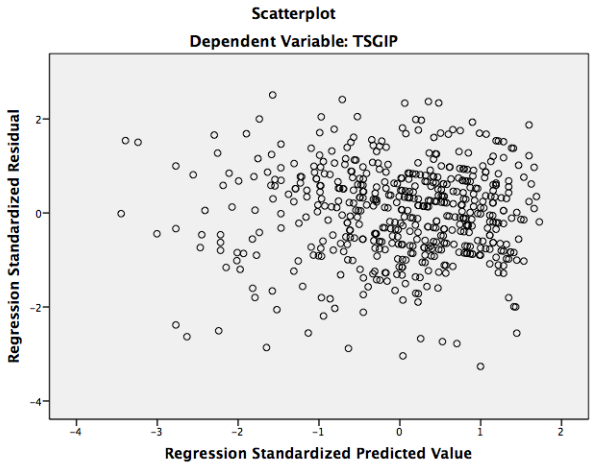
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.4595	.5315	.5075	.01389	528
Std. Predicted Value	-3.447	1.725	.003	.998	528
Standard Error of Predicted Value	.005	.012	.007	.001	528
Adjusted Predicted Value	.4570	.5317	.5075	.01394	528
Residual	-.19402	.14914	.00009	.05904	528
Std. Residual	-3.265	2.510	.001	.994	528
Stud. Residual	-3.280	2.538	.002	1.002	528
Deleted Residual	-.19572	.15242	.00011	.05999	528
Stud. Deleted Residual	-3.311	2.551	.001	1.004	528
Mahal. Distance	2.973	18.984	6.981	2.930	528
Cook's Distance	.000	.026	.002	.003	528
Centered Leverage Value	.006	.036	.013	.006	528

a. Dependent Variable: TSGIP


Histogram
Dependent Variable: TSGIP
Mean = 0.00
Std. Dev. = 0.994
N = 528
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: TSGIP
Expected Cum Prob
Observed Cum Prob


Scatterplot
Dependent Variable: TSGIP
Regression Standardized Residual
Regression Standardized Predicted Value

9.5.7. Regression 2 (with outliers removed)

Descriptive Statistics

	Mean	Std. Deviation	N
TSGIP	.5111	.05519	503
Gender	.488	.5004	502
SouthAfrican	.744	.4371	503
English	.445	.4975	503
Prof	.191	.3934	503
Field1Med&Bio	.336	.4728	503
Uni3: Wits	.219	.4138	503
HCI	13.292	9.5736	503

Correlations

		TSGIP	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	HCI
Pearson Correlation	TSGIP	1.000	-.025	.015	-.132	-.144	.068	-.047	-.170
	Gender	-.025	1.000	-.146	-.115	.190	-.038	-.007	.177
	SouthAfrican	.015	-.146	1.000	.050	-.039	.080	-.152	-.019
	English	-.132	-.115	.050	1.000	-.089	.167	.058	.046
	Prof	-.144	.190	-.039	-.089	1.000	-.206	-.012	.583
	Field1Med&Bio	.068	-.038	.080	.167	-.206	1.000	.041	-.098

	Uni3: Wits	-.047	-.007	-.152	.058	-.012	.041	1.000	-.080
	HCI	-.170	.177	-.019	.046	.583	-.098	-.080	1.000
Sig. (1-tailed)	TSGIP	.	.286	.370	.002	.001	.065	.148	.000
	Gender	.286	.	.001	.005	.000	.199	.441	.000
	SouthAfrican	.370	.001	.	.132	.190	.036	.000	.334
	English	.002	.005	.132	.	.023	.000	.096	.150
	Prof	.001	.000	.190	.023	.	.000	.393	.000
	Field1Med&Bio	.065	.199	.036	.000	.000	.	.178	.014
	Uni3: Wits	.148	.441	.000	.096	.393	.178	.	.037
	HCI	.000	.000	.334	.150	.000	.014	.037	.
N	TSGIP	503	502	503	503	503	503	503	503
	Gender	502	502	502	502	502	502	502	502
	SouthAfrican	503	502	503	503	503	503	503	503
	English	503	502	503	503	503	503	503	503
	Prof	503	502	503	503	503	503	503	503
	Field1Med&Bio	503	502	503	503	503	503	503	503
	Uni3: Wits	503	502	503	503	503	503	503	503
	HCI	503	502	503	503	503	503	503	503

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method

1	Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof[b]	.	Enter
2	HCI[b]	.	Enter

a. Dependent Variable: TSGIP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.218[a]	.047	.036	.05419	.047	4.111	6	495	.000
2	.237[b]	.056	.043	.05400	.009	4.545	1	494	.034

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

c. Dependent Variable: TSGIP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.072	6	.012	4.111	.000[b]
	Residual	1.453	495	.003		

	Total	1.526	501			
2	Regression	.086	7	.012	4.198	.000[c]
	Residual	1.440	494	.003		
	Total	1.526	501			

a. Dependent Variable: TSGIP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.522	.007		79.454	.000					
	Gender	-.001	.005	-.014	-.298	.766	-.025	-.013	-.013	.935	1.069
	SouthAfrican	.000	.006	.003	.076	.939	.015	.003	.003	.948	1.055
	English	-.017	.005	-.155	-3.445	.001	-.132	-.153	-.151	.955	1.047
	Prof	-.020	.006	-.142	-3.104	.002	-.144	-.138	-.136	.923	1.083
	Field1Med&Bio	.008	.005	.065	1.432	.153	.068	.064	.063	.928	1.077
	Uni3: Wits	-.006	.006	-.042	-.935	.350	-.047	-.042	-.041	.970	1.031
2	(Constant)	.528	.007		73.618	.000					
	Gender	.000	.005	-.004	-.093	.926	-.025	-.004	-.004	.927	1.079
	SouthAfrican	.000	.006	.003	.068	.946	.015	.003	.003	.948	1.055

	English	-.016	.005	-.142	-3.141	.002	-.132	-.140	-.137	.938	1.066
	Prof	-.010	.008	-.074	-1.340	.181	-.144	-.060	-.059	.622	1.608
	Field1Med&Bio	.008	.005	.066	1.461	.145	.068	.066	.064	.928	1.077
	Uni3: Wits	-.007	.006	-.051	-1.141	.254	-.047	-.051	-.050	.961	1.041
	HCI	-.001	.000	-.117	-2.132	.034	-.170	-.095	-.093	.638	1.567

a. Dependent Variable: TSGIP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	HCI	-.117[b]	-2.132	.034	-.095	.638	1.567	.622

a. Dependent Variable: TSGIP

b. Predictors in the Model: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	HCI
1	1	3.784	1.000	.01	.02	.01	.02	.01	.02	.02	
	2	.976	1.969	.00	.04	.00	.04	.47	.14	.01	
	3	.761	2.229	.00	.00	.02	.01	.00	.03	.88	

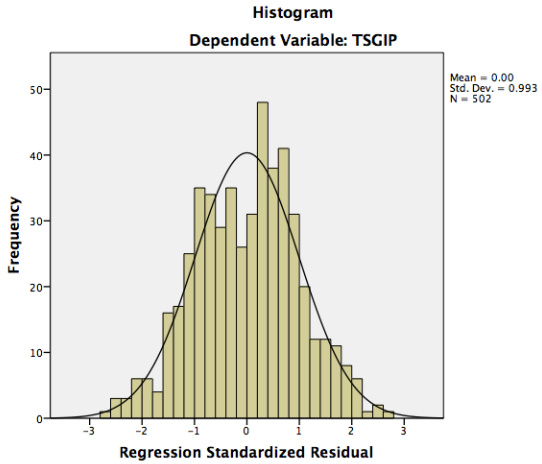
	4	.533	2.664	.00	.33	.00	.45	.08	.13	.00	
	5	.471	2.836	.01	.19	.01	.05	.41	.62	.00	
	6	.380	3.154	.02	.22	.29	.38	.01	.04	.01	
	7	.095	6.305	.96	.20	.66	.06	.02	.01	.08	
2	1	4.503	1.000	.01	.01	.01	.01	.01	.01	.01	.01
	2	1.065	2.056	.00	.01	.00	.04	.23	.14	.04	.02
	3	.767	2.423	.00	.00	.01	.01	.01	.04	.85	.00
	4	.539	2.890	.00	.39	.00	.40	.03	.10	.00	.00
	5	.472	3.087	.01	.18	.01	.07	.22	.65	.01	.00
	6	.381	3.439	.02	.22	.28	.38	.02	.04	.01	.00
	7	.190	4.867	.01	.07	.18	.06	.44	.00	.00	.72
	8	.082	7.414	.96	.12	.49	.02	.05	.01	.09	.24

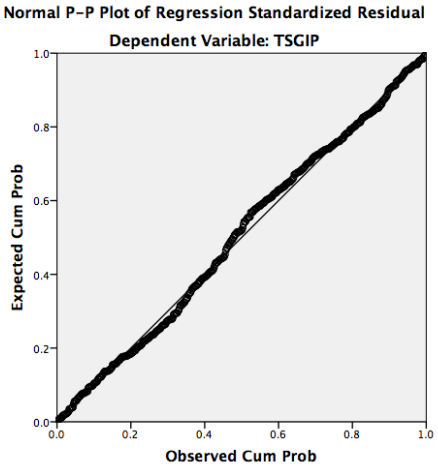
a. Dependent Variable: TSGIP

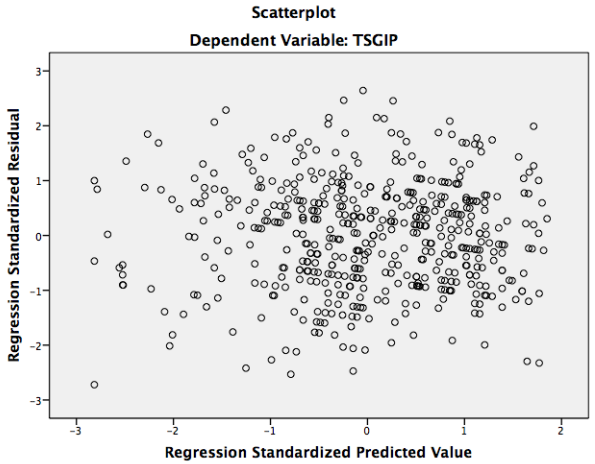
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.4743	.5353	.5111	.01306	502
Residual	-.14693	.14271	.00011	.05361	502
Std. Predicted Value	-2.815	1.851	.003	.999	502
Std. Residual	-2.721	2.643	.002	.993	502

a. Dependent Variable: TSGIP


Histogram
Dependent Variable: TSGIP
Mean = 0.00
Std. Dev. = 0.993
N = 502
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: TSGIP
Expected Cum Prob
Observed Cum Prob


Scatterplot
Dependent Variable: TSGIP
Regression Standardized Residual
Regression Standardized Predicted Value

9.5.8. Regression 3

Descriptive Statistics

	Mean	Std. Deviation	N
TSGIP	.5075	.06064	529
Gender	.492	.5004	528
SouthAfrican	.732	.4436	529
English	.448	.4978	529
Prof	.206	.4048	529
Field1Med&Bio	.342	.4749	529
Uni3: Wits	.231	.4216	529
PERSONALITY	2.2878	.68357	529

Correlations

		TSGIP	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	PERSONALITY
Pearson Correlation	TSGIP	1.000	-.028	.043	-.096	-.149	.033	-.069	.014
	Gender	-.028	1.000	-.163	-.104	.186	-.033	-.010	.004
	SouthAfrican	.043	-.163	1.000	.040	-.061	.077	-.154	.021
	English	-.096	-.104	.040	1.000	-.064	.168	.066	.077
	Prof	-.149	.186	-.061	-.064	1.000	-.190	.021	-.037
	Field1Med&Bio	.033	-.033	.077	.168	-.190	1.000	.069	.072
	Uni3: Wits	-.069	-.010	-.154	.066	.021	.069	1.000	.089

	PERSONALITY	.014	.004	.021	.077	-.037	.072	.089	1.000
Sig. (1-tailed)	TSGIP	.	.258	.164	.013	.000	.228	.056	.375
	Gender	.258	.	.000	.008	.000	.225	.412	.468
	SouthAfrican	.164	.000	.	.182	.082	.038	.000	.314
	English	.013	.008	.182	.	.070	.000	.064	.038
	Prof	.000	.000	.082	.070	.	.000	.318	.199
	Field1Med&Bio	.228	.225	.038	.000	.000	.	.057	.049
	Uni3: Wits	.056	.412	.000	.064	.318	.057	.	.021
	PERSONALITY	.375	.468	.314	.038	.199	.049	.021	.
N	TSGIP	529	528	529	529	529	529	529	529
	Gender	528	528	528	528	528	528	528	528
	SouthAfrican	529	528	529	529	529	529	529	529
	English	529	528	529	529	529	529	529	529
	Prof	529	528	529	529	529	529	529	529
	Field1Med&Bio	529	528	529	529	529	529	529	529
	Uni3: Wits	529	528	529	529	529	529	529	529
	PERSONALITY	529	528	529	529	529	529	529	529

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method

1	Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof[b]	.	Enter
2	PERSONALITY[b]	.	Enter

a. Dependent Variable: TSGIP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.196[a]	.038	.027	.05981	.038	3.461	6	521	.002
2	.197[b]	.039	.026	.05985	.000	.210	1	520	.647

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, PERSONALITY

c. Dependent Variable: TSGIP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.074	6	.012	3.461	.002[b]
	Residual	1.864	521	.004		

	Total	1.938	527			
2	Regression	.075	7	.011	2.992	.004[c]
	Residual	1.863	520	.004		
	Total	1.938	527			

a. Dependent Variable: TSGIP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, PERSONALITY

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.517	.007		73.320	.000					
	Gender	-.001	.005	-.008	-.173	.863	-.028	-.008	-.007	.933	1.072
	SouthAfrican	.004	.006	.026	.589	.556	.043	.026	.025	.942	1.062
	English	-.013	.005	-.108	-2.460	.014	-.096	-.107	-.106	.959	1.043
	Prof	-.022	.007	-.147	-3.299	.001	-.149	-.143	-.142	.930	1.075
	Field1Med&Bio	.003	.006	.024	.546	.586	.033	.024	.023	.930	1.075
	Uni3: Wits	-.008	.006	-.057	-1.297	.195	-.069	-.057	-.056	.964	1.037
2	(Constant)	.513	.011		47.128	.000					
	Gender	-.001	.005	-.008	-.183	.855	-.028	-.008	-.008	.932	1.073
	SouthAfrican	.003	.006	.025	.575	.566	.043	.025	.025	.941	1.063

	English	-.013	.005	-.109	-2.482	.013	-.096	-.108	-.107	.955	1.047
	Prof	-.022	.007	-.146	-3.283	.001	-.149	-.143	-.141	.929	1.076
	Field1Med&Bio	.003	.006	.023	.523	.601	.033	.023	.022	.928	1.078
	Uni3: Wits	-.008	.006	-.058	-1.330	.184	-.069	-.058	-.057	.957	1.045
	PERSONALITY	.002	.004	.020	.458	.647	.014	.020	.020	.982	1.018

a. Dependent Variable: TSGIP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	PERSONALITY	.020[b]	.458	.647	.020	.982	1.018	.928

a. Dependent Variable: TSGIP

b. Predictors in the Model: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	PERSONALITY
1	1	3.824	1.000	.01	.02	.01	.02	.01	.02	.02	
	2	.943	2.014	.00	.04	.00	.04	.47	.16	.01	
	3	.744	2.267	.00	.01	.02	.01	.00	.01	.88	

	4	.530	2.687	.00	.34	.00	.45	.09	.11	.00	
	5	.469	2.854	.01	.15	.01	.04	.40	.66	.00	
	6	.393	3.119	.02	.22	.29	.38	.00	.03	.01	
	7	.096	6.305	.96	.22	.65	.07	.02	.01	.08	
2	1	4.694	1.000	.00	.01	.01	.01	.01	.01	.01	.00
	2	.943	2.231	.00	.04	.00	.03	.48	.15	.01	.00
	3	.748	2.506	.00	.01	.02	.00	.00	.01	.89	.00
	4	.530	2.977	.00	.34	.00	.45	.10	.09	.00	.00
	5	.483	3.119	.00	.05	.02	.01	.40	.73	.00	.01
	6	.408	3.393	.00	.34	.18	.44	.00	.00	.01	.01
	7	.158	5.452	.05	.17	.67	.04	.00	.00	.08	.19
	8	.037	11.228	.94	.04	.09	.01	.01	.00	.00	.80

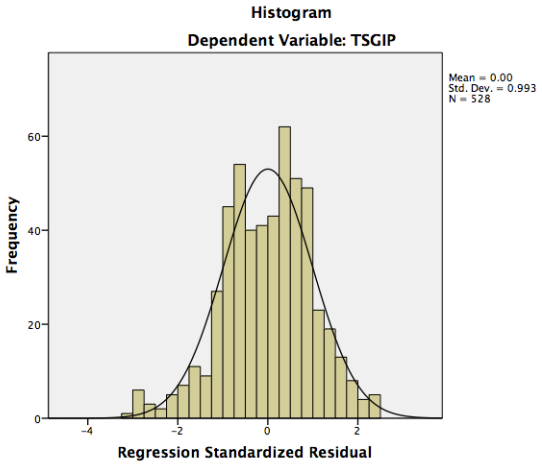
a. Dependent Variable: TSGIP

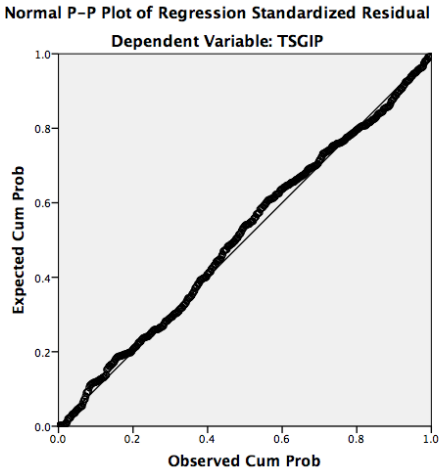
Residuals Statistics[a]

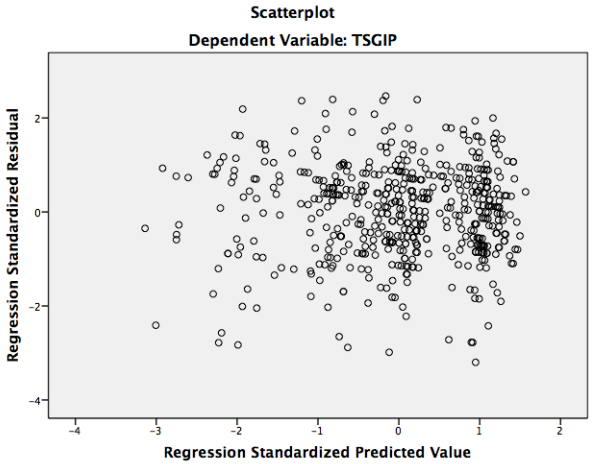
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.4700	.5262	.5075	.01193	528
Std. Predicted Value	-3.139	1.567	.002	1.000	528
Standard Error of Predicted Value	.005	.012	.007	.001	528
Adjusted Predicted Value	.4707	.5268	.5075	.01197	528
Residual	-.19145	.14766	.00011	.05946	528

Std. Residual	-3.199	2.467	.002	.993	528
Stud. Residual	-3.213	2.481	.002	1.001	528
Deleted Residual	-.19314	.14936	.00013	.06043	528
Stud. Deleted Residual	-3.242	2.494	.002	1.004	528
Mahal. Distance	2.973	20.208	6.983	2.772	528
Cook's Distance	.000	.028	.002	.004	528
Centered Leverage Value	.006	.038	.013	.005	528

a. Dependent Variable: TSGIP







9.5.9 Regression 3 (with outliers removed)

Descriptive Statistics

	Mean	Std. Deviation	N
TSGIP	.5117	.05510	507
Gender	.486	.5003	506
SouthAfrican	.740	.4393	507
English	.444	.4973	507
Prof	.191	.3937	507
Field1Med&Bio	.343	.4752	507
Uni3: Wits	.219	.4139	507
PERSONALITY	2.280013149243919	.656315966291332	507

Correlations

		TSGIP	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	PERSONALITY
Pearson Correlation	TSGIP	1.000	-.003	.002	-.112	-.125	.047	-.038	.027
	Gender	-.003	1.000	-.152	-.114	.185	-.030	-.019	-.027
	SouthAfrican	.002	-.152	1.000	.060	-.043	.069	-.153	.034
	English	-.112	-.114	.060	1.000	-.091	.165	.046	.056
	Prof	-.125	.185	-.043	-.091	1.000	-.204	-.039	-.059
	Field1Med&Bio	.047	-.030	.069	.165	-.204	1.000	.059	.083
	Uni3: Wits	-.038	-.019	-.153	.046	-.039	.059	1.000	.092

	PERSONALITY	.027	-.027	.034	.056	-.059	.083	.092	1.000
Sig. (1-tailed)	TSGIP	.	.474	.481	.006	.002	.144	.194	.273
	Gender	.474	.	.000	.005	.000	.251	.337	.271
	SouthAfrican	.481	.000	.	.090	.168	.060	.000	.222
	English	.006	.005	.090	.	.020	.000	.153	.106
	Prof	.002	.000	.168	.020	.	.000	.189	.092
	Field1Med&Bio	.144	.251	.060	.000	.000	.	.091	.030
	Uni3: Wits	.194	.337	.000	.153	.189	.091	.	.020
	PERSONALITY	.273	.271	.222	.106	.092	.030	.020	.
N	TSGIP	507	506	507	507	507	507	507	507
	Gender	506	506	506	506	506	506	506	506
	SouthAfrican	507	506	507	507	507	507	507	507
	English	507	506	507	507	507	507	507	507
	Prof	507	506	507	507	507	507	507	507
	Field1Med&Bio	507	506	507	507	507	507	507	507
	Uni3: Wits	507	506	507	507	507	507	507	507
	PERSONALITY	507	506	507	507	507	507	507	507

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method

1	Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof[b]	.	Enter
2	PERSONALITY[b]	.	Enter

a. Dependent Variable: TSGIP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.186[a]	.034	.023	.05447	.034	2.968	6	499	.007
2	.188[b]	.035	.022	.05450	.001	.374	1	498	.541

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, PERSONALITY

c. Dependent Variable: TSGIP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.053	6	.009	2.968	.007[b]
	Residual	1.480	499	.003		

	Total	1.533	505			
2	Regression	.054	7	.008	2.594	.012[c]
	Residual	1.479	498	.003		
	Total	1.533	505			

a. Dependent Variable: TSGIP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, PERSONALITY

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.521	.007		79.222	.000					
	Gender	.001	.005	.006	.141	.888	-.003	.006	.006	.935	1.069
	SouthAfrican	-.001	.006	-.004	-.093	.926	.002	-.004	-.004	.946	1.057
	English	-.014	.005	-.129	-2.862	.004	-.112	-.127	-.126	.957	1.045
	Prof	-.018	.006	-.131	-2.856	.004	-.125	-.127	-.126	.924	1.082
	Field1Med&Bio	.005	.005	.045	.986	.325	.047	.044	.043	.930	1.075
	Uni3: Wits	-.005	.006	-.041	-.915	.360	-.038	-.041	-.040	.968	1.033
2	(Constant)	.516	.010		49.432	.000					
	Gender	.001	.005	.007	.145	.884	-.003	.007	.006	.935	1.069
	SouthAfrican	-.001	.006	-.005	-.116	.907	.002	-.005	-.005	.944	1.059

	English	-.014	.005	-.130	-2.879	.004	-.112	-.128	-.127	.955	1.047
	Prof	-.018	.006	-.130	-2.830	.005	-.125	-.126	-.125	.923	1.083
	Field1Med&Bio	.005	.005	.043	.946	.344	.047	.042	.042	.927	1.079
	Uni3: Wits	-.006	.006	-.043	-.966	.335	-.038	-.043	-.043	.960	1.042
	PERSONALITY	.002	.004	.027	.612	.541	.027	.027	.027	.981	1.019

a. Dependent Variable: TSGIP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	PERSONALITY	.027[b]	.612	.541	.027	.981	1.019	.923

a. Dependent Variable: TSGIP

b. Predictors in the Model: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	PERSONALITY
1	1	3.780	1.000	.01	.02	.01	.02	.01	.02	.02	
	2	.978	1.966	.00	.04	.00	.03	.47	.12	.04	
	3	.757	2.234	.00	.00	.02	.02	.01	.04	.86	

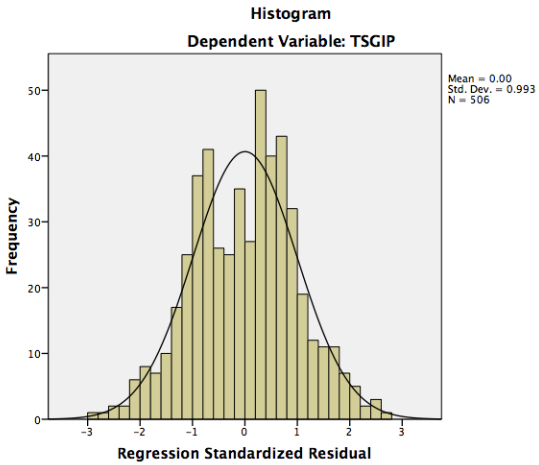
	4	.537	2.652	.00	.33	.01	.43	.08	.15	.00	
	5	.469	2.839	.01	.20	.01	.04	.40	.62	.00	
	6	.383	3.141	.02	.20	.30	.40	.01	.03	.00	
	7	.095	6.295	.96	.21	.66	.06	.02	.02	.08	
2	1	4.654	1.000	.00	.01	.01	.01	.01	.01	.01	.00
	2	.978	2.182	.00	.04	.00	.03	.47	.12	.04	.00
	3	.758	2.477	.00	.00	.02	.02	.01	.03	.86	.00
	4	.537	2.943	.00	.33	.01	.43	.08	.14	.00	.00
	5	.479	3.116	.00	.10	.02	.00	.42	.68	.00	.00
	6	.403	3.399	.00	.32	.18	.47	.00	.00	.00	.01
	7	.156	5.470	.04	.14	.70	.03	.00	.01	.09	.17
	8	.035	11.586	.95	.04	.08	.01	.01	.00	.00	.81

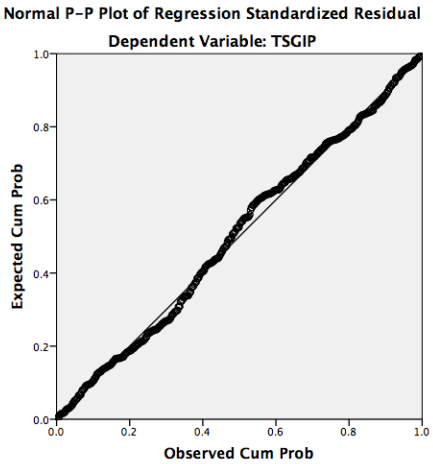
a. Dependent Variable: TSGIP

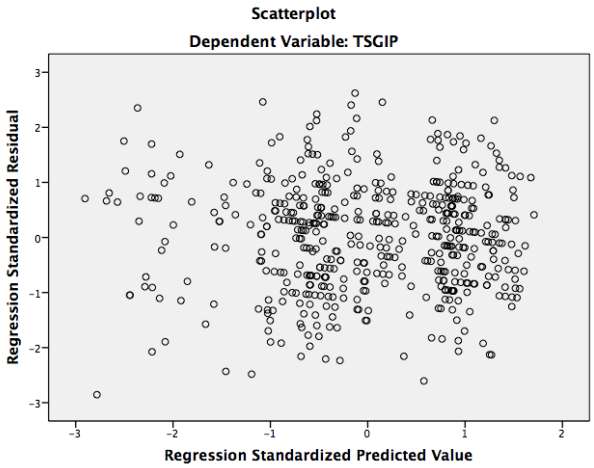
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.4817	.5294	.5117	.01033	506
Residual	-.15560	.14286	.00013	.05410	506
Std. Predicted Value	-2.904	1.708	.002	1.000	506
Std. Residual	-2.855	2.621	.002	.993	506

a. Dependent Variable: TSGIP


Histogram
Dependent Variable: TSGIP
Mean = 0.00
Std. Dev. = 0.993
N = 506
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: TSGIP
Expected Cum Prob
Observed Cum Prob


Scatterplot
Dependent Variable: TSGIP
Regression Standardized Residual
Regression Standardized Predicted Value

9.5.10 Regression 4

Descriptive Statistics

	Mean	Std. Deviation	N
TSGIP	.5075	.06064	529
Gender	.492	.5004	528
SouthAfrican	.732	.4436	529
English	.448	.4978	529
Prof	.206	.4048	529
Field1Med&Bio	.342	.4749	529
Uni3: Wits	.231	.4216	529
MOTIVATIONTOTAL	3.578463032976268	.542831152946690	529

Correlations

		TSGIP	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	MOTIVATIONTOTAL
Pearson Correlation	TSGIP	1.000	-.028	.043	-.096	-.149	.033	-.069	.124
	Gender	-.028	1.000	-.163	-.104	.186	-.033	-.010	-.018
	SouthAfrican	.043	-.163	1.000	.040	-.061	.077	-.154	.039
	English	-.096	-.104	.040	1.000	-.064	.168	.066	-.102
	Prof	-.149	.186	-.061	-.064	1.000	-.190	.021	-.023
	Field1Med&Bio	.033	-.033	.077	.168	-.190	1.000	.069	-.093

	Uni3: Wits	-.069	-.010	-.154	.066	.021	.069	1.000	.025
	MOTIVATIONTOTAL	.124	-.018	.039	-.102	-.023	-.093	.025	1.000
Sig. (1-tailed)	TSGIP	.	.258	.164	.013	.000	.228	.056	.002
	Gender	.258	.	.000	.008	.000	.225	.412	.336
	SouthAfrican	.164	.000	.	.182	.082	.038	.000	.187
	English	.013	.008	.182	.	.070	.000	.064	.010
	Prof	.000	.000	.082	.070	.	.000	.318	.299
	Field1Med&Bio	.228	.225	.038	.000	.000	.	.057	.016
	Uni3: Wits	.056	.412	.000	.064	.318	.057	.	.281
	MOTIVATIONTOTAL	.002	.336	.187	.010	.299	.016	.281	.
N	TSGIP	529	528	529	529	529	529	529	529
	Gender	528	528	528	528	528	528	528	528
	SouthAfrican	529	528	529	529	529	529	529	529
	English	529	528	529	529	529	529	529	529
	Prof	529	528	529	529	529	529	529	529
	Field1Med&Bio	529	528	529	529	529	529	529	529
	Uni3: Wits	529	528	529	529	529	529	529	529
	MOTIVATIONTOTAL	529	528	529	529	529	529	529	529

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method

1	Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof[b]	.	Enter
2	MOTIVATIONTOTAL[b]	.	Enter

a. Dependent Variable: TSGIP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.196[a]	.038	.027	.05981	.038	3.461	6	521	.002
2	.227[b]	.051	.039	.05946	.013	7.108	1	520	.008

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, MOTIVATIONTOTAL

c. Dependent Variable: TSGIP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.074	6	.012	3.461	.002[b]

	Residual	1.864	521	.004		
	Total	1.938	527			
2	Regression	.099	7	.014	4.017	.000[c]
	Residual	1.839	520	.004		
	Total	1.938	527			

a. Dependent Variable: TSGIP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, MOTIVATIONTOTAL

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.517	.007		73.320	.000					
	Gender	-.001	.005	-.008	-.173	.863	-.028	-.008	-.007	.933	1.072
	SouthAfrican	.004	.006	.026	.589	.556	.043	.026	.025	.942	1.062
	English	-.013	.005	-.108	-2.460	.014	-.096	-.107	-.106	.959	1.043
	Prof	-.022	.007	-.147	-3.299	.001	-.149	-.143	-.142	.930	1.075
	Field1Med&Bio	.003	.006	.024	.546	.586	.033	.024	.023	.930	1.075
	Uni3: Wits	-.008	.006	-.057	-1.297	.195	-.069	-.057	-.056	.964	1.037
2	(Constant)	.470	.019		24.962	.000					
	Gender	-.001	.005	-.006	-.135	.892	-.028	-.006	-.006	.933	1.072

	SouthAfrican	.003	.006	.020	.456	.649	.043	.020	.019	.939	1.065
	English	-.012	.005	-.097	-2.212	.027	-.096	-.097	-.094	.950	1.053
	Prof	-.021	.007	-.142	-3.207	.001	-.149	-.139	-.137	.928	1.077
	Field1Med&Bio	.004	.006	.035	.787	.432	.033	.034	.034	.922	1.084
	Uni3: Wits	-.009	.006	-.062	-1.427	.154	-.069	-.062	-.061	.962	1.040
	MOTIVATIONTOTAL	.013	.005	.115	2.666	.008	.124	.116	.114	.977	1.023

a. Dependent Variable: TSGIP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	MOTIVATIONTOTAL	.115[b]	2.666	.008	.116	.977	1.023	.922

a. Dependent Variable: TSGIP

b. Predictors in the Model: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	MOTIVATIONTOTAL
1	1	3.824	1.000	.01	.02	.01	.02	.01	.02	.02	
	2	.943	2.014	.00	.04	.00	.04	.47	.16	.01	

	3	.744	2.267	.00	.01	.02	.01	.00	.01	.88	
	4	.530	2.687	.00	.34	.00	.45	.09	.11	.00	
	5	.469	2.854	.01	.15	.01	.04	.40	.66	.00	
	6	.393	3.119	.02	.22	.29	.38	.00	.03	.01	
	7	.096	6.305	.96	.22	.65	.07	.02	.01	.08	
2	1	4.719	1.000	.00	.01	.01	.01	.01	.01	.01	.00
	2	.943	2.237	.00	.04	.00	.04	.47	.16	.01	.00
	3	.749	2.509	.00	.01	.02	.00	.00	.01	.89	.00
	4	.530	2.983	.00	.34	.00	.46	.11	.08	.00	.00
	5	.487	3.113	.00	.03	.03	.01	.39	.73	.01	.00
	6	.413	3.382	.00	.37	.16	.43	.01	.00	.01	.00
	7	.148	5.641	.03	.19	.77	.03	.01	.00	.08	.04
	8	.011	21.190	.97	.01	.01	.03	.01	.02	.00	.96

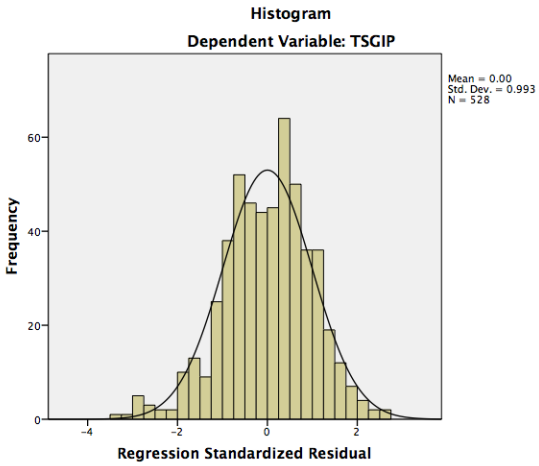
a. Dependent Variable: TSGIP

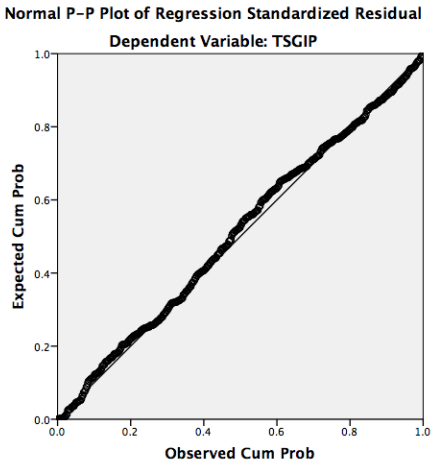
Residuals Statistics[a]

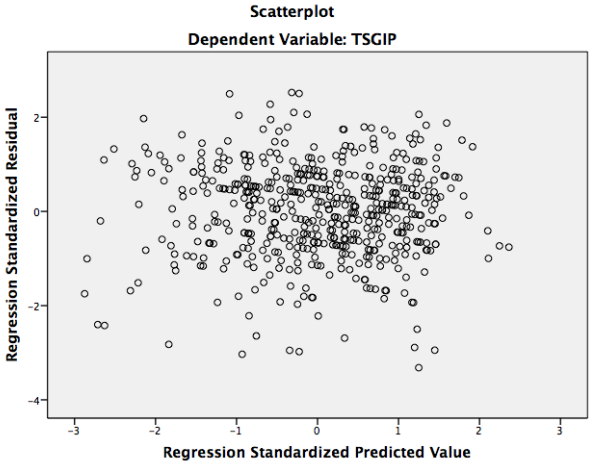
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.4680	.5399	.5075	.01373	528
Std. Predicted Value	-2.875	2.363	.002	.999	528
Standard Error of Predicted Value	.005	.011	.007	.001	528
Adjusted Predicted Value	.4694	.5410	.5075	.01376	528

Residual	-.19729	.15010	.00010	.05907	528
Std. Residual	-3.318	2.524	.002	.993	528
Stud. Residual	-3.334	2.536	.002	1.001	528
Deleted Residual	-.19922	.15222	.00012	.06003	528
Stud. Deleted Residual	-3.367	2.549	.001	1.004	528
Mahal. Distance	2.973	16.759	6.986	2.730	528
Cook's Distance	.000	.028	.002	.003	528
Centered Leverage Value	.006	.032	.013	.005	528

a. Dependent Variable: TSGIP







9.5.11. Regression 4 (with outliers removed)

Descriptive Statistics

	Mean	Std. Deviation	N
TSGIP	.5103	.05503	506
Gender	.483	.5002	505
SouthAfrican	.745	.4363	506
English	.449	.4978	506
Prof	.198	.3986	506
Field1Med&Bio	.338	.4735	506
Uni3: Wits	.219	.4142	506
MOTIVATIONTOTAL	3.573644049187530	.526107141477145	506

Correlations

		TSGIP	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	MOTIVATIONTOTAL
Pearson Correlation	TSGIP	1.000	-.020	.028	-.132	-.121	.057	-.055	.151
	Gender	-.020	1.000	-.133	-.101	.181	-.039	-.035	-.026
	SouthAfrican	.028	-.133	1.000	.026	-.040	.102	-.139	.068
	English	-.132	-.101	.026	1.000	-.068	.162	.050	-.103
	Prof	-.121	.181	-.040	-.068	1.000	-.218	-.011	-.019
	Field1Med&Bio	.057	-.039	.102	.162	-.218	1.000	.066	-.111

	Uni3: Wits	-.055	-.035	-.139	.050	-.011	.066	1.000	.027
	MOTIVATIONTOTAL	.151	-.026	.068	-.103	-.019	-.111	.027	1.000
Sig. (1-tailed)	TSGIP	.	.325	.266	.001	.003	.100	.107	.000
	Gender	.325	.	.001	.012	.000	.193	.218	.283
	SouthAfrican	.266	.001	.	.278	.185	.011	.001	.063
	English	.001	.012	.278	.	.062	.000	.131	.010
	Prof	.003	.000	.185	.062	.	.000	.400	.335
	Field1Med&Bio	.100	.193	.011	.000	.000	.	.071	.006
	Uni3: Wits	.107	.218	.001	.131	.400	.071	.	.271
	MOTIVATIONTOTAL	.000	.283	.063	.010	.335	.006	.271	.
N	TSGIP	506	505	506	506	506	506	506	506
	Gender	505	505	505	505	505	505	505	505
	SouthAfrican	506	505	506	506	506	506	506	506
	English	506	505	506	506	506	506	506	506
	Prof	506	505	506	506	506	506	506	506
	Field1Med&Bio	506	505	506	506	506	506	506	506
	Uni3: Wits	506	505	506	506	506	506	506	506
	MOTIVATIONTOTAL	506	505	506	506	506	506	506	506

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method

1	Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio[b]	.	Enter
2	MOTIVATIONTOTAL[b]	.	Enter

a. Dependent Variable: TSGIP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.201[a]	.040	.029	.05423	.040	3.502	6	498	.002
2	.247[b]	.061	.048	.05370	.020	10.747	1	497	.001

a. Predictors: (Constant), Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio

b. Predictors: (Constant), Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio, MOTIVATIONTOTAL

c. Dependent Variable: TSGIP

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.

1	Regression	.062	6	.010	3.502	.002[b]
	Residual	1.464	498	.003		
	Total	1.526	504			
2	Regression	.093	7	.013	4.595	.000[c]
	Residual	1.433	497	.003		
	Total	1.526	504			

a. Dependent Variable: TSGIP

b. Predictors: (Constant), Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio

c. Predictors: (Constant), Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio, MOTIVATIONTOTAL

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.520	.007		79.393	.000					
	Gender	-.001	.005	-.012	-.263	.793	-.020	-.012	-.012	.941	1.063
	SouthAfrican	.002	.006	.012	.277	.782	.028	.012	.012	.950	1.052
	English	-.016	.005	-.148	-3.315	.001	-.132	-.147	-.146	.963	1.038
	Prof	-.016	.006	-.117	-2.559	.011	-.121	-.114	-.112	.922	1.085
	Field1Med&Bio	.007	.005	.057	1.248	.213	.057	.056	.055	.917	1.090
	Uni3: Wits	-.007	.006	-.052	-1.159	.247	-.055	-.052	-.051	.970	1.031
2	(Constant)	.465	.018		26.105	.000					

	Gender	-.001	.005	-.009	-.206	.837	-.020	-.009	-.009	.940	1.063
	SouthAfrican	1.377E-5	.006	.000	.002	.998	.028	.000	.000	.944	1.060
	English	-.015	.005	-.135	-3.028	.003	-.132	-.135	-.132	.955	1.047
	Prof	-.015	.006	-.111	-2.441	.015	-.121	-.109	-.106	.920	1.087
	Field1Med&Bio	.009	.005	.074	1.627	.104	.057	.073	.071	.905	1.105
	Uni3: Wits	-.008	.006	-.059	-1.334	.183	-.055	-.060	-.058	.968	1.033
	MOTIVATIONTOTAL	.015	.005	.145	3.278	.001	.151	.145	.143	.969	1.032

a. Dependent Variable: TSGIP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	MOTIVATIONTOTAL	.145[b]	3.278	.001	.145	.969	1.032	.905

a. Dependent Variable: TSGIP

b. Predictors in the Model: (Constant), Uni3: Wits, Prof, English, SouthAfrican, Gender, Field1Med&Bio

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	MOTIVATIONTOTAL
1	1	3.795	1.000	.01	.02	.01	.02	.01	.02	.02	

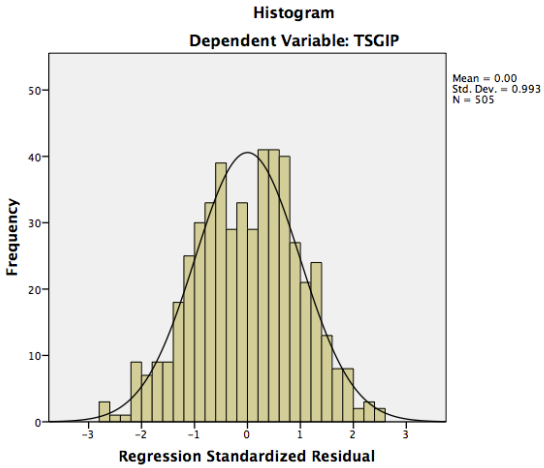
	2	.972	1.976	.00	.04	.00	.03	.46	.15	.02	
	3	.756	2.240	.00	.01	.02	.01	.01	.03	.88	
	4	.534	2.667	.00	.36	.00	.47	.09	.07	.00	
	5	.463	2.862	.00	.18	.00	.11	.39	.62	.00	
	6	.384	3.143	.02	.20	.31	.29	.02	.10	.00	
	7	.095	6.310	.96	.20	.66	.08	.02	.01	.08	
2	1	4.693	1.000	.00	.01	.01	.01	.01	.01	.01	.00
	2	.972	2.197	.00	.04	.00	.03	.45	.15	.03	.00
	3	.759	2.487	.00	.01	.01	.01	.01	.02	.88	.00
	4	.534	2.964	.00	.35	.00	.48	.11	.05	.00	.00
	5	.475	3.142	.00	.05	.01	.04	.41	.72	.00	.00
	6	.412	3.376	.00	.37	.17	.38	.00	.01	.00	.00
	7	.144	5.702	.02	.16	.79	.04	.00	.00	.08	.04
	8	.010	21.763	.97	.01	.00	.02	.01	.02	.00	.96

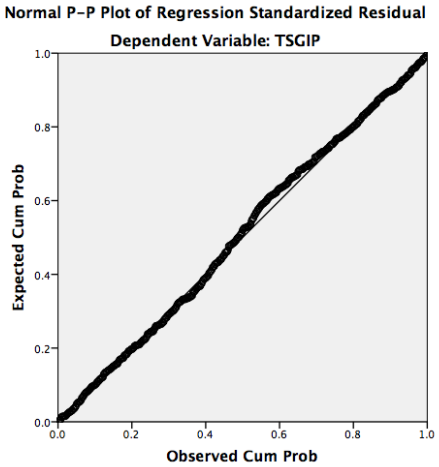
a. Dependent Variable: TSGIP

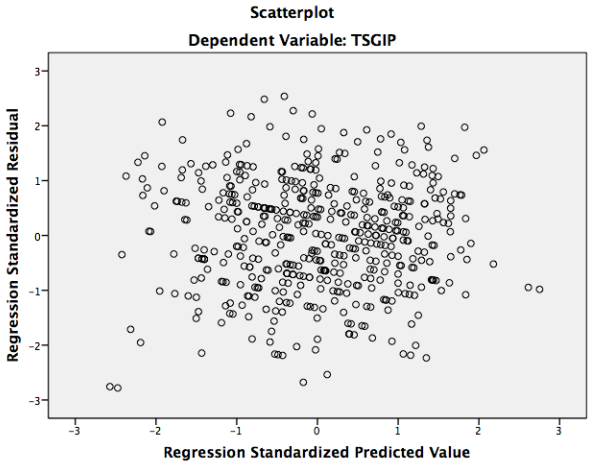
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.4754	.5476	.5103	.01356	505
Residual	-.14936	.13627	.00012	.05332	505
Std. Predicted Value	-2.571	2.752	.002	1.000	505
Std. Residual	-2.781	2.537	.002	.993	505

a. Dependent Variable: TSGIP







9.5.12. Regression 5

Descriptive Statistics

	Mean	Std. Deviation	N
TARP	1.0729	.55831	438
Gender	.492	.5004	528
SouthAfrican	.732	.4436	529
English	.448	.4978	529
Prof	.206	.4048	529
Field1Med&Bio	.342	.4749	529
Uni3: Wits	.231	.4216	529
HCI	13.709	10.0411	529

Correlations

		TARP	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	HCI
Pearson Correlation	TARP	1.000	.178	-.096	.129	.502	.098	.111	.562
	Gender	.178	1.000	-.163	-.104	.186	-.033	-.010	.177
	SouthAfrican	-.096	-.163	1.000	.040	-.061	.077	-.154	-.061
	English	.129	-.104	.040	1.000	-.064	.168	.066	.069
	Prof	.502	.186	-.061	-.064	1.000	-.190	.021	.565
	Field1Med&Bio	.098	-.033	.077	.168	-.190	1.000	.069	-.055
	Uni3: Wits	.111	-.010	-.154	.066	.021	.069	1.000	-.022

	HCI	.562	.177	-.061	.069	.565	-.055	-.022	1.000
Sig. (1-tailed)	TARP	.	.000	.022	.004	.000	.020	.010	.000
	Gender	.000	.	.000	.008	.000	.225	.412	.000
	SouthAfrican	.022	.000	.	.182	.082	.038	.000	.081
	English	.004	.008	.182	.	.070	.000	.064	.056
	Prof	.000	.000	.082	.070	.	.000	.318	.000
	Field1Med&Bio	.020	.225	.038	.000	.000	.	.057	.102
	Uni3: Wits	.010	.412	.000	.064	.318	.057	.	.309
	HCI	.000	.000	.081	.056	.000	.102	.309	.
N	TARP	438	437	438	438	438	438	438	438
	Gender	437	528	528	528	528	528	528	528
	SouthAfrican	438	528	529	529	529	529	529	529
	English	438	528	529	529	529	529	529	529
	Prof	438	528	529	529	529	529	529	529
	Field1Med&Bio	438	528	529	529	529	529	529	529
	Uni3: Wits	438	528	529	529	529	529	529	529
	HCI	438	528	529	529	529	529	529	529

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method

1	Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof[b]	.	Enter
2	HCI[b]	.	Enter

a. Dependent Variable: TARP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.572[a]	.327	.317	.46125	.327	34.797	6	430	.000
2	.649[b]	.421	.412	.42826	.094	69.812	1	429	.000

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

c. Dependent Variable: TARP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	44.420	6	7.403	34.797	.000[b]
	Residual	91.485	430	.213		

	Total	135.905	436			
2	Regression	57.224	7	8.175	44.573	.000[c]
	Residual	78.681	429	.183		
	Total	135.905	436			

a. Dependent Variable: TARP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.764	.060		12.792	.000					
	Gender	.103	.046	.093	2.260	.024	.178	.108	.089	.933	1.072
	SouthAfrican	-.073	.051	-.058	-1.414	.158	-.096	-.068	-.056	.942	1.062
	English	.157	.045	.140	3.461	.001	.129	.165	.137	.959	1.043
	Prof	.720	.057	.522	12.720	.000	.502	.523	.503	.930	1.075
	Field1Med&Bio	.207	.048	.176	4.294	.000	.098	.203	.170	.930	1.075
	Uni3: Wits	.093	.053	.071	1.752	.080	.111	.084	.069	.964	1.037
2	(Constant)	.565	.060		9.363	.000					
	Gender	.070	.043	.062	1.631	.104	.178	.079	.060	.924	1.082
	SouthAfrican	-.059	.048	-.047	-1.236	.217	-.096	-.060	-.045	.941	1.063

	English	.110	.042	.098	2.583	.010	.129	.124	.095	.942	1.062
	Prof	.425	.063	.308	6.725	.000	.502	.309	.247	.641	1.559
	Field1Med&Bio	.189	.045	.161	4.209	.000	.098	.199	.155	.928	1.078
	Uni3: Wits	.117	.050	.088	2.361	.019	.111	.113	.087	.961	1.041
	HCI	.021	.003	.378	8.355	.000	.562	.374	.307	.659	1.518

a. Dependent Variable: TARP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	HCI	.378[b]	8.355	.000	.374	.659	1.518	.641

a. Dependent Variable: TARP

b. Predictors in the Model: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	HCI
1	1	3.825	1.000	.01	.02	.01	.02	.01	.02	.02	
	2	.943	2.014	.00	.04	.00	.04	.47	.16	.01	
	3	.744	2.267	.00	.01	.02	.01	.00	.01	.88	

	4	.530	2.687	.00	.34	.00	.45	.09	.11	.00	
	5	.469	2.855	.01	.15	.01	.04	.40	.66	.00	
	6	.393	3.120	.02	.22	.29	.38	.00	.03	.01	
	7	.096	6.306	.96	.22	.65	.07	.02	.01	.08	
2	1	4.545	1.000	.00	.01	.01	.01	.01	.01	.01	.01
	2	1.021	2.110	.00	.02	.00	.04	.25	.15	.03	.02
	3	.749	2.464	.00	.00	.02	.01	.01	.02	.87	.00
	4	.535	2.916	.00	.41	.00	.40	.05	.07	.00	.00
	5	.473	3.100	.01	.13	.02	.07	.20	.69	.00	.00
	6	.393	3.401	.01	.22	.29	.38	.00	.03	.01	.00
	7	.200	4.761	.01	.07	.13	.06	.46	.01	.00	.74
	8	.084	7.372	.97	.14	.53	.03	.04	.01	.08	.22

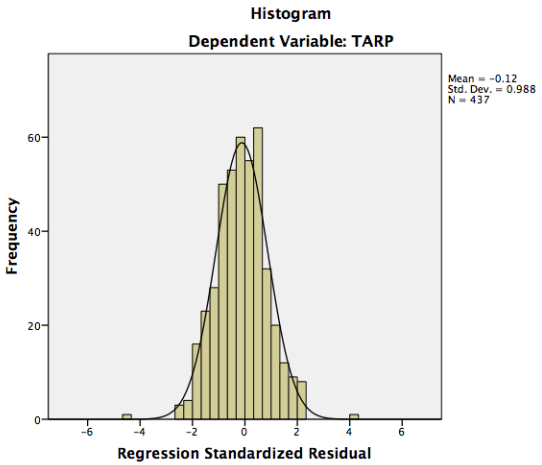
a. Dependent Variable: TARP

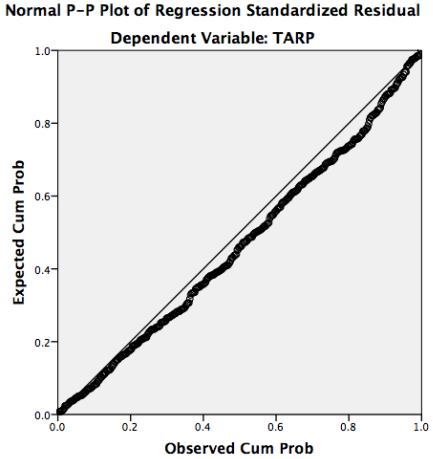
Residuals Statistics[a]

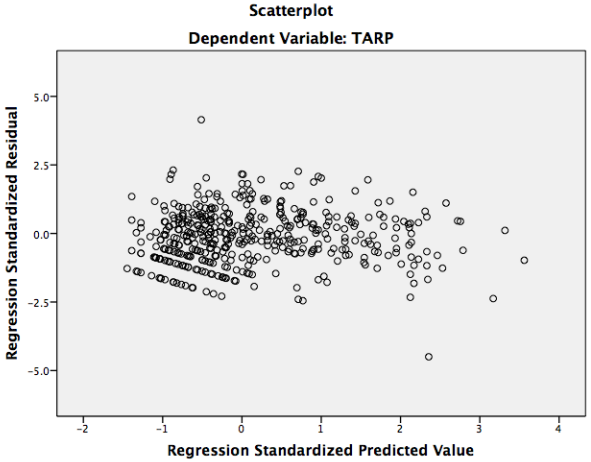
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.5483	2.3629	1.0715	.36117	528
Std. Predicted Value	-1.448	3.561	-.004	.997	528
Standard Error of Predicted Value	.041	.092	.057	.010	528
Adjusted Predicted Value	.5542	2.3813	1.1226	.36471	437
Residual	-1.92635	1.77575	-.05042	.42291	437

Std. Residual	-4.498	4.146	-.118	.988	437
Stud. Residual	-4.564	4.177	-.119	.997	437
Deleted Residual	-1.98335	1.80196	-.05149	.43120	437
Stud. Deleted Residual	-4.674	4.260	-.119	1.001	437
Mahal. Distance	2.973	18.984	6.981	2.930	528
Cook's Distance	.000	.077	.002	.005	437
Centered Leverage Value	.007	.044	.016	.007	528

a. Dependent Variable: TARP







9.5.13. Regression 5 (with outliers removed)

Descriptive Statistics

	Mean	Std. Deviation	N
TARP	1.0204	.52207	398
Gender	.489	.5004	483
SouthAfrican	.743	.4373	483
English	.451	.4981	483
Prof	.164	.3703	483
Field1Med&Bio	.333	.4719	483
Uni3: Wits	.213	.4100	483
HCI	12.414	8.7355	483

Correlations

		TARP	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	HCI
Pearson Correlation	TARP	1.000	.170	-.075	.150	.479	.062	.062	.573
	Gender	.170	1.000	-.165	-.104	.206	-.050	-.003	.171
	SouthAfrican	-.075	-.165	1.000	.019	-.035	.104	-.168	-.063
	English	.150	-.104	.019	1.000	-.064	.162	.076	.059
	Prof	.479	.206	-.035	-.064	1.000	-.241	-.066	.574
	Field1Med&Bio	.062	-.050	.104	.162	-.241	1.000	.061	-.111
	Uni3: Wits	.062	-.003	-.168	.076	-.066	.061	1.000	-.066
	HCI	.573	.171	-.063	.059	.574	-.111	-.066	1.000

Sig. (1-tailed)	TARP	.	.000	.067	.001	.000	.110	.107	.000
	Gender	.000	.	.000	.011	.000	.137	.471	.000
	SouthAfrican	.067	.000	.	.341	.222	.011	.000	.082
	English	.001	.011	.341	.	.081	.000	.047	.096
	Prof	.000	.000	.222	.081	.	.000	.073	.000
	Field1Med&Bio	.110	.137	.011	.000	.000	.	.091	.007
	Uni3: Wits	.107	.471	.000	.047	.073	.091	.	.073
	HCI	.000	.000	.082	.096	.000	.007	.073	.
N	TARP	398	398	398	398	398	398	398	398
	Gender	398	483	483	483	483	483	483	483
	SouthAfrican	398	483	483	483	483	483	483	483
	English	398	483	483	483	483	483	483	483
	Prof	398	483	483	483	483	483	483	483
	Field1Med&Bio	398	483	483	483	483	483	483	483
	Uni3: Wits	398	483	483	483	483	483	483	483
	HCI	398	483	483	483	483	483	483	483

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method

1	Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof[b]	.	Enter
2	HCI[b]	.	Enter

a. Dependent Variable: TARP

b. All requested variables entered.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.550[a]	.303	.292	.43922	.303	28.318	6	391	.000
2	.646[b]	.418	.407	.40200	.115	76.761	1	390	.000

a. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

c. Dependent Variable: TARP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32.777	6	5.463	28.318	.000[b]
	Residual	75.429	391	.193		

	Total	108.205	397			
2	Regression	45.181	7	6.454	39.941	.000[c]
	Residual	63.024	390	.162		
	Total	108.205	397			

a. Dependent Variable: TARP

b. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

c. Predictors: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof, HCI

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.753	.060		12.489	.000					
	Gender	.084	.046	.081	1.838	.067	.170	.093	.078	.924	1.083
	SouthAfrican	-.063	.052	-.053	-1.215	.225	-.075	-.061	-.051	.933	1.072
	English	.168	.045	.161	3.727	.000	.150	.185	.157	.960	1.042
	Prof	.726	.063	.515	11.580	.000	.479	.505	.489	.901	1.110
	Field1Med&Bio	.183	.049	.166	3.739	.000	.062	.186	.158	.908	1.101
	Uni3: Wits	.084	.055	.066	1.521	.129	.062	.077	.064	.958	1.044
2	(Constant)	.511	.062		8.281	.000					
	Gender	.059	.042	.056	1.397	.163	.170	.071	.054	.919	1.088
	SouthAfrican	-.041	.048	-.034	-.849	.396	-.075	-.043	-.033	.930	1.075

	English	.123	.042	.118	2.958	.003	.150	.148	.114	.945	1.058
	Prof	.391	.069	.277	5.663	.000	.479	.276	.219	.624	1.604
	Field1Med&Bio	.174	.045	.157	3.878	.000	.062	.193	.150	.908	1.102
	Uni3: Wits	.108	.050	.085	2.139	.033	.062	.108	.083	.955	1.047
	HCI	.025	.003	.419	8.761	.000	.573	.406	.339	.654	1.529

a. Dependent Variable: TARP

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	HCI	.419[b]	8.761	.000	.406	.654	1.529	.624

a. Dependent Variable: TARP

b. Predictors in the Model: (Constant), Uni3: Wits, Gender, Field1Med&Bio, English, SouthAfrican, Prof

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	Gender	SouthAfrican	English	Prof	Field1Med&Bio	Uni3: Wits	HCI
1	1	3.748	1.000	.01	.02	.01	.02	.01	.02	.02	
	2	1.030	1.908	.00	.04	.00	.02	.45	.12	.04	
	3	.758	2.224	.00	.00	.02	.01	.01	.06	.83	

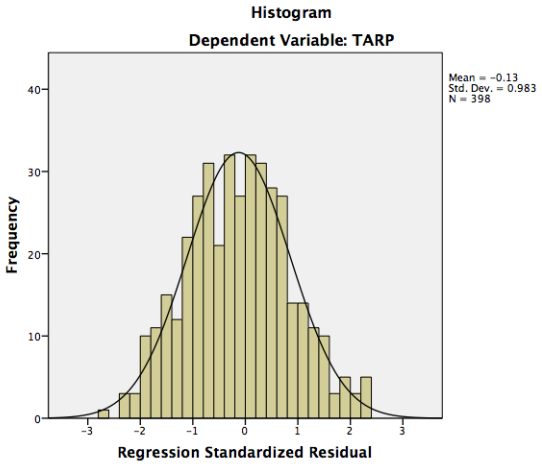
	4	.531	2.657	.00	.35	.00	.48	.08	.08	.00	
	5	.452	2.879	.01	.17	.01	.09	.43	.61	.02	
	6	.388	3.108	.02	.21	.28	.31	.01	.09	.02	
	7	.093	6.352	.96	.22	.67	.07	.01	.01	.08	
2	1	4.469	1.000	.00	.01	.01	.01	.01	.01	.01	.01
	2	1.118	2.000	.00	.01	.00	.02	.24	.13	.06	.01
	3	.759	2.427	.00	.00	.02	.01	.01	.07	.81	.00
	4	.535	2.889	.00	.39	.00	.43	.04	.07	.00	.00
	5	.454	3.137	.01	.17	.01	.11	.24	.62	.02	.00
	6	.389	3.391	.02	.21	.27	.32	.02	.10	.02	.00
	7	.200	4.731	.01	.07	.18	.06	.39	.00	.01	.69
	8	.077	7.638	.96	.13	.52	.03	.06	.00	.07	.28

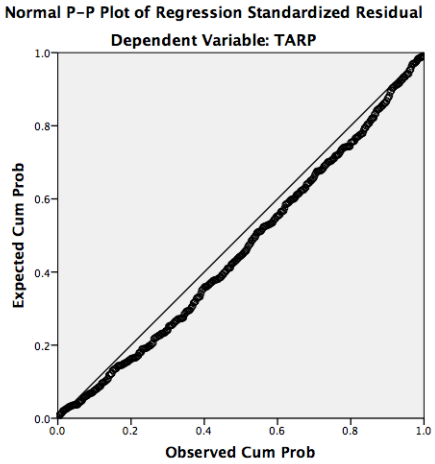
a. Dependent Variable: TARP

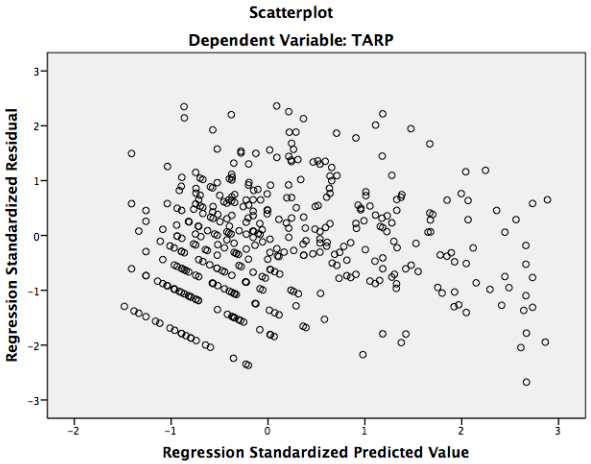
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.5202	1.9935	1.0204	.33735	483
Residual	-1.07527	.94940	-.05088	.39516	398
Std. Predicted Value	-1.483	2.885	.000	1.000	483
Std. Residual	-2.675	2.362	-.127	.983	398

a. Dependent Variable: TARP


Histogram
Dependent Variable: TARP
Mean = -0.13
Std. Dev. = 0.983
N = 398
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: TARP
Expected Cum Prob
Observed Cum Prob


Scatterplot
Dependent Variable: TARP
Regression Standardized Residual
Regression Standardized Predicted Value

9.5.14. Mediation 1

```
Run MATRIX procedure:

*************** PROCESS Procedure for SPSS Release 2.15 *******************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 4
    Y = TARP
    X = SGIPROP
    M = AMOTTOT

Sample size
        438

**************************************************************************
Outcome: AMOTTOT

Model Summary
          R     R-sq      MSE        F      df1      df2        p
      .139     .019     .604     8.582    1.000   436.000     .004

Model
             coeff       se        t        p      LLCI      ULCI
constant     1.512     .270     5.610     .000     .982     2.042
SGIPROP       .241     .082     2.930     .004     .079     .403

**************************************************************************
Outcome: TARP

Model Summary
          R     R-sq      MSE        F      df1      df2        p
      .227     .051     .297    11.795    2.000   435.000     .000

Model
             coeff       se        t        p      LLCI      ULCI
constant     2.000     .196    10.215     .000    1.615     2.385
AMOTTOT      -.070     .034    -2.097     .037    -.136     -.004
SGIPROP      -.236     .058    -4.047     .000    -.350     -.121

************************** TOTAL EFFECT MODEL ****************************
Outcome: TARP

Model Summary
          R     R-sq      MSE        F      df1      df2        p
      .205     .042     .299    19.043    1.000   436.000     .000

Model
             coeff       se        t        p      LLCI      ULCI
constant     1.893     .190     9.975     .000    1.520     2.266
SGIPROP      -.253     .058    -4.364     .000    -.367     -.139

***************** TOTAL, DIRECT, AND INDIRECT EFFECTS ********************

Total effect of X on Y
    Effect         SE          t          p       LLCI       ULCI
     -.253       .058     -4.364       .000       -.367       -.139

Direct effect of X on Y
    Effect         SE          t          p       LLCI       ULCI
     -.236       .058     -4.047       .000       -.350       -.121

Indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
AMOTTOT     -.017      .011     -.047     -.002

Partially standardized indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
AMOTTOT     -.030      .019     -.082     -.004
```

```
Completely standardized indirect effect of X on Y
         Effect   Boot SE  BootLLCI  BootULCI
AMOTTOT    -.014     .008    -.037    -.002

Ratio of indirect to total effect of X on Y
         Effect   Boot SE  BootLLCI  BootULCI
AMOTTOT     .067     .049     .008     .205

Ratio of indirect to direct effect of X on Y
         Effect   Boot SE  BootLLCI  BootULCI
AMOTTOT     .072     .064     .008     .257

R-squared mediation effect size (R-sq_med)
         Effect   Boot SE  BootLLCI  BootULCI
AMOTTOT     .006     .004     .001     .020

Preacher and Kelley (2011) Kappa-squared
         Effect   Boot SE  BootLLCI  BootULCI
AMOTTOT     .014     .008     .002     .037

Normal theory tests for indirect effect
    Effect        se         Z         p
    -.017      .010    -1.643      .100

****************** ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
     1000

Level of confidence for all confidence intervals in output:
    95.00

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
  91

------ END MATRIX -----
```

9.5.15. Mediation 2

```
Run MATRIX procedure:

************** PROCESS Procedure for SPSS Release 2.15 *******************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 4
    Y = TARP
    X = SGIPROP
    M = EXTREG

Sample size
       438

**************************************************************************
Outcome: EXTREG

Model Summary
        R      R-sq       MSE         F       df1       df2         p
     .024      .001      .719      .257     1.000   436.000      .612

Model
             coeff         se         t         p       LLCI       ULCI
constant     3.315      .294    11.269      .000      2.737      3.893
SGIPROP      -.046      .090     -.507      .612      -.222      .131

**************************************************************************
Outcome: TARP

Model Summary
        R      R-sq       MSE         F       df1       df2         p
     .250      .063      .293    14.557     2.000   435.000      .000
```

Model
	coeff	se	t	p	LLCI	ULCI
constant	2.209	.214	10.344	.000	1.789	2.629
EXTREG	-.095	.031	-3.113	.002	-.155	-.035
SGIPROP	-.257	.057	-4.481	.000	-.370	-.144

********************************* TOTAL EFFECT MODEL *****************************
Outcome: TARP

Model Summary
R	R-sq	MSE	F	df1	df2	p
.205	.042	.299	19.043	1.000	436.000	.000

Model
	coeff	se	t	p	LLCI	ULCI
constant	1.893	.190	9.975	.000	1.520	2.266
SGIPROP	-.253	.058	-4.364	.000	-.367	-.139

****************** TOTAL, DIRECT, AND INDIRECT EFFECTS ********************

Total effect of X on Y
Effect	SE	t	p	LLCI	ULCI
-.253	.058	-4.364	.000	-.367	-.139

Direct effect of X on Y
Effect	SE	t	p	LLCI	ULCI
-.257	.057	-4.481	.000	-.370	-.144

Indirect effect of X on Y
	Effect	Boot SE	BootLLCI	BootULCI
EXTREG	.004	.010	-.014	.028

Partially standardized indirect effect of X on Y
	Effect	Boot SE	BootLLCI	BootULCI
EXTREG	.008	.018	-.024	.049

Completely standardized indirect effect of X on Y
	Effect	Boot SE	BootLLCI	BootULCI
EXTREG	.004	.008	-.011	.022

Ratio of indirect to total effect of X on Y
	Effect	Boot SE	BootLLCI	BootULCI
EXTREG	-.017	.047	-.131	.054

Ratio of indirect to direct effect of X on Y
	Effect	Boot SE	BootLLCI	BootULCI
EXTREG	-.017	.043	-.116	.058

R-squared mediation effect size (R-sq_med)
	Effect	Boot SE	BootLLCI	BootULCI
EXTREG	-.001	.003	-.009	.005

Preacher and Kelley (2011) Kappa-squared
	Effect	Boot SE	BootLLCI	BootULCI
EXTREG	.004	.006	.000	.015

Normal theory tests for indirect effect
Effect	se	Z	p
.004	.009	.477	.633

********************* ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
1000

Level of confidence for all confidence intervals in output:
95.00

NOTE: Some cases were deleted due to missing data. The number of such cases was:
91

------ END MATRIX -----

9.5.16. Mediation 3

```
Run MATRIX procedure:

************** PROCESS Procedure for SPSS Release 2.15 *******************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 4
    Y = TARP
    X = SGIPROP
    M = INTROREG

Sample size
       438

**************************************************************************
Outcome: INTROREG

Model Summary
          R     R-sq      MSE        F      df1      df2        p
      .245     .060     .440   27.932    1.000   436.000     .000

Model
             coeff       se        t        p     LLCI     ULCI
constant     2.553     .230   11.096     .000    2.101    3.005
SGIPROP      .371      .070    5.285     .000     .233     .509

**************************************************************************
Outcome: TARP

Model Summary
          R     R-sq      MSE        F      df1      df2        p
      .208     .043     .300    9.796    2.000   435.000     .000

Model
             coeff       se        t        p     LLCI     ULCI
constant     1.969     .215    9.158     .000    1.547    2.392
INTROREG     -.030     .040    -.754     .451    -.107     .048
SGIPROP      -.242     .060   -4.043     .000    -.359    -.124

*************************** TOTAL EFFECT MODEL ****************************
Outcome: TARP

Model Summary
          R     R-sq      MSE        F      df1      df2        p
      .205     .042     .299   19.043    1.000   436.000     .000

Model
             coeff       se        t        p     LLCI     ULCI
constant     1.893     .190    9.975     .000    1.520    2.266
SGIPROP      -.253     .058   -4.364     .000    -.367    -.139

****************** TOTAL, DIRECT, AND INDIRECT EFFECTS ********************

Total effect of X on Y
    Effect       SE        t        p     LLCI     ULCI
     -.253     .058   -4.364     .000    -.367    -.139

Direct effect of X on Y
    Effect       SE        t        p     LLCI     ULCI
     -.242     .060   -4.043     .000    -.359    -.124

Indirect effect of X on Y
           Effect   Boot SE  BootLLCI  BootULCI
INTROREG     -.011     .014     -.039     .016

Partially standardized indirect effect of X on Y
           Effect   Boot SE  BootLLCI  BootULCI
INTROREG     -.020     .026     -.071     .028
```

```
Completely standardized indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
INTROREG    -.009     .012    -.032     .013

Ratio of indirect to total effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
INTROREG     .044     .065    -.065     .200

Ratio of indirect to direct effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
INTROREG     .046     .077    -.061     .250

R-squared mediation effect size (R-sq_med)
          Effect   Boot SE  BootLLCI  BootULCI
INTROREG     .006     .005    -.002     .018

Preacher and Kelley (2011) Kappa-squared
          Effect   Boot SE  BootLLCI  BootULCI
INTROREG     .009     .009     .000     .029

Normal theory tests for indirect effect
    Effect       se        Z        p
    -.011     .015    -.734     .463

****************** ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
     1000

Level of confidence for all confidence intervals in output:
   95.00

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
  91

------ END MATRIX -----
```

9.5.17: Mediation 4

```
Run MATRIX procedure:

************** PROCESS Procedure for SPSS Release 2.15 *******************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 4
    Y = TARP
    X = SGIPROP
    M = IDREGTOT

Sample size
       438

**************************************************************************
Outcome: IDREGTOT

Model Summary
        R     R-sq      MSE        F      df1      df2        p
     .140     .020     .573    8.713    1.000  436.000     .003

Model
            coeff       se        t        p     LLCI     ULCI
constant    3.022     .263   11.514     .000    2.507    3.538
SGIPROP      .237     .080    2.952     .003     .079     .394

**************************************************************************
Outcome: TARP

Model Summary
        R     R-sq      MSE        F      df1      df2        p
```

```
    .235     .055     .296    12.660     2.000   435.000     .000

Model
          coeff       se        t        p      LLCI      ULCI
constant    2.149     .215     9.974     .000     1.726     2.573
IDREGTOT    -.085     .034    -2.461     .014     -.152     -.017
SGIPROP     -.233     .058    -4.001     .000     -.347     -.118

************************** TOTAL EFFECT MODEL ****************************
Outcome: TARP

Model Summary
       R     R-sq      MSE        F      df1       df2         p
    .205     .042     .299    19.043     1.000   436.000     .000

Model
          coeff       se        t        p      LLCI      ULCI
constant    1.893     .190     9.975     .000     1.520     2.266
SGIPROP     -.253     .058    -4.364     .000     -.367     -.139

****************** TOTAL, DIRECT, AND INDIRECT EFFECTS *********************

Total effect of X on Y
   Effect        SE         t         p      LLCI      ULCI
    -.253     .058    -4.364     .000     -.367     -.139

Direct effect of X on Y
   Effect        SE         t         p      LLCI      ULCI
    -.233     .058    -4.001     .000     -.347     -.118

Indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
IDREGTOT    -.020     .011     -.047     -.003

Partially standardized indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
IDREGTOT    -.036     .019     -.083     -.004

Completely standardized indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
IDREGTOT    -.016     .009     -.037     -.002

Ratio of indirect to total effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
IDREGTOT     .079     .051     .009     .224

Ratio of indirect to direct effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
IDREGTOT     .086     .065     .009     .288

R-squared mediation effect size (R-sq_med)
          Effect   Boot SE  BootLLCI  BootULCI
IDREGTOT     .007     .004     .002     .020

Preacher and Kelley (2011) Kappa-squared
          Effect   Boot SE  BootLLCI  BootULCI
IDREGTOT     .016     .009     .003     .037

Normal theory tests for indirect effect
   Effect        se         Z         p
    -.020     .011    -1.829     .067

******************** ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
    1000

Level of confidence for all confidence intervals in output:
   95.00

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
  91

------ END MATRIX -----
```

9.5.18: Mediation 5

```
Run MATRIX procedure:

************** PROCESS Procedure for SPSS Release 2.15 ********************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 4
    Y = TARP
    X = SGIPROP
    M = INTREG

Sample size
       438

**************************************************************************
Outcome: INTREG

Model Summary
        R     R-sq      MSE        F      df1      df2        p
     .060     .004     .367    1.551    1.000   436.000     .214

Model
            coeff       se        t        p     LLCI     ULCI
constant    3.778     .210   17.989     .000    3.365    4.191
SGIPROP      .080     .064    1.246     .214    -.046     .206

**************************************************************************
Outcome: TARP

Model Summary
        R     R-sq      MSE        F      df1      df2        p
     .236     .056     .296   12.787    2.000   435.000     .000

Model
            coeff       se        t        p     LLCI     ULCI
constant    1.485     .249    5.965     .000     .996    1.975
INTREG       .108     .043    2.510     .012     .023     .193
SGIPROP     -.261     .058   -4.532     .000    -.375    -.148

***************************** TOTAL EFFECT MODEL *****************************
Outcome: TARP

Model Summary
        R     R-sq      MSE        F      df1      df2        p
     .205     .042     .299   19.043    1.000   436.000     .000

Model
            coeff       se        t        p     LLCI     ULCI
constant    1.893     .190    9.975     .000    1.520    2.266
SGIPROP     -.253     .058   -4.364     .000    -.367    -.139

****************** TOTAL, DIRECT, AND INDIRECT EFFECTS ********************

Total effect of X on Y
    Effect        SE         t         p      LLCI      ULCI
     -.253      .058    -4.364      .000     -.367     -.139

Direct effect of X on Y
    Effect        SE         t         p      LLCI      ULCI
     -.261      .058    -4.532      .000     -.375     -.148

Indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
INTREG      .009      .008     -.002      .031

Partially standardized indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
INTREG      .015      .014     -.003      .056

Completely standardized indirect effect of X on Y
```

```
        Effect   Boot SE  BootLLCI  BootULCI
INTREG     .007     .006    -.001     .024

Ratio of indirect to total effect of X on Y
        Effect   Boot SE  BootLLCI  BootULCI
INTREG    -.034     .037    -.148     .007

Ratio of indirect to direct effect of X on Y
        Effect   Boot SE  BootLLCI  BootULCI
INTREG    -.033     .033    -.129     .007

R-squared mediation effect size (R-sq_med)
        Effect   Boot SE  BootLLCI  BootULCI
INTREG    -.003     .002    -.010     .000

Preacher and Kelley (2011) Kappa-squared
        Effect   Boot SE  BootLLCI  BootULCI
INTREG     .007     .006     .000     .025

Normal theory tests for indirect effect
   Effect       se        Z        p
     .009     .008    1.051     .293

****************** ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
    1000

Level of confidence for all confidence intervals in output:
   95.00

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
  91

------ END MATRIX -----
```

9.5.19. Mediation 6

```
Run MATRIX procedure:

************** PROCESS Procedure for SPSS Release 2.15 *******************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
   Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 4
   Y = TARP
   X = SGIPROP
   M = INMOT

Sample size
       438

**************************************************************************
Outcome: INMOT

Model Summary
        R     R-sq      MSE        F      df1      df2        p
     .071     .005     .330    2.233    1.000   436.000     .136

Model
           coeff       se        t        p     LLCI     ULCI
constant   4.056     .199   20.364     .000    3.664    4.447
SGIPROP     .091     .061    1.494     .136    -.029     .210

**************************************************************************
Outcome: TARP

Model Summary
        R     R-sq      MSE        F      df1      df2        p
```

```
    .263     .069     .292    16.115     2.000   435.000     .000

Model
          coeff       se        t        p      LLCI      ULCI
constant    1.243     .262    4.750     .000     .729    1.757
INMOT        .160     .045    3.560     .000     .072     .249
SGIPROP     -.267     .057   -4.665     .000    -.380    -.155

************************** TOTAL EFFECT MODEL ****************************
Outcome: TARP

Model Summary
       R     R-sq      MSE        F      df1      df2        p
    .205     .042     .299    19.043    1.000   436.000     .000

Model
          coeff       se        t        p      LLCI      ULCI
constant    1.893     .190    9.975     .000    1.520    2.266
SGIPROP     -.253     .058   -4.364     .000    -.367    -.139

****************** TOTAL, DIRECT, AND INDIRECT EFFECTS ********************

Total effect of X on Y
   Effect        SE         t         p      LLCI      ULCI
    -.253      .058    -4.364      .000    -.367    -.139

Direct effect of X on Y
   Effect        SE         t         p      LLCI      ULCI
    -.267      .057    -4.665      .000    -.380    -.155

Indirect effect of X on Y
        Effect   Boot SE  BootLLCI  BootULCI
INMOT     .015      .011     -.003      .042

Partially standardized indirect effect of X on Y
        Effect   Boot SE  BootLLCI  BootULCI
INMOT     .026      .020     -.006      .075

Completely standardized indirect effect of X on Y
        Effect   Boot SE  BootLLCI  BootULCI
INMOT     .012      .009     -.002      .033

Ratio of indirect to total effect of X on Y
        Effect   Boot SE  BootLLCI  BootULCI
INMOT    -.058      .061     -.215      .015

Ratio of indirect to direct effect of X on Y
        Effect   Boot SE  BootLLCI  BootULCI
INMOT    -.054      .048     -.177      .015

R-squared mediation effect size (R-sq_med)
        Effect   Boot SE  BootLLCI  BootULCI
INMOT    -.005      .003     -.015      .000

Preacher and Kelley (2011) Kappa-squared
        Effect   Boot SE  BootLLCI  BootULCI
INMOT     .013      .009      .001      .035

Normal theory tests for indirect effect
   Effect        se         Z         p
     .015      .011     1.334      .182

********************* ANALYSIS NOTES AND WARNINGS **************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
    1000

Level of confidence for all confidence intervals in output:
   95.00

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
  91

------ END MATRIX -----
```

9.5.20: Moderation 1

```
Run MATRIX procedure:

*************** PROCESS Procedure for SPSS Release 2.15 ********************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 1
    Y = TARP
    X = SGIPROP
    M = Gender

Sample size
       437

**************************************************************************
Outcome: TARP

Model Summary
          R      R-sq       MSE         F       df1       df2         p
      .290      .084      .287    12.726     3.000   433.000      .000

Model
             coeff         se          t          p       LLCI       ULCI
constant     1.070      .026    41.490      .000     1.019     1.120
Gender        .194      .052     3.765      .000      .093      .295
SGIPROP      -.233      .059    -3.975      .000     -.348     -.118
int_1        -.286      .117    -2.438      .015     -.516     -.055

Product terms key:

 int_1    SGIPROP     X     Gender

R-square increase due to interaction(s):
         R2-chng         F       df1       df2         p
int_1       .013     5.945     1.000   433.000      .015

**************************************************************************

Conditional effect of X on Y at values of the moderator(s):
    Gender    Effect        se         t         p      LLCI      ULCI
    -.510     -.087      .084    -1.035      .301     -.252      .078
     .490     -.373      .082    -4.565      .000     -.534     -.212

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

**************************************************************************

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/SGIPROP Gender TARP.
BEGIN DATA.
    SGIProp                 Gender        yhat
     -.452     -.510     1.010
      .000     -.510      .971
      .452     -.510      .931
     -.452      .490     1.333
      .000      .490     1.165
      .452      .490      .996

END DATA.
GRAPH/SCATTERPLOT=SGIPROP WITH TARP BY Gender.

****************** ANALYSIS NOTES AND WARNINGS *************************

Level of confidence for all confidence intervals in output:
    95.00
```

NOTE: The following variables were mean centered prior to analysis:
SGIPROP Gender

NOTE: Some cases were deleted due to missing data. The number of such cases was:
92

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

------ END MATRIX -----

9.5.21. Moderation 2

Run MATRIX procedure:

********** PROCESS Procedure for SPSS Release 2.15 **********

Written by Andrew F. Hayes, Ph.D. www.afhayes.com
Documentation available in Hayes (2013). www.guilford.com/p/hayes3

****
Model = 1
Y = TSGIP
X = HCI
M = Gender

Sample size
528

****
Outcome: TSGIP

Model Summary

R	R-sq	MSE	F	df1	df2	p
.188	.035	.004	5.370	3.000	524.000	.001

Model

	coeff	se	t	p	LLCI	ULCI
constant	.508	.003	190.714	.000	.503	.513
Gender	.001	.005	.096	.924	-.010	.011
HCI	-.001	.000	-3.727	.000	-.002	-.001
int_1	.000	.001	-.481	.631	-.001	.001

Product terms key:

int_1 HCI X Gender

R-square increase due to interaction(s):

	R2-chng	F	df1	df2	p
int_1	.001	.231	1.000	524.000	.631

****

Conditional effect of X on Y at values of the moderator(s):

Gender	Effect	se	t	p	LLCI	ULCI
-.492	-.001	.000	-2.085	.038	-.002	.000
.508	-.001	.000	-3.401	.001	-.002	-.001

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

****

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

```
DATA LIST FREE/HCI Gender TSGIP.
BEGIN DATA.

   -9.985    -.492     .517
    .000     -.492     .508
```

```
    9.985    -.492     .498
   -9.985     .508     .521
     .000     .508     .508
    9.985     .508     .496

END DATA.
GRAPH/SCATTERPLOT=HCI WITH TSGIP BY Gender.

****************** ANALYSIS NOTES AND WARNINGS *************************

Level of confidence for all confidence intervals in output:
   95.00

NOTE: The following variables were mean centered prior to analysis:
 HCI      Gender

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
  1

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

NOTE: The Johnson-Neyman method cannot be used with a dichotomous moderator

------ END MATRIX -----
```

9.5.22. Moderation 3

```
Run MATRIX procedure:

*************** PROCESS Procedure for SPSS Release 2.15 *******************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 1
    Y = TSGIP
    X = PERSTOT
    M = Gender

Sample size
       528

**************************************************************************
Outcome: TSGIP

Model Summary
        R      R-sq       MSE         F       df1       df2         p
     .099      .010      .004     1.685     3.000   524.000      .169

Model
            coeff        se         t         p      LLCI      ULCI
constant      .508      .003   191.992      .000      .502      .513
Gender       -.003      .005    -.648      .517     -.014      .007
PERSTOT       .002      .004     .400      .689     -.006      .010
int_1        -.017      .008   -2.042      .042     -.033     -.001

Product terms key:

 int_1    PERSTOT     X     Gender

R-square increase due to interaction(s):
        R2-chng         F       df1       df2         p
int_1      .009     4.172     1.000   524.000      .042

**************************************************************************

Conditional effect of X on Y at values of the moderator(s):
    Gender    Effect        se         t         p      LLCI      ULCI
    -.492      .010      .006     1.624      .105     -.002      .022
     .508     -.007      .006    -1.249      .212     -.018      .004
```

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

****

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

```
DATA LIST FREE/PERSTOT Gender TSGIP.
BEGIN DATA.

    -.682    -.492     .503
     .000    -.492     .509
     .682    -.492     .516
    -.682     .508     .511
     .000     .508     .506
     .682     .508     .501

END DATA.
GRAPH/SCATTERPLOT=PERSTOT WITH TSGIP BY Gender.
```

********** ANALYSIS NOTES AND WARNINGS **********

Level of confidence for all confidence intervals in output:
  95.00

NOTE: The following variables were mean centered prior to analysis:
 PERSTOT Gender

NOTE: Some cases were deleted due to missing data. The number of such cases was:
 1

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

NOTE: The Johnson-Neyman method cannot be used with a dichotomous moderator

------ END MATRIX -----

9.5.23. Moderation 4

Run MATRIX procedure:

********** PROCESS Procedure for SPSS Release 2.15 **********

Written by Andrew F. Hayes, Ph.D. www.afhayes.com
Documentation available in Hayes (2013). www.guilford.com/p/hayes3

****
Model = 1
Y = TSGIP
X = MOTTOT
M = Gender

Sample size
528

****
Outcome: TSGIP

Model Summary

R	R-sq	MSE	F	df1	df2	p
.125	.016	.004	2.769	3.000	524.000	.041

Model

	coeff	se	t	p	LLCI	ULCI
constant	.508	.003	192.741	.000	.502	.513
Gender	-.003	.005	-.598	.550	-.014	.007
MOTTOT	.014	.005	2.783	.006	.004	.023
int_1	.002	.010	.179	.858	-.018	.021

Product terms key:

 int_1   MOTTOT   X   Gender

R-square increase due to interaction(s):
        R2-chng   F   df1   df2   p
int_1   .000   .032   1.000   524.000   .858

****

Conditional effect of X on Y at values of the moderator(s):
    Gender   Effect   se   t   p   LLCI   ULCI
     -.492   .013   .006   2.147   .032   .001   .024
      .508   .014   .008   1.854   .064   -.001   .030

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

****

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/MOTTOT Gender TSGIP.
BEGIN DATA.

     -.543   -.492   .502
      .000   -.492   .509
      .543   -.492   .516
     -.543   .508   .498
      .000   .508   .506
      .543   .508   .514

END DATA.
GRAPH/SCATTERPLOT=MOTTOT WITH TSGIP BY Gender.

****************** ANALYSIS NOTES AND WARNINGS *************************

Level of confidence for all confidence intervals in output:
    95.00

NOTE: The following variables were mean centered prior to analysis:
 MOTTOT   Gender

NOTE: Some cases were deleted due to missing data. The number of such cases was:
  1

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

NOTE: The Johnson-Neyman method cannot be used with a dichotomous moderator

------ END MATRIX -----

9.5.24. Moderation 5

Run MATRIX procedure:

*************** PROCESS Procedure for SPSS Release 2.15 *******************

        Written by Andrew F. Hayes, Ph.D.   www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

****
Model = 1
    Y = TARP
    X = HCI
    M = Gender

Sample size
       437

****
Outcome: TARP

```
Model Summary
       R     R-sq      MSE        F      df1      df2        p
    .570     .325     .211   68.499    3.000  433.000     .000

Model
           coeff       se        t        p     LLCI     ULCI
constant   1.078     .022   48.720     .000    1.035    1.122
Gender      .091     .044    2.070     .039     .005     .178
HCI         .031     .002   12.831     .000     .027     .036
int_1      -.008     .005   -1.720     .086    -.018     .001

Product terms key:

 int_1    HCI        X     Gender

R-square increase due to interaction(s):
       R2-chng        F      df1      df2        p
int_1     .005    2.958    1.000  433.000     .086

***************************************************************************

Conditional effect of X on Y at values of the moderator(s):
   Gender    Effect       se        t        p     LLCI     ULCI
    -.510     .036     .003   11.815     .000     .030     .042
     .490     .027     .004    7.143     .000     .020     .035

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

***************************************************************************

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/HCI Gender TARP.
BEGIN DATA.

   -9.920    -.510     .678
    .000    -.510    1.032
   9.920    -.510    1.385
  -9.920     .490     .852
    .000     .490    1.123
   9.920     .490    1.394

END DATA.
GRAPH/SCATTERPLOT=HCI WITH TARP BY Gender.

****************** ANALYSIS NOTES AND WARNINGS ************************

Level of confidence for all confidence intervals in output:
   95.00

NOTE: The following variables were mean centered prior to analysis:
 HCI      Gender

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
  92

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

NOTE: The Johnson-Neyman method cannot be used with a dichotomous moderator

------ END MATRIX -----
```

9.5.25. Moderation 6

```
Run MATRIX procedure:

************** PROCESS Procedure for SPSS Release 2.15 *******************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3
```

```
**************************************************************************
Model = 2
   Y = TARP
   X = SGIPROP
   M = Field1
   W = Field3

Sample size
      438

**************************************************************************
Outcome: TARP

Model Summary
       R     R-sq      MSE        F       df1       df2         p
    .288     .083     .289    9.209     5.000   432.000      .000

Model
           coeff        se         t         p      LLCI      ULCI
constant   1.071      .026    40.939      .000    1.020     1.123
Field1      .181      .058     3.096      .002     .066      .296
SGIPROP    -.231      .059    -3.929      .000    -.346     -.115
int_1       .283      .133     2.126      .034     .021      .545
Field3      .189      .071     2.647      .008     .049      .328
int_2      -.019      .156     -.120      .904    -.326      .288

Product terms key:

 int_1   SGIPROP    X    Field1
 int_2   SGIPROP    X    Field3

R-square increase due to interaction(s):
       R2-chng        F       df1       df2         p
int_1     .010    4.520     1.000   432.000      .034
int_2     .000     .015     1.000   432.000      .904
Both      .012    2.527     2.000   432.000      .081

**************************************************************************

Conditional effect of X on Y at values of the moderator(s):
   Field3    Field1    Effect        se         t         p      LLCI      ULCI
    -.217     -.358     -.328      .075    -4.352      .000     -.477     -.180
    -.217      .642     -.045      .110     -.411      .681     -.261      .171
     .783     -.358     -.347      .137    -2.541      .011     -.616     -.079
     .783      .642     -.064      .191     -.335      .738     -.439      .311

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

**************************************************************************

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/SGIPROP Field3 Field1 TARP.
BEGIN DATA.

    -.452     -.217     -.358     1.114
     .000     -.217     -.358      .965
     .452     -.217     -.358      .817
    -.452     -.217      .642     1.167
     .000     -.217      .642     1.146
     .452     -.217      .642     1.126
    -.452      .783     -.358     1.311
     .000      .783     -.358     1.154
     .452      .783     -.358      .997
    -.452      .783      .642     1.364
     .000      .783      .642     1.335
     .452      .783      .642     1.306

END DATA.
GRAPH/SCATTERPLOT=SGIPROP WITH TARP BY Field1/PANEL ROWVAR=Field3.

****************** ANALYSIS NOTES AND WARNINGS *************************
```

Level of confidence for all confidence intervals in output:
95.00

NOTE: The following variables were mean centered prior to analysis:
SGIPROP Field1 Field3

NOTE: Some cases were deleted due to missing data. The number of such cases was:
91

NOTE: The Johnson-Neyman method is available only for Models 1 and 3

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

------ END MATRIX -----

9.5.26. Moderation 7

Run MATRIX procedure:

********** PROCESS Procedure for SPSS Release 2.15 **********

Written by Andrew F. Hayes, Ph.D. www.afhayes.com
Documentation available in Hayes (2013). www.guilford.com/p/hayes3

****
Model = 2
Y = TSGIP
X = HCI
M = Field1
W = Field3

Sample size
529

****
Outcome: TSGIP

Model Summary

R	R-sq	MSE	F	df1	df2	p
.204	.041	.004	4.056	5.000	523.000	.001

Model

	coeff	se	t	p	LLCI	ULCI
constant	.507	.003	191.986	.000	.502	.513
Field1	.000	.006	-.076	.940	-.012	.011
HCI	-.001	.000	-3.842	.000	-.002	-.001
int_1	.000	.001	-.148	.882	-.002	.001
Field3	-.011	.007	-1.524	.128	-.025	.003
int_2	.000	.001	.224	.823	-.001	.001

Product terms key:

int_1	HCI	X	Field1
int_2	HCI	X	Field3

R-square increase due to interaction(s):

	R2-chng	F	df1	df2	p
int_1	.000	.022	1.000	523.000	.882
int_2	.000	.050	1.000	523.000	.823
Both	.000	.055	2.000	523.000	.946

****

Conditional effect of X on Y at values of the moderator(s):

Field3	Field1	Effect	se	t	p	LLCI	ULCI
-.197	-.342	-.001	.000	-2.736	.006	-.002	.000
-.197	.658	-.001	.001	-2.078	.038	-.002	.000
.803	-.342	-.001	.000	-1.939	.053	-.002	.000
.803	.658	-.001	.001	-1.233	.218	-.003	.001

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

```
**************************************************************************

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/HCI Field3 Field1 TSGIP.
BEGIN DATA.

  -10.041    -.197    -.342     .521
    .000    -.197    -.342     .510
  10.041    -.197    -.342     .499
 -10.041    -.197     .658     .521
    .000    -.197     .658     .509
  10.041    -.197     .658     .497
 -10.041     .803    -.342     .508
    .000     .803    -.342     .499
  10.041     .803    -.342     .489
 -10.041     .803     .658     .509
    .000     .803     .658     .498
  10.041     .803     .658     .487

END DATA.
GRAPH/SCATTERPLOT=HCI WITH TSGIP BY Field1/PANEL ROWVAR=Field3.

****************** ANALYSIS NOTES AND WARNINGS *************************

Level of confidence for all confidence intervals in output:
   95.00

NOTE: The following variables were mean centered prior to analysis:
 HCI      Field1   Field3

NOTE: The Johnson-Neyman method is available only for Models 1 and 3

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

------ END MATRIX -----
```

9.5.27. Moderation 8

```
Run MATRIX procedure:

************** PROCESS Procedure for SPSS Release 2.15 *******************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 2
    Y = TSGIP
    X = PERSTOT
    M = Field1
    W = Field3

Sample size
        529

**************************************************************************
Outcome: TSGIP

Model Summary
        R      R-sq       MSE         F       df1       df2         p
     .100      .010      .004     1.049     5.000   523.000      .388

Model
            coeff        se         t         p      LLCI      ULCI
constant      .507      .003   189.401      .000      .502      .513
Field1        .000      .006    -.046      .963     -.012      .011
PERSTOT       .002      .004     .397      .692     -.007      .010
int_1         .009      .009     .903      .367     -.010      .027
Field3       -.013      .007   -1.800      .072     -.028      .001
int_2         .000      .012     .000     1.000     -.023      .023
```

Product terms key:

```
 int_1    PERSTOT     X     Field1
 int_2    PERSTOT     X     Field3
```

R-square increase due to interaction(s):

```
       R2-chng        F      df1      df2         p
int_1      .002     .816    1.000   523.000     .367
int_2      .000     .000    1.000   523.000    1.000
Both       .002     .458    2.000   523.000     .633
```

****

Conditional effect of X on Y at values of the moderator(s):

```
   Field3    Field1    Effect        se         t         p      LLCI      ULCI
    -.197     -.342     -.001      .006     -.202      .840     -.013      .011
    -.197      .658      .007      .007     1.013      .312     -.007      .021
     .803     -.342     -.001      .010     -.120      .905     -.021      .019
     .803      .658      .007      .014      .524      .601     -.020      .035
```

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

****

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

```
DATA LIST FREE/PERSTOT Field3 Field1 TSGIP.
BEGIN DATA.

    -.684     -.197     -.342      .511
     .000     -.197     -.342      .510
     .684     -.197     -.342      .509
    -.684     -.197      .658      .505
     .000     -.197      .658      .510
     .684     -.197      .658      .515
    -.684      .803     -.342      .498
     .000      .803     -.342      .497
     .684      .803     -.342      .496
    -.684      .803      .658      .491
     .000      .803      .658      .496
     .684      .803      .658      .501

END DATA.
GRAPH/SCATTERPLOT=PERSTOT WITH TSGIP BY Field1/PANEL ROWVAR=Field3.
```

********** ANALYSIS NOTES AND WARNINGS **********

Level of confidence for all confidence intervals in output:
   95.00

NOTE: The following variables were mean centered prior to analysis:
 PERSTOT Field1   Field3

NOTE: The Johnson-Neyman method is available only for Models 1 and 3

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

------ END MATRIX -----

9.5.28: Moderation 9

Run MATRIX procedure:

********** PROCESS Procedure for SPSS Release 2.15 **********

```
        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3
```

****
Model = 2

Y = TSGIP
X = MOTTOT
M = Field1
W = Field3

Sample size
529

****
Outcome: TSGIP

Model Summary

R	R-sq	MSE	F	df1	df2	p
.164	.027	.004	2.588	5.000	523.000	.025

Model

	coeff	se	t	p	LLCI	ULCI
constant	.507	.003	192.169	.000	.502	.512
Field1	.003	.006	.462	.645	-.009	.014
MOTTOT	.013	.005	2.699	.007	.004	.023
int_1	-.017	.011	-1.571	.117	-.038	.004
Field3	-.010	.007	-1.431	.153	-.025	.004
int_2	-.016	.014	-1.146	.252	-.042	.011

Product terms key:

int_1	MOTTOT	X	Field1
int_2	MOTTOT	X	Field3

R-square increase due to interaction(s):

	R2-chng	F	df1	df2	p
int_1	.004	2.469	1.000	523.000	.117
int_2	.003	1.313	1.000	523.000	.252
Both	.005	1.419	2.000	523.000	.243

****

Conditional effect of X on Y at values of the moderator(s):

Field3	Field1	Effect	se	t	p	LLCI	ULCI
-.197	-.342	.022	.007	2.994	.003	.008	.037
-.197	.658	.005	.008	.641	.522	-.011	.021
.803	-.342	.007	.011	.572	.568	-.016	.029
.803	.658	-.011	.016	-.667	.505	-.042	.020

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

****

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

```
DATA LIST FREE/MOTTOT Field3 Field1 TSGIP.
BEGIN DATA.

   -.543    -.197    -.342     .496
    .000    -.197    -.342     .508
    .543    -.197    -.342     .520
   -.543    -.197     .658     .508
    .000    -.197     .658     .511
    .543    -.197     .658     .513
   -.543     .803    -.342     .494
    .000     .803    -.342     .497
    .543     .803    -.342     .501
   -.543     .803     .658     .506
    .000     .803     .658     .500
    .543     .803     .658     .494

END DATA.
GRAPH/SCATTERPLOT=MOTTOT WITH TSGIP BY Field1/PANEL ROWVAR=Field3.
```

********** ANALYSIS NOTES AND WARNINGS **********

Level of confidence for all confidence intervals in output:
95.00

NOTE: The following variables were mean centered prior to analysis:
MOTTOT Field1 Field3

NOTE: The Johnson-Neyman method is available only for Models 1 and 3

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

------ END MATRIX -----

9.5.29. Moderation 10

Run MATRIX procedure:

********** PROCESS Procedure for SPSS Release 2.15 **********

Written by Andrew F. Hayes, Ph.D. www.afhayes.com
Documentation available in Hayes (2013). www.guilford.com/p/hayes3

****
Model = 2
Y = TARP
X = HCI
M = Field1
W = Field3

Sample size
438

****
Outcome: TARP

Model Summary

R	R-sq	MSE	F	df1	df2	p
.600	.359	.202	45.371	5.000	432.000	.000

Model

	coeff	se	t	p	LLCI	ULCI
constant	1.074	.022	49.423	.000	1.031	1.117
Field1	.225	.048	4.653	.000	.130	.320
HCI	.032	.002	13.674	.000	.028	.037
int_1	.011	.005	2.027	.043	.000	.021
Field3	.190	.059	3.194	.002	.073	.307
int_2	.009	.006	1.395	.164	-.004	.021

Product terms key:

int_1	HCI	X	Field1
int_2	HCI	X	Field3

R-square increase due to interaction(s):

	R2-chng	F	df1	df2	p
int_1	.007	4.107	1.000	432.000	.043
int_2	.004	1.947	1.000	432.000	.164
Both	.008	2.230	2.000	432.000	.109

****

Conditional effect of X on Y at values of the moderator(s):

Field3	Field1	Effect	se	t	p	LLCI	ULCI
-.217	-.358	.026	.004	7.050	.000	.019	.034
-.217	.642	.037	.004	9.872	.000	.030	.045
.783	-.358	.035	.005	7.019	.000	.025	.045
.783	.642	.046	.007	6.289	.000	.032	.060

Values for quantitative moderators are the mean and plus/minus one SD from mean.
Values for dichotomous moderators are the two values of the moderator.

****

Data for visualizing conditional effect of X on Y
Paste text below into a SPSS syntax window and execute to produce plot.

```
DATA LIST FREE/HCI Field3 Field1 TARP.
BEGIN DATA.

   -9.980    -.217    -.358     .689
    .000    -.217    -.358     .952
   9.980    -.217    -.358    1.216
  -9.980    -.217     .642     .806
    .000    -.217     .642    1.177
   9.980    -.217     .642    1.548
  -9.980     .783    -.358     .791
    .000     .783    -.358    1.142
   9.980     .783    -.358    1.492
  -9.980     .783     .642     .909
    .000     .783     .642    1.367
   9.980     .783     .642    1.825

END DATA.
GRAPH/SCATTERPLOT=HCI WITH TARP BY Field1/PANEL ROWVAR=Field3.

********************* ANALYSIS NOTES AND WARNINGS *************************

Level of confidence for all confidence intervals in output:
   95.00

NOTE: The following variables were mean centered prior to analysis:
 HCI      Field1   Field3

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
  91

NOTE: The Johnson-Neyman method is available only for Models 1 and 3

NOTE: All standard errors for continuous outcome models are based on the HC3 estimator

------ END MATRIX -----
```

9.5.30. Post-hoc Test 1: Does SGI propensity mediate the relationship between HCI and ARP?

```
Run MATRIX procedure:

*************** PROCESS Procedure for SPSS Release 2.15 ********************

        Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 4
    Y = TARP
    X = HCI
    M = SGIPROP

Sample size
       438

**************************************************************************
Outcome: SGIPROP

Model Summary
        R     R-sq      MSE        F      df1      df2        p
     .195     .038     .197   17.263    1.000   436.000     .000

Model
           coeff       se        t        p     LLCI     ULCI
constant   3.379     .039   87.571     .000    3.303    3.455
HCI        -.009     .002   -4.155     .000    -.013    -.005

**************************************************************************
Outcome: TARP

Model Summary
        R     R-sq      MSE        F      df1      df2        p
```

```
    .571     .326     .211   104.999     2.000   435.000     .000

Model
          coeff       se        t        p      LLCI      ULCI
constant   1.008     .172    5.846     .000     .669     1.346
SGIPROP    -.122     .050   -2.455     .014    -.219    -.024
HCI         .030     .002   13.528     .000     .026     .035

************************** TOTAL EFFECT MODEL ****************************
Outcome: TARP

Model Summary
       R      R-sq       MSE         F       df1       df2         p
    .562      .316      .214   201.643     1.000   436.000      .000

Model
          coeff       se        t        p      LLCI      ULCI
constant    .596     .040   14.823     .000     .517     .675
HCI         .031     .002   14.200     .000     .027     .036

****************** TOTAL, DIRECT, AND INDIRECT EFFECTS ********************

Total effect of X on Y
   Effect        SE         t         p      LLCI      ULCI
     .031      .002    14.200      .000      .027      .036

Direct effect of X on Y
   Effect        SE         t         p      LLCI      ULCI
     .030      .002    13.528      .000      .026      .035

Indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
SGIPROP     .001      .001      .000      .002

Partially standardized indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
SGIPROP     .002      .001      .000      .004

Completely standardized indirect effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
SGIPROP     .019      .010      .004      .042

Ratio of indirect to total effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
SGIPROP     .034      .018      .007      .078

Ratio of indirect to direct effect of X on Y
          Effect   Boot SE  BootLLCI  BootULCI
SGIPROP     .035      .019      .007      .085

R-squared mediation effect size (R-sq_med)
          Effect   Boot SE  BootLLCI  BootULCI
SGIPROP     .033      .014      .011      .063

Preacher and Kelley (2011) Kappa-squared
          Effect   Boot SE  BootLLCI  BootULCI
SGIPROP     .025      .012      .006      .051

Normal theory tests for indirect effect
   Effect        se         Z         p
     .001      .001     2.070      .038

******************** ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
    1000

Level of confidence for all confidence intervals in output:
   95.00

NOTE: Some cases were deleted due to missing data.  The number of such cases was:
  91

------ END MATRIX -----
```

The first part of the output lists all variables in the analysis, indicating which is considered as a dependent variable (X, or HCI), which an independent variable (Y, or TARP [transformed ARP]) and the mediator (M, or SGI Propensity). The total sample size is also displayed.

Thereafter, a series of regression models are fitted; first predicting the mediator variable using the independent variable (step 2); then the dependent variable using both the independent variable and the mediator (steps 3 and 4); and finally the dependent variable using the independent variable (step 1).

Following the 4 steps of output interpretation provided above, the following can be concluded:

5) Path C: HCI (X) predicts ARP (Y) (Total Effect Model)
    a. F(1, 436) = 201.643, p < 0.05, R^2 = 0.316
    b. b = .031, t(436) = 14.200, p <0.05
6) Path A: HCI(X) predicts SGI Propensity (M) (Outcome: SGIPROP)
    a. F(1, 436) = 17.263, p <0.05, R^2 = 0.038
    b. b = .009, t(436) = -4.155, p<0.05
    c. This model is significant (X predicts M)
7) ARP(Y) and SGI Propensity (M) together, predict ARP (Y) (Outcome TARP)
    a. Overall model: F(1, 435) = 104.999, p< 0.05, R^2 = 0.326
    b. Path B: SGI Propensity (M) predicting ARP (Y)
        i. b = -.122, t (435) = 5.846, p <0.05
    c. Path C': HCI(X) no longer predicts ARP (Y), or is lessened, predicting ARP (Y)
        i. [X and M predicting Y] b = .030, t (435) = 13.528, p <0.05
8) Sobel Test (normal theory test) = z score test if c – c' =/0
    a. Z = 2.070, p = .038, K^2 (Kappa-Squared) = .025

Because Path C' is significant, this indicates partial mediation. The Sobel Test then shows that C and C' are different when M is included in the model. With no mediator present, ARP = .031, but with the mediator present, ARP = -.030, which means an increase in ARP when controlling for SGI Propensity. Under 'Total, Direct and Indirect Effects',, the total effect of X on T (.031) – the direct of X on Y (.030) = the indirect of X on Y(.001).

In summary, the following can be concluded:

5) X does predict Y
6) X does predict M
7) M predicts Y, while controlling for X
8) X predicts Y, controlling for M

Thus it can be concluded that SGI Propensity does change the relationship between HCI and ARP and mediation does indeed occur, with a small effect size, K^2 = .025. The null hypothesis is rejected at the .05 level of significance.

9.6. Appendix F: Interview Transcripts

9.6.1. Respondent1CF4

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
I think being part of a research team is very important. Working in isolation can be very lonely, its really good if you have a mentor so when I started out I had 2 professors that I worked for as a research assistant and did my masters and PhD. So its good if you can get a person who's senior who can mentor you and you can part of a research group in relative solution from anyone else because you always then have a forum to discuss, do reading groups and to then develop networks with people beyond this institution. There is an element that I feel is just personality that you have to be a certain type of person, that's internally motivated and actually just enjoys research to get ahead. I think also to doing research in the area that you're teaching in or the area that they're actually interested in. Its best to keep people in their area of expertise, keep them comfortable. I think also I mean there's a lot of things that I assume that would form part of… knowing, keep up to date with research and knowing what the new cutting edge issues are so that you can do research in those areas. Oh and having funding, that's a huge issue and probably close to number one. But if you don't have money to collect data especially in the type of research that I do, its time consuming, you need lots of people involved at different levels so funding is a huge issue. I think there is a lot of funding available but you have to think about how time consuming the whole process is going to be – writing the applications and so on. Its important to be able to make a difference, not to just do research for research's sake but to have some kind of impact on your field. Research has to fulfil a social function of some sort.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Personally I feel like I've got enough money that I can manage. I could always do with more but the problem is with more money you get, the more management is required to see what you're allocating where and I'll be honest with you, Wits' system for paying is shocking, its got so many hoops and its awful. So to try and even just get money to get things bought, tests or whatever, you have to put in the order six months before, then they get stuck at customs and then nobody wants to pay so you pay out of your pocket and then you get asked why, there's like a 100 levels of bureaucracy that you have to get through so, it's a nightmare.

Interviewer (probe):
Could you think of any way around it?

Respondent:

There are other ways but then its open to fraud so the issue would be much easier if each academic had their own account. So if you get funding, I just have to give a budget that's says I've spent this on this, etcetera, etcetera and I can just pay it directly, myself.

Interviewer (probe):
What about funding from outside Wits?

Respondent:
It still gets managed by Wits, so you get from the NRF, Carnegie, whatever – it goes through a university fund and you have to access it through one of the finance people, there's no such thing as money goes to you, it always goes to the university. And even if you went completely private, most funding applications want you to be affiliated with a university, so you couldn't really do it without the university's involvement. And the university system is just so cumbersome and slow and things get lost, it's a nightmare.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
I think through using networks of experts and drawing on their expertise and I mean you can do that relatively easily these days. Also looking at past other similar types of problems that have developed in the past, past models that have worked and then working out how to apply those models to this particular problem with people who have expertise in the area.

Interviewer (probe):
Do you have such problems that require real time solutions in your research?

Respondent:
Well yes there are some. One area I'm researching with school of education is the current crisis in the schooling system, where 70% of children at historically disadvantaged schools cant read and cant do maths. So we're finding all of those previously disadvantaged schools have a real problem. So we're involved in developing an intervention to try and address that very problem and we've tried a number of interventions in KZN with no success. We've done randomized control trials, where we've tried to have a set of schools that get the intervention and those that don't and we've found that there's actually no improvement which is really concerning. So now we're looking at why those didn't work and what we can do to fix that.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:

Being research productive, you have to be pretty internally motivated so you have to just want to d it, you have to love research because the external rewards are not very many, maybe getting your name on a publication and building up your career trajectory but those are very slow so they're not immediate things so I think in terms of personality you probably need to have fairly good attention to detail but not to be too obsessive, you need to have a balance. But in terms of other personality qualities I would say those are probably the main ones… and being flexible and open minded.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
For each person it's slightly different. I started my career as an honours student and I didn't think at the time that I would become an academic but I was trained quite early on in the way of doing research in cognitive psychology and so on and I found that I really enjoyed doing research. Conceptualizing research projects and then carrying them out is what I really enjoy the most. So what I enjoy about the fact that you see a project through from an idea that you had and then investigated and did a review and you actually see it take shape into something meaningful like a research project that answers a particular question so to me that's very rewarding and then publishing it and getting feedback – whether positive or critical – to show that you've made a contribution, that your research has value, that's what I find rewarding.

9.6.2. Respondent2AF3

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
The attainment of innovative research relies on involvement with innovative researchers. Collaboration is extremely important. Collaborations with brilliant people will invariably lead to brilliant research. Access to money is important. You can't do anything without money, of course. Now, the thing is brilliant people tend to have access to money. Because they're brilliant. And from that, you can get better quality – more innovative – output.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
{Laughs} Lets not talk about money, its just a pain in the ass. Next question.

Interviewer: Question 3 (Global Catastrophe)

Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Important to communicate your findings to the public – journals are the only way to get there. Scientists are nerds – they stick to the rules and cant communicate to the public. We want to the public to be interested. We can use climate change as an example. There's been a lot of public interest, especially in the last decade. But prediction in geoscience is impossible. Only forecasting is possible.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Research is evaluated differently. I disagree with the NRF ratings, its evil and destructive and racist. The system is flawed, by rating people on performance in the past 8 years. For example, if you compare Einstein in 1905 to Einstein in 1925 – he's the same brilliant scientist. But just because his output differed you're going to give him a different rating? Its nonsense. No credence is given to potential. Its elitist. There are sociological reasons for a few black A-rated scientists. And it's demoralizing – you try and try and try and you might not even get the recognition you deserve. The USA doesn't do that – anyone can apply for a grant, its very competitive but they don't only give it to the clever guys. That provides motivation for innovation. The system is far more equitable. But different fields have different costs. Especially in geosciences, there's lots of fieldwork and it's a much slower process. The scientific method is a success factor – you can formulate a testable hypothesis before you begin to address a specific question. This is very important. We should train scientists at Wits to use the thesis method. What question am I asking? This is very philosophical, we're asking 'what is science'? Well Carl Popper says science must be falsifiable. You can only specify 'incorrect', you eliminate the possibility to find answers then you test the possible hypotheses. A multidisciplinary approach is very important for innovative and new discoveries. The point at which science intersects in a 'tetrahedron' – get away from the corners. It's the point where disciplines meet that's the important stuff

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Patience, persistence, efficiency and don't get bogged down. You don't have to necessarily be a nerd to be successful. I'm not a nerd. But I work hard and I play hard. Also, intellect is important. Some people are smarter than others. That's why we have to find the superstars. That's where your innovation comes from.

Interviewer: Question 6 (Motivation)

Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
The system in South Africa is very different to that in the USA, where I come from. If you're good at what you do, Wits likes that and so they give me things, equipment, etcetera. But money? Not for me. I don't ever see the money do I don't actually care. Funding and evaluation is entirely different in the USA. In South Africa, it's a real shitty situation. The only motivation in South Africa is money and you know, its probably the government's fault. What's required is better incentives. In the USA research is self-driven, think of Einstein. What goals are important in South Africa? If you surround yourself with good people, the money will follow. Don't be wasteful and use it productively.

9.6.3. Respondent3AF1

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Accelerating research is a difficult one, because the deeper you go into things the slower it makes research. Because you gather more information and you take longer analyse it. So my research has not been speedy research, its been picking up a few problems that we're working on over some period of time. For example my postdoctoral study on kudus extended over 10 years. And then recently carried on with Kruger Park after that and it was only just recently been completed, so… these projects span for quite a long period.

Interviewer (Probe):
So how you go about improving lets say, the quality of your research?

Respondent:
The 2 main things I've done, the one is to link up with computational modelling support, way back in time. Because I actually majored in physical sciences before transferring into biological sciences. So I had some of that background. And so early on, even before I computers I got interested in trying to model.. The outcome, trying to project the consequences of the research. And went more deeply in modelling backup and then use innovative data recording strategies like that, recording continuously what animals would do which was then decoded by the early Apple computers, the first desktop computers that came out. And then recently, with the technology we've jumped into using GPS satellite collars. To see what the animals are actually doing, we can actually collect simultaneous data to see what the animals are doing all at the same time in the same place, that's the stuff I'm working on now.

Interviewer (Probe):
What practices would you recommend be implemented to improve innovative output?

Its very much as I've demonstrated in my own work, to back up what you collect in one study by extending it with a computational model, then you can look at what might have happened if things were different. That then generates further questions with that feedback to and from, which I've advocated very strongly. The one course I continue to teach is the introduction to computational modelling for conservation biologists.

Interviewer (Probe):
Has the Internet changed things in that regard?

Respondent:
Its changing it in a small way, in that if I want to get some information, you know, I can go into Google and sort of… type words and get information very quickly. But its superficial information. Like, Wikipedia for example will just give you a very quick summary of a field. What I rely on more is in depth scientific articles, not the Internet. Though I suppose I do get the articles through the Internet these days. But you know, it can be overwhelming and there's a danger of false information. So I tend to try avoid being sucked in too deeply into sitting around computers. But really the best thing about the internet is the way you're linked into colleagues, I can contact people, send a message through and it goes straight through, that network of connections among people in various fields is a main benefit.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Budget constraints have been very cramping. My main point has been to do lots of research with very little money. There's money allocated for us but its very hard to tap into it, with all the competition in conservation funding. I mean to get those GPS collars I spent my whole years budget, even beyond.. so I had to recover that in subsequent years.

Interviewer (Probe):
Have you used, or can you name any alternative methods of research funding?

Respondent:
Its very time consuming you know, so the trade off between the time trying to get the money and the time making do with the money you have, going ahead and doing the research.

Interviewer (Probe):
Have you heard ever heard of Crowdfunding? Do you think it has any potential in academia?

Respondent:
I've noticed Crowdfunding coming to the fore. If I was seeking money now I'd probably try exploring it but I don't know how it works in practice.

Interviewer: Question 3 (Global Catastrophe)

Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
The main problem with catastrophes is lacking the baseline information. I actually dealt with the disappearance of antelope in the Kruger Park. A species, which had been well conserved there, went down in numbers and we jumped into that situation. So what we did was collect a large amount of information, collected it through the Kruger Park, we analysed it and put our fingers on the change in water holes, the predators etcetera. But it took a long time to do that, and the time it took was too late for people in the Park… Its about getting as much information as possible and analysing it in order to try an reduce the uncertainties.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
The thing with science, is you tend to get a lot in one certain paradigm, it dominates. Somehow those paradigms get changed by people seeing things differently. In some sense, working remote from people in North America and Europe and coming from a physical science background, I do see some things differently. We've tried to challenge some of the paradigms in our field. But they're so ingrained; it's difficult to get enough information to reverse them that they still persist on.

Interviewer: Question 4.1 (Journal Publications)

Respondent:
I think so. One of the challenges in science is to actually generate something, which is genuinely ground-breaking and then actually to get other people to appreciate what you've found. New discoveries often have obstacles to getting first published, but you know, things eventually break through if…

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Its leadership and collaboration. I came to Wits because of a certain person who'd been appointed professor here. And that's where I felt the field of ecology was going to develop so… I came her on a temporary position to help establish the ecology program. You know you get certain people in science who are antagonistic towards each other and the challenge is finding people who can openly collaborate. Also you require a lot of empathy and teamwork and getting people to feel like they're part of a team.

Interviewer: Question 6 (Motivation)

Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
You must perceive a particular mission that you want to achieve, you know. You must have a goal that you're working towards. And the challenge of course is to get the opportunities so you can't guarantee will come. What you need to do is position yourself so that when the opportunity is open you can jump in and take advantage of it. That's the experience I've had.

9.6.4. Respondent4AF3

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Certainly speed in my case has never been a big issue. We take things as they come and sometimes the results take years before we actually get the results we want. So speed has never really bothered me, we don't really go for quick turnaround, we go for results.

Interviewer (Probe):
And in terms of productivity?

Respondent:
Well I've never had a problem there; you know my outputs are certainly above average. It's a case of whether I find interesting projects to look at. And that goes up and down, at the moment we're on an upward trend because we're funding new areas to work in that we've never worked in before so those are going to continue now for the next few years, you get them done and then it sort of fades off for a little bit but it still keeps going of course, there's always background stuff but more or less that's the way I work.

Interviewer (Probe):
What about 'innovative' research, things that are ground-breaking or game changing, what factors such innovative research?

Respondent:
Well certainly in my area, all my work has been regarded as being innovative but its not intended to be that from the start, I look for gaps in the literature. I think I'm driven largely by curiosity. I don't follow what's popular at the current time. Most people will do that because that's where the funding is, I've never chased that sort of project so I tend to work in little areas where you see a gap and you're curious about why things behave the way they do and a couple of my main contributions have come from saying the theory says there should bee this answer but the experiment shows that there's not. So you start looking at that and decide and then we've made 2 or 3 breakthroughs by exactly looking at that sort of issue.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Yes probably the sources for my research would be the department of defence; they're obviously interested in those sort of areas. The people that are looking at body armour protection for soldiers and that sort of thing. And I think one could raise some funds there. Anything to do with high energy blasts. And then also of course on the aeronautical side.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Well you'd immediately try and identify specifically what happened. I mean this whole issue of IED's in Afghanistan. There are models now about how to make a lab experiment, which simulates the same blast as an IED does, for head injury. For immediately we'd start looking at that kind of model. We build the rig, do some tests as quickly and get the results. The reputation I have internationally is mainly experiment work that will be in our laboratory here. We had a review of my unit some 2 years ago, international reviewers, there were 3 of them – Japan, Israel, Russia. They said my lab is probably the 3rd best in the world, because of our approach to quickly getting answers. I mean I've got these 4th years coming in here – they're doing novel work that's never been done before. I tend to chose that sort of project and that's why the innovation comes out of it. Some of them fall flat. You know you get the idea and you build the rig and the answer… you don't get the answer you want. The one case we had is we had there was a difference between theory and experiment… and back in 1947 a mathematician suggested what the solution was. Experimentalists have looked at it for the last 20 years and said that's not a solution because you can't see it. So we got into our lab and built a rather unusual and unique… what's-it-called and we proved it. So it took over 20 years to show that was the case. It was by identifying that there's a gap between theory and experiment and what can we do to solve this and people have tried all sorts of things. And we happened to hit on the right way of doing it.

Interviewer (Probe):
What inputs where fundamental into solving these kinds of problems?

Respondent:
It was a case of building what we called {unintelligible} which are laboratory devices for building waves that mimic what happen out in the open so we're experimentalists primarily but more recently we have to do a lot more computer simulations because they can give you more answers than the experiments can. So we do both now, we always insist on doing both.

Interviewer (Probe):

Where do you get the information, what sources?

Respondent:
Standard. The literature, surveys, Google, I belong to couple of communities, Research Gate, which keeps me informed all the time of people around the world in my field who are publishing, so I get information daily as to what other people are up to.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Yes well, I've never had that feeling myself. I mean my work tends to be innovative in the sense that and… it gets published! So I don't think it's a constraint, I think the publishing business today has become a little bit of a problem. I mean when I get requests – 2 or 3 a day – to publish in odd journals all over the place but I restrict myself to journals have a reputation, prestige.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Personality-wise, it is such a wide range. I tend to be quiet and rather humble, other people tend to be very outgoing and aggressive and we communicate still, we have common grounds. I think the range is huge. I don't think there's any particular trait that… I mean the ones that I relate to in my contacts internationally are people who are also to some degree driven by curiosity. Because we talk the same language, then. Rather than those that do purely incremental work because that's where the funding is. The Americans tend to be a little bit… they drive that wave because they do need the better resources for their labs, instrumentation. We get away with very little actually and maybe that's part of our success sin that it's an efficiency issue.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
Well for me, it comes back to the curiosity. It see again the gap and I want to know why its there and what we can do about it and that's really the only interest, I mean that's why I'm still here. I retired officially from the university 20 years ago. And the university has been kind enough to keep me going on and give me an offer for new computers and yes… in fact there's a famous saying by Confucius I think… is that if you love what you do, you'll never work a day in your life. So for me, perhaps I haven't worked for many years {laughs}. It's a hobby, in that sense.

9.6.5. Respondent5AF4

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Ok so I was trained in African studies. That's where my first work was, when I wrote my first book. And then I've worked on from there, transnational work, thinking about Africa, African literary developments and how they've travelled around the world and then more recently I started work on Africa and India and trying to understand the Indian Ocean world, is sort one of the comings of strategic arenas, which will be very important for what happens here.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Innovation is about drawing unusual links between things so innovative research firstly cannot be done quickly, and it is very much it's about constantly being prepared to move beyond a comfort zone. Because if you look at one little area and you sit there and that's all you do, you can do interesting forms of research but I think increasingly, giving the way that the world is going and that we all have to try and understand globalization and trans-nationalism its constantly then about saying ok, I've learned this, that's now in my comfort zone, I've got to move on. So it's also about a constant process of education.

Interviewer (Probe):
Anything else?

Respondent:
You've got to work very hard. {laughs}

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Look it varies enormously from discipline to discipline. So if you're a nuclear physicist you need reactors, you know tis millions and billions. In the humanities its very cheap research, ok what I need is books, archives and time. So that's really the main constraint. It's much more a constraint of time, rather than a constraint of money. You know, one can obviously always use more money, its not a major constraint though.

Interviewer (Probe):
Hypothetically, lets say you undertook a project that required a lot more money? How would you go about it getting the funds?

Respondent:
Well it would be. There are the recognized funding agencies, you would apply to them. There'd be a number of ports of call when you design the project and try the appropriate agencies.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
It has… I can't. I mean I work on literature, so its not… you are assuming there that people are doing sort of real, you know… medical, engineering, that sort research, that's not what I do.

Interviewer (Probe):
Well let's say you were faced with a problem in your field that needed to be solved quickly? Not necessarily life threatening, how would you expedite the process?

Respondent:
Only if you can give me a concrete example. I think you're assuming a very particular model, you're imagining a researcher and what I'm trying to tell you is that you need to perhaps change that model, because that's not what I do. Humanities research is also often long and slow; it's about stories and the function of stories in the world and those sorts of things. Innovation in humanities and philosophy and those sorts of things, as I say, what you do is draw together bodies of scholarship in ways that haven't been done before. So what I'm saying is that in doing this research, I'm showing you to one of the boundaries of your own thinking.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Its this principle that I said earlier, its about drawing links, putting together things that people normally think of as separate. So that is people, and that's often what paradigms do, is that they initially very productive but then they constrain you and it becomes a comfort zone. Ok so for example very often, the way that humanities research is going now, is mostly people think in national containers. We're doing South African history, Indian history, whatever it may be. So there you've got to go, ok I'm trained in South African literature, that's how I was trained, but now I've got to leave that behind. I've got to go and say, what are the links between these different paths? How will I formulate ways of thinking that will enable us to do research, which draws links between different parts of the world? The way for example that much of our thinking is organized is a cold war model, so what the cold war did was it carved the world up into first second and third world and then it divided the third world into areas and you either do Latin-American studies or you do African studies or you do Asian studies and that's absolutely how departments are set up, that's how publishing operates and then you've suddenly got to go ok well that's not how the world works anymore, how do I start thinking about linkages between them?

Interviewer (Probe):
How do you make such a link?

Respondent
Well there's all sorts of ways, I mean you partly you've got to go and look to see if there are any people who thought about this before. There's always are some and the world is full of information. Then you go, ok, I can do this by comparison, I can compare South Africa and India in terms of education, poverty, race and caste, whatever. The other one is to say what are the connections? Who are the people who've travelled backwards and forwards between these places, what are there ideas and then you find the linkages?

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
I think, you get very good journals and very bad journals. I think very much its model that is really on the way out because you know journal articles are read by apparently 5 to 6 people. And I think increasingly there is this thing of – if you look at for example – the research assessment exercise in the UK, which is how they rank departments in terms of output – there recently they introduced the thing of impact. So I think its going to be much more… so I don't really know, it's a very interesting time. But I think the whole journal thing is really unsustainable in the long run, because really I mean, all that work…. And what has happened to journal publications is that its this kind of publishing models where academics donate their labour free because you're not getting paid for the journal publication and then there's these huge massive publishing conglomerates who are making money out of that so its really unsustainable.

Interviewer (Probe):
Do you think the advent of the Internet and this interconnectivity could change the game in the next few years?

Respondent:
Ok definitely, I mean it is already, it certainly is. I think its much more about also putting out work, the output. You could also put out a blog or whatever and you get immediate feedback and immediate… people immediately notice whereas a journal publication can take sometimes up to 3 years to come out. So I think also its influencing the way that people work so its easier to work across national boundaries, there's all sorts of experiments where people actually put up a book manuscript out there and then get enormous feedback and then actually use that so it's a much more cooperative model of production.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:

I think you've got to be quite humble, you have to be very critical about what you do and you can never think that you've got the answer. Because once you've got the answer you stop thinking you know. So I think just really think it is, its humility, you've got to have an intellectual humility because otherwise you cant learn, you may become arrogant and think you don't have to learn anything.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
It's about curiosity. It about… again that comfort zone thing. Not knowing something and becoming bored with it. So you get curious about how you could move beyond that or here are these 2 things that people think of as extreme opposites, how does one put them together? So, it think it is about a curiosity about the extraordinariness of the world. And then its hard work but its very much a huge privilege because you're doing this work that you love and its very hard often to find that. Because most people just hate their jobs. I mean I work a huge amount of after hours work but it's a pleasure. You're paid to be curious, its wonderful.

9.6.6. Respondent6AF3

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
I was always fascinated by patterns and symmetry, in nature or in engineering, in arts, even in philosophy. What we call symmetry, things like changelessness in the midst of a change. So basically I study the mathematical principles that underlie patterns and symmetry. The area that I use in order to unearth these symmetries is called group theory, which is quite a complicated mathematical concept. It's really quite beautiful.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
You're looking at fundamental questions that are unresolved. Well, to tackle that – we live in a modern age, with advanced algebraic computing systems where you have a computer that can do integrated algebra to resolve those kinds of issues. But because we live in this modern age, we must also be careful not to solely rely on modern computing.

Interviewer (Probe):
Any other factors?

Respondent:

I think time is an important thing, because I find myself not having time, I find myself sitting in traffic, taking kids to school, not finding parking at Wits – I find that's a big issue, I think that hinders my research. I'm not able to devote enough time because of administration and looking after certain things at university. Too many distractions, which I think is really a challenge of modern day living because you have to multitask. And sometimes, when you want innovative research, multitasking can distract, in my particular case. I need undivided time to answer some of these questions I'm working on. It's the age we're living in.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
That's an interesting question. A few years ago I did have budget constraints because I didn't the so-called NRF funding that I did. In the last few years I've been fortunate, it's more than sufficient.

Interviewer (probe):
And what about alternate method of funding?

Respondent:
I would look to industry. I've looked to industry many times. We had a program in industrial mathematics where we got funding from industry.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
That's a very interesting question because we work in epidemiology also trying to resolve these problems using mathematical models for HIV, TB, etc. they're complicated models that cant be resolved very quickly. But I think as a researcher approaching these very complex problems, its not an issue of being a genius, its just an issue of how much experience you have and even though you have limited time you can make use of asking quick, insightful questions, trying to refine the problem, slowly getting closer and closer to the solution.
Probe: but where would you get the information you need to do so?

Yeah well you need to extrapolate and model by using not the experiments, but your mind simulations and your mind experiments. If you look at Einstein for example, you can do that as a mathematician and you can come very close to those solutions and then of course, once certain things are available more, then you can actually test them. So basically you have these benchmark solutions that sometimes may look silly and stupid. A lot of these models are simple – they do not mimic the real situations but without them you wouldn't be able to get to the real solution

Interviewer (Probe):

So what about having people from different areas of expertise contributing to the solution?

Respondent:
Oh yes, it certainly would benefit. We actually have workshops like that, different expertise with different outlooks, it gives the variables that are important... And in that way in this modern world today we have the Internet, with this connectedness and so on, so one can do huge amounts of work compared to when I was a student when it wasn't possible like it is today. Also, the internet has created the problem of choice. Sometimes we don't know where to go, there are too many options to be able to factor out properly. A problem of overload. That's why sometimes its better to be very simple. That's often where those brilliant innovations and solutions come from, from those who can think clearly and simply. Sometimes you put too many variables in, which only compounds the problem and makes it more difficult.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Sometimes people think of academic research as mundane and non-consequential, no impact on society and son on but I think in mathematics that been has been shown not to be true because you can apply mathematical research in problems that are facing us, like changes in conservation, problems in industry and mining. You can get beautiful solutions that actually are very relevant. In South Africa to a large extent, we've relied on this non-innovative aspect for a long time. That has changed now; people are getting more together, networking. We can solve problems in climate change… I mean now for example people have taken on the rhino poaching problem using mathematical models and statistics and so on. Things are changing.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
That's a good question, um… sometimes when you're stuck in your own box, it can be inhibitive. To not see some of the innovative research that comes out from the real life challenges people are facing. Other times people say hey wait a minute, these are solvable, we can actually tackle this.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Look research cannot be done in isolation. You have universities where there isn't critical mass of researchers. I mean we come from that, having very isolated pockets of people working on problems. I think being focused is important, because there are many fields which are so broad these days, its difficult to choose one aspect of that particular field or discipline, the personality aspect is there. You need to have the

belief in you that you can do it, and then have the necessary tools to do so. You need to have the right attitude, say 'hey, I can do anything', and of course have the time and the facilities. Its important not to get discouraged. If you feel that you can do something then you can do it.

Interviewer (Probe):
Have you ever heard of crowdsourcing? What are your thoughts on crowdsourcing in academia?

Respondent:
I think it's important to have synthesis of that, because your synthesis could be different from me. And combining them together could combine the solutions to these problems. If you bring them together then you can unify them in a particular way, it's very important to do that. That's what research is all about – you take in all the knowledge of people who have worked on the problem, nothing in isolation. Its like Newton and Robert Hook, you know that story? There was a lot of contention, but in the end it was 'standing on the shoulders' that led to the solution. And that's how it happens in the world, that's how we move forward.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
I think its pretty much what I said for the last question… um, for personality. It's the same thing. Motivation depends on what kind of person you are. Its different for everyone.

9.6.7. Respondent7AF1

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Well I think that the most important thing is to have a research question that is cutting edge. I mean you're trying to do something that is bold and ambitious intellectually. And then secondly, you'd need to – certainly in my field – you need to develop a team of people who are intrigued by that same question and come from different backgrounds, you know, different academic interests if you want. And the synergies that come around, seeing something that's cutting edge and fascinating would… get everyone going. And getting a bunch of different perspectives from people who see the world slightly differently, have different viewpoints, mental models – you bring that all together and everyone's… keen, you get a hell of a spark out of that and I think that's where a lot of innovation comes. Those teams have to be well managed you know, if not then everything falls apart. Because there are a lot of egos involved.

Interviewer: **Question 2 (Funding)**

A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Well you know research funding is always a constraint and you know, the South African situation is not particularly easy and so what we do is we link up with colleagues from the US because they can still attract big chunks of money for research but then you've got to have interesting topics, you know something that's going to fire them up and there other thing I would mention is that, a donor in the private sector. Even some kind of… what do they call these things… a trust or whatever, because of their attractiveness of certainly the project on the coast, um… that's a possibility.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Interesting question. I mean I would imagine the first thing that you would need to do is to get on top of that problem as soon as possible. You know, throw whatever research techniques you have or whatever, get whatever perspectives you can from a wide range of people and then figure out a plan of action. In the environmental sphere its not that easy, you know to find a cure for Ebola than a cure for global warming. So, you know there's a sense of in the field that I operate a sense of hopelessness because you need to change so many behaviours from individuals to global institutions to get anything to happen so you know, we've become rather… yeah a lot of the stuff that I work in, I know these problems have already started, I know they're out of control already but not many other people seem to be awake to that reality so you live in a kind of isolated mental space if you know what I mean. So the first thing I would so is to assemble teams of really clever people.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
No, I don't think paradigms are constraining. You know the role of science is to challenge paradigms all the time so you constantly {unintelligible} until you find something that may blast them away and then you're into a completely new space. You know I cant think of any research that I've done that is paradigm-busting, you know other than getting into social research from a natural science perspective is quite unusual and I've published quite a bit in the social sciences and trying to deal with the social science language and yeah. Some of it is challenging but I managed to do that but I wouldn't say that that's breaking any paradigms.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Yes. Yes yes yes. You know to get in the top journals you've got to do really innovative stuff. Ah, there's a whole lot of other shit about publishing that I wont go into, clearly its an imperfect process and a lot of people get in for the wrong reasons but still you've got to get to a certain level excellence and innovation before you can even think of going there.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Well you know I think in my opinion teamwork is so important so if you've got a lot of people with lots of emotional intelligence and confidence, they're great. People who don't need to be managed because they tend to be sort of.... Bulldoze their views, but the more you get from the other side the better.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
Well I mean I would say in general factors, clearly a drive, a curiosity, you know, a passion to get the stuff out and to keep that knowledge engine going and you know publication is ultimately the you know, the benchmark for research., certainly in my field. So that really helps and the ability to put in the hours, you've got to have a lot of discipline, it takes a lot of that. And you know there are big emotional costs to that that people should be mindful of. And then also the enabling environment is really important, the environment you're in, the academic leadership that you have and so on and so forth.

9.6.8. Respondent8AF1

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Ok well my general research area would all be encapsulated by the term microbial ecology or environmental microbiology. But we obviously focus substantially within that, so one of the areas within in that would be terrestrial soil microbe ecology, essentially a set of habitats on which we focus our techniques, but the core of what we do is try to understand the microbial diversity, community structure and function in different environmental systems and the interactions between environmental substrates and the micro organisms and their processes.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Well we're talking almost… philosophy of research here… driving innovative practices. The preparedness of the researcher, to maintain an awareness of what you might call cutting edge technology around the world and the preparedness of the researchers, if its within their ability to engage with the cutting edge technologies, in other words to bring them into their research practices. There are a lot of controls of that, physical, financial and intellectual. I mean I can give you technical examples and the best example would of course be the one that has become the benchmark for the type of work I do which is meta-genomics, genomics and high frequent mix generation sequencing.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Well all research is constrained by budgets, we could all do with more budget. The response that I've taken is to, I think the phrase is in English is… um.. cut your cloth to suit your size or something like that. So we essentially utilize the budget we have to do as much as we possibly can in a particular research project. And in a practical example, this would be in the number of samples we would process so if I had twice the budget I would probably process twice as many samples and that would expand the statistics of the analysis. And so one adapts naturally, I dare say there are also some techniques we cannot afford to use, that we might like to but don't. and the response in terms of speaking to change the budget is principally in terms of seeking continually new opportunities for funding and at least having a fair shot at any opportunity that's relevant to what we do.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
It doesn't particular apply to what we do at all. But from my knowledge of people working in related areas who are more closely related to that, I think experiences that depending on the nature of the catastrophe, the real time solutions, which are funding options, tend to be relatively responsive. So for example with Ebola, once the crisis was well-established I think researchers around the world were finding that medical research and other funding councils were shifting budgets into that were making funding available for those that wished to apply. So there is a relatively rapid response to this. The other broad response would be internal that is those organizations specifically designed to deal with things like Ebola or national health laboratories which shift internal resources even more quickly to deal with that.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
That's a very sweeping and… extremely naïve statement to make. In fact, it poorly represents the nature of research. The nature of research is by its nature incremental and from time to time leads to the realization that a paradigm is inappropriate and a new one is needed. The suggestion that we're all sticking to paradigms which are all wrong and its going to take something highly innovative to turn us all around is just… to put it in vernacular, its just bloody stupid. So, look most of the paradigms we work under are perfectly good paradigms and good scientific practice means we're prepared to move with the changing wave of evidence. So I would say that everything we do has a reasonably innovative element to it and there are degrees of innovation of course. The fact that I know that what we do in my lab is reasonably innovative comes from the fact that we publish extensively in some of the better journals around the world. And one of the requirements for publication in these higher status journals is that there has to be a level of novelty – the same as innovation. And if its not sufficiently novel, it doesn't get published – if its not taking the subject forward in some way, breaking a bit of new ground. Very few scientists have the luxury of operating in what we call eureka mode – which is a major breakthrough. That's not how science works and if anybody thinks it is then they have no idea. So this is actually a very complex, multi-dimensional gradient we're dealing with.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Enthusiasm, is undoubtedly necessary. Imagination is very important. Energy is critical. And inquisitiveness, always asking questions – curiosity.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
Well I'm excited by research. I've been excited by the prospect of dreaming up some interesting little project and getting some money and getting students and learning something, publishing some papers. And I've been excited by it for 35 years and I'm still excited by it. Its much more than just a job, I still get a buzz out of it. Cant ask for more than that!

9.6.9. Respondent9BF4

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Oh gosh. So roughly speaking, it involves. There are a number of different phases of it. But most recently is trying to work with various organizations and groups and trying to see what the best mix of them is for making places safer and also looking at,

I want to know if certain places are safer than others. And currently I'm interested in the experiences of drug users in city spaces.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Ok, innovative research for my perspective is generated by thinking through an imaginary lens rather than through a {unintelligible} lens. Which means looking into the future to try and think about ways in which things can be done that are not necessarily being done presently. So challenging the traditions in terms of theory, practice and policy and trying to come out with new ways of doing… that generates interest and cooperation between different types of people.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Well its not so much a bureaucratic thing… look, it depends on where you're looking for funding from. So if you're looking at something like how to improve the quality of life of drug users in South Africa, ultimately what you need in order to be able to do that properly is government funding. If government doesn't see this as a priority area, even though it should be, that's not going to happen, so its not going to be streamed in. And so then what you have to do, is you have to downscale the interventions which you would like to enact from the research that you're doing and you tend to then look higher either towards the private sector or NGO's or donor organizations for funding, all of which come with a whole string of conditions. And those conditions can be very problematic. So at the moment, I'll give you an example, which we want to pilot something which is called 'Opiate Substitution Therapy' which is basically giving people who are addicted to heroin a form… a better form of medication, a substitute for heroin. Now where we landing ourselves at the moment – because governments not taking this as a serious problem even though it is – is we are considering going to the drug manufacturers to talk to them about financing a project like this. Now once you start getting that kind of industry involved, A, you promoting a particular drug company and particular drugs which not really what we would want to but we're landing up there because government has left us with no choice. At the same time I really think that its important for young researchers like yourself to keep in mind that not all research needs funding and that if you waste funding you may lose the moment at which research is really required. So often particularly people in the social sciences tend to do research without funding. Usually the funding comes later on, sometimes it never come and that's not always a prerequisite for doing research.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Well I mean you know… simulations happen all the time in the field that I work in. so for example, in policing – which is an area I research, lets say a disaster happens like Marikana and so often what happens is you try reconstruct the events of Marikana to try and say what would be a better way of dealing with the police in that situation, that would be a really interesting case to do a simulation of that – in other words to put police in that situation and saying how could you have dealt with this in a better way and to see if they actually have the capacity to think outside of what happened previously and move forward from that. Its preparation, basically, for practitioners to think back and think forward to improve on outcomes. And you can do that in a very local way, you don't have to have great knowledge of global strategies to do that.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Oh yes absolutely. No question.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
In my field, yes. In the field of criminology. You know, it depends on where you publish. So if you publish in largely American journals in the field of criminology they're going to be very quantitative and if you're more of a qualitative researcher like I am then you would tend publish in more European and more other types of journals. However having said that, there are shifts even in the American, very empiricist sort of… criminology. So these are not static things, these are things that move according to what people see is working and what becomes more current and who the leaders in the field are and that shifts all the time.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
I mean I think, you know it depends on what area of research you're going to go into. But you know in the areas that I work in, I suppose the traits you need are being sociable, being grounded, there's also a sense of being intrepid – in other words going into places that are not always necessarily safe or comfortable, that's really important. Being prepare to be challenged and corrected where you may not necessarily understand something. And I think being open to taking risks is also another important factor. But I suppose it would be different for someone who wants to do archival research, they'd have to be very patient, maybe feel comfortable in a confined space, you know, I think those are the important things for archival work.

Interviewer: Question 6 (Motivation)

Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
For me the motivational factors translate into something actionable. Its about being taken seriously in the environment in which you work. When I do get to write up what I've been researching, it does have its own sense of energy, to be able to create stories of the stuff that I'm trying to make sense of. So I guess all of those. And I suppose as you become better known as a researcher its about networking both locally and globally with people interested in similar things and that takes you even further.

9.6.10. Respondent10AF4

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Look, I'm a philosopher, its very hard for philosophers to explain what they do. But, one way to understand philosophy is a rational or systematic inquiry into issues that are important in human life and that are somehow beyond the prevue of the sciences. So, scientists will say one thing causes another and a philosopher will step back and say well what do we mean by 'cause' or what does it mean for something to bee a cause. A scientist will say they know something and a philosopher will step back and ask what is knowledge, when do we know something, what's the difference between astronomy and astrology for example. And then finally, scientists describe the world and philosophers prescribe the way the world ought to be so we think a lot about ethics, good and bad, right and wrong, justice, injustice which scientists don't think about in the first instance. So that's the nature of philosophy and I follow the values in that last category of thinking about human values, trying to get clear on what they are and I do work on a variety of different field in value theory but the 2 I'm most known for are the meaning the of life on the one hand and the African ethic of Ubuntu on the other. When it comes to meaning and life, what many of us in the English speaking world do is try develop a theory of it and a theory is supposed to be a basic principle that captures what all the things that make your life meaningful have in common. So, intuitively meaning can come from making a discovery, or raising a child or loving spouse or writing some poetry or making some art, working for a charity, etcetera etcetera. and what many do is try to figure out is there one thing all those things have in common, that makes them meaningful as opposed to meaningless. So that's what I do on the meaning of life side and then on Ubunutu I've been trying to do something similar, I've been trying to develop a theoretical approach to understanding African ethics, so there's lots of different matters associated with Ubuntu, person to person, charity begins at home, family first, the sense that Mandela has Ubuntu and Tutu has Ubuntu, but criminals don't. And so I'm trying to figure out or articulate an explicit principle that would capture all the things that Ubuntu would have in common.

Interviewer: **Question 1 (Innovative Research)**

In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Look one thing, is networking, by which I mean broadening your circle of acquaintances, meeting new people. That's definitely just in my personal experience one major factor. Not only in myself but in those I see around me so for example, I am originally from the US and I moved to South Africa well first in 1999 but permanently in 2004 and just that move really forced me to think about western paradigms from a new perspective. And I became acquainted with these other ethical philosophical world views and I had to think of w ay to relate them somehow to what I learned in the US. You have to reject them or integrate them or favour them because they were incompatible in various ways. So simply, meeting people from South Africa and then lately I've been engaging with China. I've met Chinese philosophers, the firs time ever African and Chinese philosophers have spoken to each other. And again, its just another broadening of horizons that has to take place on both our parts and to do it. So that's one thing, it's networking. Meeting new people with new ideas. I can't really think what else might lead to innovation, can we move to the next question?

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
You know I'm not unhappy about that, I mean South Africa's one of the only countries in the world where the department of higher education and training provides a pay-out for each article and book chapter I produce and it varies from university to university but I get 35000 rand per article or chapter that I produce and I produce a lot of them. So, I mean for a philosopher, its pretty hard to beat the position I'm in. I get plenty of money to travel, and buy books and invite people and stuff, I don't really have any complaints and the system works reasonably well, it favours those people who are productive, it doesn't favour those who are unproductive. There's no other country in the world I know of that does it.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
The one thing that comes to mind – I've actually thought about Ebola in particular, and one thing I wish the African Union would be doing right now, is compiling a list of grassroots organizations and NGOs, so obviously they've got contacts with the 56 or however many African governments there are on the continent but I doubt very much that they know or if they have contacts beyond the governments. But its those people on the ground, the people in the NGO's, it's the doctors going off in to the field that have the most information available. And they're also the best networks, the ones in those positions who distribute the solution, as it were. So I think before these

kinds of disasters start, ideally you want a list of contacts that you can draw upon to help distribute solutions or devise plans.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Uh. {laughs}. No, I mean look the only way to develop is to have a paradigm, and over time people pick at it and find weaknesses and counterexamples and then you develop a new paradigm on the basis of those. So, I mean yes sometimes they constrain because there's always something that's more dominant than something else but there's no other alternative, you need to have certain ways of viewing the world, you'd have something to start with and if I look at the progress of science, you know you've got dominant paradigms there but its by far the most successful academic endeavour ever, right? Science does pretty darn well compared to anything else you propose as a means to find out about the world. So I guess I disagree.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
No, I don't. but is complicated reason as to why not. So, so for example, I do work in African philosophy, and a lot of what I do, I've accomplished I like to think as making it, bringing it to a known African audience, so I've had pretty good success publishing in English speaking international journals. And there's an appetite for different approaches to thinking about ethics and politics, however you've got to package it in a way that's going to be taken seriously or is going to be of interest to the editors or referees of those journals. So, the problem I don't think isn't that there's some kind of active discrimination against African views which some of my African brothers and sisters perceive, I don't think that's the deep problem the deep problem is that there's a certain professional standardized norms that you've got to learn in order to package the work in way that will be of interest to the people who control the journals. And once you can master that stuff you can get published.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Look, you need to be fairly confident to be able to question dominant paradigms, as it were. And that doesn't come easily, especially when you're starting out. And then you really need to be fairly driven as well, you need to have sense that the work you're doing is important and you've got to be able to withstand rejection and to put the time in, these things don't happen over night. It takes a long time, several years to develop a really plausible alternative way of viewing tings. So it takes determination and confidence in terms of personality.

Interviewer: Question 6 (Motivation)

Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
Well, no I think the evidence on motivation, the findings show that's its really the internal stuff that drives people and in fact the studies have been wondering well if we compare the internal motivation with a combination of internal and external factors, which will do better? And so far the data shows that its just purely the internal stuff. That once you introduce external factors people's motivation declines. So I think ultimately it is an intrinsic desire t o want to discover something, to make a contribution to a field. That's ultimately I think what drives at least the people I'm familiar with. You've got to like it for its own sake.

9.6.11. Respondent11AF1

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
So I'm in charge of the evolutionary studies institute, I'm the director here and also the international centre of excellence for paleo-sciences. So I have an overview of all paleontological types of research that happens in the country and I work very closely with what other people are doing. So, the sort of research that we are involved in in South Africa, and I'm going to talk generally and then get more specific. We are looking at the fossil heritage of south Africa, of rocks of different ages to look at changes that have happened through time. And that involves quite a lot of different aspects of work, it means that we're looking at the fossil of animals and plants to understand these species and we're working from rocks that are 500 million years old right up until the more recent couple of thousand years. Our ultimate aim is to look at biodiversity changes and to see when animals go extinct and if there are major extinction events, or if things just go extinct all along the way and if there are major extinction events, what drives them, what causes them to happen.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Ok. A lot of innovative research is serendipitous but you don't really find things especially in palaeontology unless you go and look for them. So, the chance of finding something is… you never know. But if you have a well-put together research question at the beginning that asks a whole lot of questions, and then you find that you get answers to a whole lot of subsections of it. So innovative research in palaeontology is really… would be finding something that other people haven't found before. Making a new ground-breaking discovery that is a missing link between something and covers a certain field that you didn't expect to find. That would be innovative and then also, coupled with that is if you can find – as we did earlier this

year – that you've got a… when you're looking at biodiversity changes through the rock record and you suddenly find you've got an extinction event that a whole lot of animals go extinct at the same time. And you then find, that its happening at the same time in… you see… we find this record on land in South Africa and this is the first time its been recognized on land, 260 million years ago. But they found a similar thing happening to marine faunas, animals living in the sea in China 260 million years ago. So to bring that together – from sea in China to land in South Africa, and then to find the cause of it in volcanic eruptions, that is quite innovative and to bring these points together.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
We've permanently got budget constraints, we permanently cash strapped because palaeontology is not necessarily a direction, which is going to bring an industry money. We do applied work from time to time when looking for mineral deposits, mineral explorations such as diamonds for instance but generally we don't get industry money so we are permanently cash strapped. But the way we cope with that is you have a certain vision in mind, you try and raise the funding to establish or to do that and generally you will fall short financially but then you just cut out part of the research you were going to do.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
In a circumstance like that, you know I don't really deal with those sorts of things but I guess what ones got to try and then do is try think of what way you're going to solve that problem. Now, with us those sorts of minor little, they would happen in much more minor way. Say for instance they are building a road down to Clarence and they find a dinosaur in the way. Now, they immediately call me and tell me there's a dinosaur there. I don't have the funding for that dinosaur so I've got to think of a way how do I get this funding and I would imagine that's what would happen in these calamitous things you would have to think how do I solve this problem, how to I approach a way to solve this problem and the first thing you have to think of is funding – where do I get the money from to assist me to solve this problem because in order to solve the problem I have to have expertise in x, y and z and I may have to buy it or fly it in rom overseas and so one would ideally have to think about firstly what is the problem that you've got to solve, secondly, the expertise that you require, thirdly the equipment you'll need and then work out your budget to match all of that.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:

I don't agree with that because I think that innovative research often isn't entirely serendipitous and so often in finding an important ground-breaking discovery its just because of chance. One could for instance… uh.. electricity. 100 years ago or 200 years ago you were thinking of ways to create light, you would have experimented with candles and lamps and all sorts of things and not gone the electrical route which was entirely serendipitous so I don't agree with that at all, I think you have to allow a lot of free range research and then you get answers coming back on these sorts of things. Its an expensive way but if you… we're all ploughing through the dark anyway, any researcher is ploughing through the dark and so you have to have… you cant say your researchers are exploring and might hopefully find something. I quite like the system that the NRF has; they rate and reward their top scientists who come back with results, as an incentive.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Yes I certainly do. And I think that peer reviewing is a very important part of it. Its obviously got problems and the problems might arise from minor and petty jealousies that the reviewer doesn't like you, your particular research because it goes against his research but I think that generally the peer review approach works quite well and I think that it does allow progress to remain in science.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
I work in a field peripheral to palaeoanthropology where there are huge personality conflicts because they've got so few fossils to work on and so they fight like mad over petty little things. Personally I think that personality clashes are detrimental, I think one achieves one more if you collaborate with people and you get on well together and yes you allow each other to disagree but in that way I think one achieves far more. In places where you have clashes it wastes a lot of time in academia. As a head of department I send my life sorting out clashes between people, which is unnecessary. I collaborate with a lot of people all over the world and I think we work well, we respect each other, we might disagree but we never let that get in the way of science.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
Ok. I think that what motivates people, particularly people that are keen to do research is an enquiring mind and to find answers to questions along the way. I find in my experience of working with people that the people that are really exciting to be with are those that ask why all the time. And then work to try and understand why.

Now my wife gets very cross with me because she says I always question everything but I think that is what a scientist does, it's an inquisitiveness. And it's not in a critical way but it's to try and understand your observations. And I guess that what motivates us all the time is that when we have a good scientific question – a why – we go out into the field, you find the specimens that can solve that problem and you answer the question, which usually will bring up another 10 questions that need answering as well. And so I think that's what drives innovative research and discovery.

9.6.12. Respondent12AF3

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
I work on understanding the biology of the organism that causes TB.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Freedom. Academic freedom, resources to pursue ideas that are somewhat off the beaten track and time to think and explore. These are all factors that are at a premium in our environment.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Yeah no, I think that we are in a resource constrained environment, there's no question about it. I've been fortunate to be involved in a field which, in the area of infectious diseases which has gained international and local attention. And so my own research has been fairly well funded over the years. But I think one of the issues that we face is that the field I'm working, which is really aimed at doing the science that is necessary in order to support the discovery of new drugs for the treatment of TB. It's a complex scientific field, fraught with a lot of scientific uncertainty and there is an expectation that we can deliver faster than what is scientifically realistic. So I think there's always going to be challenges with respect to trying to be innovative in areas that have… are associated with, in this case a medical emergency. So there's a push from government, not just in South Africa but across the world for new tools to manage this disease but the science still needs to be done while we're trying to develop these new tools so there's that inherent tension which has been fairly complicated to manage but not impossible. As far as streamlining funding, I'm not sure what is really meant by streamlining, I think that we are a grossly under-resources field in general. Work that's being done in the field of TB suggests that we are underfunded… probably funded to 1 sixth of what is needed in order to realistically develop tools to detect, to prevent and to treat the disease. So

streamlining is not really an option, we need more funding and we need to be able to bring new innovative thinkers into what is a very challenging field. And so I think a big issue here is the issue of advocacy for why this kind of science is important.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Ok so real time solutions are coming from open access, which is very highly publicized. Work that's coming out now, where researchers are working across the world have been making available in real-time the sequences of Ebola virus strains. So the sharing, creation of virtual networks for surveillance has turned out to be extremely important tool for the management of outbreaks. But this happens you know, with these very acute illnesses from the time of the onset of the outbreak to the time of the actual development of the epidemic is very, very quick. I work in a field where things happen a lot slower than that. We've known about so-called extensively drug-resistant TB for years and we know that it is spreading but I think the key here is to use…to combine the availability of open sharing of information which in some cases is not so easy but I think in the field of disease outbreaks its certainly gaining traction. Where people can actually track and monitor in real time a disease outbreak. In fact I just read a paper 2 days ago, in Genome Biology, talking about the way in which this kind of model has now been established with the case of Ebola and I think we just need to make sure that we follow suite. So I'm very optimistic about the ability of public health systems to respond in this kind of way. Of course, its totally reliant on the availability in sites where the diseases take place, where the diseases take root, its important to have the technology available which is the laboratory technology plus the IT infrastructure so that we can participate in these kinds of networks. And certainly in South Africa, that's not an issue at all.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
No I mean that's a gross generalization. I've got no idea who on earth would say that. That makes absolutely no sense. I mean are people who are saying that the discovery of restriction enzymes, which is completely fundamental research in academia, which lead to the creation of the {unintelligible}-technology industry, is that of no value? I mean, I think that's an insulting and ludicrous statement. I think that there's… Research can fall into 2 categories, its not basic and applied, its good and bad research and research that is good is generally innovative in as much as it yields new discoveries, but there's also incremental work of great importance, you get a quantum leap made by somebody and then others build that field and you constantly are standing on the shoulders of giants, so to speak so research goes in fits and starts, is… so I'm… it would be good to know to whom that statement is attributed, because I'm not aware of anybody who would. Ascribe to such a statement.

Interviewer: Question 4.1 (Journal Publications)

Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Ok so this is a more complex question because of the dramatic changes that have taken place in the field of journal publication, its now become, with open access, with the fact that we are metrics crazy, where you can measure the number of times your article is downloaded, where in the world of social media where everything is far more open and people are trying to promote themselves because this is what universities are no recognizing is how many times your work has been cited. I think publication practices have change dramatically and there is definitely a push towards selling ones research in a way that one has a big story, a big punch attached to it so you can get into the top scientific journals. In my career, which has been a long one in science, I've seen this as a fundamental change. It used to be good enough and in fact, accepted and promoted that you report your best science. The place where you reported it was much less important than the quality of what you reported and moreover it was better to send a complete story than to slice it into little pieces that would have a sting in the tail that would attract readership. So I think publication practices currently do have a risk in that they're promoting more hype – they're hype driven and I think we need to be very cognizant of that. You know this is the world that were operating in where people will put their CV's online with all their old metrics about their publications. And yeah, you have to ensure that when you come across papers that feel like its more hype than substance, its important to be scientifically trained to the point that you can actually read through the hubris and get to what the scientific facts are. So it's a… we're in a complicated and changing space of these… the way in which science is being published. But I am strongly supportive of the idea of putting information out there - open access, its very expensive to publish open access but its important to give your research visibility, to make it accessible to as many places and people in the world who can actually read it. What's it doing to the quality of science I don't know, there's still outstanding science that's being done, there's still bad science that's being done. But again if you're properly trained and educated you ought to be able to distinguish those 2 classes of publications.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Personality characteristics, to be innovative you need to be adventurous. Adventurous and fearless I would say are the 2 key traits associated with the most innovative scientists I've come across. People who are quite sure of themselves and have, you know… Innate confidence, and that's to be distinguished from arrogance.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:

You need to love what you're doing. I'd say more than anything, this is a vocation, it's a lifestyle, this is not something that you walk into the office and start doing at 9 in the morning and leave at 5 in the evening and I think that's the key issue. Top researchers are consumed by what they do, which of course has its own consequences, but those are to me are the key characteristics, you have to be constantly burning in your head to want to answer a key question and I think another key characteristic is that you need to be able to take failure, because a lot of the most innovative research fails a lot of the time before you hit what you're looking for and so resilience is another key characteristic. And optimism.

9.6.13. Respondent13AF1

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Ok so I'm professor Tim Noakes and I've been in medical science research since 1976. My main interest has always been the sport sciences and sports medicine and I look mainly at human biology to try understand what makes humans function under different environmental and other conditions. So we study humans at different altitudes, in the heat, in the cold and try to figure out what factors determine their performance.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
I think it's a creative thinker who doesn't think along the conventional lines. The key is that we are educated in our undergraduate training to learn the textbook and to think and so your value how well you can repeat to the lecturer what the lecturer taught you. And that's ok for undergraduate training but you have to get rid of that very quickly. My great fortune was that I was trained as a medical doctor, trained in medicine; I went to into nutritional science for which I had no conventional training. So I had no conventional biases, so I had to work it out for myself. And when you come from outside a discipline, you very quickly see what is rubbish. Because you see all these paradoxes where people explain something then just say 'well, we don't quite understand that' or 'this is just the way it is' and don't ask questions. And I spend my life looking at paradoxes.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
So I was in biology and biology is the most expensive research model. I guess there are others, but biology is very expensive and we basically found funders who were independent of the outcomes. Coz once you have a funder who depends on the outcome, your research is shot, and you'll only find what they want you to find. And

so we find that the companies that were prepared to allow us to do what we wanted to do were better.

Interviewer (Probe):
Have you heard of crowdsourcing and crowdfunding? Do you think they have any value for academic research?

Respondent:
Yes. I formed a foundation; the Noakes foundation and we were definitely looking at the possibilities of crowdfunding. We have used it to fund a documentary, which was released globally a while ago so yes we've got some experience with it.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
That's easy because we do have diabetes and the obesity epidemic in my field, which is… current. And its caused by the profession. We caused the problem by giving the wrong advice to people, we tell them to eat the wrong food and then we've got this whole abnormal food supply, processed foods. So it's happening at the moment and we are actively involved in trying to change it. And the way to change it is firstly that all the doctors have to admit that they were the problem and the same for the dieticians. And if that doesn't work, you have to work through the public so we told the public that they are getting the wrong information, they had to change. And that produced change in the society because the society's not looking after their interests. So if you want to look after your own… your own health, you better look after your own interests.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Ja no it still absolutely is and it's worse than ever. And its got worse. And the reason its got worse is because the market is running some medical research, by that I mean the pharmaceutical industry and they run it for their own gain. They only produce innovation which is not true innovation and that's why we don't have any serious drugs we can that we can seriously attack disease. We don't have any. Because they're all ineffective because their models are. So for example, we treat nutritional disease and we wonder why it doesn't work. The answer is because haven't treated the primary cause of the problem. So you see what's going to happen is that eventually the public will just stop believing these pharmaceutical companies and then it will be done but its going to take a long time for that to happen. What I've realized is that you have to educate the public and the public has to start believing the truth rather than just brainwashed falsehoods that they've been given.

Interviewer: Question 4.1 (Journal Publications)

Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Oh no I mean I cant even bother to read the medical journals because they're an extension of the pharmaceutical industry and so they publish these long diatribes on drug trials which, when are the drugs are relatively ineffective and they're not treating the real cause of the problem. So you have this multi-billion dollar industry, which is not innovative, its only protecting the industry. Lets say the pharmaceutical industry produces a new drug. Who will have researched it? Who will have been the primary driver? Will it have been the professors of medicine or surgery or pharmacology? Who will become the main spokesperson for that drug, it will be the professor. And the professor will tell his students that this is the most famous drug ever. And that doesn't matter what the outcome of this drug is, the benefits or otherwise. Once the company has their profitable model, the industry plans it and promotes it. And we just fall for it.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Oh um… absence of hubris {laughs}, humility and ability.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
Truth. Not in it for money, just in it to find the truth.

9.6.14. Respondent14AF1

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Well there are several factors. I think the first one is interest in whatever you're doing and by that, one is really intrigued, you're willing to continue even after several failures. Persistence, endurance and also I mean a very inquisitive mind. You know, questioning you know all theories and ways of thinking. That's how scientific advances are made, you know.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Well, look, there are always different permutations of research funding. The researchers must be in apposition to develop projects, which are attractive if you want funding. Because the funders want to be quite sure that they're investing money on the right people, on the right ideas. But having said that, its very difficult, I mean. I mean to get funding, particularly from international bodies, that's where the NRF has in fact been very helpful. You know, at least even though you might not get a lot of money, as long as one is actually active. One can get reasonable funding from the NRF, the DST, from the medical research council. I mean depending again on what area or project you're working on. So to conclude it's all about finding the right research projects, something you can sell to the funders.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
You know look, I don't quite actually with that statement. I do agree that its impossible to predict something like an earthquake, I mean there are so many factors involved that I don't think… you know, just like we cant predict weather with 100% accuracy. I think some of these new diseases, even with Ebola; I think we could see it coming, to be quite honest. We might have known that Ebola specifically was coming but I think the expectation from the number of you know… Diseases and the severity of the diseases is going to increase, as we march on into the coming century. Due to changes for example in climate, you know global warming and climate changes. But I do agree with you that you can only deal with a problem once it has actually come. A disease like for example Ebola is a haemorrhagic disease, one the many known of that type. And I think what we need to do really is prepare ourselves before… you know for such types of diseases, be there Ebola or something just as bad or worse.

Interviewer (probe):
So what kind of preventative measures can use for future such outbreaks or catastrophes?

Respondent:
Well with all these diseases that a very highly contagious, I mean for example. So, I think if you prepare on means and ways of dealing with such kinds of diseases that will be severe in populations where they're very dense or concentrated, whether in fact one can perhaps maybe improve the population's lifestyle and etcetera. Where we can enhance people's understanding of problems that materialize out of some cultural habits like eating raw meat from certain animals and that kind of thing. One could actually minimize the risk in that way. So in a way, I'm talking in terms of general preparation and making contingency plans for similar problems. We cannot afford just to wait until we're struck with a disaster. And maybe, something positive might come from this recent Ebola outbreak. I mean, some of the countries, which have suffered most. Their preparation has improved drastically, especially compared to what it was before. So they've learned something new.

Interviewer: Question 4 (State of Academia)

Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Well look, I don't agree actually. Any kind of research that is done with good intentions is good research. knowledge will always be useful perhaps not immediately but in future, you cannot tell when a certain form of knowledge is going to be help you. And I think it is good to be strategic. Better to have the knowledge and not a need to use it, rather than not have it all when we actually do need it. And as I mentioned to you before, I mean most of the research for example in medical research and diseases like we were talking about before – they tend to get more glory than the basic sciences. People tend to forget that the microscopes and equipment used to identify certain pathogens were built and designed by physicists in the first place. What I'm trying to say essentially is that any form of knowledge is actually useful knowledge, whether it has immediate application or not.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Well some do. You know, others actually don't. well look, I think we're at a crossroads here. Particularly with the open access journals right now. One has to be very careful. I mean some f these journals to be quite honest are just there to make money. Thy make money from what they charge for publications, publication fees. So as a researcher, having invested the time and effort into doing research, one has to be very careful on where in fact you publish. And being the common goal of most researchers is to get as much exposure as possible. So as I say again, some journals yes, others not quite and us researchers have to be careful.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Research is not easy to do, lets put it that way. It requires time and there'll always be frustration when things are not working or going the way you want. So I think perseverance and persistence is very important. I always tell my students the difference between a very effective researcher and one who's not is very simple – the effective one is persistent, he doesn't give up the first time. One has also got to be interested in what they are doing. If you don't have interest then you're wasting your time, your persistence won't last very long.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:

I think the motivational factors, you know one has to enjoy research, enjoy doing what they're actually doing. You can't afford to be working in a field, which doesn't actually grab your interest. There are times, I can tell you from personal experience - I don't like students walking into my office and asking me to give them a research project, I normally don't do that. I want the student to decide on something that interests them, what would you like to work on? And it's when you are able to take ownership of your project, say this is mine… that's when it becomes something different. And that links back to that persistence that I spoke about before.

9.6.15. Respondent15AF3

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Right so I am a chemist by training. The branch of chemistry that I'm trained in is inorganic chemistry and inorganic chemistry is the chemistry of metal irons/ions? Now my particular interest is metal ions particularly in biological systems. So my research area is really a transitional area between physical chemistry, inorganic chemistry and medicine and biology.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Innovative research is an interesting thing. One of the things that I think stimulates innovative research is the ability to look at pervading dogma, and essentially to test widely held hypotheses. Then to try and design experiments which either look at the validity – and you have to be open minded about this, you cant design the experiment say – if I show this then I'm going to overthrow the status. Essentially you have to be open minded about it. You take a prevailing hypothesis and say right, in terms of this hypothesis; if I do A B and c then I should get X Y and Z. And if that is indeed the case, that's fine, you haven't confirmed anything, you've just shown that the hypothesis shows a reasonable explanation for it is you've discovered. The real eureka moments come when you deign an experiment and some of the results don't make sense in terms of prevailing hypotheses. Its that point that really is one of the driving forces behind science. Its to conceptualize experiments which either, that essentially overturn the prevailing views. And as I said, they are few and far between, probably happened twice to me in my entire research career.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Right well generally speaking – and this is a situation that prevails not only in South Africa but around the world – that if there is the spending of public money, especially in times of constraints, then funders in order to justify the spending of that public

money would seek some kind of return on investment. And so when one sets up a research program, one has to keep that in mind, you basically have to play the political game and say well if everything comes out the way I think its going to come out, then this is the end product that I'm going to deliver. Now that probably happens 1 fifth of the time but in the meantime what you're doing is investing in essentially, new knowledge for its own sake. And also the training of new students and that is a payback whether or not the funding is available. Generally speaking one has to realize that I think scientists around the world, the idea of being able to house all the equipment and resources that you want in one locality is long gone. And that in fact is one of the important new developments, certainly since the Second World War. Also the formation of large teams and essentially collaborative research. so there is a particular that I wish to do and I would look, I would do a careful cost analysis and say look, this is going to cost 20 million rand, its ridiculous, I'm not going to able to justify that, and I would struggle to get the funding to do that. So far better is, I know someone in Germany who has exactly this type of equipment, then make contact with him. Generally speaking scientists and very open and welcoming to collaborative experiments. I think that's the way of science, collaboration across laboratories and the exchange of ideas and sharing of information, I think that's the only way that science can progress. To provide everyone with everything they need, its just not affordable.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
That is a very difficult question. You see essentially what it needs –is good information and the free flow of information. And the problem is that quite often, the free flow of information – although people are often sceptical about allowing this information out – the reasons could be political, they could economic, or simply the unwillingness to put your head up and say you know, I've seen this, that or the other. It really does require an almost commitment to addressing the problem, irrespective of the consequences and I think in retrospect, if Ebola had been, if people had come clean about Ebola right up front, I think the problem might have been solved before it became the catastrophe that it did. But I think it requires a willingness to transcend these narrow interests, in order to do that sort of thing. It's very difficult.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
No absolutely not, that's the whole beauty of academic research is that its… its what's called blue skies research. Blue skies research in fact has in its very core, the overthrow of paradigms. Kuhn's analysis of the progress of science for example, it speaks exactly to that. And I think this is what drives a lot of blue skies research is the ability to suddenly realize or stumble across something that no ones eve thought of and to look at things from a different angle. So no, admittedly of course a lot of the establishment will sometimes buckle and resist this sort of thing, typically science and

scientists write papers that get sent off to journals and if the paper challenges existing or prevailing popular views, you sometimes might find it difficult to get that work published. In that respect, the science establishment as it were does tend to fight against innovative research. The point is if you make a convincing enough case, then generally, in my opinion at least these contrary views do get aired, they then become the subject of intense debate and then eventually the situation will clear and it gets settled one way or another. A good example, well about 20 years ago now was the business about cold fusion, I don't know if you remember it? You can look it up. Now this was a… if it had been proven to be correct, it would have been revolutionary for science. Now the proponents of that work convinced the referees that this, it had merits, the work was published, it became a very, very hot topic all around the world for about 2 or 3 years until people were convinced that they were unable to reproduce those results. And it wasn't fraud on the basis of the original proponents of the theory; they saw something that they honestly thought was this phenomenon called cold fusion. Other people were unable to reproduce it, its now been discredited and obviously something must have gone on in that laboratory that no ones been able to reproduce.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Yes I think they do. I think honest good quality journals are essentially handled by honest good quality editors and honest good quality referees. Im not one of these people who advocate for example, the publication of open source material which undergoes very, very scant reviewing if any reviewing t all. I mean, I just don't have any confidence in the quality of the papers published in there. Now there are some very good open source journals but there a lot of predatory journals. There's the sort of journals that you can email every day saying give us your paper, we'll publish it within 2 weeks in exchange for which, you pay us 500 dollars. And that is just feeding on this obsession that academia has with numbers of publications. Irrespective of quality. I am much more prepare to trust a paper which is published in an imminent journal which I know has a good strict editorial policy and a refereeing policy.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Yes well. It may sound strange but sometimes, a scientists ability to get on with people is extremely important. If you have a problematic person, someone who picks a fight with everyone, or who is just a toxic individual, quite often that person's work is not taken seriously because no one can actually get on with the guy. So its diplomacy, the tact, the ability to be interested and to be able to talk to people and convince them is an extremely important aspect of science. And that's why I always encourage my students for example to go to international conferences and to present their work because there they get training on how to essentially "sell their product". It

is really a sales pitch and it shouldn't be underestimated, the importance of being able to sell an idea.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
What motivates scientists to do what they want. Sometimes, some scientists spend their entire lives essentially turning the handle, almost. In other words reproducing results which if you sit back dispassionately and think about it, say well I could have predicted that in the first place. And there's an awful lot of that that goes on. But every now and then, you get what I call that eureka moment when suddenly you can see something from a totally different point of view and explain something which has puzzled you and your colleagues for many years. Its that excitement that really drives scientists. That's one factor. The other factor, also not to be underestimated is that many scientists engage in science because they believe that they're going to make a difference. To their society. For example, people studying new materials for energy storage really believe that if they crack this, then really our energy problems are solved, or reliance on fossil fuels will be something of the past. So its that willingness, or that determination to make a difference to society at large that drives a lot of science. That's another factor. A third factor, is pure ego. If you show something that no one has ever shown, and everyone says gee that looks good, that sort of feeding of the ego is enormously important for many scientists that I know.

9.6.16. Respondent16AF2

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Ok well I actually have several fields of research. one of them is, we do economic experiments that is experiments with people that we bring into a lab or we go out to the field that are designed to give us data we need in order to be able to estimate the way that they'll respond to changes in risk and that is relevant to lots of areas in policy, usually when anyone undertakes any policy or when companies market a product or financial services, etcetera how people are going to respond to it a function of what kind of risk, their appetite for risk is. That's one major area. I also have an offshoot of that, a particular vulnerability/risk taking extensively, which is addiction through an experimental focus. And as an aspect of that we've done a certain amount of neuro-economics so most of our experimental methods are behavioural that is people come in and they do things in the lab, but sometimes we have them do those things while we're examining their brains in an imaging scanner because there's certain information people cant report if they don't know it but its reflected in their brain responses. I also do a lot of pure theory, work on the mathematical structures that link all the sciences together. We refer to that as foundations – how is it that you can have one world that is independently study-able from so many angles, one world in which there can be both physics and economics and biology and all the other sciences, clearly they're all sciences of one world so there should be relationships

among them and those relationships should be mathematically modelled. So I've got an extensive body of work on that.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
In general, all research that is highly prestigious, or that tends to attract high levels of reward (funding and recognition) all such research tends to be innovative. Scientists are strongly incentivized to be innovative because if they're not then by definition, all you're doing is cleaning up the details of other people's activity. And you can make a nice quiet living that way but you're never going to achieve high growth in your lab or in your institution or in your personal career opportunities. So the reward structure of science already encourages everybody to be as innovative as possible. The main barrier is that there are relatively few good ideas you have that somebody else isn't having at the same time, because there's a lot of scientists in the world so to distinguish the innovators from the others is not necessarily that the innovators are unique and have all the ideas, it's the innovators are better at taking the insights, which are occurring typically in any places or in many brains and figuring out how to actually implement them, that is figuring out how to actually get the work done first.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Everybody's research faces budget constraints of course; no one has an infinite amount of resources. So, there are some sexy new ways in which people trying to find resources, you know there's crowd-funding, crowdsourcing. Put a research problem out on the web and try to get a whole bunch of people to work on it just out of their own intrinsic motivation, you don't have to pay them {laughs}. And most of them will do irrelevant things but if there's enough of them, somebody's probably going to do something useful. You could of course crowd-fund, you could use the Internet to try and raise money for your research project and there have been some labs that have been successful at that. For the most par though, scientists that work in university atmospheres are a bit dis incentivized from seeking resources from unorthodox sources and the main reason for that; its not so much a problem in South Africa but in most of the world, universities depend for a large part of their income on government agencies that fund research also lavishly funding the university infrastructure as part of the research funding so therefore the universities don't like it when researchers find their own innovative sources of funding, because they tend to support only the research and not the university infrastructure. So I think that's actually the single biggest barrier at the moment, the way the international research institutions have evolved. Universities have become dependent on their researchers seeking funds from the standard sources because the standard sources pay for the university infrastructure.

Interviewer: Question 3 (Global Catastrophe)

Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Well you know, there's hardly likely to be a general answer to that question. There are whole fields where catastrophe and catastrophe response is what science is studying in the first place. I mean if you're in earthquake research or in tsunami research, what you're studying is precisely how to respond to an emergency. Therefore when an emergency happens, you will have thought about it quite a lot. I think those systems; the world capacity for responding with very well informed emergency responses to kinds of things that are in their nature emergencies is really good, right? I mean the response of the world's scientific community to the giant tsunami 10 years ago was terrific. I mean, it was instantaneous and it was really organized. Where things like Ebola, you know you don't want all or even most of your medical researchers devoting their attention to pandemics. Most people die of more pedestrian things, {laughs}, you know cancer. And so the consequences inevitably when something like Ebola breaks out, you have to quickly identify the very small subset of the medical research community that has every thought about responses to public health emergencies of that sort. And typically the network isn't already there, so the network has to self assemble in response to the crisis. And when a network has to self-assemble, inevitably there's a lag and in the meantime, people are dying and things are raging out of control and you're busy trying to erect the control structures. I have y doubts that there's anything in particular – you know you are asking the right person this question because I work on risk, right? And you're asking really about risk, you're asking about how we manage catastrophes risk in this case. Catastrophe risk is intrinsically very hard to manage, because the more resources you put into protecting yourself against catastrophes and being really ready to respond to them, the more risk averse you're actually being. Because you're going to be diverting resources from high frequency, low impact things to low frequency high impact things. But most of the worlds biggest problems are the former kind. So if you take a whole lot of resources off the high frequency low impact things, what you're in effect saying is we're so worried to make sure that we can respond to the catastrophes that we tolerate quite a high level of cost and suffering due to the high frequency things by nature, if the thing is high frequency then its low impact and vice versa. Despite all the confusion and slowness in responding to Ebola, its not at all obvious to me that the right response is to say lets divert a whole bunch of work from cancer research to African tropical flu research. Undoubtedly we would be much better prepared for the next Ebola-type event but I suspect the net bill in terms of human suffering would actually be greater, because we'd be neglecting something that in affects one in three people at the expose of something that however catastrophic affects one of 5 million people.

Interviewer (Probe):
You know its occurred to me, you mentioned self-organizing networks and also crowdsourcing, do you think there something that could be put together with those 2 concepts in terms of responding to a catastrophe?

Respondent:

Of course those things can be useful but one needs to be pretty careful, using technologies like that. I mean, a disorganized response to a catastrophe, that is in the sense that there isn't much control over the response but is spontaneously emerges from multiple, along multiple channels, that will typically have a bunch of good properties but it will typically also have a bunch of bad properties. I'll give you an example; within 24 hours of the Tsunami in Indonesia, in Thailand, within 24 hours there a bunch of sites online, soliciting donations. But a significant proportion of those sites and the ones that were up fastest were fraudulent. So a lot of money was raised but quite a lot of money was stolen as well.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Yeah basically, it is. I mean, it is. Academic research is – I don't think being constrained by paradigms is a problem – its important to be constrained by paradigms, ok research that is not constrained by paradigms tends to devolve into speculation. There's a reason we're constrained by paradigms, because that way we accumulate knowledge instead of just developing isolated patches. If people just feel free to reinvent the world anew every time they walk into the lab, they may have never learn anything because she's not really leveraging the accumulated wisdom of all her peers. But if she does find out something, chances are no one will quite know how to integrate it, so its quite important in science to be constrained by paradigms. That's different from, the value that academic research offers that is plodding and boring because it tends to bureaucratically controlled. And that's because the majority of the world's universities are probably funded and therefore there's a strong expectation that quality will be intensively monitored but making the scientists constantly write reports about, to ensure that she's doing what she's supposed to when somebody who's not a scientist determined what she's supposed to do, because they approve the expenditure. Naturally, that makes research slower and conservative in a bad way. It just makes people, it encourages them to work on problems the granting panel will be familiar with so they get the grant. But, it's a little hard to know… thank goodness that private entities do research because if all research was done in public entities then it would all be slow and bureaucratic. We probably need bits of both, we wouldn't want all our research done on either side. Private sector entities tend to monopolize the knowledge for obvious reasons.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Yeah, I don't think that's any part of the problem at all. When its tue that the highest prestige journals in any given field tend to be quite hard to get into with new ideas, on the other hand when a new idea does get into those journals, you know then that's a really important one. So, having a mix of journals, some of which hare harder to get into and some of which are not, is exactly right. If you really have a a new worthwhile idea, you will be able to publish it somewhere. If its not obviously a great idea, chances are you're not going to get it into the higher prestige journal, meaning you

cant publish at all and many good ideas start in lower visibility journals and work up. But they get there. But the point is its very useful having journals that are extremely choosy and picky about what they accept because as I said, that helps to solve the needle in the haystack problem. We all know that there's great ideas out there but we all have limited time so if I see a really interesting new idea in the American Economic Review, I know that survived one hell of a battle to get there.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Well contentiousness, a researcher who is not extremely diligent and painstaking is going to make a lot of mistakes. So, you have to have the mindset that just sweats the small stuff. And a certain amount of tolerance of risk, a very risk averse researcher is unlikely to accomplish anything meaningful.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
I think its also equally clear, the 2 giant motivators of research are first curiosity, someone who's not actually curious about how the world works is very unlikely to be a really successful researcher. And the other one is a certain kind of narcissism, you have to be motivated by the thought that people are still going to be paying attention to your contributions after you're gone. Because the returns to truly innovative research typically don't take the form of money or high status, except within your community, so you go to a modest grave but you go thinking that maybe you will have built something that maybe will last for a long time.

9.6.17. Respondent17AF4

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
My research is fairly traditional, its based on the works of Chevy (unintelligible?) largely, I've been spending much time on that and its not so much the subject that will concern you but the nature of the research which primarily deals with the examination and transcription of manuscripts. Now the Internet has become an extremely important aspect of this – to be able to get all these rare transcriptions available to everyone. I'm enormously indebted to the Internet.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Accessing the information via the Internet is innovative – but it depends on your knowledge on where to go, to find the resources you're looking for. Innovative research has to do with open access. It now has become the norm for research, you know. I sitting in SA, research a British writer/poet who's works only exist in the States and in England – I mean, I don't have to go there any more – it's all available to me on the Internet. Also the fact, if I need an article – 9 times out of 10 I an get it immediately by simply using internet library resources. Its taken me well beyond the kinds of things I used to do when I first started out, where if I wanted an article, I had to order it from a library, waited then had to return it after 3 weeks. I had to travel, spend hours at libraries, it was very complex, so for me innovative very much for me lies in that dimension. And its available of course, to just about everybody today.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
I think the NRF is basically a funding instrument, it would appear to be a rating instrument as well so, and there are many ways in which you can access funds from the NRF. The funds available to me are not nearly comparable to the sciences of course, where vast amounts of money are needed to conduct experiments. Of course there's research that has commercial benefit that is funded from external sources and such, but in my field, the NRF is the primary source of research funding.
Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Well you see innovative research, as you've previously described it happens all the time. And technologically, like we spoke about the Internet before – in terms of research media and different ways of accessing information and knowledge that's probably fairly conservative, people just go round and round doing the same thing but certain breakthroughs and innovations have occurred, very interesting hyper textual experiments are taking place on the Internet, where you get readings and layers of information which can be accessed at the same time in a kind of three dimensional space. I think there's a lot of potential for that and probably my field lacks that kind of innovation but in terms of what we do in our field, we're innovating all the time, we have to break new grounds and we have to explore beyond our paradigms, otherwise there's no point in research.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Yes I think they do and probably more than before, because before, as I said I would have to order an article. Now I can do a search for anything, you can information in a way that was not possible before, a lot of new information is available immediately

whereas before it wasn't possible. So I think yes, definitely the journals are definitely important. The only problem here is that too much has been written, much of it is actually useless. But it probably happens in all fields, a lot of stuff is just wasted but the rest is good and the system works like that, so you have to be a good enough researcher to know what's rubbish and know what to concentrate on. It's a skill, a lot depends on the people conducting the research, You see me, I'm not hostile to the internet at all, I've got colleagues who hate the internet, saying there's so much rubbish there, I don't mind about the rubbish. Its like my wife, she'll walk into a shop that's full of junk, but she'll be able to pick out exactly what she wants – and that's the sign of a good researcher – it's a skill and I think its up to the researcher to learn that skill. So journals are undoubtedly valuable but books are too and books have been marginalized up to fairly recently. So yes, journals are definitely important, and increasingly important is the fact that we can now access these journals almost immediately, whereas before we weren't able to.

Interviewer (Probe):
So do you think in terms finding solutions to problems in real time, you may be able to use the Internet?

Respondent:
Oh yes. I've been retired for 5 years and even 5 years ago I thought my colleagues were half asleep, I don't want to praise myself because I'm not that good on the internet, I mean there are millions of people who are far better than I am but I learned that it's a fantastic resource.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Firstly, the top people in your field – if you can be in contact with them that's fantastic, if you cant, that's unfortunate. Also of course if you cant contact the directly, you can contact them by reading their books and papers and articles, etcetera. My own view is that people talk to each other less than ever before. Even at universities, we've lost collegiality and people feel that they don't have the time to sit around and talk. But talking is the lifeblood of a university so conversations are probably more important than the actual experiment. And that's… shocking, it will frighten most scientists but its actually true and we need to be more in touch with some very bright people in this world.

9.6.18. Respondent18CF1

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Basically, I do research in the field of paediatrics, mainly. Also looking at vaccinations to protect… and so we work in a few areas. So the first area is in clinical research, looking at vaccines. So that's basic research, looking at the genetics of the

pathogens and that. And then we do some phase 1, 2 and 3 clinical trials which done with industry so, we get industrial grants.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
I think its having people who can actually see what has potential. In other words, people who've got an eye for it. Unless you've got an eye for it, you can have 100 researchers following like sheep and it just… don't get you anywhere. Without having that, that eye for potential, for seeing things that are unusual, you're never going to pick it up. So you've got to be able to generate, you've got to see what information is around you and be able to ask the right questions around it.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Look you know we get our money, our unit is quite a well-funded unit. Our money comes from both within and outside South Africa, mostly outside – from the Gates foundation and from national institute of health in the US, the CDC. So what we do is we do trials and then we cross subsidize money from the trials to fund others in the unit.

Interviewer (Probe):
How else? Does your research have enough popular appeal to generate funds from the public?

Respondent:
Um, no, you know… there are successful models. I mean for example there's things called the meningitis fund in the UK, which is kind of a public funded, you know we… um… public donors would sometimes donate bits of money to these charities, or they raise money as charity which is then used for research specifically say for meningitis. So you can for example, if you have a vaccine for meningitis use those funds. So there is public interest, there is an awareness so it's possible.

Interviewer (Probe):
Have you heard of Crowdfunding? Do you think it has any potential in funding academic research?

Respondent:
Yes and no… um. (long pause) I mean its uh… its an interesting question. You know, if you had to do something like that with HIV – so ok, I mean anyone who's looked up HIV on Google, gets an opportunity to drop a few… a bit of money. The question is who would that go to? Because you know, you can look at HIV from so many different levels. And you know starting at the very basic level you can say well why don't we… the disease is almost 100% preventable so surely we should be promoting

education and that's where the money should go. There's no point in finding a cure for a disease that's preventable. So you know some people could argue at that very basic level. If you want to take it a step further you could say well, this money should go towards lobbying government and improving the distribution and the use of antiretrovirals so there's less suffering. And then you know you take it to the next level where you say well hang on a minute, maybe we should be looking at new drugs or drugs that are less likely to cause resistance or improve side effects. So it depends. There are people that, who are potentially suffering with the ARVs and want to take it up to the next level and then um… you know there's people who are more kind of… open who would say well lets look at the fundamentals of the disease and lets do basic research into genomics and proteomics and that and see if we can.. .you know, fundamentals of how the system works, so if you can unravel it from that side. But then you're spending huge amounts of money, on something, which has a benefit potentially only 20, 30, 40 years down the line. So if you want to throw money, even personal money – particularly in the case of personal money – people who throw personal money at this want to see results. So if you can show results, some kind of definite impact – in terms of HIV. But once you go into the more cryptic, kind of fundamental stuff, it's a lot harder to explain to someone – well we went and sequenced the genome of 10 0000 patients and there's an interesting change and mutation in whatever it is. So it's interesting. Even with the best researchers it's difficult.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Look I think there's been several models. You know Ebola was one, swine flu was another. So I think we have learned certain things from…. And I think the reality is that the more educated the public and the better your lines of communication, the more chance you have of responding. So for example countries with poor infrastructure were slowest to eradicate Ebola and those with good infrastructure were better. You know in the case of the Tsunami in Japan, people were already recycling waste the moment the water had receded, where you contrast that to something like Haiti where they're still cleaning up the rubble. So it's very much the level of development of the population that's hit by the disaster.

Interviewer (Probe):
And from the perspective of a researcher, if you're looking for a cure or something, do you feel that's an issue of information availability?

Respondent:
Absolutely, because its quite easy for the moment the disaster hits for the government to say look, stop what you're doing, this is a problem this is an immediate threat, throw everything have at it. And you also need to, you need a lot of social and medical support. Because the problem now is that I could theoretically go into the lab, culture Ebola and inject it as a potential vaccine, which would not take me long at all but I haven't done any of the safety, I haven't done any of the… you know that sort of stuff. And it might actually work but in a state of desperate need, that might be

allowed but in normal conditions that wouldn't be allowed at all. So, the question is, in a situation like that you would need a very broad relaxing of all the restrictions in order to go ahead and synthesize that.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
In a way, there is some truth in it because you know academics are starting from the beginning each time, each new class of students, they've got to bring people's levels up to a certain level before they can go forward again. Sometimes they've got a dynamic group that's firing away like crazy. But the other advantage for an academic, because if you're in industry – unless the research turns an immediate profit, you're not going to cut it. Whereas a lot of academic funding allows you to dabble in things which are kind of have secondary benefits which would actually amount to something significant. So, you know most innovations in the world, they still come from academics. Ja I mean its you know… a lot of things you'd find in current bits of technology were all sort of university projects.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Look there's an essential way of communicating. They range in quality. There is – I wonder if you can say – it does force people to turn out quantity rather than quality because… um… but ja, I mean at least the information is out there. I think journals are, it's a difficult thing because in the medical field you'll find that an example would be if you have say, a drug for high cholesterol. So if you look at cholesterol and cardiac disease and all that, you would find millions of articles, you do a web search and it would pretty much dominate your search criteria. Now, if people go say on a low carb diet, you'll find that their cholesterol profile changes, the inflammatory markers go down and your risk of cardiac disease goes down and yet you wont find articles on changing diet because nobody does that research, there's no funding incentive to do that research. So there's an incredible skewing of information by journals in terms of quantity. The more articles on a subject, would suggest that the research is more robust but that's not necessarily true because it's skewed by the amount of funding which is pushed into it.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
That's quite an interesting thing because I think it takes quite a lot of different people to – you know there's people who are very good listeners, in other words they they're good at putting a good group together, they are happy to employ slightly off the wall, innovative thinkers that are very good at steering them to the right results and these people are actually very useful because they're not necessarily the most innovative

people themselves but they're very good group leaders and that actually helps to get the best out of the innovative thinkers. The problem is that either the thinkers – by the fact that they are so lateral thinking, they're actually their own worst enemy in a sense, they often struggle to get the message out there or to see the bigger picture of what they're doing or to manage their research staff and that so its difficult, what is the recipe for success? And I've seen those work, I've seen people who are individually brilliant with no people skills and on the other side, people who are not that brilliant but have very strong personal skills and they've built up strong research just by managing the people that they have.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
Look, a lot of it is ego. I will admit that egos actually quite important, you know there's a small little nerd who's been beaten up most of his life gets an opportunity to show the world that he's actually a hell of a lot smarter than everybody thought. There are those types, people I think who want to make money in research, they normally come up with an idea and they push that idea and they sell it off and they've got much better marketing skills and much better people skills, you know.

9.6.19. Respondent19AF1

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Well it depends what you mean by innovative. See, it sounds to me like you're talking about technology development, right? So all research is innovative because all research is new. You know what I mean? So I mean, in my field we don't iron out new techniques, what I do is look at lots of different animals and ask the appropriate questions, which is the innovative part of it. So I don't know if that really applies to what I'm doing?

Interviewer (Probe):
Well what I'm talking about is more radical research as opposed to incremental. Can you name any contributing factors?

Respondent:
Ok well my personal research, I wouldn't call it radical. I say dolphins are stupid and not intelligent. All right so I took a chosen thing and turned it on its head but I did that through a lot of grind looking at animals brains and figuring things out and proposing new ideas, so I wasn't actually using new techniques or anything like that but using new ideas to go forward.

Interviewer (Probe):
And what were those kinds of ideas?

Respondent:
A friend of mine, we were drinking beer in Finland and she was telling me about some work that some friends of hers had done and it just sort of dawned on me one day, that this is something that I should do, something for research. So just maybe you would call it networking? Listening to what people have to say. Being open, open-minded.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
{Laughs} Bureaucracy is the thing that kills. You know there's one thing I could say about Wits, that they may not like but at Wits for every academic staff that's supposed to do research, there's 1.3 to 1.5 administrative staff. Ok, we as researchers at Wits, we're absolutely tied up by bureaucracy so often. And it's a phenomenon that's happening worldwide, its not just Wits. The bureaucrats, the administrators tend to evolve very quickly, and it's also happening at the NR, in fact I have {unintelligible} big chunks of NRF staff for administrative salaries. So it's kind of a weird thing. But now then to look outside of the traditional funding agencies, is never really easy it depends on what kind of work you're doing. If you're trying to cure AIDS or whatever then people are willing to give money for that. If I'm trying to understand the brain of an African wild dog, then most people don't really give a rat's ass about that, you know what I mean? You know, so it depends what you do. Even in the fact that I do that kind of thing, there are people around that have a lot of money, that are interested in this sort of work, people like… have you heard of Paul Allen the co-founder of Microsoft? So yes, he has the Allen Foundation which you know… he set up the one brain institute in the US and he has a strong interest in African animals and so on. And he's actually someone that's on my… who I would approach for funding. You know, the US army invited me to a little conference to talk about funding opportunities with them and I sent in a few applications and they said 'oh shit we're out of money sorry'. Yeah so, there are some alternatives but you have to really look you have to be in the know to figure out what those alternatives are, they're not often very well advertised.

Interviewer (Probe):
So the Internet has had a significant impact on research in that regard?

Respondent:
I wouldn't think so. I mean I have gone on the internet to look for something you know, type in something like Science in Africa for example and the… 99.99% of the websites are just pure nonsense, so you don't have the time to sift through all those things.

Interviewer: Question 3 (Global Catastrophe)

Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
{Laughs maniacally}. Well you need all the money in the world to do whatever you want for things like that. Um, well jeez I wouldn't know, mate. That to me is just such a big question. I think that question unfortunately not very specific and that's going to be hard to give an answer to.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
I think there's 2 aspects, there's people that… it depends on the personalities, there's those that are doing academia basically just as a job. They come to work, they do their teaching, the do a little bit of research and then they go home and they're done. Then there's those who are very passionate about research. So those that are doing it just because its part of their job, probably are much more likely to stay within the paradigm. Those that are very passionate about their work are more likely to break paradigms and ignore it and be seen as people who are a bit out there and that sort of thing. So I think its more a personality thing.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
I just got a bunch of reviews back asking for what a different change {unintelligible} in my work. {Laughs}. Um… some of the journals are good; again a lot of it comes down to the editor and chief of the journal. Let me give you an example, there was a journal call Journal of Comparative Neurology, which is quite a good journal in our field, has an impact factor of about 3.5 so its pretty reasonable across most fields. The previous editor was one of these guys who really had his paradigm about the way certain parts of the brain work and so on and if you challenged his view there was no way you'd get your paper published, it would be rejected. Now with a new editor who was much more open minded and willing to let things happen and willing to have the scientific discourse, now that journal publishes really interesting stuff. So yes, the {unintelligible} between academia and journals and the publishing, getting grants, all those things. The biggest problems I think is that its all done anonymously. So if I get a paper from someone to review, I can screw them over and make sure they don't get published. You know, so the anonymity of the peer review process is a real problem. That I think is blowing things up quite a bit. But you have to play the political game, that's the problem. {Laughs}. And we're in a field that actually shouldn't be political.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
{Laughs} um, a strong scepticism of authority. You know, actually a disrespect for authority s a very good thing. And that's probably the best thing. And then just being generally open minded and accepting. You know, being a person that's open to change.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
External doesn't. Unless you're internally motivated, you wont do research. So the dean of the faculty cant say 'I want you guys to produce some really good stuff today', that's not going to happen, you have to be motivated from within. And internal motivation is just a curiosity. The sort of bottom line is trying to figure out why we're here, how we got here; the existential questions are what drive us.

9.6.20. Respondent20AF1

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Well I can only really speak from my experience so there are a few things off the top of my head. The one is, playing to the strengths of an African context, so you've got a lot of strengths in Africa. There's a very well developed education system. So we have very good training hospitals and all that sort of thing. And the research that works really well focuses on marrying that with a research focus, matching with South Africa's help problems that makes a lot of good innovative research. Another thing that we have is that we're situated geographically at the interface of three ocean systems – Indian, Atlantic and the Arctic ocean systems and a lot for the good research that we do is in oceanography, fisheries management sort of… modelling of fisheries and all of that sort of thing which is world class. Another thing that we have that's geographical is being in the southern hemisphere, like Australia… we're on the best places to do cosmological research. The third thing I can think of is, from an South African perspective – in South Africa we're fortunate to have a good infrastructure which the rest of Africa doesn't. In more cerebral research things, where don't require a large amount of infrastructure, so research in modelling – ok, so you get all the data which is accrued elsewhere in the world, so froe example the large hadron collider, places like that. So a lot of work in south Africa is things like writing software and thinking up experiments that you can do with data that's already been generated. So that is a major really obvious thing that South African scientists can do. So most of it is actually computational data analysis so my area that I work on. I sort of that sort of thing but with biological data, so there's tons of data that's generated, genome sequencing data from viruses through to mammals and things like that. So a lot of the high profile work done in South Africa is in analysing that sort of data, large big data repositories where people are compelled scientifically, I mean morally… for

these databases. We have the same sort of setup in biology now, we're starting to get what people have in cosmology and in particle physics where all the data from these big projects is available for anyone to analyse. And the area where African scientists have a big opportunity is in thinking of innovative ways to analyse that data, to understand stuff about how the universe works and such. Its big data research, it's coming from all over the world and if you combine it with this infrastructure, well it s absolutely fucking brilliant.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Ok so that is a complete… well, if you went to 90% of other scientists at universities they would agree with you. You know what the biggest budget constraint in research is though? The salaries of the people doing the research. People have got this idea that if you build a fucking baseball diamond people will come. I mean it's a metaphor but it's actually quite accurate. But that's the way research is done here. We provide money and then research will be done. So there's another way of doing research though, entirely, where you don't even have to rely on the money. I haven't had a single grant in the last five years! I get money from the NRF; they just give me money for doing nothing. So how's that possible? I don't need money to do research, and nor does anyone else. So a lot of scientists don't actually realize that and the problem isn't with the funding agencies, its with the universities they don't even realize that they can actually have scientists that cost them nothing that actually make them money from their research. So what I would like to see is research funders – so, an innovative way of providing research funding – is you don't provide them with money to researchers to do research. Half the money is given to universities to pay researchers to do free research. And they sort their own shit out. You do your research but we want 5 or 10 papers a year from you. And as long as you get that target we'll pay you your salary. Screw the problems that you're working on. You can pay people that are doing research in the right area., in an area that you think is worthwhile, that's completely valid. But the specific details of the problems? It's a… I mean… research organizations don't even realize this. That most people when they write grants to do research; they don't even spend the money on the stuff they said there were going to spend it on. Like 90%. And I'll tell you why. Because you can't predict what research is going to work and what isn't. You can have the greatest research idea in the world and it will fail in the first step! And I mean no one even reads the research reports. It's just some bureaucratic bullshit that they put in there just to keep you honest. But no one ever checks up and says hey can you give back the money because you didn't actually do what you said you were going to do. None of that shit happens! Even the big international research funders, they don't check!

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:

So if you were following Ebola in the scientific literature, you would know that the response was very, very fast. Ok, so the work that data scientists are doing is devising the tools that are necessary to respond. So I write software for example for analysing genetic exchange between viruses and there's others looking at millions of different other factors related to these viruses. So when an epidemic happens, you can generate all this data in the field, the guys in the fields had 'minions', which sequences the virus in the blood of the Ebola victims. So there was very high volumes of Ebola sequence data being generated within the first month of the epidemic and within about 3 or 4 months the first papers were being published. And that data wasn't analysed 2 months before those papers were published and steps were already being taken to work on the solutions, you know to find the vaccine, try figure where the virus came from, etc. using the tools that were devised. It's difficult for you, not being in the field, to conceptualize how well it actually went.

Interviewer (Probe):
So what was the key factor that enabled that to happen?

Respondent:
Well the key factor is actually just random chance people deciding to work on this thing or that thing, there wasn't any overwhelming social imperative put in place in the 1970s that forced people to do this work, and people chose to do it randomly. So forcing people to focus on the applications of things is kind of a recipe for mediocrity, its got to be open. Its like the old school thing people say when people still gave a shit about horseracing, its horses for courses. Ok, certain are interested things are like really high performance but with very little practical application, just because they're interested in the problem. Different people are interested in different things.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Well that statement is itself not innovative and constrained by paradigms. Besides that, I think the main criticism of academic research is that its not applied enough. So when I for example, got interested in doing something, writing a computer program that analyses genetic combinations of virus sequences. Now I have no interest in actual epidemiology of any of that sort of stuff. None of the potential applications of the software. I'm not really that interested in that. It just so happened to have some important relevance in Africa. And I'm not just being difficult here, its incredibly difficult day to day to motivate yourself to do all those little trivial, sometimes boring steps that you have to do to get to work in research. I mean I'm sitting in my lab or at the computer rather than going to the beach. Or playing StarCraft. I'd much rather be doing that.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:

So this is exactly what I'm saying. How do you define ground-breaking or innovative research? Really hard. I can't judge! I'll read something in a journal article and it looks good to me! Its in Nature magazine or whatever, but I guarantee for every article that's in Nature or Science, that's a really hot topic, there are another 10 in journals that you've never even opened that are just as good or better. So, everyone wants to judge research by these individual article citations, which is ok but some papers that get highly cited are cited for the wrong reasons. Because they're the 'straw man' hypothesis that's put up so everyone can hack it down, some papers are highly cited because they're not good, but because contain some useful information, the guy was just in the right place at the right time that did an experiment that showed something that turned out to be quite useful. So now what if you've got a researcher that's got 10 papers like that? That's the thing. You get another guy that doesn't publish anything, they're just not interested in 'levelling up', they just enjoy the grind. So who's the better scientist? The guy publishing a whole bunch of junk? Or the guy who's grinding and producing innovative experimental approaches for doing stuff that actually have huge application potential. It's very hard to judge.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
The small steps. Challenges presented by the small steps. The challenges themselves. Something that's difficult but not so difficult that you cant actually do it. All of life is like a computer game, where what motivates you to try harder is failing but not failing so badly that you realize that you have no chance of progressing. You can identify another possible avenue that you can take. Again and again. And you make slow progress. Its like up 'level up'. You've accumulated progress, some bit of knowledge or whatever it is. So the demotivating thing is when you think you're further ahead than you really are and you suddenly realize actually I'm much further back than I thought I was. Or your progress is in the wrong direction. So what I'm getting at is that those are the things that motivate you, the day-to-day challenges, not the grand overarching challenges.

9.6.21. Respondent21AF1

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Yes well. As you know I'm in the nutrition division so I'm a qualified and registered dietician and I have a masters in public health and a PhD also in nutrition so all my research has been nutrition related but not solely on nutrition, but it also covers some of the chronic diseases such as for example type 2 diabetes and different types of malnutrition and also things like epidemiology and then I've worked a lot with masters and PhD students with a whole range of other subjects according to their interests. But usually, obviously its nutrition related in some way.

Interviewer: **Question 1 (Innovative Research)**

In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
The type of research that I've always been involved in has been basic and applied. Nutrition of the population has always been a big issue in South Africa. So, most of the projects that I've written grants or proposals for have been as a result of problems that we've seen in South African populations for example looking at nutritional status of different groups, then looking different ways of doing interventions, to intervene in certain problems, which are applied to specific areas so we can see the problems. So its very much basic applied type of research and I really envy people that can do what we call the blue skies type of research, which is just for the hell of it, you know… in other words to… discover new things, not necessarily because there's a specific problem that needs to be addressed but because it'll be interesting to see where it goes, you know.

Interviewer (Probe)
And what factors so you think contribute to innovation?

Respondent:
Well part of the success is, we always have postgraduate students working on the project, they get their masters and PhD's and we run publications, we actually think its unethical not to publish, whether the results are negative or positive, we always publish them. So that for us would be a big success factor. Sometimes when we find specific problems, we used to do what we call policy briefs, which was basically a short summary of the problem and our findings. For example, advertising to children on television, what the adverts were that we found, the main adverts. And then drawing up a set of recommendations ad those policy briefs were then sent out to members of parliament and, department of health, government officials, and etcetera.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Yes, in sense, sometimes you can get private funding. You know, there's a lot of food companies in South Africa and we do have a code of ethics that in other words we would not accept funding from coca cola, put it that way. But there are many companies that are what we regard as ethically advertising and producing products that are beneficial to people. So, we do access that sources and also smaller sources, we try for international funding as well. Then we're competing with people from all over the world, we have been successful with a few so but funding, you're quite right. Funding does always limit the size of the project, or the extent that you can do. Fortunately, nutrition is one of those areas where you don't require expensive equipment, so you can actually do a lot on quite a little bit of funding. The type of funding we normally need is for fieldwork and that kind of thing, not big equipment and that kind of thing. Except if we're doing blood tests, which we sometimes do, it gets a bit more expensive because they have to go the lab, etc. so that tends to be a bit more expensive.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Well you know, there is a sort of global catastrophe. One of the issues is always food and nutrition. That, regardless of whether its whether weather or earthquakes or war, nutrition is always a huge issue. So I think that there is, we would certainly be able to assist in terms of looking at the extent of the problem in terms of food available, food security, and nutritional status of all the people that are involved, that would be the type of research that we would be doing and also we would be able to make recommendations on how to get food, what type of food people should be having, the best at the lowest cost, obviously because its going to be a huge expense to feed people.

Interviewer (Probe):
How would you go about obtaining that information needed to solve the problem? What's the most efficient and quickest way for that information to be dissimilated?

Respondent:
Well fortunately, we do work with FAO and WHO, FAO being the Food and Agricultural Organization, which is the United Nations body and same with the WHO. They have all the information in the world, literally one email can access so much information, and also on their website, they have information on catastrophes, feeding people, that sort of thing. O it wouldn't be a problem; I don't see it as a huge problem in terms of the type of research that we would be doing to get information from the WHO.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Well I think I mentioned it earlier on, the fact that – and I know the nutrition community, I know all the PhDs and professors and whatever that are working in nutrition in south Africa so everybody's more or less in the same boat, we're all working on problems and they're not necessarily, well… innovative, but they're all analysing the situation and looking at ways of solving it, or dealing with the problem. So nutrition related issues are very often related to HIV and TB, which are 2 huge problems and then the chronic problems like obesity and type II diabetes, which are growing all the time. We're getting the double burden of malnutrition where you have a very overweight, obese woman in a household with a thin, malnourished child so you know, how do you deal with that? You have to do some kind of intervention and see if there's ways and means that you can deal with that. And that's basically what most of the universities are doing nutrition are involved with; specific diseases that are the main problems, specific ways of dealing with those problems and taking… using masters and PhDs, even honours students to do that kind of research.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
I would say yes, I mean there's lots of publications where you do wonder how they ever got published but if you are working on a specific problem, obviously the first thing you do is you go and look if its available, what everybody else has done. And obviously don't repeat exactly what they do but it gives you an idea of how you can take the whole thing further so I think in a sense, it is small little steps that each research project grows a little bit more and find out a little bit more and so on. So we keep learning from that and build on that.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
That is very difficult question {laughs}. Well I suppose curiosity, would somehow be involved and lack of knowledge or… um… wanting to make a difference as well. As I said, we don't just want to repeat what everyone else has done. You want to make it better.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
Well you know I think academics to a certain degree have got very big egos, they like to see their names on publications. I do think the returns of what you put in, I mean there are… if you're a hard working academic and you are doing research and you're doing different research and its published and people notice you globally, then I think that is a reward in itself. And something that we all aim for, as academics, to become internationally known for what we do.

9.6.22. Respondent22CF1

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
So my lab on focuses on biomedical TB research with the idea of discovering new drug targets and developing a new vaccine. The other thing we do is development of new industry standards for the whole lab diagnostics. So for example, we developed the government in 2010 in terms of diagnostics, there was no mechanism for quality assurance and verification of diagnostics on the floor, in their laboratory. So my laboratory developed a set of {unintelligible} that the government could use for a new diagnostic program and which allowed them to roll out this new diagnostic to over 800 labs in the country. Also we started providing the product to international lab

programs on the African continent and now I think more than 40 countries use this product.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
I think being in the right environment, working in a well funded field, working in something where there's perceived – at least from a medical perspective – whether there's a perceived medical need so the perceived medical needs, correct environment, having incredibly bright students and post doctoral students from different backgrounds and of course, good funding base that creates a mix where you know people believe they're working on something relevant, one can see an endpoint and one works towards it using every possible angle. It's very difficult to be innovative when you're not sure what problem you're trying to address.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
I think that there's not enough funding programs that you know fund what is termed as blue skies research, I don't know if you've ever heard of the term. Which is kind of just funding something because it sounds incredibly interesting. These days a lot of funders have moved towards 'what is going to be your impact, how many lives are you going to save, how is this going to change the world and you know, drop the jaws of everyone in the room' and that's a tough thing to ask of any researcher, whether you're a regular researcher or a Nobel prize winner. But the pursuit of research is the pursuit of new knowledge and without the application of that knowledge; there are always things unknown at the time the research is being done. So I would advocate for more funding., more funding that goes to something that's… you know, blue skies type of research. Fundamental biological research, just to try and understand these basic mechanisms, without actually leading to some sort of clinical outcome, you know. These things are every important and I think innovation comes from there.

Interviewer (Probe):
Are you familiar with Crowdfunding? Do you think it could be viable in academic research?

Respondent:
It sounds kickass interesting {laughs}. I mean I think its sounds like an incredibly exciting way of looking at a problem. A couple of things that come to mind though is how would one regulate that type of thing? You have a lot of people contributing and you know, I would assume that 80-85% of that is not useful and you know, I just don't know how one would filter that type of information to find something that's useful. You know the best way to get as far away fro the solution as possible is to put 5 scientists on it. So they'll never reach consensus {laughs} so I don't know if that's

the right way of doing it. You'd have to find out what the needs are. I think that would be useful.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
So first I would need to assess the situation. Get as much information a possible. Get, sense of what the geographical layout of the situation is, who's involved, what geographical barriers are there and the size of the problem. The second is one would need a sense of what type of intervention one could draw up immediately and how one could follow that up. So lets say, in the case of a global catastrophe, my first thought would be containment – how does one keep the problem from getting worse. And so you continue to either – a small geographical area or… one cannot stop the problem from getting worse unless one institutes an intervention. So then I would take a multi-pronged approach of containment vs. intervention, in terms of intervention… so lets take Ebola again, it's a very good example. The first thing I would do is to make that there's no further transmission of infection or further deterioration in the communities that are infected and keep them contained. And then I would call on the global scientific community to say this is a problem we need to fix what is the global consensus, I would seek out international aid in terms of funding, expertise, hands on the ground and try to contain the sort of political fallout of the situation. And then finally introduce an intervention of the global confrontation, but if it were a catastrophe; I would give it 24 hours, that's it. What I don't receive within 24 hours is not considered and then I would deal with the problem at hand. After a few days I would evaluate if it is working, I wouldn't go longer than 3 days if it's an infectious disease. And if its not working I would go back to the consultative route to see what suggestions are there but if it is working I would scale it up.

Interviewer (Probe):
Linking that to before, what would be your thoughts on involving the crowd? For example there's been monitoring of social media in order to detect outbreaks of flu and things like that.

Respondent:
So lets qualify it. If it's a medical situation, or a breach of containment of disease, then I would not. I would unequivocally say I would not involve a crowd type situation because the problem is, especially in situations like this, there's a herd-mentality where a couple of people say things and then some people follow it and then more and more and its very difficult to find the truth out of that. In this case I would turn to expert consultation. But lets say for example after we've contained the situation and we want to understand what the socio-economic and socio-political impacts of the rampant disease that moves through an environment like that, after there's no longer any threat to human life, I would open it up to a more broadly consultative platform to say this is what happened, this is how we contained it, what are your thoughts. I just believe that when people's lives are at risk, those who are in possession of expert knowledge and people who are trained and who have a background in the area of question need to be consulted. I mean, then I would turn it

back on you and say if you had the flu and I told you to go to the golf club and ask people how to deal with your flu, would you do that or go to your doctor? {laughs}

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
I just think the way that academic research is funded now that it cannot be driven by paradigms, I think a lot of funders ask you – like the Gates foundation for example – if your research is based on an established paradigm or dogma please don't submit it. We don't want to fund it. So I just think funders are really pushing people to think out of the box and then specifically say we will not fund x, y and z so come up with something new otherwise don't apply. I don't believe that hold true any more and one can just see that in the way technology is associated with academic research has quantum leaped in the last 10 years. There've been more developments in the last 10 years than in the last century.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
No. I mean journal publications promote research that I think is perceived to be topical in the field. And that's not necessarily innovative. Its very subjective, it s what the editor feels is interesting and sometimes the editor doesn't even know the reality of a disease on the ground and so… I don't think journal articles re a good measure of anything.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Persistence. That's it.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
I think being an environment where you can see the reality of a disease. So I don't know necessarily if I would have developed this product that's currently being used in 40 countries, if I was not in a country that was endemic with TB. And one of the rules that I have for the product is that endemic countries get it for free, so I pay the cost of production and all the high {unintelligible} countries – like South Africa, India, China – their programs are based no the actual postage cost of the material but they get everything for free. I believe that being in the environment that you can see the reality of the problem you're trying to solve really gives you the impetus to solve that

problem, using a multi-faceted approach and watching it from a distance I don't think is the same in any way. You know, perhaps in a more well resourced and more funded lab in the future but they can always be brought in to play a very important part by the person who's on the ground. SO I just believe that innovative research comes from people who see problems, have a clear connect with the reality of the problem and don't necessarily have a solution but then they go out to seek the solution So for example, I knew that any product I make, it has to be stable at room temperature and it has to be in the most simplest form because its going to go on a dirt road in Afghanistan you know, from Kabul to a point of… to a clinic in the middle of nowhere in the hot heat of the desert so creating a wonderful product that requires a cold chain is not going to be useful. So I know that, because I've been to clinics in Kayaletsha and in Soweto and I've seen there isn't even electricity for a fridge so there can never be a product that requires a cold chain. I don't think that a developer sitting somewhere separated from the problem can see that reality.

9.6.23. Respondent23CF1

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
I work on {unintelligible}. We use them as indicators for water quality.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
I suppose what we… the innovation here is mostly {unintelligible} development. And then I've also been responsible for some water research commission reports which then led to manuals and stuff, which was developed which was then rolled out and the number of water practitioners were trying to employ what we developed, which was originally an R&D project.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
What I've been doing successfully was getting my research funding from the water research commission. There was also an initiative, which was led by the Danish, water research funding for South Africa where I got some funding from and then of course the university's got our policy for research publication, which also helped. So that's the main sources. But I must say that my research is not extremely expensive, the most expensive part is the travelling and field work so that… you know equipment wise the university is quite good.. we use research funding you know, so most of it is being funded by that. Then also, we have an analytical facility where all our instruments are, and in that facility we also do private work and the funding

model for the private work is that the funding goes into trust funds and that is then used by our faculty to negotiate with management.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Ok well I mean of course one cant plan for it, being a disaster or catastrophe as you say. You know I think just being very flight footed and I think we actually had some practice with it last week with the student unrest, we had experiments running and whatever and we had to make changes and whatever. And I mean there, you just have to make do with what you have available. And I think that would be the same with something like that. When I was a student I was working with a research assistant for an A-Rated researcher and he used to say there's only 2 types of researchers; those that will say I need big {unintelligible} to do my research and then sit and wait and those that say I need {unintelligible} for my research and then go home and start working. And I really think you know, what happens between your ears is more important than what is in your {unintelligible}. Many of the things that people buy… I've been to a conference last week where I was a representative and my thought when I came back to my husband you know I said people are always {unintelligible}. There were students there travelling, from here, students travelling to… not flying Mango or something, it was R4000 a ticket as opposed to… for Mango… then they were all staying in 4-star bed & breakfasts and then they were all {unintelligible} and I was saying to my husband, I've never seen so much waste. But its government paying for this so people just went wild so if you use this analogy of you know, I can do research or I cant do research, I just need it to be a bit innovative, and I really think you know, that would be an example of how not to do it, how not to be innovative. I mean, there's a lot money wasted, I don't think we're really at the point where research funding is under… they will tell you that it is but that's because they haven't tried. There's a lot you can do with a lot less.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
It is though, you know. I wonder if there was no reward for publication, how many publications would be written in South Africa. There's a lot of rubbish published. I mean ok, maybe there's nice words for rubbish but you understand what I'm saying. A lot of people would do the same thing over and over; it's a recipe that becomes {unintelligible}. Stream A, Stream B, Stream C, Winter, Summer, Autumn, blah blah, it's the same thing over and over. And this thing feeds itself because the supervisor needs to train students, the student doesn't have a job so they do a {unintelligible}. The supervisor pays the student, because he needs to get promoted. They ask for funding not because they want to solve the problem but because they want to be promoted. You know, they submit to a journal because they wont be promoted without sufficient publishing. You know, there's a lot of this kind of thing.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
You know it, I mean because you know… it's really quite esoteric. So there's… I've been in the field for a while, so you get to know the situation. So I mean the journal editor can only work with what they receive. It depends on what's being sent to them in the end. And you've got these academics and students that have to publish a certain number of times a year so they're sending in whatever they can. It's a complex situation.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
I think stubbornness sort of works. It's not the most pleasant thing to work with…. You know in an environment with a lot of stubborn people but it helps you know because you have to be stubborn enough to believe that something that everyone thinks is going to fail, you have to be stubborn enough to force it through. Of course, I mean at the level we do research there's some basic sort of intelligence already in place. But I think thereafter, its really the ability to go back and try again.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
I think… its about what you want to know about things. That's why most people do research. Those are the perfect researchers but unfortunately I think the system doesn't tolerate them that much because managers need to have… I mean the VC's (?) compete with another for publications. So a person must… you know, the dreamers, those ones with a strong internal motivation lasts very well. So the perfect researcher would be a perfect match between the internal and external factors. External being things like acknowledgement, promotion, salary, blah blah. I mean but, I've seen many times at our university, there's only a certain point up to which you can pay a person and then they'll tell you I'm not interested, I wont do it. And you can put money on the table and they won't do it because it's just not about the money. Most professors will tell you they're not here for the money because otherwise they'd be out in private practice.

9.6.24. Respondent24CF1

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:

Well I'm a physiologist so I mainly do, I don't want to call it clinical research, but I do work on patients rather than {unintelligible}, so pain caused by nerve injuries.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
I suppose what is… its… opportunity is one. But also you need to be able to recognize opportunity, you need to know what's happening in the field. So its good basic knowledge but also observing or seeing opportunities in your… wherever you are, or wherever the gaps are in the environment. And that might be a particular cohort of patients that's unique to your situations, it might be having a different angle of attack in terms of maybe drawing from other areas of the literature to lets say, try a different angle when the current angle is approaching a problem not working. Those sorts of phenomena. Approaches.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
I suppose by its very nature the funding mechanism is wasteful. Its bureaucratic because it has to go through the traditional scientific method…. for assessment is to peer review which is a very wasteful process. Its prone to error, its prone to bias. People favouring some people, not others, etc. but unfortunately its not something that's going to change anytime soon because it is quite robust in terms of… it can take a while to happen but it does eventually… something does come out at the other end. I supposed one is somehow marketing yourself, making it through certain organizations, things like KickStarter or something like that. If you've got an innovative idea, seeing if you can publicly fund. And when I say publicly I mean the general public, not through the taxpayer's money. So its about being able to generate ideas which people see a benefit in, and that might not necessarily be an output, something like KickStarter has a product that gets produced. But it might just be, the output is a new piece of information. There probably are people out there that appreciate that. But it probably doesn't have as much cash as something that produces a product. But it is another way of approaching it, doing a KickStarter type approach to funding.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Well I suppose that's the advantage of history, it comes into play. So if you look at it from an epidemiological point of view, something like an outbreak of a disease, you'll have models from others types of diseases, lets say it's a different type of hemoratic disease or SARS virus or Ebola or whatever it might be, you do have some history in

terms of public data, a lot of data, big data on disease spread, the profiles, what actions are taken to curb that. So I think on a very short notice you can probably do… implement plans to these curves or try to follow the curve based on historical evidence, how the disease or whatever, the process of that happening – how to try mitigate, while you muster your troops to start investigating the particular problem. So you have generalist approach and then while you're mounting the generalist approach you also in the background start doing the specific approach at the same time.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
No I don't think it is that much, I suppose like I said earlier about potentially funding you might get into the paradigm trap where new ideas aren't as robustly supported financially because the reviewers of the grant, etc. might have their own personal biases against the new theory or have built up a reputation based on an existing theory or paradigm, so there is that potential. But there are funding mechanism for initiatives and different approaches. So if you got the NIH and that, who have specific funding mechanisms, which approach that. In South Africa, we don't have those funding mechanisms really for… I suppose there is blue skies research but nobody really knows what that's all about. Its quite random in terms of the nature of the calls, even calls from the Gates Foundation, which are always weird and wonderful, how to use a cell phone to identify HIV or whatever it might be. So there's definitely, I'd say, it the wrong thing to say that academic research is stuck. If anything, its quite innovative, if anything I think its become more innovative and its become more innovative as we move into this information age, you know sharing information, information becomes more widely available you get different people from different fields integrating new knowledge from other fields and you see these spurts of activity. But it does work like that you know, there are periods of stasis and it requires some sort of trigger often to then have a change in mind-set, which then triggers other new bursts of activity and then settles down again and then another burst. Because you do need, before you can have a… sometimes it can be something like a technological advancement. You might not be able to measure something because you don't have the technology, you might think 'oh this might be a wonderful thing to do' but until the technology catches up to your thought process and what your ideas are, you're a bit stuck. So the technology and the intellectual development have to go in step with each other, if you want a speedy, sustained innovative research coming out.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Umm… no because they take too long. I think by the time you get something out.. it's speedier little bit more now with these [re-print publications coming out, the ones that are accepted you have an early version up on the web within about a week or so. The print copy might only be 6 months, even a year later, so that does speed up the information, or the transfer of information. But I think its still quite a slow process. I

think one of the hurdles was people guarding their data rather than making the data open to anybody to access.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
I think these days it's the willingness to entertain alternative ideas. And you have to hold the current ideas and play with them in the concepts of the new ideas to see if they can work. And that leads into the ability to…nobody can possess all the skills now to do everything that needs to get done. So it involves, in order to see progress you often need collaboration. These days, especially in biomedical research nobody has all the skills, the toolset to drive innovation anymore. O it relies heavily on collaboration and that collaboration, often if it moving outside into new fields and across fields – interdisciplinary, that definitely stimulates innovation because people can feed off each other especially if you've got a good working relationship between your collaborators.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
I think its… well there's to things, you can have somebody I suppose who's driven by the desire to… for glory. So there's the personal reward aspect to it. But there's also the… want to know something new. Sometimes people just.. 'oh I'm interested in something, I'd like to know how this works. Curiosity. So I think you'll generally end up with a combination of both, coming through. But there's a lot of people out there who are out there just for the power and the posture but there's also those who are there for innovation and then those very good guys who have both things happening at the same time.

9.6.25. Respondent25CF3

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Ok, I look at particle physics, the theory side. So, just calculating the fundamental particles, what their interactions and dynamics are. In particular, for the Higgs-Boson at the moment, that's sort of the… interesting area in particle physics.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:

Well, research should be innovative at the beginning, otherwise its not research, its just study. So in terms of factors to help with innovative research, obviously you need access to resources – to all the previous stuff that's been done, so you don't reproduce certain work. Also, an environment where you've got a bit of freedom where you can work outside the box. I think those are the most important factors.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Well I mean in my field, because its very much theoretical, just the application you do rely on government funding or private funds that are set up who are not interested in business at all, rather just in industry innovations. So in that sense, for my research it would be about streamlining the application procedures through the NRF, because its incredibly bureaucratic here compared to other countries.

Interviewer (Probe):
What are your thoughts on obtaining funds via crowdfunding?

Respondent:
I think it's a great idea but in particle physics, these experiments run into the billions of euros, so crowdsourcing isn't really a solution for that. But for smaller sorts of projects, that can be quite useful. It's just a matter of marketing to get the message across to the crowd, or the people who may be interested.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Well not exactly my research field but the internet as invented by physicists, to share information as quickly as possible. So a lot of particle physics research is done in real time. Information is shared directly from the experiment to a system of computers and internet connections to people who then do data processing and that sort of thing. So I mean the internet itself was designed to solve these sorts of problems. So I guess taking advantage of the connectivity of the world would be the best way to approach these sorts of things, or lets say to 'prepare' for such things.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
Well, I'd say that's certainly not the case in my experience. As I said earlier, if its not innovative then it's not really research, that's just people studying. There is an element of research where you need to build on what has been done before you; you know there's a… cranking of a handle, so to speak. But all of that is part of

developing new ideas as well; that you have to know other logical conclusions of someone else's work so you can start rebuilding models.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Well I think it's very different from field to field. Certainly in my field, getting that 'peer-reviewed' is a little bit of a status symbol, especially if you're reporting to government and so forth. Because they'll only recognize certain peer reviewed publications. But the peer-reviewing process is not perfect. Most of the people who do referring such as myself, its on a purely voluntary basis and its done anonymously so quality control is a bit questionable. And its always seems to be at the discretion of who the editor is so some journals I'll avoid because the editor is a dickhead. But other places, you know that they're interested in this kind of work so actively try and publish there first. So I mean I think, there's probably a few ways to do it, whether you have a certain review system that's not anonymous, which might make the reviewers a little more careful. And I think trying to make things a little more open source to open up that free exchange of ideas, instead of worrying about the money making machine, focusing on the actual research instead of getting more subscriptions.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
In research in general a lot of hard work is required. You can have a great light bulb moment but unless you actually do the hard work to realize it into something useful, its will just sit in someone's' back drawer. Certainly like I see with a lot of the students here that do graduate studies – the ones that want to work hard, they don't just rely on moments of inspiration certainly do much better.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
A lot of internal motivation is more important. Someone has to be doing this because they really want to. You know, if they're just interested in money then they wouldn't be going into research, they'd be going off into industry to make more money with a mind-numbing job. But someone who is very much internally motivated and disciplined, that's the more important thing, at least in my opinion.

9.6.26. Respondent26CF3

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
I research elemental nuclear structures. And I work at a predominantly iThemba labs, which is down in the Cape and is a facility used for cancer therapy or radioisotope production and for basic physics. And the basic physics part is what I'm involved with and the type of measurement that you would do for certain projects would perhaps impact on supernova explosions and the modelling of those explosions would produce heavy elements, which are distributed throughout the universe.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
I think there would be 2 different aspects. Innovative research leading to a marketable product and innovative research leading to advancement of knowledge and understanding the world around us, not necessarily marketable. So innovative research might for example have something to do with development of new lasers for sending signals down optic fibres, that is the sort of work that we are presently doing in the school of physics here at Wits in terms of looking at polarization to increase the bandwidth, to increase the information carrying down an existing optic fibre and it can be fairly straightforward to increase a hundred fold, the bandwidth of existing communications infrastructure. We have a new laboratory called 'Structured Light Laboratory' and a new distinguished professor who joined us from the CSIR national laser centre and his basic research is leading to many new types of innovative marketable products that only once the fundamental measurements and physics has been done. The other side, in terms of advancement of knowledge with the example I gave you is by measuring particular reaction rates, that could be applicable to the evolution and development of the supernova, it allows the modelling of that supernova to be done more accurately and to understand how frequently supernova explosions might have occurred and since the original big bang and the start of our universe and then of course the development of galaxies, stars, planets and evolution of life, in terms of the elements available and the distance from a particular star. So that is not a marketable thing, it is something to understand the world around us as opposed to putting it on an advert and trying to sell your product.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Well NRF underpins quite a lot of the research done at universities in dedicated laboratories. NRF also is looking after big science projects in South Africa via funding of course, you're aware of the Square Kilometre Array project. We have the gamma ray telescopes in Namibia; we also have the SA Cern program. South Africa is party to the work on the Atlas project and funding ultimately through DST from the government for that very large initiative and I don't think we can take. Look NRF might be called something else in the future, one never knows but ultimately the funding comes from the government and I think we're looking to go back to the

source of funding, the government funding and how that is going to be apportioned and what would qualify a necessary increase in that funding so that South Africa can have a more global presence and recognition.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Well, this already in terms of infrastructure is available. You probably will remember 15 years ago or perhaps 20 years ago, the Internet was really non-existent. You had to go to a library. If the library didn't have the book, then there were inter-library loans and if you needed something quick you phoned up a colleague or an institution and they sent a fax. Now that is totally superseded by a rapidly developing in terms of information storage internet access to those storage facilities and I think the question if it were posed 25 years ago or 20 years ago would have been a lot more relevant. Now it is taken for granted that you get your information really at the drop of a hat anywhere in the world with satellite communication and you know even cell phone communication at any time.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
All the technological developments we have seen over the last 50 or 80 years or so or even 100 years have been the result of basic research in physics in particular and in chemistry and in biology. Lasers were a lab-curiosity in the 50s and 60s and all of a sudden without the laser, todays modern technological advancements would not be possible. There are so many spin offs. Laser range finding for example and how the oceans have change in height and the plate tectonic movements and so on, its amazing how much in terms of modern measurement techniques we rely upon and original discovery and the curiosity. Without that basic research we would not have those sort of applications and medical applications and everything. Everything is base don basic research, I would say.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
There are some internationally recognized journals that only publish innovative content and the more detailed and deeper sort of research in terms of expanding what has already been measured to different systems or different areas of the same sort of content go in the more standard journals. Without the journals dedicated to new types of findings then the awareness in the scientific community would be very much less. Perhaps that would lead onto open access and the notion that there should be other routes for making a scientific work available not just paper journals or electronic, but there are many so called 'predator' journals springing up all over the place trying to

get the basic research through and also to see how that basic research can deliver a marketable product. Within the next 20 years I believe the landscape is going to change again tremendously.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Its normally the academic who is generally of a humble nature. We do get some very flamboyant academics who want to have their name recognized internationally, want to be seen as leaders and actually take other peoples work and put it forward as their own. These more aggressive academics. There are very many academics who are very humble who do ground-breaking work perhaps don't get the recognition internationally, than they might deserve on the world stage. One of the colleagues here at Wits postulated a mechanism for the recurrence of malaria – once a person has had malaria then the disease comes back again quite frequently, after a few years or even more often and there is a particular dormant state of the malaria which nobody believed at the time and it was only about 15 or 20 years later that that dormant state was actually found individuals and its been attributed to the recurrence of malaria. Now that academic that I know is a world expert in that area and in problems with different sorts of infestations in organisms and he's on call essentially most of the year to look at problematic outbreaks of things like Ebola and so on. So, he's a very humble person, he's a thinker and he looks to try and discover what is behind a problem that perhaps other people have not realized.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
Dedication to what that person is doing. I don't have a job, I have a way of life. And many of my colleagues feel the same way. They don't go to work they don't go the office they have a way of life. And I don't think there are too many part time nuns or part time ministers of religion or whatever, you're dedicated to your subject, you're dedicated to your ideals and the true academic is somebody who doesn't look for the best salary, but looks for the solution to a problem. I say to the students who are starting off in physics, well what do historians do? They look at me blank and then eventually somebody says 'history', what do psychologists do, psychology. And I carry this on for 5 or 10 minutes, what do chemists do, chemistry, what do physicist do? And my answer is that physicists do everything. Once you have a degree in physics. Once a person has a post graduate degree in particular a PhD in physics then that person can apply what has been learned in terms of problem solving to any sphere of life. It could be in the banking environment, in mining, in South Africa in particular, it could be in a totally different field – it's the way to solve problems and how to think about solving problems, that's what a physicist is good for.

9.6.27. Respondent27AF1

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Ok well I was Wits for the whole of my career and my main research interest was in liver disease, which has the highest incidence a tumour of the sub-Saharan black African population in the world and its devastating that population because of the frequency of this tumour which has a very bad prognosis, there's very effective treatments and many of them die at an early age. So I was at Wits until 8 years ago when I had to retire and then I came to Groote Schuur in Cape Town, where I still go in every day but obviously I'm not so much involved in active research as I was in Johannesburg because I'm retired and so on. But I do still retain an interest in research and I'm writing articles and book chapters and that on liver disease in general and liver cancer in particular.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Well I'll talk on the medical viewpoint, that's the only viewpoint I have. Clearly the important thing in medicine is to look for something that needs to be done. Some disease is very common in the population to which you have access and which ahs serious consequences. In other words what im saying is you don't want to get too enthusiastic about treating acne in the white population or something like that. You've got to find a disease that is really common, has devastating consequences and hence is having major negative impact on the population with which you have access. Its no good going saying I want to study this particular disease which occurs commonly in this population if you don't have access to that population. You've got a take a problem that you're in close proximity to and that hasn't been researched or is poorly understood, then you make research in that kind of thing.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Ok well let me first tell you, there is very limited resources available for doing research n this country, in South Africa. Its very difficult to get money to do your research and this is a major problem that we all have to face in South Africa, doing research and there's very little finance supporting it. So if its possible you want to do research on something that doesn't need a lot of money, you what I mean? You want to for example take a disease where the diagnosis of a disease is fairly evident clinically in other words you can make a diagnosis merely by examining the patient, you don't have to send off blood for expensive tests or x-rays because the problem is that there are financial constraints to research in sub-Saharan Africa so you want to try choose something you can do research at a reasonably cheap level. There are funds available you can apply to various funding agencies who will have money for research, but now you're in competition with all the other chaps who need that

money. So you've got to be able to persuade the people who have money that your research is important and that you will do a good job of it. Its not like being in a very wealthy country like the US where there's lots of money for research, funds are very limited in this part of the world. There a problems that need to be attended to and the problem is that very often you don't have the finances to do it.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
It would be very difficult as I mentioned, you've got to have… you cant do research without reasonable sums of money, it not possible. you cant do reasonable, important research without some kind of financial backing, you've also got to have salaries for people to work for you. What you can accomplish as single person is limited; you've got to have a little team around yourself to help you.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
I think in fact it is reasonably innovative, if I take my own example is that you look around to find a major problem. In other words, you don't go for something that's not important. You should be curious about issues that are by the nature, their frequency and their importance and look at that.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Well yes I do because you know people doing research, the first thing,… if you come to a new job and you see as a doctor there's a major problem that needs to be assessed, the first thing you have to do is to find out about the disease but you also must consult the literature, you know there's a huge medical literature and a lot of it is not linked to your particular interest and you need to know the literature, what has been done what needs to be done, what are the things people are thinking about.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Let me just say what I did, first of all, I looked at a problem that was immediately important – so you have to be devoted, you have to apply where you can for funding to whatever funding agency is available and you have to be passionate about what you're researching.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
I think its important to be enthusiastic yourself. Show that you are working actively in a particular problem and this is what you're doing and you will then attract certain people to join you. If you take for example in the medical profession if you have a physician or surgeon in a fairly prominent position who wants to do research- if they can be enthusiastic and show the way then they'll attract others to do the same.

9.6.28. Respondent28CF3

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Ok it's mainly in theoretical computer science so part of it basically mathematics, just proving theorems but there's also areas of application for example visual passwords. So normally when you log into a computer you have an alphanumeric password, but what we wanted to do is to use visual passwords so instead of typing in a password, you will chose one of a number of pictures that look close to your password and then you choose your password out of that. So that's one application of the theoretical work that I do and another application is to automatically check beginner's programs – people who have never programmed before and are just starting out and if you imagine that's now a class of high school or university students, its quite a large class and you don't have so many staff members who can check every students program to find where the mistakes are so we try to automatically check the students programs. And a third application would be where you a model a virtual cooperative with a formal grammar – which is basically what I do – it was developed by people in the 1960s, it was developed organically.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
I think you mainly need people who have education, enough education to understand what is already out there and then put it together in a different way and add a new idea. I don't think you necessarily need a lot of money. So its more at least in my area, its more about having time and the basic knowledge – so, having had a proper education and spending time thinking about it and it also helps if you have a couple of people who can work together because maybe the students might have new ideas but I'm the one for example who supervises, I'm the one who has the experience and knows already what is out there and to also make the student doesn't go too far off the path so in general its not so much about money but its about time and having a good basis of education.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Well ok {laughs} a good part of my research is actually funded by the NRF and a smaller part is money that I've earned from publications or student graduations and I do need a bit of money for my research because I once a year go to Sweden where I meet with other researchers and it makes quite a difference sitting in the same room as opposed to just talking over email or Skype or whatever. So what would I do if I didn't have the NRF? Well I would hope that I would get more money out of my publications and student graduations. Other things I currently do is look on websites like Research Africa where they tell you about other sources of funding. I haven't been very successful yet in getting funding but at least the information is there. I don't think I would go to private companies, I know some of my students do but I wouldn't because its very foundation research, it won't have application tomorrow.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
I think the only thing would I suspect would be to talk to other people around you and try and pass on the information as quickly as possible. Communication.

Interviewer (Probe):
Do you think the Internet and all these social media conduits for information could have an impact on this kind of thing?

Respondent:
Its made both a positive and a negative difference. I think it has made, yes a positive difference especially in Africa apparently most African countries have completely skipped the landline, and most people regardless of how poor they are, they have cell phones of some type or other so I think that could definitely be used in that environment. But then of course, I'm really not a field researcher but I think in many societies there's still a good deal of verbal information that goes from A to B so that one would have to use. So in some situations the only thing you really can do is to use your smartphone if you have one and get onto the Internet and get information. Though like I said the Internet can also have a negative impact, there can be information overload and people may not know what to filter out.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
I suspect most research done by academics I innovative but its not necessarily something that you can go buy in a shop tomorrow. But I guess you also have to then

go and find what you need with an academic because in Germany for example, most of the research is done in {max-blanket?} institutes and those people also teach but they're not considered academics in the classic sense, they're first of all considered researchers. But I don't understand how one can actually do research that's not innovative. Maybe people do make the assumption that most of the real research is don either in garages or in the big research departments of big companies like chemical companies and car companies and so on. That may be true but I think most of those people, in these companies they actually together with staff embers at universities so that they can access to the students and also access to the knowledge of the staff members at universities. Maybe there are also R&D departments at companies that are completely independent of universities, at least once they have the graduates appointed to them. And maybe that's considered innovative because once they've worked for seven years then finally they come out with a new car or new aspirin or whatever, but I cannot actually understand how one can say that research at university is not innovative.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
I think people nowadays are not pushed to work in circles but they're pushed to work in very small steps. But the problem is not really with the journals, but rather with the universities who want to see you publish many papers in one year. While at the same you still have to do admin and teaching student who are not very well prepared. So the only way you can actually come up with all those papers that the pen pushers would want is to write shorter papers with smaller results. Maybe in the past you would wait for 3 years until you published everything together but nowadays that's not very good for your career or for your funding so now you do salami science, the moment you have a little bit you can publish you just publish. So I really don't see the problem with the journals. I mean of course some journals have the problem that they have long turn around time from the date you submit until its finally published, easily 3 years can go past. Some of them try to go past by at least publishing it in an intermediate form on the Internet so its actually available on the internet. But really I don't see that the problem is with journals its more with the systems in which academics work.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Courage. To do what you think you should be doing instead of what you're told to be doing.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
I think for PhD students for example, the motivation would be that they are supposed to publish before they can get their degree and you normally cant publish something if its not at least a little bit original. Then also for all students if they want to maybe go do a higher degree at a better university or different country for them to stand out in a mass of applications, maybe the university gets 100 000 applications or whatever, because the numbers are just… just to stand out in a mass of number of people who have straight A's, etcetera, etcetera. its very good to have a publication, that's what I tell my students at least, always. So that's for students and for academic staff, promotion. Them mere fact that you have to get promotion or to get an NRF rating or so… but in the end I think its mainly just about driving yourself because the only reason you're at the university usually is because you would like to do research, or else you'd be out there somewhere making big money and driving a big car and so on. It's a passion. And I think that's in the end the main motivation.

9.6.29. Respondent29CF2

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
My own research is around land rights, both nationally and internationally but these days its taken more an African… um flavour. I have been approached by the World Bank to assist with one of their programs on the human rights side. So that's the main area in which I work but my main area is land rights and social rights and I've been working in that area for more than a decade, perhaps two.

Interviewer: **Question 1 (Innovative Research)**
In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Well you know, it's moving away from the beaten path first and foremost, I would say. In other words there's a lot of talk about orthodoxy but I think innovative research is about revisiting some of the accepted principles and trying to view them from a different paradigm. One kind of example, I'm sure there are other forms of innovative research where you uncover new statistical data or you're curious about a particular answer to a question and then discover a range of new answers.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
You know, I wouldn't make it a win or lose game because you know, in funding today its about incentives. People who receive rewards for research are only those who are successful at it. So your big issue is not so much to grow… to expand those who are actually successful, your big issue or challenge is how to get others who are

less successful to do so with a certain degree of ease and probably to funded for the mistakes that they make, but eventually who stumble upon an answer.

Interviewer (Probe):
So what kind of mechanisms or vehicles would you use in order to generate this kind of funding?

Respondent:
Well for example if you look at a funding agency, then I would ask for stages in the research inquiry. To decide how the payouts will work. For example if there's a very innovative topic and very innovative question that requires one form of investigation or another, credit should be given for that. Ok. And then, the stages of the rollout thereafter can easily be quantified too, so there's no wait for one big bang. And so it's not a kind of… slot machine payout. It's incremental.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
Oh that is a hard question. {Laughs} that's every researchers headache! Everyone likes to be able to find a timeous solution, that's what scientists want; it's the timing of the result. But I'm afraid life doesn't quite work that way. And research sometimes has a nasty habit of imitating life. And so I would say um…. I'm merely speculating. I would say you need to have all your {unintelligible} and hope that one {unintelligible} in time.

Interviewer (Probe):
Has the Internet had quite a significant impact in that regard?

Respondent:
Well let's put it this way, the Internet might be a good vehicle for instant information but is it really viable? Which is the stuff of science, isn't it? Of research. Its not a conclusion… we all nowadays, lets say we have a problem in country X… but merely narrating that doesn't provide research, its solution seeking around that actually. Before you solution seek you need to verify that so for example if we take that plane crash in Uganda, the first thing we have to figure out is whether the plane has crashed or not. You tend to the immediate emergency needs and thereafter look at how did it crash. What caused it? So you know I think the Internet has a role to play, but to place all our hope in the Internet would take away from the research enquiry.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
I totally disagree. Just because I don't like what you are doing… what's the word? The right to use {unintelligible} that debunk what you're doing. Very many of the larger social {unintelligible} that relate to research, they're the ones that most people

walk away from. Or where you know, questioning whether a solution can be found or otherwise. We cant despond to an endeavor and stay persistent to find an answer. So I wouldn't go into that direction.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
Well lets put it this way. You know, research for the sake of research is important. For some people you know… everything requires a value immediately, instantly. So if its not given an added value then we need to discount it as speculative academic research. But who knows how much of this speculation in the end adds up to one or other lets say… conclusion, with the right kind of research question. So I don't think there's… I think that the academic endeavor is undervalued by you know, by a kind of entrepreneurial view. That's not realistic. I think research for the sake of research is fundamentally important. The value we get from it, we'll leave that to the people who do the accounting to work out, but I think research is important because it's important.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
I think curiosity is a big part. You know, I think it takes a certain type of personality to think outside the box in other words, someone who's not boxed in by the hegemonies… because if you are then you're in the wrong business. And that's not simply to say that you must be artful for the sake of it and be 'off the wall' so to speak, there has to be links with realism and the like. So I'd say you need a resilient personality, one that's curious but one who's willing to be persistent until either a negative or positive answer to your question appears. And its ok to do research for a long time and receive a non-answer, right? That in its own is worthy to some degree of lets say… recognition. It's about being dogged in wanting to answer a question that interest you.

9.6.30. Respondent30CF3

Interviewer: Before we start, could you briefly describe your research so I can get a better understanding of your work?

Respondent:
Ok, its fundamental research. Um… not directly related to immediate application in industry for example. Mostly curiosity driven, which is a bit of luxury nowadays. But that is the environment in which I do research. The major area of study is condensed matter physics so it's related to understanding the properties of materials at a microscopic level.

Interviewer: **Question 1 (Innovative Research)**

In the context of this research, 'innovative research' refers to academic research that breaks new grounds and/or challenges the status quo. In your experience, what are the factors that generate innovative research?

Respondent:
Well of course that is the ultimate kind of research that I do. Um… {sighs}… to do groundbreaking research is not something of course {laughs}, not something that happens every day. I do have a publication that has been cited 20000 times so I have made a contribution at a certain level to the field in which I work. It's debatable whether that was groundbreaking research, or a breakthrough, it was a simple idea that others would have come up with as well but the citations suggest that it was a reasonable contribution to the field.

Interviewer (Probe):
What factors contributed to you writing that particular piece?

Respondent:
What factors contributed? Its an accumulation of things, its understanding the field in which I work, talking to the right people to stimulate ways of thinking, there's no one factor which speaks to this kind of thing. Of course you need to understand the field in which you work, so a deep understanding of your research area is a requirement for doing innovative or groundbreaking research, it's not the kind of thing that happens if you're… by accident. It requires years of, well, not necessarily years of experience but at least a deep understanding of at least a limited field of research.

Interviewer: **Question 2 (Funding)**
A lot of research face budget constraints. Can you think of any way to streamline research funding or think of alternate methods of research funding?

Respondent:
Well I do have some funds at the moment, from industry. Student scholarships, fortunately the field in which I work has some interest to the… certain fields of industry. One of my students is sponsored by Johnson-Mathe, a specialized pharmaceutical company but my interest in materials overlaps with some of the kind of things that they do. They do have a research section and so its possible to sometimes find research funding from industry for fundamental research but only in selected area of research in physic would you be able to do that. If you want a broader answer to your question {laugh}, which I suggest, which may not be achievable, to do fundamental research you have to be able to have freedom to do research, if you're given some funding to do, what sometimes we refer to as Blue Skies research, which is curiosity driven research. And you need funding for that, many discoveries in science… it wasn't well formulated projects with a well-formulated goal. You cant do research properly if you're not allowed the leeway to follow dead ends. You learn that. And that leads into discovering something new. So funding for curiosity-driven research is essential, certainly in an academic research.

Interviewer: Question 3 (Global Catastrophe)
Hypothetically, in the case of a global catastrophe where information is only available once the problem has already started (for example, Ebola or an earthquake), how would you enable the formulation of a 'real-time' solution?

Respondent:
I've never thought of that. So I wont give you a well through through answer to that. Um. But if one has a crisis that serious, what one would have to do is ascertain what resources are available and then work from there.

Interviewer (Probe):
Lets say the most important resource you need is information. How would you go about obtaining it quickly and efficiently?

Respondent:
The first thing to do is to determine what the remaining resources are to actually obtain information from. So if the… um… {sighs}. If something like social media still exists, of course that, you could use that to try contact as many people who have some understanding or some information to try to pull it in some way. But it will depend on what is still available at the time of crisis. Um, without having a basic scenario of what you're dealing with, the first thing you'll need to do – in that case – would be to determine what ways you have available to obtain information. And if there are people who have information then of course they have to somehow be convinced to work together and um… pull the information so that it can be analyzed and used to find a solution.

Interviewer: Question 4 (State of Academia)
Historically, academic research has been described as non-innovative or 'constrained by paradigms'. Do you think such an outlook still applies today?

Respondent:
There um… both scenarios probably do exist simultaneously. Um, some form of research is funded by agencies that require that the research is done in a certain field, and they're looking for specific answers and that will constrain some research but there are um… paradigms that exist and there are ways of funding research and research that's being done which is completely curiosity-driven, looking for new solutions perhaps, for old problems or looking for new problems to find solutions so I don't think that there is a specific paradigm that can be used in this case for academic research. It um… varies from research field to research field, in the way that funding is obtained and so I don't think – I never think – the school of physics where I am, most people here are doing fundamental research that is not constrained in many ways, apart from lack of funding. But actual research is open. It is not informed by specific preconceived notions, in my definition fundamental research has to be open. You have to do it with an open mind. Look for surprises, or not be too surprised if you find that what you discover is actually different to what preconceived ideas may lead you to think. Certainly in the line in which I work, research is completely open.

Interviewer: Question 4.1 (Journal Publications)
Do you feel that journal publications that accept academic work sufficiently promote innovative research in your field?

Respondent:
{Sighs}. There again, the field is quite wide. The number of journals that publish research in the field that I do my work in and related fields have increased quite

dramatically over the last number of years. Some of the better-established journals are changing their criteria for accepting articles and insist that they have to be novel. For each article that is published. So, you can still find journals that are publishing, that is valid and informative but which does not need a novelty component and that sometimes is necessary just to understand what happens. But some of the new journals now insist that there has to be something definitely new in each publication.

Interviewer: Question 5 (Personality)
In your experience, which personality factors do you think contribute to innovative research?

Respondent:
Well, probably one of the most important factors is the… being prepared to do a lot of work. You don't do research without doing a lot of preparation and that requires dedication, being prepared to put in the hours, to acquire the knowledge and to interpret or understand the field in which you work. So that probably is, if not… probably the main factor is dedication. Perhaps a bit of imagination helps as well but I think that is secondary.

Interviewer: Question 6 (Motivation)
Describe what motivates you to research. Specifically, what external factors (such as your work environment) and internal factors (such as curiosity) do you think motivate you?

Respondent:
{Sighs} well the main motivation probably is curiosity, trying to understand the world in which you live in. and how it works. The material world, in my field. Curiosity is a sufficient driving factor to be sufficiently rewarding if you find a solution to… if you can satisfy your curiosity; that is probably the kind of satisfaction that researchers in academia work with.

9.7.7. Appendix G: Ethics Clearance and University Permissions

9.7.7.1. Ethics Permission from the University of Witwatersrand

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Rubin

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H15/05/36**
PROJECT TITLE	Second generation innovation and academic research productivity in south African Universities
INVESTIGATOR(S)	Mr A Rubin
SCHOOL/DEPARTMENT	Economics and Business Science/
DATE CONSIDERED	22 May 2015
DECISION OF THE COMMITTEE	Approved unconditionally
EXPIRY DATE	02 June 2017

DATE 03 June 2015 **CHAIRPERSON** (Professor T Milani)

cc: Supervisor : Professor C Callaghan

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

_____ **Signature**

_____/_____/_____ **Date**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

9.7.7.2. Research Permission from the University of Witwatersrand

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

OFFICE OF THE DEPUTY REGISTRAR

23 June 2015

TO WHOM IT MAY CONCERN

"Second Generation Innovation and Academic Research Productivity in South African Universities"

It is hereby confirmed that the enclosed research material has been distributed in accordance with the University's approval procedures for such a project. Please be advised that it is your right to withdraw from participating in the process if you find the contents intrusive, too time-consuming, or inappropriate. The necessary ethical clearance has been obtained.

Should the University's internal mailing system be the mechanism whereby this questionnaire has been distributed, this notice serves as proof that permission to use it has been granted.

Students conducting surveys must seek permission in advance from Heads of Schools or individual academics concerned should surveys be conducted during teaching time.

Nicoleen Potgieter
Deputy Registrar

Private Bag 3, Wits, 2050, South Africa | **T** +27 11 717 1204/8 | **F** +27 86 553 2271 | www.wits.ac.za

9.7.7.3. Research Permission from the University of Pretoria

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

RESEARCH ETHICS COMMITTEE

Tel: +27 12 420 3395
E-mail: ronel.rensburg@up.ac.za

11 August 2015

Strictly confidential

Mr A Rubin
Department of Management
School of Economic and Business Sciences
University of the Witwatersrand

Dear Mr Rubin

Project:	Second generation innovation in South African universities
Researcher:	Mr A Rubin
Degree:	MCom (Management)
Supervisor:	Prof C Callaghan

Thank you for the application you submitted to the Committee for Research Ethics, Faculty of Economic and Management Sciences.

I have pleasure in informing you that this committee formally approved the above study on 4 August 2015. The approval is subject to you abiding by the principles and parameters set out in your application and research proposal in the actual execution of the research.

As the research includes campus intercepts among staff of the University of Pretoria, written permission has also been obtained from our Registrar, Prof NJ Grové. A copy of his approval is attached for your information.

This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Codes of Research Ethics of the University of Pretoria if action is taken beyond the approved proposal.

We wish you success with the project.

Sincerely

pp PROF RS RENSBURG
CHAIR: COMMITTEE FOR RESEARCH ETHICS

cc: Prof C Callaghan

Members: Prof RS Rensburg (Chair); Prof R van Eyden(Deputy Chair); Dr WM Badenhorst ; Prof HE Brand; Prof DJ Fourie; Prof JF Kirsten; Prof BA Lubbe; Prof MC Matthee; Prof SG Nienaber; Ms K Plant; Dr M Reyers; Prof R van Eyden; Prof C van Heerden; Prof JJ van Vuuren; Prof M Wiese
Administrative officer: Mr M Deysel

9.7.7.4. Research Permission from the University of Kwa-Zulu Natal

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

26 November 2015

Mr Asaf Rubin
School of Economics and Business Science
University of Witwatersrand
Johannesburg

Dear Mr Rubin,

Protocol reference number: HSS/0982/015M
Project title: Second Generation Innovation and Academic Research Productivity in South African Universities

Full Approval – Expedited Application

In response to your application received on 21 July 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)

/ms

Supervisor: Professor Chris Callaghan

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

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9.7.7.5. Research Permission from the University of Cape Town







aculty Office

"Our Mission is to be an outstanding teaching and research university, educating for life and addressing the challenges facing our society."

9.7.7.6. Research Permission from the Nelson Mandela Metropolitan University

• PO Box 77000 • Nelson Mandela Metropolitan University
• Port Elizabeth • 6031 • South Africa • www.nmmu.ac.za

Nelson Mandela Metropolitan University
for tomorrow

Chairperson: Research Ethics Committee (Human)
Tel: +27 (0)41 504-2235

Ref: [H16-BES-BMA-EXT-001/Approval]

Contact person: Mrs U Spies

9 March 2016

Dr J Krüger
Faculty of BES
Department: Business Management
South Campus

Dear Dr Krüger

SECOND GENERATION INNOVATION AND ACADEMIC RESEARCH PRODUCTIVITY IN SOUTH AFRICAN UNIVERSITIES

PRP: Dr J Krüger
PI: Mr A Rubin

Your above-entitled application served at Research Ethics Committee (Human) for approval.

The ethics clearance reference number is **H16-BES-BMA-EXT-001** and is valid for three years. Please inform the REC-H, via your faculty representative, if any changes (particularly in the methodology) occur during this time. An annual affirmation to the effect that the protocols in use are still those for which approval was granted, will be required from you. You will be reminded timeously of this responsibility, and will receive the necessary documentation well in advance of any deadline.

We wish you well with the project. Please inform your co-investigators of the outcome, and convey our best wishes.

Yours sincerely



Prof C Cilliers
Chairperson: Research Ethics Committee (Human)

cc: Department of Research Capacity Development
Faculty Officer: BES