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An examination of student factors related to performance on an undergraduate research skills course

Submitted in partial fulfilment of MA in Psychology by Research Report and course work

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Abstract

Quantitative research skills are a key set of abilities that are important for the production of quality research leading to increased knowledge. It is therefore imperative that these skills are taught to and understood by not only academics, but all those involved in the practice of Psychology (National Research Foundation [NRF], 2005; Woods, 2005). At the University of the Witwatersrand one of the research skills courses with the highest yearly intake is the Research Design and Analysis IIA (RDA IIA) course offered by the School of Human and Community Development.

The aim of this research was to explore whether factors not related directly to teaching and learning-based interventions but still predictive of performance on the RDA IIA module could be identified. More specifically, cognitive learning style, learning strategies employed, motivation and level of statistics anxiety, as well as pre-existing factors such as gender, age and school performance, were examined in order to determine the degree of their effect on RDA IIA performance.

The sample consisted of eighty Psychology students who had previously completed the RDA IIA course. Each participant completed the Motivated Strategies for Learning Questionnaire (MSLQ), the Felder-Solomon Index of Learning Styles (LSI), an adapted scale of statistics anxiety and a self-developed biographical questionnaire.

The results suggested that the most predictive factors of RDA IIA performance were school marks ($p<0.0001$ for overall Matric mark) and age ($p=0.0106$), the effect of which far outweighed any other variables. The scale data indicated that self-efficacy ($p<0.0001$) was the most predictive factor of RDA IIA performance, with motivation ($p=0.0047$), help seeking ($p=0.0531$), statistics anxiety ($p=0.0041$) and a reflective learning style ($p=0.0071$) being less strongly related to RDA IIA performance. The variables of race ($p=0.0024$) and Maths level in Matric ($p=0.016$) also showed significant differences in RDA IIA performance. On the basis of these findings it was suggested that future interventions should focus on those who did not perform well at school or who did standard grade Maths in Matric and that within these bounds

interventions should focus on increasing motivation, self efficacy and help seeking behaviour while reducing statistics anxiety.

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Chapter One: Introduction

The ability to conduct and analyse research is an important skill for many in their professional careers and, more crucially, is a vital asset to the academic and social spheres of a country (cf. Lutsky, 2006; Scheaffer & Lee, 2006; Woods, 2005). This is especially true of developing countries such as South Africa where new research is necessary in order to understand and contextualise the changing socio-political climate (cf. Lindsay, 1997; Shackleton, Riordan, Simonis, 2006). It is therefore critical that skills related to conducting and analysing research are taught and fostered in every discipline at the tertiary level in order to produce top quality researchers across the spectrum. This goal, however, tends to become problematic in many fields, as research courses have been shown, both internationally and in South Africa, to have high levels of difficulty and, as a consequence, high failure rates (Laher, Israel & Pitman, 2007; Murtonen & Lehtinen, 2003). This may be due in part to the difficulty of the course, anxiety regarding the mathematical nature of some of the content or an increase in student diversity leading to a bigger range of factors that must be dealt with in an intervention (Laher, Israel & Pitman, 2007; Lindsay, 1997; Shackleton, Riordan, Simonis, 2006).

The University of the Witwatersrand, located in Johannesburg, South Africa, offers a number of modules focused on teaching research skills across various Faculties and Departments. Of these, the undergraduate module Research Design and Analysis IIA, offered by the Department of Psychology (School of Human and Community Development), has one of the largest student intakes owing to its being compulsory to attain a major in Psychology or Organisational Psychology. Approximately 400 students register every year and, despite numerous interventions at the lecture, tutorial and materials levels, the failure rate remains relatively high (Laher, Israel and Pitman, 2007). This high failure rate, within the context of continued teaching and learning interventions designed to provide critical factors for encouraging deep learning (Biggs, 1989, 1996, as cited in Israel, Pitman & Greyling, 2007), suggests that factors other than those directly related to teaching practices on the module may affect student performance.

The aim of this research was thus to explore whether other factors not related directly to specific types of teaching and learning-based interventions but still predictive of performance on the RDA IIA module could be identified. More specifically, the role of non-intellective student factors such as cognitive learning style, learning strategies employed, motivation and level of statistics anxiety were examined in order to determine the degree of their effect on RDA IIA performance. As these factors are susceptible to intervention, it was hoped that determining their relative importance in predicting RDA IIA performance could potentially provide highly relevant information regarding future interventions and teaching practices, as well as improving pass rates. Other pre-existing factors, such as gender, age and school performance, were also examined, with the recognition that were these to prove significant in determining RDA IIA performance, their pre-determined nature would make it far more difficult to incorporate these effectively to change performance outcomes on the module.

Chapter Two: Literature review

The importance of research

Internationally it has been noted by many authors that quantitative research skills are vital to the discipline of Psychology as well as to students on an individual level (Lutsky, 2006; Scheaffer & Lee, 2006). As research is in many ways the driving force in any discipline, especially within the social sciences, it seems vital that these skills are taught at a university level so that institutions can drive towards ever greater understanding and an increase in knowledge (National research foundation [NRF], 2005; Woods, 2005). Within the multifaceted and complex world that is the discipline of psychology, research is paramount as the understanding of human behaviour is the basis upon which everything rests. It is for this reason that the teaching of quantitative research skills in psychology has been of so much interest both internationally (cf. Delbeke, 2003; Lutsky, 2006) and within South Africa (cf. Israel et al., 2007; Laher et al., 2007). This, however, is problematic as research skills and statistics courses tend to be challenging for students and often show high failure rates (Murtonen & Lehtinen, 2003). It has also been suggested that they may be inadequately taught within the university context (Delbeke, 2003; Lutsky, 2006).

Within South Africa a similar situation presents itself - research skills are no less important and there is no reason to believe that the courses that are offered are less challenging. In fact, when one considers the fact that the South African context in many ways offers a different environment to the rest of the world and the fact that psychological research may have a role to play in the alleviation of many of the country's problems, its worth is even more evident (Woods, 2005). The challenge of teaching research skills is therefore an important one and one that has been taken up by almost all South African universities, including the Department of Psychology at the University of the Witwatersrand. This Department offers several research-oriented courses at both undergraduate and postgraduate level, the most basic of which is the Research Design and Analysis IIA course offered at the second year undergraduate level (Laher et al, 2007).

The RDA IIA course

While the University of the Witwatersrand offers several courses in quantitative research skills at various levels of study, by far the largest of these is the compulsory second year module 'Research Design and Analysis IIA' (RDA IIA), which registers approximately 400-500 students every academic year (Laher et al., 2007). The RDA IIA course is taught in three sections: statistics, research design and psychometrics (Kriel, 2005). The RDA IIA course, in line with international trends, is challenging and presents with a relatively high failure rate (Laher et al., 2007). It has also been shown to be a good predictor of postgraduate performance within the Discipline (Thatcher & Greyling, 2006).

Due to this and available literature, such as Barraket (2004), on how best to teach students and research students in particular, many steps have already been taken by the Department of Psychology to try to help students to come to terms with the course and the work (Israel, Pitman & Greyling, 2007; Laher et al., 2007). This includes the use of small group teaching, detailed instructional material and practical examples to create an environment for deep learning that is necessary for this type of course (Israel et al., 2007; Laher et al., 2007). The lecture notes and all course materials that are given to students have also been created so that they are in line with the lecture content, goals of the course and the assessments (Laher et al., 2007). Lectures on these topics are then backed up by use of compulsory, weekly tutorials that are taught by the Honours or Masters students from the Psychology Department (Kriel, 2005; Laher et al., 2007). These tutorials use small group teaching and are in place as they give an opportunity for deep learning and present a different teaching environment that is thought to be beneficial by authors in the field and their success has already been demonstrated as pass rates have improved since their inception (Laher et al., 2007). An optional course called "Basic-Maths-for-Stats" is also offered to help students to familiarize themselves with the necessary mathematics needed for the statistics section This is vital as mathematics as a school subject is not a pre-requisite to study psychology at the University of the Witwatersrand (Laher et al., 2007).

Despite the implementation of these teaching practices, it remains the case that some students are successful on the RDA course while others are not, and the reasons for

this remain unclear. There are, however, many factors that might potentially play a role in determining or influencing performance on the course. Many of these are present within the structure of the course itself, such as the practices and interventions discussed above, but others relate more to the students themselves. Each student brings with him/her a unique cocktail of previous experiences, skills and preferences and these may very well influence their performance. To further complicate the situation studies have shown that a more student focussed teaching styles may lead to deeper learning by students and as such the characteristics of the student population and their implications for teaching and learning in South Africa are clear (Lonka, Olkinuora & Makinen, 2004). When one then brings the focus back more specifically then to the matter of the teaching of research skills in general, and of the RDA IIA course, in particular the unique context is evident. Not only is it important for the university, the country and the students themselves to have a course that conveys a good grounding in research methodology but the manner in which to do this necessitates a better understanding of individual student's needs. It is for this reason that this area of investigation, which has only been researched rarely in South Africa, could provide invaluable information for decision makers on the RDA IIA course. The desired outcome is therefore is to create new interventions that may further enrich the learning experience of those registered for the course.

The individual student factors that may important are numerous and varied in what effect they could have and in what could be done to correct for them. Some factors, such as personality or gender, are fixed and cannot or should not be changed. Others, such as intelligence, are not only fixed but may not in fact influence performance at a tertiary level to the extent that one would imagine (Furnham, Chammorro-Premuzic & McDougall, 2003; Neisser et al., 1996; Sternberg, 1996). There are, however, other factors that are present within individual students that may not only affect their performance on the RDA IIA course but could also be accommodated for, changed, taught or worked around in order to improve student performance on the course. This study proposes an examination of four such factors: cognitive learning style, learning strategies, motivation and statistics anxiety. This is in line with many studies that have attempted to explain student performance in terms of individual factors in a variety of contexts, such as distance education (cf. Powell, Conway & Ross, 1990), pharmacy

students (cf. Chisholm, Cobb & Kotzan, 1995) and high school/college environments (cf. Finger & Schlesser, 1965).

It is hoped that a more detailed exploration of these factors and their influence on student performance on the RDA IIA course may shed some light on how best to improve the course for the benefit of the students that take it and therefore the Discipline of Psychology as a whole. Deeper understanding of the role these factors play in determining performance may also lead to more directed and improved interventions that assist students to overcome obstacles relating to a course widely regarded as 'difficult' (Laher et al., 2007). This guidance seems invaluable considering the fact that student diversity over the last 10 years has increased to allow a greater variety of students from a myriad of different backgrounds to enter university (Lindsay, 1997; Shackleton, Riordan, Simonis, 2006). Each of these individuals may respond differently to interventions and may require different teaching contexts in order to perform to the maximum of their abilities.

Cognitive learning styles

Cognitive learning styles quite simply are the distinctive methods that an individual uses in order to process information (Kolb, Boyatzis & Mainemelis, 2000; Sternberg & Grigorenko, 1997). They are an idea that has captivated the attention of researchers and psychologists for many years and whose roots can be traced back to Jung and his work on psychological types in 1923 (Sternberg & Grigorenko, 1997). Since then many models have been proposed and many measures developed that claim to assess cognitive learning styles. On the basis of the models themselves, the number of cognitive learning styles measures has been estimated at almost a hundred (Reid, 2005).

As so many measures are available, it is not surprising that a great deal of research has been conducted in the field of cognitive learning styles using a range of variables such as gender (cf. Severiens & ten Dam, 1994; Park, 2001), curriculum (cf. Chamillard & Karolick, 1999; Ishiyama & Hartlaub, 2003), type of assessment (cf. Lu & Suen, 1995), culture (cf. Singh, 1988; Park, 2001) and teaching style (cf. Singh, 1988). Regardless of what measure they use, common to all of these studies is the

idea that cognitive learning style in some way influences performance on academic tasks. While it must be noted that this is not an assumption that has been supported in all the conducted studies (cf. Skogsberg & Clump, 2003; van Zwanaberg, Wilkinson & Anderson, 2000; Kovacic & Green, 2004), many studies have found at least some support for the influence of cognitive learning styles (cf. Chamillard & Karolick, 1999; Ehrman & Oxford, 1990; Ishiyama & Hartlaub, 2003; Snyder, 2000).

The theory of cognitive learning styles that will be used for this study is that of Felder & Soloman (ND). This model, and its associated scale - the Felder-Solomon Learning Styles Inventory - was chosen for three main reasons: it has a long history of use with more than 100, 000 tests completed every year, it has been used in South Africa before and, despite originally being designed for use with engineering students, it has been used successfully in and been shown to apply to a number of different faculties and areas of study (Litzinger, Lee & Wise, 2005; Sanders & Vally, 2006). Research has also made it clear that there is a large overlap between many of the theories and measures of learning style, therefore it seems sensible to apply a single widely accepted model of cognitive learning styles as representative of the broader field (Reid, 2005).

The Felder-Solomon model conceptualises cognitive learning style as being composed of four elements: sensing-intuitive, visual-verbal, active-reflective, and sequential-global (Litzinger et al., 2005). Each individual is placed somewhere along a scale between the two poles and each of these poles represents a difference in the manner in which individuals process information (Litzinger et al, 2005). Sensing individuals are more oriented towards hard facts and practicality while intuitive individuals are characterized by innovative ways of thinking and a focus on underlying meaning; visual individuals prefer information that is presented in a visual medium such as a picture or flow chart while verbal individuals prefer information to be presented via spoken word or textually; active individuals tend to prefer working through problems from a ‘hands-on’ approach and enjoy group work while reflective individuals tend to be more solitary and prefer to solve problems by thinking them through and reflecting on the different aspects they present; and, lastly, sequential individuals tend to work in a linear fashion and learn in increments while globally inclined learners consider problems as a whole and tend to learn in leaps of insight

(Litzinger et al, 2005; Felder & Solomon, ND). Each of these facets of learning styles might therefore represent an important aspect of how individuals process information and cannot be overlooked when one wishes to identify factors that lead to student performance on a course that has a large amount of challenging content that students must learn and understand. In addition, lecturers often tend to adopt their own learning styles when teaching, and the RDA IIA module may unconsciously reflect the preferred styles of the lecturers teaching the course, as opposed to those of the majority of the students (Henson & Borthwick, 1984).

While some theorists regard cognitive learning style as a relatively fixed feature for each individual, this assumption has been shown to be not entirely correct as cognitive learning style has been shown to change with context (Reid, 2005)**.** Some authors therefore argue that it can be altered and taught (Reid, 2005). Thus if cognitive learning style is found to be an important predictor of performance on the RDA IIA module, it should theoretically be possible to train students in preferred ways of processing the RDA syllabus. In addition, the methods of teaching on the course itself could possibly be adapted to take cognitive learning style differences into account. For example, Singh (1988) suggests the use of different teaching methods and materials in order to compensate for differences in learning style, while Lu and Suen (1995) raise the possibility that cognitive style affects assessment preference and therefore performance and perhaps course assessment should make use of a variety of assessment forms. Reid (2005) suggests a number of ways in which the learning environment can be altered to take a variety of learning styles into account while Felder and Solomon (ND) suggest several ways in which students can study and work by taking their individual learning styles into account.

Learning strategies

The ways in which students process information are obviously important, however other factors, such as how students study and prepare for assessments, could be equally important in determining performance on the RDA IIA module. Learning strategies are concerned with how a student prepares and learns particular information, and may change with context and subject matter (Reid, 2005).

The idea of learning strategies is therefore logically linked to that of cognitive learning styles, as it seems impossible that how an individual prefers to process information is unrelated to what methods they use to learn. They are, however, also very different concepts. Learning strategies are more dependent on context and type of information and tend to vary based on the nature of the material, while cognitive learning styles underpin all learning and tend to be more consistent, even when approaching very different types of learning tasks (Reid, 2005; Sternberg & Grigorenko, 1997). Learning strategies therefore tend to be more flexible and open to change and students can be taught to use different and more appropriate learning strategies based on what they want to achieve (Boudah & O'Neill, 1999). Previous research has shown that learning strategies correlate at least to some extent with assessment preferences (Birenbaum, 1997), with some authors showing several aspects of the potential use of learning and studying strategies (Lonka, Olkinuora & Makinen, 2004). It is worth noting that although some research has found only low correlations between strategy use and performance, some of this research made use of inappropriate instruments or samples, for example, a study by Kivinen (2003) made use of young school children who may not have yet developed effective learning strategies.

The Motivational Strategies for Learning Questionnaire (MSLQ), used in the current study, divides learning strategies into two types: cognitive and metacognitive strategies, such as rehearsal, elaboration, organisation and critical thinking; and resource management strategies, such as time and study environment management, effort regulation, help seeking and peer learning. The nature of the RDA IIA course means that it deals with difficult concepts, large volumes of work and, perhaps most importantly, content that students are in general unfamiliar with. The obvious implication is that students may lack the appropriate strategies to adequately cope with the type and volume of information that they are presented with and could therefore battle to perform well on the RDA IIA course.

The factor of learning strategies is one that is exceptionally important at university level and, in particular, for the more challenging courses on offer such as RDA IIA (Hattie, Biggs & Purdie, 1996). It is also a factor that, if found to be predictive, could be changed and taught if it is deemed necessary. This could be done either in lectures

or as a separate mandatory workshop and could prove to have very positive results in terms of improving student performance or assisting students to cope with the demands of RDA IIA. Hattie et al. (1996) suggest the most effective methods of structuring such interventions focus on active student participation, contextual validity and increasing metacognitive awareness.

Motivation

Motivation is concerned with what drives human beings to achieve a goal or objective. It does not include how an individual goes about completing the tasks that are involved in the achievement of that goal but simply what drives the person to achieve it (Weiten, 2001). Within the field of teaching and learning, the idea of motivation is tied closely to the idea of learning strategies (Weinstein, Goetz & Alexander, 1988; Hidi & Harackiewicz, 2000). Motivation in terms of learning is concerned with a student's willingness to work hard and to apply knowledge or learning strategies (Weinstein, Goetz & Alexander, 1988). A student may therefore have highly effective learning strategies and have a learning style that is very appropriate to a course such as RDA IIA and may still perform badly because they lack the motivation to do otherwise (Hidi & Harackiewicz, 2000). Motivation as a construct within learning is not something that can be thought of as a one-dimensional factor (Pintrich & De Groot, 1990). It is made up of a variety of aspects, all of which play an important role in a student's motivation to learn, study and work.

This being the case, motivation seems to be an important factor to explore in relation to performance on the RDA IIA course. The Motivational Strategies for Learning Questionnaire (MSLQ), used in the current study and previously employed by Pintrich and De Groot (1990) and Kivinen (2003), measures three aspects of motivation that stem from the expectancy-value model of motivation – Expectancy, Value and Affect (Pintrich & De Groot, 1990). The Expectancy component is essentially concerned with students' beliefs of whether they are capable of performing the necessary tasks and whether their performance on the course is as a result of their own actions, while the Value component is concerned with what motivates students to actually do the work for the course (Pintrich & De Groot, 1990). The Value component also examines students' goals for the course, while the Affective

component is concerned with student's emotional responses to the course. Perhaps the most important aspect of this last component, and the only one tapped by the MSLQ, is that of test anxiety (Pintrich & De Groot, 1990).

Previous studies, such as that of Pintrich and De Groot (1990), found that the most predictive motivational factors were aspects of the three main components. Intrinsic value (Value component), self-efficacy (Expectancy component) and test anxiety (Affective component) all nearly uniformly correlated with performance as measured by assignment marks, test marks and overall grade for students. A similar result was found by Kivinen (2003). Other studies have shown the strong influence of motivation in various forms on academic performance and a number of other factors. Richardson (2007) showed that some demographic variables such as gender and previous education led to different scores on the MSLQ motivation subsections and that motivation (Particularly self-efficacy) showed a positive relationship with academic performance.

The RDA IIA course, despite its usefulness and the value that it adds to students' knowledge, is still not the course that students most look forward to at the outset of their undergraduate degrees (Laher et al, 2007)**.** Logically, this occurs for two reasons: firstly, it is difficult and secondly, it does not seem to fit in or conform to what students understand to be psychology (Laher et al., 2007). The difficulty aspect may therefore undermine the expectancy and affective aspects of student motivation on the RDA IIA module, while the lack of obvious relevance may undermine the value component. Motivation therefore seems an important aspect to investigate, as it is one of the more predictive factors found in the literature and could potentially be problematic for the course.

If it is found that motivational factors are an important aspect of RDA IIA, some type of intervention may be necessary in order to convey to students the importance of the material covered and the link between motivation and attitude and success on the course. For example, skills sessions over and above tutorials in which students could be guided through study skills and would have time and opportunity to practice certain elements of the RDA course might help to reduce test anxiety and increase students' feelings of self-efficacy. Finding innovative ways to emphasise the

importance of research skills both in the workplace and in everyday life to students might also be necessary, however it must be noted that finding ways to alter student motivation is notoriously difficult and may require more detailed research (Hidi & Harackiewicz, 2000).

Statistics anxiety

Anxiety has for many years been known to negatively affect performance both within academic and non-academic contexts (Rosenfeld, 1978). Anxiety is characterized by feelings of apprehension or fear towards a particular event, circumstance or even a course such as mathematics and statistics (Weiten, 2001).

Statistics anxiety, feelings of apprehension or fear towards statistically based tasks and theories, has been shown to negatively affect undergraduate performance in general and is closely related to the more general concept of mathematics anxiety (Schacht & Stewart, 1990; Hembree, 1990). Although mathematics anxiety and statistics anxiety each have their own measures, both tap into issues that are most likely to negatively affect students on the RDA IIA module. Many of the students entering the module are unable to distinguish statistics as a field related to but separate from mathematics, have had little experience with mathematics at the school level and did not expect to encounter it again, and are therefore understandably anxious (Laher et al., 2007). This situation is further complicated by the fact that high school mathematics is not a pre-requisite subject to study psychology at the University of the Witwatersrand and the fact that many students may have not been exposed to a statistics course before RDA IIA (Laher et al., 2007). The levels of mathematics and statistics anxiety could therefore be very high among students in RDA as it has been suggested to be in other undergraduate research skills courses and their negative effect could therefore be very large (Bridges, Gillmore, Pershing & Bates, 1998).

If statistics anxiety is shown to be predictive of performance, there are ways in which it can be combated (Hembree, 1990). Logically a first step might be to rethink the voluntary nature of the 'Basic-Maths-for-Stats' programme as this may lead to lower levels of mathematics anxiety, which may reduce the levels of statistics anxiety. The

other option would be an intervention that placed students who showed high levels of statistics anxiety into a programme that allowed them more time to practice statistics outside of normal lecture/tutorial time. This would familiarize them more with statistics, in line with treatment proposed by Hembree (1990), who showed systematic desensitisation to be the most effective treatment for mathematics anxiety. Various other methods such as the introduction of humour into statistics teaching have also been suggested as possible answers to the problem of statistics anxiety (Schacht & Stewart, 1990).

Biographical information

Although the primary focus of this research is to identify non-intellective factors susceptible to intervention that affect RDA IIA performance, it must be recognised that other pre-existing and pre-determined factors such as age, race, gender, home language, area of study (Faculty) and school performance may also predict performance on the RDA IIA module. Although these factors cannot be changed, if any of them prove to be predictive of success in RDA IIA, then further research investigating the reasons for this would become crucial. Furthermore, these factors, while possibly not directly predictive of performance themselves, could possibly affect or even determine other factors such as levels of statistics anxiety and motivation, or types of learning strategies and cognitive learning style, particularly within the South African context where historically these factors have often determined access to resources (Klasen, 1997)**.** Such factors include school marks, age, type of school attended, maths level in matric, gender race and faculty. While the possibility exists that some of these factors may prove to be highly significant in analysis, they will not form a major component of discussion as they are not amenable to change. They may however serve to define the populations on which interventions may be most successful.

Conclusion

The importance of teaching research skills such as statistics and research design is high, not only for students and their future careers in the field of psychology, but also for universities, the country and the field of psychology itself. Every attempt must therefore be made to understand what can be done to improve the understanding and

abilities of students in relation to these skills. The identification of factors that are predictive of success on courses related to this, such as the RDA IIA module in the Department of Psychology at the University of the Witwatersrand, may shed some light on this issue and may have a positive impact on the course itself.

The Current Study

The present study investigated the value of the factors of a school marks, age, cognitive learning style, learning strategies, motivation and stats anxiety in predicting the academic performance of students on the RDA IIA course. The effect of the demographic variables on RDA IIA performance was also investigated. Further, the study investigated if the predictive variables differed across the biographical factors of race, gender, faculty, maths level (higher grade or standard grade) and type of school attended (Government or private).

The purpose of the study was to utilise the information regarding the differences between the groups and the information on the most predictive factors to further inform the interventions that have been put in place on the RDA IIA course. This is an important goal as the fail rates for the RDA IIA course have remained high despite the current interventions (Laher, Israel & Pitman, 2007). This may be due to an increased student diversity and the possibly significant effect of individual factors on RDA IIA performance that may not be appropriately addresses by the intervention that have thus far been implemented.

Chapter Three: Methodology

Sample

The sample consisted of 80 students from the University of the Witwatersrand (age range 19-50, mean age 22) who had completed the RDA IIA course at some point in their university careers. This was a purposive sampling strategy as a particular characteristic within the participants defined their eligibility to be a part of the sample (Babbie & Mouton, 2004).

The sample was predominantly female with only 15% of the sample being male. The sample was also made up primarily of white participants (72% of the sample). The majority of the participants were from the Faculty of Arts (63% of the sample). The question was language of instruction in high school conveyed very little information as all except one participant indicated that they were taught in English. The distribution of the sample with regards to the type of school attended (government or private) was roughly equal with 53% of the sample having attended a private school and 47% having attended a government school.

Table 1- Sample Demographics

	Race						Faculty			
	Sample size	Coloured	White	Black	Indian	Asian	Arts	Science	Commerce	Other
Male	11	0	9	2	0	0	7	4	0	0
Female	69	2	48	9	9	1	44	15	3	7
Total	80	2	57	11	9	1	51	19	3	7

The sample was obtained by approaching second year, third year and Honours level Psychology classes at the end of lectures. After a brief explanation of the research and a discussion of what participation would require the questionnaires were left near the door for the students to collect as they exited the room. It was conveyed to students that only those who had completed the RDA IIA course were eligible to participate. The sampling technique was therefore purposive in nature (Babbie & Mouton, 2001).

Instruments

The study made use of four instruments: a brief self-developed biographical questionnaire, the Motivational Strategies for Learning Questionnaire (MSLQ), the Felder-Solomon Learning Styles Inventory (LSI) and an adapted scale of statistics anxiety.

Biographical Questionnaire

The biographical questionnaire (please see Appendix B) asked for demographic information to be used for the purposes of describing the sample as well as addressing the second research question. Information requested included age, gender, race, Faculty, type of school attended, language of instruction and marks obtained for Matric in English, Mathematics and overall. In addition, students were asked to provide their student number and information about when they registered for the RDA IIA module in order for their RDA IIA mark to be obtained. It was made clear in the initial approach, the participant information sheet and the biographical questionnaire itself that this was entirely voluntary and that only their mark for the single RDA IIA module was to be obtained.

The Motivational Strategies for Learning Questionnaire (MSLQ)

The Motivational Strategies for Learning Questionnaire (MSLQ) (please see Appendix C) is a questionnaire that aims to identify both students' motivational beliefs and their learning strategies. It is a self-report measure containing 81 items scored on a five point Likert-type scale ranging from 1 (not at all true of me) to 5 (very true of me) (Kivinen, 2003). It is divided into two subscales: the Motivation subscale and the Learning Strategies subscale. These subscales are then further divided into subsections and each of these subsections is made up of a set of specific elements (please see Figure 1 below) (Kivinen, 2003).

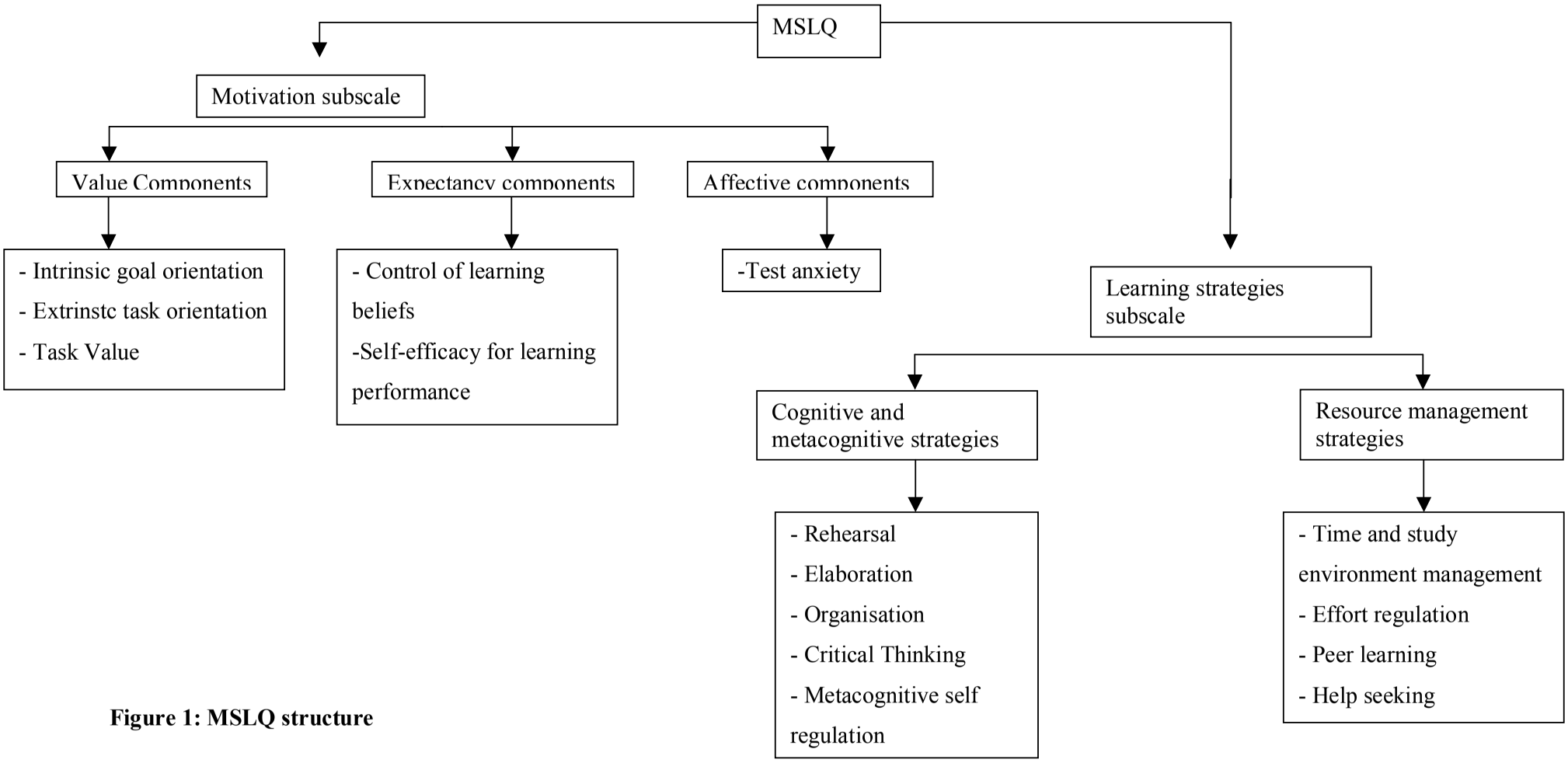

Figure 1: MSLQ structure

Internal consistency scores for the MSLQ range from 0.45 to 0.91 for the subsections (Kivinen, 2003). The validity of the scale is in the form of correlations with final grades. The separate elements were correlated with grade and show trends in the correct directions as defined in literature and by common sense. Correlations varied from -0.27 for test anxiety to 0.32 for effort regulation (Kivinen, 2003).

The Felder- Solomon Learning Styles Inventory (LSI)

The Felder- Solomon Learning Styles Inventory (LSI) (please see Appendix D) was designed to measure the preferences that students have for the dimensions of the learning style model proposed by Felder and Soloman (Litzinger, Lee, Wise & Felder, 2005). The scale consists of four scales: sensing- intuitive, visual-verbal, active-reflective, and sequential- global (Litzinger et al., 2005). Each of these subscales has 11 items, the items are dichotomous and scoring gives a score between 0 and 11 on each subscale. This then places the individual somewhere between the two poles of that subscale (Zywno, 2003).

The LSI has been used extensively in research and the online version in the past has been completed more than 100, 000 times per year (Litzinger et al., 2005). It has also been used in the South African context (Sanders & Vally, 2006). Data from five different studies place the Cronbach's Alpha Coefficients for each subscale somewhere between 0.41 and 0.76 (Felder & Spurlin, 2005). The LSI therefore shows reliability at least as good as many of the cognitive learning style measures. The factor structure, while logical, does not exactly match the subscales (Litzinger et al., 2005). However, some validity has been shown by the ability of the LSI to show expected differences between students from different faculties and majors (Felder & Spurlin, 2005). Some authors have raised concerns over the reliability and validity of the LSI and this is an obvious limitation of its use (Markham, 2000). The same concerns are, however, true of all the measures of cognitive learning style and may therefore be a product of the difficulty in defining and operationalising the concept.

The Statistics Anxiety Scale

The Statistics Anxiety Scale (please see Appendix E) that was used was a modified version of the Mathematics Anxiety Rating Scale developed by Richardson and Suinn (1972). This was modified by Pitman and Fisher (2000) for use in the context of the RDA IIA programme. The changes made were threefold: firstly the items that were related more to test anxiety than to maths anxiety were removed, secondly the language was adapted to be more appropriate for the South African context and, thirdly, the concept of statistics was substituted for mathematics.

The adapted scale is a 27-item scale that is scored on a five point Likert-type scale ranging from 'not at all' to 'very much'. The scale is scored by adding the scores for every item to generate a total. The higher the total, the higher an individual's level of statistics anxiety is. A pilot study conducted on 166 RDA IIA students in 2000 yielded a Cronbach's Alpha co-efficient of 0.96 (Pitman & Fisher, 2000).

Procedure

After the University Ethics board had granted ethical clearance and the researcher had obtained permission from the course coordinators for the second year, third year, Honours and part-time programmes in the Psychology Department of the University of the Witwatersrand to approach students at these levels (please see Appendix F), the research began. A suitable time to approach the classes was decided upon with the individual lecturers that were teaching at the time when the study commenced.

The researcher approached the classes and briefly explained that the goal of the research was to examine the relationship between a set of student factors and RDA IIA performance. Where it was unethical for the researcher to approach a class, this approach was made by a third party to whom no such ethical considerations were applicable.

The students who then chose to participate were given a questionnaire pack containing a participant information sheet (Appendix A), the biographical questionnaire (Appendix B), the MSLQ (Appendix C), the LSI (Appendix D) and the Statistics Anxiety Scale (Appendix E). Participants were informed that the pack

should take roughly an hour and a half to complete and were asked to complete the questionnaire pack at home and return it to a box placed in their classroom during selected lectures for three weeks after the initial distribution. An additional box was placed in the main psychology office during the study in order to allow participants to return questionnaires there should they prefer it.

Each pack was assigned a random participant number in order to identify it. The only information linking a specific pack to a specific participant was the student number sheet on the first page of the biographical questionnaire. In order to protect the confidentiality of the participants these sheets were removed from the packs and a third party collated the marks and assigned them to a participant number. This was done by creating an Excel spreadsheet with the participant and student numbers and having the independent third party link the RDA IIA marks to the student number and then delete the student number column. Once this had been done the student number sheets were destroyed. At no point did the researcher have access to the student numbers, the participant numbers and the marks for the participants. This was in order to ensure that the researcher could not know to whom which mark belonged.

Ethics

Ethical clearance for this study was granted by the University of the Witwatersrand HREC Ethics Committee (clearance number: H070613).

Participants were provided with a participant information sheet detailing the requirements of the study and their ethical rights (see Appendix A). During the research, the participant information sheets were detached from the pack and kept by the participants. They contained contact details for the researcher and the supervisor, as well as the conditions of participation. As such they explained that neither participation nor providing RDA marks was mandatory, that participants had the right to withdraw at any time and to continue without providing their student number, and described the procedure for how the marks were collected and that this was in place to protect the participants' confidentiality.

The study's main ethical concern stemmed from the fact that students were asked to disclose their student numbers so that RDA IIA marks could be obtained. This was tackled in three ways: questionnaires were numbered with a participant number and distributed in a random order so that no student could later be identified, permission was asked before marks were looked at by the experimenter and the marks were assigned to the random participant number each student was assigned by someone other than the experimenter, so that the experimenter never had direct access to a participants' marks and student number. The student number sheets, which contained the participant number and student number, were destroyed once the marks had been captured for every person in the sample.

The other issue of concern was the researcher's role as a tutor in the RDA IIA programme. The researcher was therefore in a position of power in relation to the current RDA class and could not approach them directly for fear of seeming coercive. The class was therefore initially approached by a neutral party who asked all those who were interested to stay behind. The researcher then addressed those that chose to stay.

As outlined by the participant information sheet, no individual feedback was given to participants but once the study has been completed a one-page summary of the general findings of the study will be placed on the RDA IIA notice board, a central location with which all students who took part would be familiar. Participants who wanted to receive a longer version of the findings were informed in the participant information sheet that they could do so by emailing the researcher at the email address provided on the information sheet and requesting such feedback.

As the information collected was generally not of a highly sensitive nature, no harm to the participants was expected and none was reported during the course of the study. There were no direct benefits for participation and it was emphasized that participation was entirely voluntary and that participants could withdraw at any time until submitting the completed questionnaire pack with no negative consequences. The return of the pack was anonymous.

Data analysis

Suitable statistical analyses were used to answer the research questions asked in the study. Prior to carrying out these analyses, it was necessary to first establish whether the data was suitable for parametric analysis and whether the instruments used in the study (the MSLQ, Felder-Solomon LSI and adapted Statistics Anxiety Scale) were reliable and valid.

Checks on parametric assumptions

The study intended to use parametric statistical techniques such as ANOVA, t-tests, regression and correlations to analyse the data obtained and answer the research questions. Prior to running the analyses, however, it was necessary to check that the data met the criteria for conducting parametric statistical analyses.

The first assumption for running parametric statistical analyses is that dependent variables should produce interval-scaled data. The measures used were either based on 5-point Likert type scales (as in the case of the MSLQ and the Statistics Anxiety Scale), or were based on a dichotomous forced choice scale (as in the case of the Felder-Solomon Index of Learning Styles). The Felder-Solomon LSI scale produces values on four subscales each made up of 11 items. It can therefore be assumed that the data is interval in nature due to the number of items. The MSLQ subsections have a minimum of 4 items each and, as such, the subsections, subscales and the total scale presumably have at least an interval scale of measure as well. The Statistics Anxiety Scale uses only the total score based on all 27 items, therefore this value is also assumed to be interval. The data from each measure was therefore considered to be interval in nature and the parametric criterion met.

The second parametric assumption is that the data must be normality distributed. Scores obtained from the MSLQ, Felder-Solomon LSI and Statistics Anxiety Scale, as well as RDA IIA marks and Matric marks, were checked for normality. This was done by creating a histogram for each variable, as well as by running Kolmogorov-Smirnov tests for normality (please see Appendix F). The data for RDA IIA marks and MSLQ scores showed clear patterns of normality. Statistics anxiety was negatively skewed. The Felder-Solomon LSI active-reflective subscale was bimodal, while the remaining

subscales were negatively skewed. In none of the distribution analyses was the Kolmogorov-Smirnov D value in excess of 1 or –1, and as such, the data was assumed to have an acceptable level of normality for parametric analysis.

The third assumption for parametric statistics is that variance between the groups is equal (this assumption is not necessary for regression and correlation). This was tested by running Levene's tests for each t-test and ANOVA. In most of the cases the data showed equality of variance, and where this was not true, it has been stated and the appropriate non-parametric equivalent test used.

The fourth assumption for parametric analysis is that the sample is both random and independent. Within the present study a purposive sampling technique was used in order to obtain an appropriate sample, therefore the study does not meet this criterion. It should, however, be noted that due to ethical constraints such as informed consent and the impracticality of random selection, it is extremely difficult to obtain a random, independent sample in a psychological research study. As is common in psychology, however, this criterion was assumed to have been met in order to allow for statistical analysis (Welman & Kruger, 2001).

Based on this assessment of the parametric criteria, it was considered appropriate to carry out parametric analyses (except where otherwise indicated) to analyse the data.

Reliability and validity of instruments used in the study

Although in some cases the measures used in this study had been used extensively in research conducted internationally and to a lesser degree in South Africa, this did not necessarily mean that they remained valid and reliable in the South African context or for the present study. Reliability and validity checks were therefore particularly necessary.

Cronbach's Alpha Coefficients were calculated for the subscales of each of the scales used in the study. These are used to check the degree to which the scale items are related to one another, and as such, as a check on the internal consistency reliability of the measures (Cohen & Swerdlik, 2005; Howell, 1999). Values above 0.7 are

considered acceptable and values above 0.8 are considered good (Cohen & Swerdlik, 2005).

Principal components factor analyses with varimax rotations were also run on each of the scales. These aim to identify the underlying constructs that the measures tap, and, as such, are used as a check on the validity of the measures in question (Howell, 2001). Four methods were used to decide on the number of factors retained in each factor analysis: the Eigen values, the scree plot, the total variance explained and the theoretical number of factors the scale should have had. Factors with eigen values higher than one were retained, although this is generally an overestimation. The scree plot shape was also used to suggest the number of factors to be retained, although this is generally an underestimation. The total variance explained was used to retain factors that explained 50-60% of the variance or higher (the minimum amount was dependent on the number of items in the scale).

As seen in the results presented below, all the instruments except the Felder-Solomon LSI were found to have acceptable levels of reliability and validity.

Establishing the most predictive factors

The first major question under investigation in the study was concerned with establishing which of the factors measured were most predictive of RDA IIA performance. This was answered using correlations and a set of forward stepwise regressions.

Pearson's correlation coefficients were run between RDA IIA marks and the data obtained from the Felder-Solomon LSI, the MSLQ, the Statistics Anxiety Scale and biographical data that was appropriate (age, school marks obtained in Matric). The purpose of these correlations was to give some indication as to the nature of the relationship between the variables in the study and RDA IIA performance.

The correlations gave an indication of the relationship between the individual variables and the RDA IIA marks but failed to take several variables into account at the same time. A set of stepwise regressions were therefore run in order to further

gauge the nature, direction and strength of the variable-RDA IIA relationship. A stepwise procedure was used as it allows for the inclusion of only those factors that explain a significant proportion of the variance in the RDA IIA marks over and above the variables that precede them in the analysis (Howell, 2001). The regressions were run with the RDA IIA marks as the DV in each case and the IV's as follows: demographic variables, MSLQ subscales and total, MSLQ subsections, Felder-Solomon LSI subsections, Statistics Anxiety Scale, all of the scale data (where the term scale data refers to the data generated from all of the scales used in the study), all of the scale data and finally all of the data from the study. The strength of the relationship in each case could be estimated using the R-Squared value. The R-Squared value represents the proportion of variance in the DV that is explained by variance in the IV (Howell, 2001).

Aside from the correlations and stepwise regressions, several ANOVA's and t-tests were run in which the demographic variables were used as the IV and RDA IIA marks were used as the DV. The following variables were used as IV's: race, faculty, gender, type of school attended and maths level in Matric. These tests were performed to establish whether RDA IIA marks differed significantly between the groups for any of these demographic variables thereby indicating possibly problematic groups. The report only presents those results that were significant.

Establishing differences in predictive factors across groups

The second major question under investigation in the study was concerned with investigating if the four proposed predictive variables (cognitive learning style, learning strategies, motivation and statistics anxiety) differed across the biographical factors of race, gender, faculty, maths level (higher grade or standard grade) and type of school attended (government or private).

In order to answer this question several ANOVA's and t-tests were run in which the demographic variables were used as the IV and the proposed predictive variables were used as the DV. The following variables were used as IV's: race, faculty, gender, type of school attended and maths level in Matric. These tests were carried out to establish

whether the predictive factors showed different levels across the demographically defined groups. The report only presents those results that were significant.

Establishing the relationship between school marks and the study variables

A further analysis was carried out in order to establish the nature of the relationship between the data generated by the scales used in the study (i.e. the four proposed predictive variables) and the participants' Matric marks by calculating Pearson's correlation coefficients. Further Pearson's correlation coefficients were also calculated between the three different Matric marks in order to assess the degree of similarity between them. While these two sets of analysis do not seem to seem to relate to either research question at first glance, they emerged as necessary during the course of the study due to the highly significant relationship between school marks and RDA IIA marks.

Significance level

In the analyses that were run for the present study the significance level was always assumed to be 0.05 or 5%. This was true for the ANOVA's, t-tests, entry into the regression models and the Levene's tests. The stepwise regression model utilised a significance level of 0.5 for inclusion in the analysis and thereafter a significance level of 0.10 for the factor to remain in the model.

Software

All statistical analysis was conducted using SAS version 9.1 and enterprise guide version three. SAS is a statistical analysis program that allows for coded data to be imported from Microsoft excel, as was the case in this study, and other database/spreadsheet programs and analysed using a variety of statistical tests.

Chapter Four: Results

The present study had two main areas of investigation - the first focused on which variables were most predictive of RDA IIA performance and the second evaluated to what extent these factors differed between the different groups as defined by the demographic variables. The analyses which follow attempted to answer these questions. The question of which factors were most predictive of RDA IIA mark was focused on in the scale data/demographic data-RDA IIA mark correlations, the scale data/demographic data-RDA IIA mark regression analyses and the ANOVA's/t-tests in which RDA IIA marks were the DV. The second question was investigated through the use of ANOVA's and t-tests run for the variables of race, faculty, gender, school type attended and maths level in Matric with the four proposed predictive variables as the DV. Other analyses are present but they feed into the analyses for the areas of investigation and are not the main focus of the study.

The results section is split into different sections on the basis of what type of analyse they contain: summary statistics, reliability and validity of instruments, correlations, regressions, ANOVA's and t-tests.

Summary Statistics

Table 2 presents the basic summary statistics obtained for each of the variables measured in the study and used to answer the research questions.

Table 2- Summary Statistics					
Variable	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**N**
RDA IIA marks	65.56	16.31	13	100	73
Maths Matric	64.44	14.15	40	92	64
English Matric	73.93	9.16	50	92	67
Overall Matric	70.02	9.34	50	90	60
Statistics anxiety	60.03	20.34	29	112	80
Sensing intuitive	15.73	2.97	10	22	80
Visual verbal	15.45	2.77	7	20	80
Sequential global	15.41	2.36	4	20	80
Active reflective	17.078	1.98	12	22	80
Motivation	21.30	2.66	12.54	28.5	80
Learning strategies	29.86	4.33	18.89	39.86	80
Total of MSLQ	51.16	5.85	37.83	66.63	80

Reliability and Validity of Instruments

The following section contains the analyses run to establish the reliability and validity of the instruments used in the study before other analyses were run to address the research questions.

MSLQ
Cronbach's Alpha

As seen in Table 3, the calculated Cronbach's Alpha Coefficients for the MSLQ in the present study were 0.86 for the motivation subscale of the test, 0.89 for the learning strategies subscale of the test and 0.91 for the complete scale. The subsections of the test showed the following Cronbach's Alpha values:

Table 2- Cronbach's Alpha Coefficients for the MSLQ subsections			
Section	**Alpha**	**Section**	**Alpha**
Total Scale	**0.91**	**Learning strategies**	**0.89**
Motivation	**0.86**	**Cognitive & metacognitive strategies**	**0.89**
Value component	**0.82**	Rehearsal	0.75
Intrinsic motivation	0.56	Elaboration	0.68
Extrinsic motivation	0.65	Organisation	0.74
Task Value	0.78	Critical thinking	0.85
Expectancy	**0.89**	Metacognitive self regulation	0.68
Learning beliefs	0.65	**Resource management strategies**	**0.56**
Self-efficacy	0.92	Time and environment	0.53
Affective component	**0.76**	Effort regulation	0.55
Test anxiety	0.76	Peer learning	0.73
		Help seeking	0.55

The Cronbach's values for the total scale and the subscales were excellent, while the components generally showed good values with the exception of the resource management component. The subsections, however, showed erratic values with some good to excellent and some poor. This may have been due, in part, to the small number of items that make up each subsection. Overall, the internal consistency reliability of the scale could be considered at least adequate, possibly tending towards good.

Factor analysis

Due to the fact that the sample size was only 80 the factor analysis was run using the motivation and learning strategies subscales separately in an attempt to maintain the suggested minimum ratio of at least two participants for every item (Howell, 2001). In the case of the learning strategies subscale this could not be achieved, as the number of items was 49. This small sample size regrettably means that the results for the learning strategies factor analysis must be interpreted with caution.

Motivation

The motivation subscale is made up of 31 items and 6 subsections. A factor analysis was run on all the items and a varimax rotation was used.

The Eigen values for the factors suggested that 9 factors should have been retained. The scree plot suggested that 6 factors should have been retained. Since the scree plot value was in line with what was expected and as it was seen that 6 factors explained 0.64% of the variance, 6 factors were used. The following loadings were found:

Table 3- Factor structure for the motivation subscale of the MSLQ											
Scale	Item	Subscale	Subsection	Factor	Not loaded	Scale	Item	Subscale	Subsection	Factor	Not loaded
1	1	Motivation	Intrinsic goal orientation	1		4	18	Motivation	Control of learning beliefs	2	
1	22	Motivation	Intrinsic goal orientation	2		4	25	Motivation	Control of learning beliefs	1	
1	16	Motivation	Intrinsic goal orientation	5		5	5	Motivation	Self -Efficacy	1	
1	24	Motivation	Intrinsic goal orientation	5		5	6	Motivation	Self -Efficacy	1	
2	7	Motivation	Extrinsic goal orientation	4		5	12	Motivation	Self -Efficacy	1	
2	11	Motivation	Extrinsic goal orientation	4		5	15	Motivation	Self -Efficacy	1	
2	13	Motivation	Extrinsic goal orientation	4		5	20	Motivation	Self -Efficacy	1	
2	30	Motivation	Extrinsic goal orientation	4		5	21	Motivation	Self -Efficacy	1	
3	26	Motivation	Task Value	1		5	29	Motivation	Self -Efficacy	1	
3	4	Motivation	Task Value	2		5	31	Motivation	Self -Efficacy	1	
3	10	Motivation	Task Value	2		6	3	Motivation	Test Anxiety	3	
3	23	Motivation	Task Value	2		6	8	Motivation	Test Anxiety	3	
3	27	Motivation	Task Value	2	X	6	14	Motivation	Test Anxiety	3	
3	17	Motivation	Task Value	5		6	19	Motivation	Test Anxiety	3	
4	2	Motivation	Control of learning beliefs	6		6	28	Motivation	Test Anxiety	3	
4	9	Motivation	Control of learning beliefs	6							

The extrinsic motivation, test anxiety and self-efficacy subsections were seen to hold together to at least some extent, all loading on their own factor. Task value loaded, in part, on a solitary factor but one of its items did not load at all suggesting that it should perhaps have been altered. The problematic areas of this factor solution seemed to be with the intrinsic motivation and control of learning beliefs subsections. Each of them showed two items loading onto a single factor. This seemed to suggest that these items are in fact tapping the suggested variable, but the remaining 2 items from both loaded with either task value or self-efficacy. This is in some ways not surprising as the idea of self-efficacy and task value seem to be logically connected to both intrinsic motivation and control of learning beliefs. The factor structure of the motivation subsection was therefore seen to be passable but not perfect.

Learning Strategies

The learning strategies subscale is made up of 49 items and nine subsections. Since the ratio of two participants per item could not be maintained on this subscale the information should be treated with some caution.

The Eigen values suggested 15 factors should have been retained, the scree plot suggested that nine factors should have been retained. Since the scree plot values coincided with the number of subsections, nine factors were retained. This was further backed up by the fact that the cumulative total for nine factors was 0.60. The following loadings were found:

Table 4- Factor structure for the learning strategies subscale of the MSLQ											
Scale	**Item**	**Subscale**	**Subsection**	**Factor**	**Not loaded**	**Scale**	**Item**	**Subscale**	**Subsection**	**Factor**	**Not loaded**
7	39	Strategies	Rehearsal	2		11	79	Strategies	Metacognitive self-reg	4	
7	46	Strategies	Rehearsal	2		11	36	Strategies	Metacognitive self-reg	6	X
7	59	Strategies	Rehearsal	2		11	78	Strategies	Metacognitive self-reg	7	
7	72	Strategies	Rehearsal	2		11	55	Strategies	Metacognitive self-reg	8	
8	53	Strategies	Elaboration	3	X	11	33	Strategies	Metacognitive self-reg	9	X
8	62	Strategies	Elaboration	3		11	61	Strategies	Metacognitive self-reg	9	
8	64	Strategies	Elaboration	3		12	43	Strategies	Time and environment	2	
8	69	Strategies	Elaboration	3		12	70	Strategies	Time and environment	5	
8	81	Strategies	Elaboration	3		12	77	Strategies	Time and environment	5	
8	67	Strategies	Elaboration	6		12	35	Strategies	Time and environment	7	
9	63	Strategies	Organisation	2		12	52	Strategies	Time and environment	7	
9	49	Strategies	Organisation	6		12	65	Strategies	Time and environment	7	
9	32	Strategies	Organisation	7	X	12	80	Strategies	Time and environment	7	X
9	42	Strategies	Organisation	9		12	73	Strategies	Time and environment	9	X
10	66	Strategies	Critical thinking	3		13	60	Strategies	Effort regulation	2	
10	71	Strategies	Critical thinking	3		13	74	Strategies	Effort regulation	7	
10	47	Strategies	Critical thinking	4		13	37	Strategies	Effort regulation	8	
10	51	Strategies	Critical thinking	4		13	48	Strategies	Effort regulation	9	
10	38	Strategies	Critical thinking	8		14	45	Strategies	Peer learning	1	
11	54	Strategies	Metacognitive self-reg	1		14	50	Strategies	Peer learning	1	
11	57	Strategies	Metacognitive self-reg	1		14	34	Strategies	Peer learning	2	
11	76	Strategies	Metacognitive self-reg	1		15	40	Strategies	Help seeking	1	
11	41	Strategies	Metacognitive self-reg	2		15	68	Strategies	Help seeking	1	
11	44	Strategies	Metacognitive self-reg	4		15	75	Strategies	Help seeking	1	
11	56	Strategies	Metacognitive self-reg	4		15	58	Strategies	Help seeking	8	

The factor analysis showed, problematically, that seven items did not load on any factors. These items would need to be reviewed as to the reason for this. In terms of the factor structure, rehearsal and elaboration are the only subsections that seemed to generally hold together.

The time and environment subsection seemed to be tapping two separate factors - an examination of the items seems to show some were more geared towards the time aspect (items 70 and 77), while some were geared towards place, environment and organisation (items 35, 52 and 65). Item 80, despite not loading, had its highest loading on the same place, environment and organization factor. Item 73 appeared to be focused more on class activity and less on studying - it did not fully load but had its highest loading on factor 9 along with items 48, 61, 42 and 33 which all seemed to have some aspect of class or course focus (see Appendix C).

The help seeking and peer learning subsections generally loaded on one factor and as such should perhaps be combined. This is especially true as the two factors may be related, in that the notion of asking for help seems to be related to the notion of asking others for help, or "peer learning".

The critical thinking subsection loaded on both factor 3 and factor 4. Factor 3 includes most of the elaboration items and it may be that critical thinking and elaboration loaded together as they are similar concepts. Further it appeared that factor 4 is a purely critical thinking factor.

The most problematic subsections were metacognitive self-regulation, effort regulation and organization. These sections all loaded together on a number of factors. This was especially true of metacognitive self-regulation as it loaded on all seven different factors. There is some suggestion from this that these three factors in general and metacognitive self-regulation in particular may be difficult to define, and therefore to measure, accurately. They may therefore be present in those who participated but these factors may underlie, or be inexorably bound to, the other factors that have been measured.

On the basis of the results above, the factor structure for the learning strategies was not ideal since some of the factors seem to be loading on more than one factor or not loading at all. Despite this fact there was some evidence for the cohesiveness of the scale in that the subsections generally loaded as expected. The problematic loading may have been due, in part, to the sample size being smaller than expected or due to a different interpretation of the questions by a South African population.

Felder-Solomon Index of Learning Styles
Cronbach's alpha

The LSI items were dichotomously scored and as such the appropriate measure of internal consistency were Kuder-Richardson values. The interpretation of the values is the same as the interpretation of Cronbach's alpha coefficients.

Table 5- Cronbach's alpha coefficients for the Felder-Solomon index of learning styles

Subscale	Kuder-Richardson
Active-Reflective	0.49
Sensing-Intuitive	0.78
Visual-Verbal	0.67
Sequential-Global	0.49

The internal consistency of the measure was questionable as two of its subscales showed values of 0.49 with the remaining subscales showing values that were appropriate or at least approaching appropriate. These values are not encouraging and as such the reliability of this measure is limited.

Factor Analysis

The Eigen values generated suggested that 17 factors should have been retained, while the scree plot suggested that 10 factors should have been retained. In order to satisfy both of these criteria, as well as the criterion of variance explained, 11 factors, explaining 60% of the variance, were retained.

Table 6- Factor structure for the Felder-Solomon LSI							
Scale number	**Item**	**Subscale**	**Factor**	**Scale number**	**Item**	**Subscale**	**Factor**
1	2	Sensing-Intuitive	8	**3**	4	Sequential-Global	None
1	6	Sensing-Intuitive	2	**3**	8	Sequential-Global	3
1	10	Sensing-Intuitive	4	**3**	12	Sequential-Global	None
1	14	Sensing-Intuitive	None	**3**	16	Sequential-Global	5
1	18	Sensing-Intuitive	2	**3**	20	Sequential-Global	None
1	22	Sensing-Intuitive	9	**3**	24	Sequential-Global	3
1	26	Sensing-Intuitive	None	**3**	28	Sequential-Global	5
1	30	Sensing-Intuitive	9	**3**	32	Sequential-Global	10
1	34	Sensing-Intuitive	8	**3**	36	Sequential-Global	None
1	38	Sensing-Intuitive	2	**3**	40	Sequential-Global	None
1	42	Sensing-Intuitive	3	**3**	44	Sequential-Global	5
2	3	Visual-Verbal	6	**4**	1	Active-reflective	4
2	7	Visual-Verbal	1	**4**	5	Active-reflective	4
2	11	Visual-Verbal	1	**4**	9	Active-reflective	None
2	15	Visual-Verbal	7	**4**	13	Active-reflective	11
2	19	Visual-Verbal	6	**4**	17	Active-reflective	7
2	23	Visual-Verbal	None	**4**	21	Active-reflective	3
2	27	Visual-Verbal	1	**4**	25	Active-reflective	4
2	31	Visual-Verbal	1	**4**	29	Active-reflective	1
2	35	Visual-Verbal	None	**4**	33	Active-reflective	None
2	39	Visual-Verbal	None	**4**	37	Active-reflective	11
2	43	Visual-Verbal	11	**4**	41	Active-reflective	4

An examination of the above factor structure showed that while some of the items for each scale loaded on the same factor, the remaining items loaded on a number of disparate factors or not at all. Further there were a large number of factors that loaded on no factor at all. This factor structure therefore showed that none of the subscales held together in a meaningful manner. The validity of the measure is therefore questionable.

It should however be noted that the suggested ratio of 2 participants per item could not be maintained for this factor analysis and as such the results should be interpreted with caution.

Statistics anxiety scale
Cronbach's alpha

The statistics anxiety scale showed a Cronbach's alpha coefficient of 0.96. This is excellent and suggests that the measure shows good internal consistency reliability.

Factor analysis

The Eigen values suggested 5 factors be retained while the scree plots suggested 1 factor be retained. The cumulative total using only 1 factor was nearly 0.5 and as such a one-factor solution seemed to be the most appropriate.

The Statistics Anxiety Scale therefore seemed to measure only a statistics anxiety factor. This factor structure suggests that the validity of the scale is good.

Conclusions

As has been noted above several times, the sample size in the present study was 80 participants. The result of this is that the preferred ratio of two participants per item could not always be maintained. This is problematic in terms of the interpretation of the factor analysis as it means that these results must be interpreted with caution. The decision was made to include the factor analysis despite these limitations for two reasons:

- The instruments used have a limited history of use in South Africa, and, as such, their validity in the South African context needed to be determined for not only this study but South African research in general;
- While the results of the analysis must be interpreted with caution, the sample size is large enough that such analysis was not without merit.

On the basis of the analyses reported above it was concluded that while the MSLQ and Statistics Anxiety Scale showed good to excellent internal consistency reliability and decent levels of validity, the Felder-Solomon LSI did not. As a consequence of this the analyses based on the Felder-Solomon data in the sections which follow should be interpreted with caution as there is no solid evidence that it measures what it claims to measure or that it can do so in a consistent manner.

Correlations

The following section reports three sets of correlations: the correlations calculated between the scale/demographic data and RDA IIA marks (research question one), the correlations calculated between the scale data and the Matric results (research question two) and the correlations between the three sets of Matric results (research question two).

RDA IIA

Table 8 contains the Pearson's correlation coefficients calculated between final RDA IIA marks and the variables in the study. This was done in order to determine if any relationship was present between the variables and the final RDA IIA marks.

Table 7- Pearson's correlation coefficients for the scale/demographic data with RDA IIA marks								
Variable	**RDA**	**P**	**Variable**	**RDA**	**P**	**Variable**	**RDA**	**P**
Maths mark in matric	0.50977	<.0001	Test anxiety	-0.21393	0.0692	Help seeking	0.09872	0.406
English mark in matric	0.42796	0.0005	MSLQ-Learning strategies subscale	0.11604	0.3283	Stats anxiety	-0.33235	0.0041
Overall mark in matric	0.68564	<.0001	Cognitive and metacognitive strategies	0.09345	0.4316	Felder-Sensing intuitive	-0.02679	0.822
Age	0.19425	0.102	Rehearsal	-0.09869	0.4061	Felder-Visual verbal	-0.12414	0.2954
MSLQ-Motivation subscale	0.32699	0.0047	Elaboration	0.18769	0.1118	Felder-Sequential global	-0.03713	0.7551
Value component	0.2561	0.0287	Organisation	-0.02853	0.8106	Felder-Sequential global	-0.03713	0.7551
Intrinsic	0.24022	0.0407	Critical thinking	0.17249	0.1445	Felder-Active reflective	0.16099	0.1736
Extrinsic	0.12258	0.3015	Metacognitive self regulation	0.16339	0.1672			
Task value	0.24313	0.0382	Resource management	0.10884	0.3593			
Expectancy component	0.47357	<.0001	Time and environment	-0.10412	0.3807			
Control of learning beliefs	0.22616	0.0544	Effort regulation	0.21054	0.0738			
Self efficacy	0.52741	<.0001	Peer learning	0.06636	0.577			

An examination of the correlations above shows that the following variables were significantly correlated with RDA IIA marks: English Matric marks, Maths Matric marks, overall Matric marks, intrinsic motivation, task value, self efficacy, the motivation subscale of the MSLQ and statistics anxiety.

The correlations for the Matric marks all show moderate-strong, positive correlations of 0.43, 0.51 and 0.69 for English, Maths and overall respectively. The relationship is positive as expected and shows that better school performance is related to better RDA IIA performance.

Extrinsic motivation, task value, self-efficacy and the motivation total are all values obtained from the MSLQ. Intrinsic motivation and task value show similar correlation coefficients of 0.24. These are therefore weak-moderate, positive correlations suggesting some positive relationship between these variables and RDA IIA marks. The positive nature of the relationship implies that higher levels of intrinsic motivation and greater perceived task value of RDA IIA are related to higher RDA IIA marks. The motivation total shows a moderate positive correlation of 0.33, implying that the higher levels of motivation are generally associated with higher RDA IIA marks. The most significant of the MSLQ subsections was the self-efficacy subsection, which showed a moderate-strong, positive correlation of 0.53, implying that higher levels of self-efficacy are generally associated with higher RDA IIA marks.

Finally statistics anxiety shows a moderate, negative correlation of –0.33, thus implying that lower levels of statistics anxiety are generally related to higher RDA IIA marks. This was as expected at the commencement of the study.

Predictive variables vs. Matric marks

The following correlation analysis was run in order to establish if the Matric marks showed any relationship with the scale data, in particular the scale data that was shown to be predictive of RDA IIA marks in the sections that follow

Table 8- Pearson's correlation coefficients for the scale data with Matric marks

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0							
Variable	Maths	English	Overall	Variable	Maths	English	Overall
Intrinsic motivation	0.13175 0.2994	-0.00931 0.9404	0.00864 0.9477	Time and environ	-0.25551 0.0416	-0.05529 0.6568	-0.11915 0.3645
Extrinsic motivation	0.15040 0.2355	0.18365 0.1368	0.25436 0.0499	Effort regulation	0.05924 0.6420	0.18541 0.1331	0.13781 0.2937
Task value	0.15564 0.2194	0.14142 0.2536	0.17870 0.1719	Peer learning	-0.02313 0.8560	-0.15701 0.2045	-0.03532 0.7888
Control of learning belief	0.18949 0.1337	0.21922 0.0747	0.37194 0.0034	Help seeking	-0.00515 0.9678	-0.04912 0.6931	-0.01640 0.9010
Self efficacy	0.33783 0.0063	0.27719 0.0232	0.45441 0.0003	Stats anxiety	-0.34324 0.0055	-0.06414 0.6061	-0.16220 0.2156
Test anxiety	-0.06929 0.5864	-0.16381 0.1853	-0.02022 0.8781	Felder-Sensing intuitive	-0.00128 0.9920	0.24877 0.0424	0.06224 0.6366
Rehearsal	-0.06455 0.6123	-0.21131 0.0861	-0.11711 0.3729	Felder-Visual verbal	-0.19570 0.1212	0.11240 0.3651	-0.01262 0.9237
Elaboration	0.00305 0.9809	0.13295 0.2835	0.26630 0.0397	Felder- Sequential global	-0.07707 0.5450	0.05564 0.6547	0.04216 0.7491
Organisation	-0.16672 0.1879	-0.02242 0.8571	0.05867 0.6561	Felder-Active reflective	0.02811 0.8255	0.07357 0.5541	0.10720 0.4149
Critical thinking	0.18352 0.1466	0.11047 0.3735	0.27944 0.0306	MSLQ-Motivation subscale	0.24834 0.0479	0.18032 0.1442	0.35784 0.0050
Metacognitive self regulation	0.05425 0.6703	0.12704 0.3056	0.24116 0.0634	MSLQ-Learning strategies	-0.02948 0.8171	-0.01079 0.9309	0.11853 0.3671

Table 9 shows that self-efficacy shows significant, moderate, positive relationships with all the Matric marks gathered. The overall motivation shows significant, moderate, positive relationships with maths and overall marks. Statistics anxiety shows a significant, moderate, negative relationship with maths marks only. All of these relationships are in the expected directions.

Some interesting patterns are therefore visible in the correlations above, such as the fact that self efficacy is strongly related to overall marks and maths marks, but not to English marks. It may be the case that self efficacy is more important in more logical/mathematics based courses such as RDA IIA and less so for more language-based courses such as English. Further the fact that statistics anxiety is only significantly related to maths marks in school seems to highlight the validity of the instrument as well as the relationship between maths and statistics anxiety. The fact that motivation correlates with maths and overall marks but not English marks is interesting in that it may also reflect inherent differences in the nature of language-based courses and logical/mathematically based courses.

Table 9- Correlations between matric marks

Pearson Correlation Coefficients **Prob > |r| under H0: Rho=0**			
	Maths	**English**	**Overall**
Maths	1.00000	0.44354	0.72400
Maths		0.0003	<.0001
English	0.44354	1.00000	0.76988
English	0.0003		<.0001
Overall	0.72400	0.76988	1.00000
Overall	<.0001	<.0001	

As one would expect the Matric marks obtained in the study correlated highly with one another. An examination of the table above showed that all of the Matric marks correlated significantly, strongly and positively with one another. Interestingly, Maths and English correlate strongly with one another but the strongest relationships present exist between Maths/English and overall Matric marks. This is to some extent expected since the overall mark is an average of all of the Matric marks and therefore contains the marks for these two subjects.

Regression

The following section reports seven sets of stepwise regression analyses. In each of the first six cases the DV was the RDA IIA marks, while the IV is some aspect of the scale data, the demographic data or all of the data. The seventh regression analysis was conducted using the overall matric mark as the DV and all of the data generated

by the scales used in the study as the IV's. The first six of regression analysis are therefore answering research question one, while the final regression is concerned with question 1 in that the nature of the matric mark- RDA IIA mark relationship necessitated further investigation.

RDA IIA Marks

MSLQ Subscales and total

The regression analysis showed that only the motivation subscale of the MSLQ met the criteria to be retained in the analysis. The model fitted the motivation subscale ($F_{1,71}$=8.50; p=0.0047). The R-squared for the model was 0.1069.

The implication of this is that the motivation subscale of the MSLQ is significantly related to RDA IIA marks. The R-squared for the model suggests that the motivation subscale explains 10.69% of the variance in the RDA IIA marks and as such the relationship is fairly weak. Further the learning strategies subscale and the total of the MSLQ did not explain a significant portion of the variance over and above the motivation subscale and as such they were removed.

MSLQ Subsections

The regression fitted originally with six variables that were above the 0.05 level: self-efficacy, help seeking, elaboration, intrinsic motivation, extrinsic motivation and organization.

The stepwise process then removed all of the variables except help seeking and self-efficacy suggesting that these were the most predictive variables.

Table 10- Stepwise regression results for the MSLQ subsections						
Step	**Variable Entered**	**Number Vars In**	**Partial R-Square**	**Model R-Square**	**F Value**	**Pr > F**
1	MSLQ-Self efficacy	1	0.2782	0.2782	27.36	<.0001
2	MSLQ-Help seeking	2	0.0378	0.3160	3.87	0.0531

This regression showed that the variables of self-efficacy and help seeking were significantly related to RDA IIA marks. Help seeking explains only a small proportion of the variance in RDA IIA marks (3%) with self-efficacy explaining the majority (27.82%). The model shows a fairly strong relationship with the combined variables explaining 31.6% of the variance in RDA IIA marks.

Felder-Solomon LSI subscales

The model failed to fit any variables since no variables met the 0.05 p value minimum. In essence this result showed that when only the Felder-Solomon LSI data is considered it is not significantly related to RDA IIA marks at all, as none of the subscales had the minimum significance value required to be entered into the model. In light of this finding it was necessary to examine if the Felder-Solomon LSI data formed an underlying factor. Further regressions were therefore run which placed the Felder-Solomon LSI scores as the IV's and English marks, Maths marks, overall Matric marks and the subscales of the MSLQ that were predictive as the DV's. The analysis showed no relationship between the Felder-Solomon LSI subscales and any of the above-mentioned variables. A further analysis was run with the Felder-Solomon LSI subscales as the dependent variable and the demographic factors as the explanatory variables in order to further examine if any differences existed on this variables between the groups. This too showed no significant results.

Thus the Felder-Solomon LSI scale data did not seem to be related to any of the other important variables nor did it differ between groups. The scale therefore does not

seem to be the basis for any of the other variables and it does not seem to have an effect which is simply masked by the other variables. Given the poor reliability and validity of the Felder-Solomon LSI scale for this study, it must be remembered that these results should be interpreted with caution.

The Statistics Anxiety Scale

Since the Statistics Anxiety Scale generates only one score it was run without the stepwise procedure as a non-fitted regression. The model was significant with an $F_{1,71}=8.82$, $p=0.0041$. The R-squared for the model was 0.1105.

The regression shows that statistics anxiety is related to RDA IIA marks but that this relationship is fairly weak as it only explained 11% of the variance in RDA IIA marks.

Demographic variables

The model was run using the variables of school (government/private), gender (0-female, 1=male), Maths standard grade (0=no, 1=yes), age, maths mark in Matric, English mark in Matric and overall mark in Matric. These variables were all either intervally scaled or had been coded as 0 and 1 to create a dummy variable which was interval in nature.

The model fitted originally with the variables of age, maths mark, English mark, overall mark and school having a p value of >0.05. However, the only variables maintained were age, English mark and overall mark.

Table 11- Stepwise regression results for the biographical variables						
Step	**Variable Entered**	**Number Vars In**	**Partial R-Square**	**Model R-Square**	**F Value**	**Pr > F**
1	Overall	1	0.4688	0.4688	40.60	<.0001
2	Age	2	0.0724	0.5412	7.10	0.0106
3	English	3	0.0386	0.5798	4.04	0.0506

The model shows a large R-squared value suggesting an extremely strong relationship between the IV's - overall Matric mark, age and English Matric mark - and the DV - RDA IIA mark - whereby the IV's explained 57.98% of the RDA IIA mark variance.

The scale data

The combined scale data (i.e. all four proposed predictive factors) was run using the subscales from the MSLQ, the subscales from the Felder-Solomon LSI and the Statistics Anxiety Scale score. The same variables from the MSLQ regression were still significant as was the active reflective subscale of the Felder-Solomon LSI.

Table 12- Stepwise regression results for the combined scale data						
Step	**Variable Entered**	**Number Vars In**	**Partial R-Square**	**Model R-Square**	**F Value**	**Pr > F**
1	MSLQ-Self efficacy	1	0.2782	0.2782	27.36	<.0001
2	MSLQ-Help seeking	2	0.0378	0.3160	3.87	0.0531
3	Felder-Active reflective	3	0.0686	0.3846	7.69	0.0071

The model shows a fairly strong relationship with the IV's explaining 38.46% of the RDA IIA mark variance. This is, however, still much weaker than the R-squared value seen in the demographic variable regression.

The combined scale and demographic variables

When all of the data was entered into the model it showed that only the variables of English Matric mark, age and overall Matric mark were retained.

Table 13- Stepwise regression results for scale and biographical data combined

Step	Variable Entered	Number Vars In	Partial R-Square	Model R-Square	F Value	Pr > F
1	Overall	1	0.4688	0.4688	41.47	<.0001
2	Age	2	0.0723	0.5410	7.24	0.0099
3	English	3	0.0396	0.5806	4.25	0.0451

The model above shows that when all of the data is considered the scale data does not explain a sufficient proportion of the RDA IIA mark variance for it to be included in the analysis. Thus the overall model suggests that the variables of age, overall Matric marks and English Matric marks provide the best predictors of RDA IIA performance.

Matric marks

The strength of the Matric mark- RDA IIA mark relationship was such that the possibility existed of the effects of the scale data being masked. If this was the case then the scale variables could possibly be acting as an underlying variable that was related to school performance and thus RDA IIA performance, but this relationship could be masked by the Matric marks. Table 15 represents the results of a stepwise regression run using the scale data as the IV and the overall Matric marks (which were shown to be the most predictive) as the DV.

Table 14- Regression results for scale data predicting overall Matric marks						
Step	**Variable Entered**	**Number Vars In**	**Partial R-Square**	**Model R-Square**	**F Value**	**Pr > F**
1	MSLQ-Self efficacy	1	0.2065	0.2065	15.09	0.0003
2	MSLQ-Intrinsic	2	0.0708	0.2773	5.59	0.0215
3	MSLQ-Critical thinking	3	0.0551	0.3324	4.62	0.0359
4	MSLQ-Extrinsic	4	0.0479	0.3803	4.25	0.0440

The model above is interesting in that the scale data shows the same R-squared in predicting overall Matric marks as it does in predicting RDA IIA marks. The majority of the variance explained in the model is also due to the variable of self-efficacy thus once again suggesting its importance.

Multicolinearity

Multicolinearity refers to the condition whereby the independent variables in a regression analysis are not mutually exclusive, i.e. there is an interdependency between them (Farrar & Glauber, 1967)**.** In this study, the areas identified as being most at risk in relation to the effects of multicolinearity were school marks and the scale data drawn from the MSLQ. This was due to the fact that these measures were composites of some of the other scores. For instance the motivation subscale of the MSLQ is an average of the subsections within motivation, and overall Matric mark was calculated based on an average which included Matric English mark and Matric Maths mark. For this reason it was decided that diagnostics of multicolinearity should be run and the effect of this issue investigated.

The presence and extent of the multicolinearity was established using tolerance scores, variance inflation factor (VIF) and colinearity diagnostics.

Table 15- Tolerance and Variance Inflation Factor for School Marks								
Variable	**Label**	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Tolerance**	**Variance Inflation**
Intercept	Intercept	1	10.61352	4.96361	2.14	0.0375	.	0
Maths	Maths	1	0.30564	0.04891	6.25	<.0001	0.81063	1.23361
English	English	1	0.54632	0.07278	7.51	<.0001	0.81063	1.23361

Table 16- Collinearity Diagnostics for School Marks					
Number	**Eigenvalue**	**Condition Index**	**Proportion of Variation**		
			Intercept	**Maths**	**English**
1	2.96738	1.00000	0.00173	0.00400	0.00145
2	0.02493	10.90940	0.15036	0.94585	0.05098
3	0.00768	19.65164	0.84790	0.05015	0.94757

Table 15 and Table 16 above show the multicolinearity diagnostic criteria for the Matric marks. One can see from the fact that the tolerance values are below 1 that there may be some multicolinearity between the school marks. The VIF, however, is below 10 and the condition index does not exceed 50. These results suggest that there is some multicolinearity but it is at best only marginally significant (Howell, 2001).

Looking at the same calculations for the MSLQ, the multicolinearity was strikingly apparent. The motivation and learning strategies subscale showed tolerance values of 0.07 and 0.02 respectively. The VIF for these sections were 14.6 and 47.7 respectively, well above the benchmark of 10. Further the condition index was well above 50.

Due to the obvious multicolinearity in the MSLQ data, the stepwise regression analyses were rerun excluding the total, the motivation subscale and the learning strategies subscale. The regression results showed that the factors of overall school marks, age, English marks and critical thinking were retained as significant with an overall r-squared of 0.64. This pattern is similar to previous runs that included the

aggregate MSLQ data. Further the analyses were also rerun excluding overall school marks, MSLQ total, motivation subscale and learning strategies subscale. These results showed that self efficacy, help seeking and a sensing intuitive cognitive style become significant along with age, maths marks in matric and English marks in matric. The model fitted with an overall r-squared of 0.60. The MSLQ data excluding the total, motivation subscale and learning strategies subscale were also rerun alone and showed exactly the same results as were previously found with this analysis.

It seems from these rerun analyses that while there may be a very small amount of multicolinearity within the school marks, there is still a significant portion of variance that is explained by overall school marks that is not explained by maths and English marks alone. The multicolinearity within the MSLQ data, in contrast, was undeniably high but the effect of its removal was limited to only the increased significance of the critical thinking subsection.

ANOVA's and t-tests

The following section presents the results of the ANOVA's and t-tests that were run in the study. The first set of tests was concerned with RDA IIA marks and thus the first research question, and the second set was concerned with the predictive variables and thus the second research question.

RDA IIA performance

These analyses were run to examine if the different categories defined by the biographical data were in some way able to define statistical differences between groups in terms of RDA IIA performance. The t-tests and ANOVA's were therefore run using the RDA IIA marks as the DV and the demographic variables as the IV's in each case. Those ANOVA's and t-tests that were significant are reported here.

The first ANOVA was run using the race data. It showed that significant differences existed between the RDA IIA scores of the different racial groups in the study ($F_{4,68}$=4.60, p=0.0024). Post hoc Tukey's testing showed that white students (mean=70%) differed from both black (mean=50%) and coloured students (mean=47.5%), with white students scoring higher, but that no differences existed between the other groups (Cohen's D=1.55). This result seemed odd and may simply

have been a product of the small sample size of black, coloured, Indian and Asian students. For this reason a non-parametric Kruskal-Wallis was run. This showed significant results ($\mathbf{X^2}$ =17.45, p=0.0016). Despite the significance of these results it should be noted that the sample size and make up of the sample limit the validity of any claims on the basis of these results. As such further study would be necessary before any claims on the influence of race on RDA IIA performance could be made.

A t-test was run using the maths standard grade variable as the IV. This showed a significant result (t_{62}=2.49, p=0.016) thus suggesting the RDA IIA scores differed significantly between those who did maths higher grade and those who did maths standard grade. An examination of the means showed that the significant difference was due to those who did higher grade maths (mean=65%) scoring higher than those who did standard grade maths (mean=49%) (Cohen's D=0.67).

Other analyses were run using RDA IIA mark as the DV and the other demographic variables; Gender, faculty, and type of school attended as the IV's for the respective analyses. None of these analyses, however, showed a significant result.

Predictive variables

Further analysis was done to examine if there were statistically significant differences in the levels of the four proposed predictive factors between the groups.

Race

A set of ANOVA's were run using race as the IV and the predictive variables as the DV's in each case. Maths and overall Matric marks differed significantly between the racial groups.

Table 17- ANOVA table for maths marks with race as the IV

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1859.48252	619.82751	3.46	0.0218
Error	60	10752.26748	179.20446		

Table 17- ANOVA table for maths marks with race as the IV					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Corrected Total	63	12611.75000			

Cohen's D=1.12

Table 18- ANOVA table for overall marks with race as the IV					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	748.200505	249.400168	3.18	0.0310
Error	56	4397.282828	78.522908		
Corrected Total	59	5145.483333			

Cohen's D=1.15

The analyses presented above showed that significant differences existed between the different racial groups on overall Matric marks and maths marks as p was less than 0.05 in each case. An examination of the means showed that white students generally scored higher across both subject areas but post hoc Tukey's testing showed that this was only significantly higher on overall Matric marks.

Faculty

A set of ANOVA's were run using faculty as the IV and the predictive variables as the DV's in each case. The variables of self-efficacy and statistics anxiety were significantly different across the faculties as seen in the fact that the p value was less than 0.05.

Table 19- ANOVA table for self efficacy with faculty as the IV					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	2	6.32068317	3.16034159	4.55	0.0135
Error	77	53.46818402	0.69439200		
Corrected Total	79	59.78886719			

Table 20- ANOVA table for statistics anxiety with faculty as the IV					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	2	4704.04071	2352.02036	6.47	0.0025
Error	77	27991.90929	363.53129		
Corrected Total	79	32695.95000			

Post hoc Tukey's testing for each ANOVA showed that science students showed higher levels of self-efficacy (Cohen's D=0.85) and lower levels of statistics anxiety (Cohen's D=-1.03) than arts students. Science students however did not differ from those students in commerce or other disciplines, and arts students did not differ from commerce and other discipline students. It should be noted that differences may have existed between the other faculties but that the small sample size did not allow for these differences to be significant in the analysis.

Gender

A set of two independent sample t-tests were run using gender as the IV and the predictive variables as the DV's in each case. The Levene's test showed that statistics anxiety did not show equal variances across the genders and therefore the Satterthwaite value was used. The variables of self-efficacy and statistics anxiety were significantly different across the two genders as seen in the fact that the p values were less than 0.05 for each test.Table 21- T-Test table for self-efficacy and statistics anxiety with gender as the IV

Variable	Method	Variances	DF	t Value	Pr > |t|
MSLQ-Self efficacy	Pooled	Equal	78	-2.13	0.0366
MSLQ-Self efficacy	Satterthwaite	Unequal	12.1	-1.81	0.0948

A set of two independent sample t-tests were run using gender as the IV and the predictive variables as the DV's in each case. The Levene's test showed that statistics anxiety did not show equal variances across the genders and therefore the Satterthwaite value was used. The variables of self-efficacy and statistics anxiety were significantly different across the two genders as seen in the fact that the p values were less than 0.05 for each test.Table 21- T-Test table for self-efficacy and statistics anxiety with gender as the IV

Variable	Method	Variances	DF	t Value	Pr > |t|
Stats anxiety	Pooled	Equal	78	2.26	0.0264
Stats anxiety	Satterthwaite	Unequal	24.4	3.56	0.0016

Table 22- Equality of Variances table for gender t-test

Variable	Method	Num DF	Den DF	F Value	Pr > F
MSLQ-Self efficacy	Folded F	10	68	1.55	0.2817
Stats anxiety	Folded F	68	10	3.77	0.0266

Examination of the means showed that the differences present in self-efficacy and statistics anxiety were due to male participants scoring higher on self-efficacy (Cohen's D=-0.65) and lower on statistics anxiety than female students (Cohen's D=0.88).

Type of school attended

A set of t-tests were run using the type of school attended as the IV. This analysis showed that none of the variables differed significantly across the two groups.

Maths level

A set of t-tests were run using the maths level (standard grade or higher grade) and the predictive variables as the DV's in each case. The variables of overall Matric mark,

English Matric mark and self-efficacy differed significantly across the two groups as seen in the fact that the p values for each test were less than 0.05.

Table 23- T-Test table for the maths level analysis					
Variable	**Method**	**Variances**	**DF**	**t Value**	**Pr > |t|**
English	Pooled	Equal	62	2.32	0.0236
English	Satterthwaite	Unequal	23.2	2.17	0.0404
Overall	Pooled	Equal	53	2.33	0.0234
Overall	Satterthwaite	Unequal	22.9	2.36	0.0275
MSLQ-Self efficacy	Pooled	Equal	68	2.36	0.0212
MSLQ-Self efficacy	Satterthwaite	Unequal	33	2.29	0.0287

Table 24- Equality of Variance table for the maths level t-test					
Variable	**Method**	**Num DF**	**Den DF**	**F Value**	**Pr > F**
English	Folded F	15	47	1.30	0.4789
Overall	Folded F	40	13	1.04	0.9983
MSLQ-Self efficacy	Folded F	19	49	1.15	0.6725

Examinations of the means showed that the differences in the above t-tests were due to the fact that standard grade students showed lower Matric marks (English-Cohen's D=0.047, overall-Cohen's D=0.73) and lower levels of self-efficacy than higher-grade maths students (Cohen's D=0.68).

Conclusions

The analyses presented above showed that race and maths level showed significant differences in RDA IIA marks across the groups. These differences were due to white students and higher grade maths students scoring higher on RDA IIA. However, the sample breakdown does limit the extent to which the race data can be considered as valid. A similar pattern was also seen in the Matric marks analysis which showed that race also showed differences across Matric marks, while faculty showed science

students as scoring higher on self-efficacy and lower on statistics anxiety than other disciplines. The variables of self-efficacy and statistics anxiety also differed between the genders with male participants scoring higher on self efficacy and lower on statistics anxiety than female participants. Finally those participants who did higher grade maths in matric showed higher Matric marks and higher levels of self-efficacy than those participants who did standard grade maths in matric.

It is interesting to note that differences in the levels of the predictive variables did not necessarily translate into higher RDA IIA marks. This is seen in the fact that science students and male participants did not necessarily score higher in RDA IIA despite showing higher levels of self efficacy and lower levels of statistics anxiety.

Chapter Five: Discussion

Findings

The most predictive factors were seen to be overall Matric marks, English Matric marks and age. In terms of the scale data, the factors of self-efficacy, help seeking, critical thinking and statistics anxiety were all significantly predictive. Significant differences in RDA IIA marks also existed between the racial groups and between the different maths levels (higher grade and standard grade).

Significant differences in self-efficacy levels existed between the genders, different faculties and maths level as well as between the faculties and genders in statistics anxiety. Only the variable of race showed significant differences across the Matric marks. No other significant differences existed between the groups.

Cognitive style

The results showed no support for cognitive style as a predictor of success on the RDA IIA course, unlike previous research using the concept of learning style as a predictor of academic performance which has shown at least some support for this (cf. Chamillard & Karolick, 1999; Ehrman & Oxford, 1990; Ishiyama & Hartlaub, 2003; Snyder, 2000; Park, 2001). There are however a number of studies which have shown a similar pattern of results to that of the current study, in that they showed no support for the use of cognitive learning style in general (cf. Skogsberg & Clump, 2003; van Zwanaberg et al., 2000) and no support for the use of the Felder-Solomon Index of Learning Styles in particular (Kovacic & Green, 2004).

This result was surprising when one considers the nature of cognitive learning style and the influence that it should have on learning from a common sense perspective. It seems logical that cognitive learning style would directly influence RDA IIA performance but this was not seen in the analysis. In fact, only the active-reflective subscale was significant and this was only in the total scale regression. It was possible that cognitive learning style could have been the basis for some of the other variables however this would have been seen in the regression analysis in which the scale was

run as the IV with an attempt to predict the other measures used. These results too showed no significant relationships, suggesting that this was not the case.

The apparent lack of support for cognitive learning style in this study is problematic and leads to one of two possible conclusions. The first is that the measure used, the Felder-Solomon Index of Learning Styles, was not a valid and reliable measure in the South African context for this study and as such did not provide a true measure of cognitive style. The alternative is that cognitive style as a concept has no impact on student performance on research courses and as such should not be used in any form of predictive sense. Examining the factor structure and the Cronbach's alpha values for the measure one seems forced to conclude that it is the former that is correct. It seems that the measure may not be appropriately tapping the underlying construct and as such should be examined to find the reason for this or altered in order to improve its validity and reliability. Alternatively a better measure should be found.

Learning strategies

The results of the present study show that the total of the learning strategies subscale of the MSLQ was not predictive of overall RDA IIA marks. This was seen in the regression run on just the MSLQ data, the total scale data and all of the combined data. The learning strategies subscale also showed a correlation of only r=0.12 with RDA IIA marks.

The analysis on the subsections of the learning strategies subscale showed that only two of the subsections: help seeking and critical thinking were seen to be predictive of RDA IIA performance. The help seeking variable was significant in the regression run on only the MSLQ subscales as well as on the overall scale data. It was not, however, significant in the regression using all the available data. The critical thinking variable was significant only in the rerun, scale only regression run in the multicollinearity section. The correlations show a similar pattern in that only the help seeking and intrinsic motivation subsections showed significant correlations with RDA IIA performance, with help seeking being the stronger of the two relationships. Critical thinking in contrast does not show a significant relationship with RDA IIA marks.

These results are in line with previous findings such as those of Kivinen (2003), who also found little support for the use of learning strategies to predict academic performance. The Kivinen study, however, used school children and it was assumed that the university context would necessitate the importance of appropriate learning strategies, and as such the negative findings of the Kivinen study were considered to be a product of the sample. There have also been several other studies however, primarily those conducted by Pintrich, that have shown significant relationships between learning strategies and performance and have done so using the MSLQ (Corno & Kanfer, 1993).

The results of the present study are somewhat problematic in that one would assume that learning strategies should be related to performance logically, particularly at a university level, and due to the fact that some studies have found this relationship. The assumption that learning strategies play no role at all would then seem a short-sighted one, particularly in light of the previous supporting research. It is therefore possible that in the present study the sample homogeneity and generally high performance of the sample may have led to a situation where the learning strategies profile of the sample was very similar and thus did not show enough variance for the relationship to be accurately gauged. Further research therefore seems necessary before it can be claimed with any certainty that learning strategies are not important predictors of research course performance.

Motivation

The motivation subscale of the MSLQ was found to be significant in the analysis but only when it was entered into a regression using only the MSLQ subscale data. Further analysis using the subsection data as well as the data from the other scales and the demographic information showed no significant relationship between total on the motivation subsection and RDA IIA marks. The subsection of self-efficacy, however, did show a highly significant relationship with RDA IIA marks and appeared as significant in the regressions using the combined scale data as well as the regression run using only the MSLQ data. When self-efficacy was entered with all of the available information, though, it ceased to be significant due to the strength of the relationship between Matric marks and RDA IIA marks.

The fact that motivation seems to be a predictive factor at least to some extent is not a surprising one. It has been identified as an important factor in academic performance at a theoretical level by Hidi & Harackiewicz (2000). It has also been shown to be important at an empirical level by Pintrich and De Groot (1990) and Kivinen (2003).

The findings of the present study are different in that they show self-efficacy to be the most predictive scale-generated factor while previous research using the MSLQ has shown that the subsections of intrinsic motivation, self-efficacy and test anxiety are all significant predictors (Pintrich & De Groot, 1990; Kivinen, 2003). Self-efficacy is defined as an individual's perceived capability to perform certain actions (Schunk, 1991). This judgement is based in part on the individual's belief in their own mastery of the subject matter (Schunk, 1991). This result of self-efficacy as highly predictive is not unique as it has been shown to be a very important predictor of academic performance in previous studies by Zimmerman, Bandura and Martinez-Pons (1992), Burton and Dowling (2005), Wolters and Pintrich (1998), and by Richardson (2007). Interestingly the Zimmerman et al. (1992) study also found previous academic performance to be more predictive than self-efficacy and goal setting.

Statistics anxiety

Statistics anxiety was shown in the analysis to be somewhat predictive of RDA IIA marks - it was significant in the regression in which it was run alone as the predictor of RDA IIA marks but ceased to be significant when combined with the other scale data and the overall data. The statistics anxiety regression also only showed an R-squared value of 0.11 implying that while it was predictive of RDA IIA marks this was only to a very small extent.

The amount of research that has been conducted on the negative effects of anxiety on performance in general and on the effects of maths and statistics anxiety on performance in particular is vast (Rosenfeld, 1978). Most of these studies state that anxiety is a major factor in student's academic performance and it is universally seen that high levels of anxiety have a negative impact on performance. In a research based

course with a major statistics component, such as RDA IIA, one would expect statistics anxiety to prove a significant variable.

The nature of the course and the nature of statistics anxiety as mentioned above suggest that the sample that was obtained should once more be highlighted. Due to the sample's homogeneity and generally high performance in RDA IIA, it is possible that the relationship between statistic anxiety and RDA IIA performance is a much stronger one but that this was simply not seen in this sample. Further research is therefore suggested so that the importance of the effect of statistics anxiety can be appropriately gauged.

Biographical information

The demographic information that was gathered in the study showed overwhelmingly that it provided better predictor variables than the scale data. These variables were significant when entered with the biographical data alone as well as when the combined data was entered. The stepwise regression analysis kept the variables of age, overall Matric marks and Matric English marks. The total R-squared for the regression of these three variables was 0.58. This is a large value and shows much more variance explained than the scale data which when combined showed an R-squared of 0.38.

The ANOVA's which were run using this data further showed differences between the race groups on RDA IIA marks as well as differences on the basis of whether or not the student did higher grade or standard grade maths at school. The race data is problematic as it may simply be a product of the homogeneity of the sample (mostly white females participated) but it may also be due, in light of Matric English marks being a predictive factor, to a higher competence in English. The differences between the higher grade and standard grade maths groups seems logical in that RDA IIA by its very nature has a large quantitative basis, particularly in the statistics course. What is therefore surprising is the fact that maths marks were not predictive in the regression analysis and that statistics anxiety proved to not be significant as an overall variable.

Differences across the biographical variables

It is interesting to note that in the analysis conducted to examine the groups defined by the biographical information for differences in terms of the predictive variables that the variables of race, faculty, gender and maths level all showed significant differences across two or more of the predictive variables. However, it is only race and maths level that differed significantly in terms of the RDA IIA marks. It is interesting in light of this that the variables of type of school attended, faculty and gender showed differences across the scale based variables but not in the Matric marks, whereas the variables of race and maths level showed differences across the Matric marks.

It seems from this that while some of the variables may differ across the groups, the relationship that these variables have with RDA IIA performance is the same. To explain further, where Matric marks (which were the most predictive factors) differed across the groups these groups showed differences in RDA IIA marks as expected. The conclusion that seems most logical from these findings is that the relationship between the explanatory variables and RDA IIA performance is the same regardless of the biographical variables for each participant. The concern, however, is why these groups would show different Matric marks and RDA IIA marks. The variable of maths level does not present a significant concern as one could assume that those students taking higher grade maths may be generally better academically and thus their performance at both school and university level would reflect this. The differences across the racial categories are more problematic, though, as no immediate explanation seems forthcoming. The differences could be based on a difference in schooling or perhaps language proficiency or may simply be due to the fact that the sample was largely made up of white participants. More study would therefore be necessary before conclusions could be drawn as to why these differences exist.

It should however be noted that the differences present between the different racial groups with regards to school marks may in fact have been an artefact of the sample. As mentioned previously the sample may not have been representative in terms of race as the vast majority were white and female. The highly significant nature of the relationship between matric marks and RDA IIA marks present in this study may

therefore manifest in this way without the existence of any real differences in the general population.

Previous academic performance

In the present study the student's previous academic performance was the most significantly predictive factor for their RDA IIA performance. This is seen in every analysis that was conducted. This was not considered likely at the commencement of the study due to the lack of recent research that attempted to investigate school marks as a factor. Its obvious significance is therefore surprising.

There is a small amount of previous research that has attempted to explain university performance or entry on the basis of school marks. In terms of choice to enter university, Gayle, Berridge and Davies (2002) showed that high school marks were an influential factor. Other research on predicting university performance using school performance has shown correlations of between 0.12 and 0.5 depending on the subject and the sample (cf. Davis, 1936; Hawks, 1931; Douglass & Michaelson, 1936; Judy, 1971; Kahn & Nauta, 2001). Much of the research is, however, exceptionally dated and it seems that such study has fallen by the wayside as years have passed with the vast majority of the studies (only a very small percentage of them are listed here) being conducted in the 1930's (cf. Davis, 1936; Hawks, 1931; Douglass & Michaelson, 1936; Judy, 1971). It seems somewhat paradoxical in light of the often relatively high correlations that were found in these studies that post 1930's the number of studies examining the relationships between school and university achievement has declined to such an extent. One possible explanation is that not much more could be done over and above the research that had already been conducted. The alternative is that perhaps the burgeoning popularity of psychometric testing, that began in earnest with the Binet-Simon scale in 1905 and was reaching mass popularity towards the end of the 1930's, may have led researchers to disregard school achievement as less important and as carrying less weight as a research tool than standardised test scores (Gerberich, 1963).

Regardless of the odd nature of this research gap, the findings of these studies, as well as the present study, seem to suggest that some form of general academic skill, as

seen in school performance, constitutes a better predictor of performance than the other variables measured here. However, as has been mentioned previously in this paper, intelligence scores generally do not form good predictors of university performance and neither does cognitive ability (Furnham et al., 2003). Further, some studies have shown the effect of previous academic qualification to be non-significant when one takes motivation into account (Richardson, 2007). The implication for what is assumed to be measured by school marks and for the nature of intelligence and cognitive ability is therefore unclear and further investigation into the connection between these factors and university performance seems necessary.

Chapter Six: Conclusion, limitations and directions for future research

Conclusion

The results of the present study are interesting in that the data from the scales, which the literature considers to be important in academic achievement, show such low predictive value. It seems that while this data is predictive to some extent, if one considers it in isolation, the variables tapped by the scales do not appear to explain a significant amount of RDA IIA mark variation when one considers them in conjunction with experience (age) and general academic talent (school marks). It is also true however that the relationship between the scale data and school marks was similar to the relationship between the scale data and RDA IIA marks. This may suggest that while school marks are the most predictive factors, they are based on a set of variables that may include the other variables from this study.

The question then remains as to how future interventions in the RDA IIA program should be structured. In order to answer this question it seems important to begin to understand why these variables are significant and what interventions are possible.

The variable of the individual's age, or perhaps more accurately, their length of time at tertiary level study or other post schools activities, may link to a level of general maturity and exposure to either the world in general or the university context in particular. Either of these areas of experience could be important factors in academic performance as they may influence the manner in which students think, study and behave with regards to research-oriented courses. This is, however, not a simple matter to understand with regards to the present study as information on how long the participants had been enrolled at the University or what they may have done between high school and university was not gathered.

Similarly the school marks that an individual achieves must be based, at least in part, on a general academic skills factor. Whether this factor is intelligence as defined and measured by the various intelligence measures or is a separate skill that is based more

heavily on the ability to study and learn is unclear (Neisser et al., 1996). The present study excluded intelligence measures as instruments on the basis of previous research showing that they are not good predictors of university performance and logistical constraints such as the length of time participants would have required to complete the questionnaire pack. This is a limitation as some form of intelligence measure would have been useful in gauging the nature of the relationship between RDA IIA performance and the underlying factor that predicts schools marks.

What is clear in an examination of these two variables is that the factors of age and general academic talent seem difficult or impossible to change through any intervention process. It is also clear that some form of academic skill, which is in part reflected by school marks, will always be an important factor in predicting RDA IIA marks. Added to this is the possibility mentioned above that school marks themselves are based at least partially on some of the variables found in this study, which suggests that while it would be tempting to base the interventions simply on those students who did less well in school and who did lower grade maths this may not be an appropriate answer.

An additional feature of the study that warrants consideration as a factor in this decision is the fact that while the scale data shows low predictive power compared to school marks, the relationship may be weaker than it should have been due to the homogeneity of the sample. The sample was made up of primarily white, female participants and as such the sample could have shared similar backgrounds and may therefore have shown less variability in terms of their learning strategies, motivation and statistics anxiety levels than a more diverse sample would have done.

In light of this it seems important to place the interventions at a level where they may prove to be effective for the greatest number of individuals. For this reason the recommendation made here is that interventions be aimed at the factors that the scale data showed to be important while at the same time taking into account the demographic factors. The most predictive of the factors was school marks, meaning that intervention should be aimed firstly at those who show lower overall school and English marks, particularly for Matric. Within this group it seems logical to further focus on those students who did not do higher grade maths at school level. With the

population thus defined one should begin by intervening on the factors that the scale data showed to be significant, namely motivation, self-efficacy, help seeking, statistics anxiety, critical thinking and a reflective cognitive style. It is true that these variables were not significant when the demographic variables were taken into account, however, not only do they seem open to intervention within the defined group, but they are also significantly related to the school marks themselves.

The interventions should, on the basis of this, attempt to foster a sense of motivation in general and more specifically should encourage notions of self-efficacy. Designing an intervention that attempts to convey the importance and value of the RDA IIA course for the students themselves may do this. Students could also be encouraged to try extra work, do additional reading and examples in order to increase feelings of self-efficacy by providing greater understanding, less anxiety and a sense of competence with the work. Further it may be necessary to provide some students with a mentor or additional tutorials in which they may ask questions and get more help as it was also seen that help seeking behaviour was predictive of RDA IIA mark. These additional tutorials as well as the additional work may also increase the students' understanding of statistics material, may teach them to interact with material in a more critical manner and could therefore lead to lower stress, and it also provides the perfect platform from which the RDA team can try to alleviate some of the students' statistics anxiety. The 'basic-maths-for-stats' course could also be made mandatory in order to further alleviate statistics anxiety. The same platform could also be used to encourage a reflective approach to learning as this seems more appropriate to the RDA course than the more active style. This would however require teaching students how to think through problems critically by themselves, a skill which may be hard to foster.

The suggestion of such interventions may falsely appear to be easy and, as mentioned previously, interventions that focus on motivation are notoriously difficult to implement (Hidi & Harackiewicz, 2000). Self-efficacy similarly seems problematic from an intervention standpoint as the extent to which it is open to intervention is not clear and any intervention on self-efficacy would suffer from the same weaknesses as an intervention on motivation. A similar issue is presented by the reflective cognitive learning style in that many authors consider it to be a fixed attribute that is not open to

intervention. The fact that some authors such as Reid (2005) and Felder and Solomon (n.d.) have suggested ways in which cognitive learning style may be changed and accounted for lends some credence to the idea of intervention but this is an area that will require trials and refinements over several years in order to structure the intervention appropriately.

The statistics anxiety intervention is the one that seems easiest to implement and such interventions have a history of success (Hembree, 1990). The concern would be, as it is for the previous aspects, the problem of attendance. Many students may not wish to attend such classes and tutorials and short of making attendance mandatory no answer as to how to encourage participation seems forthcoming. The interventions all therefore hinge on the question of student attendance and it seems impossible to reduce statistics anxiety, increase motivation and self-efficacy and foster better habits if students are too nervous, embarrassed or proud to ask for help. This may be due in part to the nature of students' expectations about university and perhaps can only be changed if the context is made more open and easy for the students to navigate. To some extent this is achieved by the tutorial programme in place already but more research and interventions on this aspect seem necessary.

Limitations

The greatest limitation present in the study was the small sample size. The sample size was only 80 participants of the several hundred that were approached and the 300 questionnaire packs that were handed out. This remained to be the case despite numerous visits to the classes concerned. The sample was also homogenous in terms of demographics and was composed primarily of white females. While it is true that this is in part reflective of the population that study psychology at the University of the Witwatersrand, there also seem to be elements of volunteer bias (Rosnow and Rosenthal, 1991). Further the sample showed generally good RDA IIA marks with the mean in the 60% range and the modal score being 80%. This is in line with a suspected volunteer bias and it is expected that if the complete population was accessed a greater variance would be seen in the marks. While this is clearly a problematic aspect of the study little could have been done to counteract it given ethical and time limitations.

Another aspect of concern was the apparent lack of validity and reliability present in the Felder-Solomon Index of Learning Styles measure. Whether this was due to the measure itself being poorly constructed, its inapplicability in the South African context, the specific sample in this study, or simply the difficulty of measuring cognitive learning style in general is unclear.

The study was retrospective in nature, asking students to think back to being in RDA IIA and then answer the questionnaires. This is clearly problematic as their responses are based on a remembrance of the experience as opposed to being in the context at the time.

An intelligence measure was not used in this study due to previous research showing that it may not be a good predictor of university performance (Furnham et al., 2003; Neisser et al., 1996; Sternberg, 1996). This, however, does not explain the predictive ability of school marks. As such, a measure of intelligence or academic ability would have been extremely useful as it may have provided more information on the nature of academic performance.

A possible major issue was the presence of multicolinearity in some of the measures used in this study. This was particularly evident in the multicolinearity analysis run for the MSLQ data. It seems that the effect of this multicolinearity was, nevertheless, rather small and the results did not change significantly when the problematic items were removed. The results of the present study are therefore sound but the possible effects of multicolinearity such as this should be borne in mind in future when similar research is conducted.

Directions for future research

The study should perhaps be replicated during the RDA IIA course, preferably at the beginning of the year. The approach could be made by the RDA IIA team in order to encourage better response rates. This would allow for a larger sample size as well as having the benefit of having students complete the questionnaire while they are completing the course in question. In addition an alternative measure should be found

to replace the Felder-Solomon Index of Learning Styles, as its usefulness in the present study was limited.

Future studies should include different variables such as an intelligence measure in order to more fully evaluate what factors are important predictors of performance on research courses. For the same reason a measure of independent learning may prove insightful in light of the predictive power of the self-efficacy variable. These types of studies are important as they may allow for a set of scales to be developed that explain RDA IIA marks better than school marks. Part of this would include studies on what variables are predictive of performance at school level as the marks are so strongly related.

The suggestions above are based on improving the design of the current study but it should perhaps be noted that an area that should be explored in future studies is the effectiveness of the interventions that have been put in place on the basis of this study and any similar studies that may be conducted. This is important as the goal of research in this area is to inform course changes and interventions and ultimately lead to a better learning opportunity for students and higher pass rates. While simply studying the factors that are important is informative and useful it is also obvious that studies focusing on the interventions will be necessary.

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Appendix A- Participant information sheet

[Departmental approved letterhead to be provided for submission to the Ethics Committee by the research supervisor]

My name is Jarrod Payne and I am conducting research for the purposes of obtaining my Masters in Psychology by Coursework and Research Report at the University of the Witwatersrand. My area of focus is the Research Design and Analysis IIA (RDA IIA) module and factors that affect student performance on this course. The purpose of this study is to shed light on important areas for students with a goal of improving the course for the benefit of the university, the Discipline of Psychology and the students themselves. I would like to invite you to participate in this study.

Your participation is strictly voluntary and you will not be advantaged or disadvantaged by choosing to participate or not to participate in this study in any way. You are also free to withdraw from the study at any time during data collection with no negative consequences.

Participation in the study will require you to complete the questionnaire pack at home and return it to a box placed in your classroom during selected lectures over the next three weeks or a box in the main psychology office (U211, 2nd floor, Umthombo Building). The questionnaire pack contains three scales and a biographical questionnaire which should take roughly an hour and a half to complete. The packs each have a random participant number to identify them. The first sheet of the biographical questionnaire also has the participant number and asks for your student number. This is asked for so that your RDA IIA marks can be collected and captured. This first sheet is the only way to link your student number to your other responses. Your RDA IIA marks will be linked to your student number by an independent person who will, once finished, destroy all of the student number sheets to protect your confidentiality. At no point during or after the study will the researcher have access to your student number as well as your participant number and marks. Providing your student number is completely optional and you may choose to participate in the study without providing your student number.

Filling out and returning the questionnaire pack will be taken as consent to take part in the study. Once the study has been completed a one-page summary of the results will be displayed on the RDA notice board on the mezzanine level (between the second and third floor) of the Umthombo building. If you would like a longer version of the study results, you are welcome to email the researcher at rdastudy@hotmail.com with the subject "Study feedback". Feedback will then be emailed to you. No individual feedback will be available, however, as responses are anonymous.

Your participation in this study would be greatly appreciated. This research will provide information that may be useful in structuring the RDA IIA course and future intervention. This is important not only because the course is a compulsory one within the Discipline of Psychology but because it is also important for postgraduate Psychology degrees, Psychology careers and the Discipline itself.

Kind Regards
Jarrod Payne

Contact details: Jarrod Payne: Number- 0834159372, email rdastudy@hotmail.com

Nicky Israel: Number- (011)717-4557, email- Nicole.Israel@wits.ac.za

Appendix B- The Biographical questionnaire

Participant number:_____

How many times have you registered or did you register for the RDA IIA module?

_____

Please list the years in which you did so:

Student number:

Note: By choosing to disclose you student number you are giving the researcher permission to have a third party access your RDA IIA results under the conditions explained in the informed consent letter. This is voluntary and you may choose to continue with the rest of the questionnaire without filling in your student number.

Participant Number:_____

Gender (Mark one): | Male | | Female |

Age:_____

Race (Mark one): | White | Black | Indian | Coloured | Asian |

Other (please specify): _____

(Please note this question is asked for statistical purposes only and is not meant to offend in any way)

Faculty (Mark one): | Science | Arts | Commerce | Other |

Type of school attended (Mark one): | Private | Government |

Language/s you were taught in at high school: _____

School marks for matric (Please be as accurate as possible).

Note: HG=Higher grade SG= Standard grade

English: | HG | SG | _____

Maths: | HG | SG | _____ (If you did not take maths in matric leave blank)

Overall average: _____

Appendix C- MSLQ items

Please answer these questions only in relation to the RDA IIA module. If you have already completed RDA IIA, please try to answer as you think you would have answered while you were taking the course.

	Part A. Motivation	1=not very true of me 5 =very true of me
1	In a class like this, I prefer course material that really challenges me so I can learn new things.	1 2 3 4 5
2	If I study in appropriate ways, then I will be able to learn the material in this course	1 2 3 4 5
3	When I take a test I think about how poorly I am doing compared with other students.	1 2 3 4 5
4	I think I will be able to use what I learn in this course in other courses.	1 2 3 4 5
5	I believe I will receive an excellent grade in this class.	1 2 3 4 5
6	I'm certain I can understand the most difficult material presented in the readings for this course.	1 2 3 4 5
7	Getting a good grade in this class is the most satisfying thing for me right now.	1 2 3 4 5
8	When I take a test I think about items on other parts of the test I can't answer.	1 2 3 4 5
9	It is my own fault if I don't learn the material in this course.	1 2 3 4 5
10	It is important for me to learn the course material in this class.	1 2 3 4 5
11	The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	1 2 3 4 5
12	I'm confident I can learn the basic concepts taught in this course.	1 2 3 4 5
13	If I can, I want to get better grades in this class than most of the other students.	1 2 3 4 5
14	When I take tests I think of the consequences of failing.	1 2 3 4 5
15	I'm confident I can understand the most complex material presented by the instructor in this course.	1 2 3 4 5
16	In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	1 2 3 4 5
17	I am very interested in the content area of this course.	1 2 3 4 5
18	If I try hard enough, then I will understand the course material.	1 2 3 4 5
19	I have an uneasy, upset feeling when I take an exam.	1 2 3 4 5
20	I'm confident I can do an excellent job on the assignments and tests in this course.	1 2 3 4 5
21	I expect to do well in this class.	1 2 3 4 5
22	The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.	1 2 3 4 5
23	I think the course material in this class is useful for me to learn.	1 2 3 4 5
24	When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.	1 2 3 4 5
25	If I don't understand the course material, it is because I didn't try hard enough.	1 2 3 4 5
26	I like the subject matter of this course.	1 2 3 4 5
27	Understanding the subject matter of this course is very important to me.	1 2 3 4 5
28	I feel my heart beating fast when I take an exam.	1 2 3 4 5
29	I'm certain I can master the skills being taught in this class.	1 2 3 4 5
30	I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.	1 2 3 4 5
31	Considering the difficulty of this course, the teacher, and my skills, I think I will do well inthis class.	1 2 3 4 5

		1 2 3 4 5
	Part B. Learning Strategies	1 2 3 4 5
32	When I study the readings for this course, I outline the material to help me organise my thoughts.	1 2 3 4 5
33	During class time I often miss important points because I'm thinking of other things.	1 2 3 4 5
34	When studying for this course, I often try to explain the material to a classmate or friend.	1 2 3 4 5
35	I usually study in a place where I can concentrate on my course work.	1 2 3 4 5
36	When reading for this course, I make up questions to help focus my reading.	1 2 3 4 5
37	I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.	1 2 3 4 5
38	I often find myself questioning things I hear or read in this course to decide if I find them convincing	1 2 3 4 5
39	When I study for this class, I practice saying the material to myself over and over.	1 2 3 4 5
40	Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.	1 2 3 4 5
41	When I become confused about something I'm reading for this class, I go back and try to figure it out.	1 2 3 4 5
42	When I study for this course, I go through the readings and my class notes and try to find the most important ideas.	1 2 3 4 5
43	I make good use of my study time for this course.	1 2 3 4 5
44	If course readings are difficult to understand, I change the way I read the material.	1 2 3 4 5
45	I try to work with other students from this class to complete the course assignments.	1 2 3 4 5
46	When studying for this course, I read my class notes and the course readings over and over again.	1 2 3 4 5
47	When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.	1 2 3 4 5
48	I work hard to do well in this class even if I don't like what we are doing.	1 2 3 4 5
49	I make simple charts, diagrams, or tables to help me organise course material.	1 2 3 4 5
50	When studying for this course, I often set aside time to discuss course material with a group of students from the class.	1 2 3 4 5
51	I treat the course material as a starting point and try to develop my own ideas about it.	1 2 3 4 5
52	I find it hard to stick to a study schedule.	1 2 3 4 5
53	When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions	1 2 3 4 5
54	Before I study new course material thoroughly, I often skim it to see how it is organised.	1 2 3 4 5
55	I ask myself questions to make sure I understand the material I have been studying in this class.	1 2 3 4 5
56	I try to change the way I study in order to fit the course requirements and the instructor's teaching style.	1 2 3 4 5
57	I often find that I have been reading for this class but don't know what it was all about.	1 2 3 4 5
58	I ask the instructor to clarify concepts I don't understand well.	1 2 3 4 5
59	I memorise key words to remind me of important concepts in this class.	1 2 3 4 5
60	When course work is difficult, I either give up or only study the easy parts.	1 2 3 4 5
61	I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course.	1 2 3 4 5
62	I try to relate ideas in this subject to those in other courses whenever possible.	1 2 3 4 5
63	When I study for this course, I go over my class notes and make an outline of important concepts.	1 2 3 4 5
64	When reading for this class, I try to relate the material to what I already know.	1 2 3 4 5

65	I have a regular place set aside for studying.	1 2 3 4 5
66	I try to play around with ideas of my own related to what I am learning in this course.	1 2 3 4 5
67	When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.	1 2 3 4 5
68	When I can't understand the material in this course, I ask another student in this class for help.	1 2 3 4 5
69	I try to understand the material in this class by making connections between the readings and the concepts from the lectures.	1 2 3 4 5
70	I make sure that I keep up with the weekly readings and assignments for this course	1 2 3 4 5
71	Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.	1 2 3 4 5
72	I make lists of important items for this course and memorise the lists.	1 2 3 4 5
73	I attend this class regularly.	1 2 3 4 5
74	Even when course materials are dull and uninteresting, I manage to keep working until I finish.	1 2 3 4 5
75	I try to identify students in this class whom I can ask for help if necessary.	1 2 3 4 5
76	When studying for this course I try to determine which concepts I don't understand well.	1 2 3 4 5
77	I often find that I don't spend very much time on this course because of other activities.	1 2 3 4 5
78	When I study for this class, I set goals for myself in order to direct my activities in each study period.	1 2 3 4 5
79	If I get confused taking notes in class, I make sure I sort it out afterwards.	1 2 3 4 5
80	I rarely find time to review my notes or readings before an exam.	1 2 3 4 5
81	I try to apply ideas from course readings in other class activities such as lecture and discussion	1 2 3 4 5

Appendix D- The Felder-Solomon Learning Styles Inventory (LSI)

Please answer these questions only in relation to the RDA IIA module. If you have already completed RDA IIA, please try to answer as you think you would have answered while you were taking the course.

1. I understand something better after I
   - ☐ **(a)** try it out.
   - ☐ **(b)** think it through.
2. I would rather be considered
   - ☐ **(a)** realistic.
   - ☐ **(b)** innovative.
3. When I think about what I did yesterday, I am most likely to get
   - ☐ **(a)** a picture.
   - ☐ **(b)** words.
4. I tend to
   - ☐ **(a)** understand details of a subject but may be fuzzy about its overall structure.
   - ☐ **(b)** understand the overall structure but may be fuzzy about details.
5. When I am learning something new, it helps me to
   - ☐ **(a)** talk about it.
   - ☐ **(b)** think about it.
6. If I were a teacher, I would rather teach a course
   - ☐ **(a)** that deals with facts and real life situations.
   - ☐ **(b)** that deals with ideas and theories.
7. I prefer to get new information in
   - ☐ **(a)** pictures, diagrams, graphs, or maps.
   - ☐ **(b)** written directions or verbal information.
8. Once I understand
   - ☐ **(a)** all the parts, I understand the whole thing.
   - ☐ **(b)** the whole thing, I see how the parts fit.
9. In a study group working on difficult material, I am more likely to
   - ☐ **(a)** jump in and contribute ideas.
   - ☐ **(b)** sit back and listen.
10. I find it easier
    - ☐ **(a)** to learn facts.
    - ☐ **(b)** to learn concepts.
11. In a book with lots of pictures and charts, I am likely to

- ☐ **(a)** look over the pictures and charts carefully.
- ☐ **(b)** focus on the written text.

12. When I solve math problems
    - ☐ **(a)** I usually work my way to the solutions one step at a time.
    - ☐ **(b)** I often just see the solutions but then have to struggle to figure out the steps to get to them.
13. In classes I have taken
    - ☐ **(a)** I have usually gotten to know many of the students.
    - ☐ **(b)** I have rarely gotten to know many of the students.
14. In reading nonfiction, I prefer
    - ☐ **(a)** something that teaches me new facts or tells me how to do something.
    - ☐ **(b)** something that gives me new ideas to think about.
15. I like teachers
    - ☐ **(a)** who put a lot of diagrams on the board.
    - ☐ **(b)** who spend a lot of time explaining.
16. When I'm analyzing a story or a novel
    - ☐ **(a)** I think of the incidents and try to put them together to figure out the themes.
    - ☐ **(b)** I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.
17. When I start a homework problem, I am more likely to
    - ☐ **(a)** start working on the solution immediately.
    - ☐ **(b)** try to fully understand the problem first.
18. I prefer the idea of
    - ☐ **(a)** certainty.
    - ☐ **(b)** theory.
19. I remember best
    - ☐ **(a)** what I see.
    - ☐ **(b)** what I hear.
20. It is more important to me that an instructor
    - ☐ **(a)** lay out the material in clear sequential steps.
    - ☐ **(b)** give me an overall picture and relate the material to other subjects.
21. I prefer to study
    - ☐ **(a)** in a study group.
    - ☐ **(b)** alone.
22. I am more likely to be considered
    - ☐ **(a)** careful about the details of my work.

- ☐ **(b)** creative about how to do my work.

23. When I get directions to a new place, I prefer
    - ☐ **(a)** a map.
    - ☐ **(b)** written instructions.
24. I learn
    - ☐ **(a)** at a fairly regular pace. If I study hard, I'll "get it."
    - ☐ **(b)** in fits and starts. I'll be totally confused and then suddenly it all "clicks."
25. I would rather first
    - ☐ **(a)** try things out.
    - ☐ **(b)** think about how I'm going to do it.
26. When I am reading for enjoyment, I like writers to
    - ☐ **(a)** clearly say what they mean.
    - ☐ **(b)** say things in creative, interesting ways.
27. When I see a diagram or sketch in class, I am most likely to remember
    - ☐ **(a)** the picture.
    - ☐ **(b)** what the instructor said about it.
28. When considering a body of information, I am more likely to
    - ☐ **(a)** focus on details and miss the big picture.
    - ☐ **(b)** try to understand the big picture before getting into the details.
29. I more easily remember
    - ☐ **(a)** something I have done.
    - ☐ **(b)** something I have thought a lot about.
30. When I have to perform a task, I prefer to
    - ☐ **(a)** master one way of doing it.
    - ☐ **(b)** come up with new ways of doing it.
31. When someone is showing me data, I prefer
    - ☐ **(a)** charts or graphs.
    - ☐ **(b)** text summarizing the results.
32. When writing a paper, I am more likely to
    - ☐ **(a)** work on (think about or write) the beginning of the paper and progress forward.
    - ☐ **(b)** work on (think about or write) different parts of the paper and then order them.
33. When I have to work on a group project, I first want to
    - ☐ **(a)** have "group brainstorming" where everyone contributes ideas.
    - ☐ **(b)** brainstorm individually and then come together as a group to compare ideas.

34. I consider it higher praise to call someone
    - ☐ **(a)** sensible.
    - ☐ **(b)** imaginative.
35. When I meet people at a party, I am more likely to remember
    - ☐ **(a)** what they looked like.
    - ☐ **(b)** what they said about themselves.
36. When I am learning a new subject, I prefer to
    - ☐ **(a)** stay focused on that subject, learning as much about it as I can.
    - ☐ **(b)** try to make connections between that subject and related subjects.
37. I am more likely to be considered
    - ☐ **(a)** outgoing.
    - ☐ **(b)** reserved.
38. I prefer courses that emphasize
    - ☐ **(a)** concrete material (facts, data).
    - ☐ **(b)** abstract material (concepts, theories).
39. For entertainment, I would rather
    - ☐ **(a)** watch television.
    - ☐ **(b)** read a book.
40. Some teachers start their lectures with an outline of what they will cover. Such outlines are
    - ☐ **(a)** somewhat helpful to me.
    - ☐ **(b)** very helpful to me.
41. The idea of doing homework in groups, with one grade for the entire group,
    - ☐ **(a)** appeals to me.
    - ☐ **(b)** does not appeal to me.
42. When I am doing long calculations,
    - ☐ **(a)** I tend to repeat all my steps and check my work carefully.
    - ☐ **(b)** I find checking my work tiresome and have to force myself to do it.
43. I tend to picture places I have been
    - ☐ **(a)** easily and fairly accurately.
    - ☐ **(b)** with difficulty and without much detail.
44. When solving problems in a group, I would be more likely to
    - ☐ **(a)** think of the steps in the solution process.
    - ☐ **(b)** think of possible consequences or applications of the solution in a wide range of areas.

Appendix E- The Statistics Anxiety Scale

Please answer these questions only in relation to the RDA IIA module. If you have already completed RDA IIA, please try to answer as you think you would have answered while you were taking the course.

For each of the following situations, please choose the **level of anxiety** that best matches the amount of anxiety you would experience in that situation. Mark your response with an X in the appropriate box.

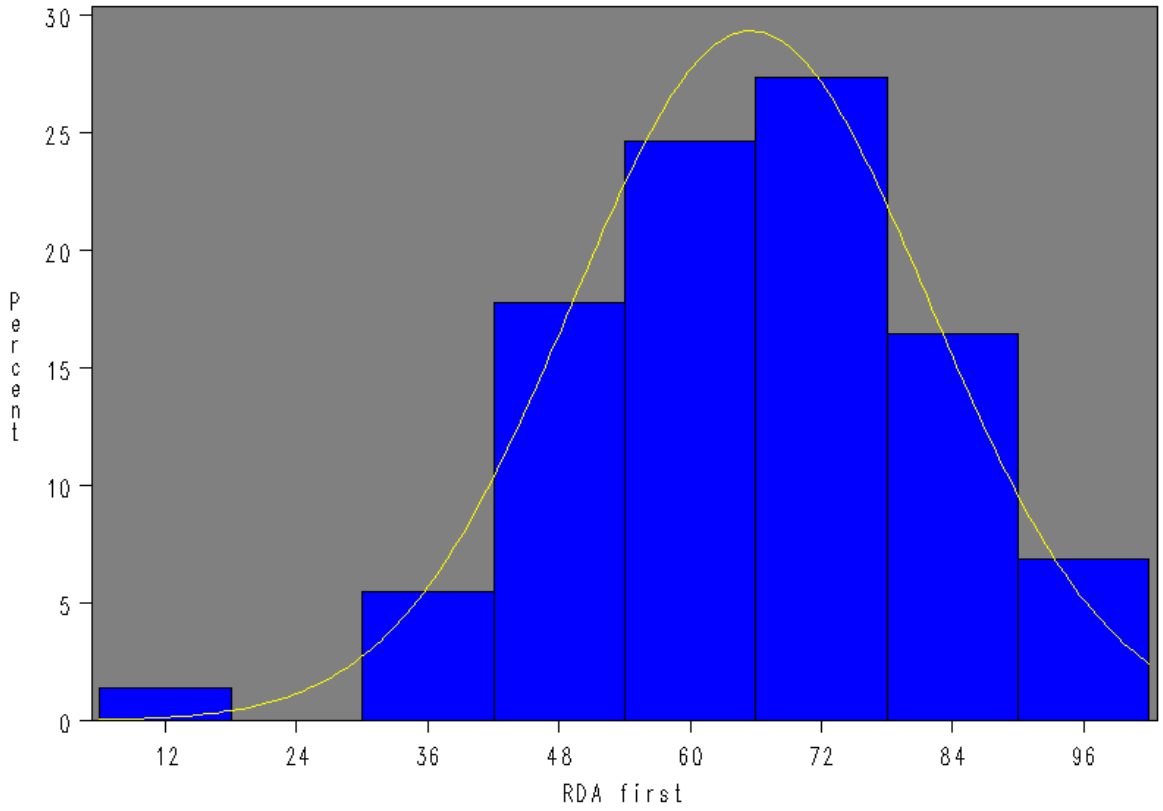
E.G. If you would feel a little anxiety, choose level **B** (A little)

	A *Not at all*	**B** *A little*	**C** *A fair amount*	**D** *Much*	**E** *Very much*
1. Opening a stats book and seeing a page full of problems.					
2. Listening to a lecture in a stats class.					
3. Starting a new chapter in a stats book.					
4. Signing up for a stats course.					
5. Picking up the stats textbook to begin working on a homework assignment.					
6. Realising that you have to take a certain number of stats classes to fulfill the requirement of your major.					
7. Not knowing the formula needed to solve a particular problem.					
8. Being given a homework assignment of many difficult stats problems which is due in the next class meeting.					
9. Being given a quiz in a stats class.					
10. Listening to another student explain a statistical formula.					
11. Working on an abstract mathematical problem such as: "If x=outstanding accounts, and y=total income, calculate how much you are left for recreational expenditures."					

12. Hearing a friend try to teach you a statistical procedure and finding that you cannot understand what he/she is telling you.					
13. Walking on campus and thinking about a stats course.					
14. Watching a teacher work an algebraic equation on the blackboard.					
15. Walking into a stats class.					
16. Solving a square root problem.					
17. Looking through the pages of a stats text.					
18. Walking into a stats tutorial.					
19. Talking to someone in your class who does well, about a problem and not being able to understand what he/she is explaining.					
20. Being asked to explain how you arrive at a particular solution for a problem.					
21. Reading and interpreting graphs or charts.					
22. Tallying up the results of a survey or poll.					
23. Doing a word problem in algebra.					
24. Sitting in a stats class and waiting for the instructor to arrive.					
25. Being called upon to recite in a stats class when you are prepared.					
26. Buying a statistics textbook.					
27. Asking your statistics instructor to help you with a problem that you don't understand.					

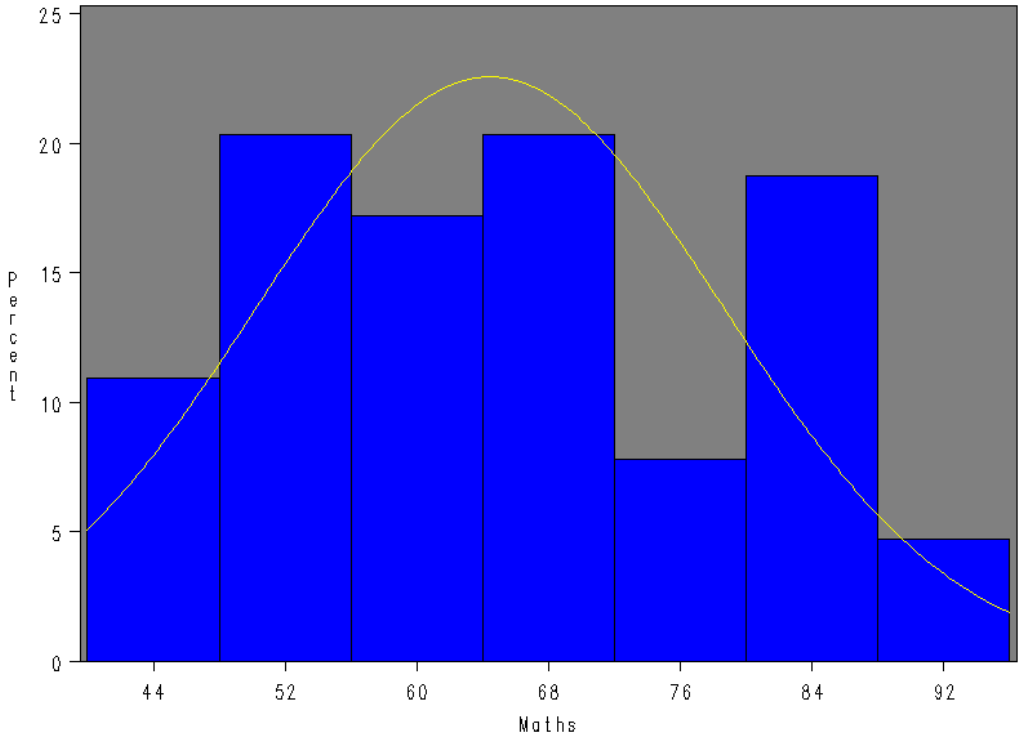
Appendix F- Tests for normality

RDA IIA marks



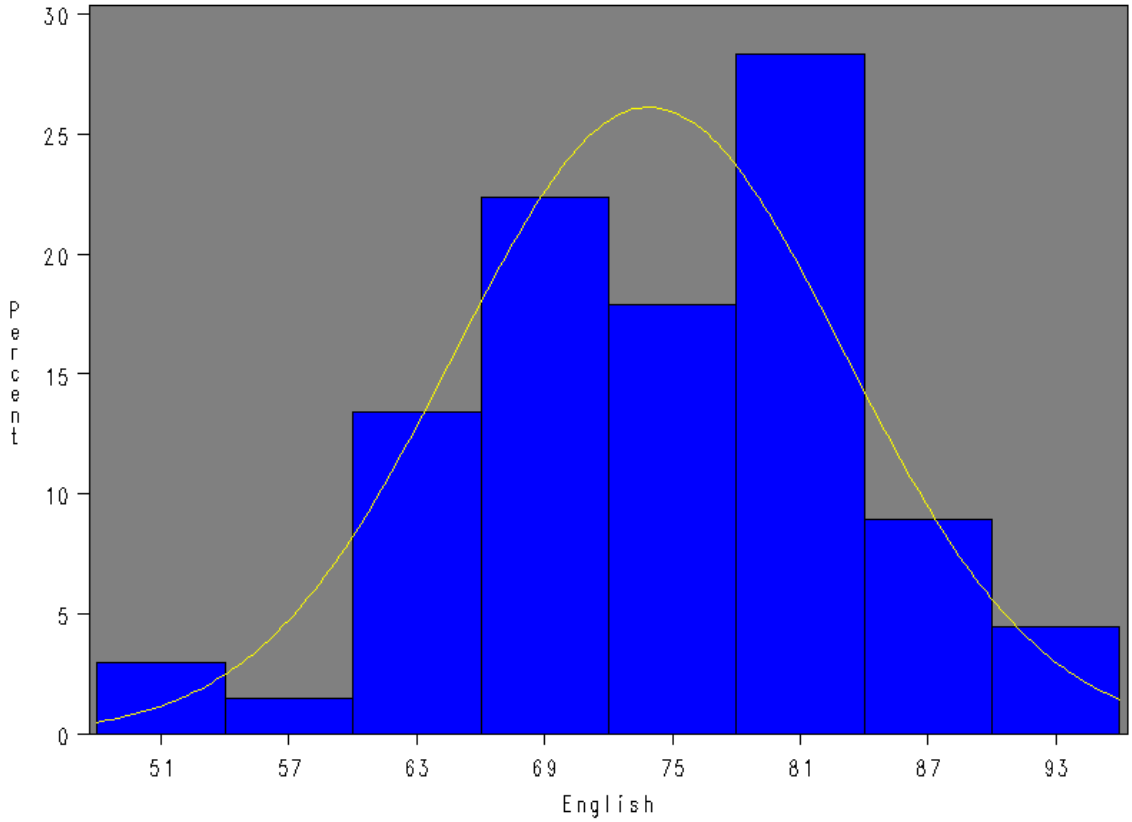
Goodness-of-Fit Tests for Normal Distribution				
Test		**Statistic**	**p Value**	
Kolmogorov-Smirnov	**D**	0.05405472	**Pr > D**	>0.150

Matric maths marks



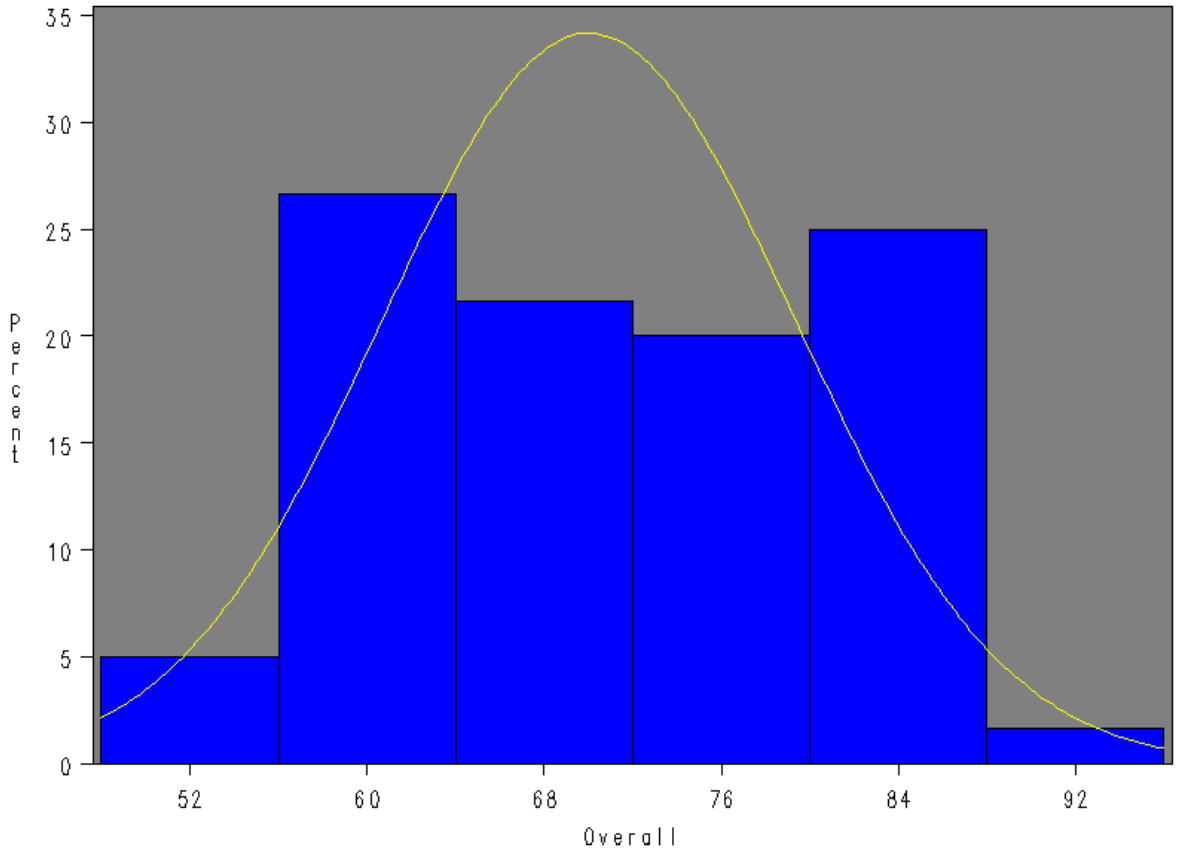
Goodness-of-Fit Tests for Normal Distribution				
Test		**Statistic**	**p Value**	
Kolmogorov-Smirnov	**D**	0.09869199	**Pr > D**	0.123

Matric English marks



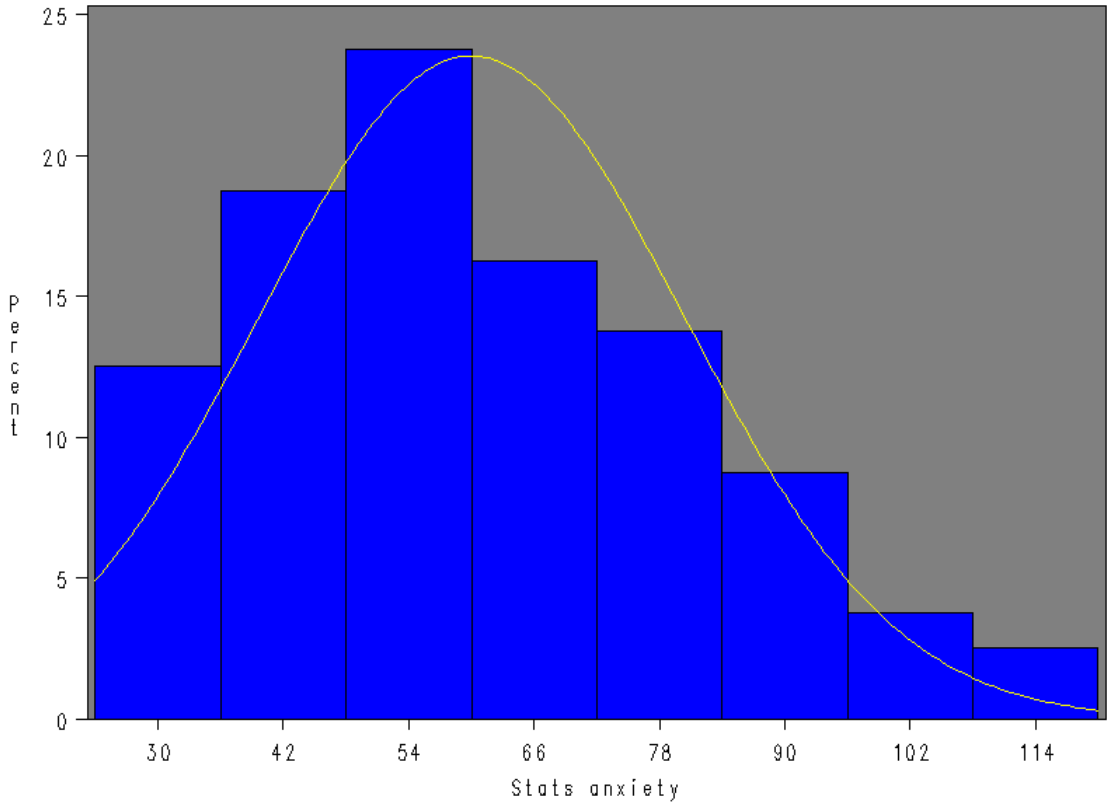
Goodness-of-Fit Tests for Normal Distribution				
Test		**Statistic**	**p Value**	
Kolmogorov-Smirnov	**D**	0.13435543	**Pr > D**	<0.010

Matric Overall Marks



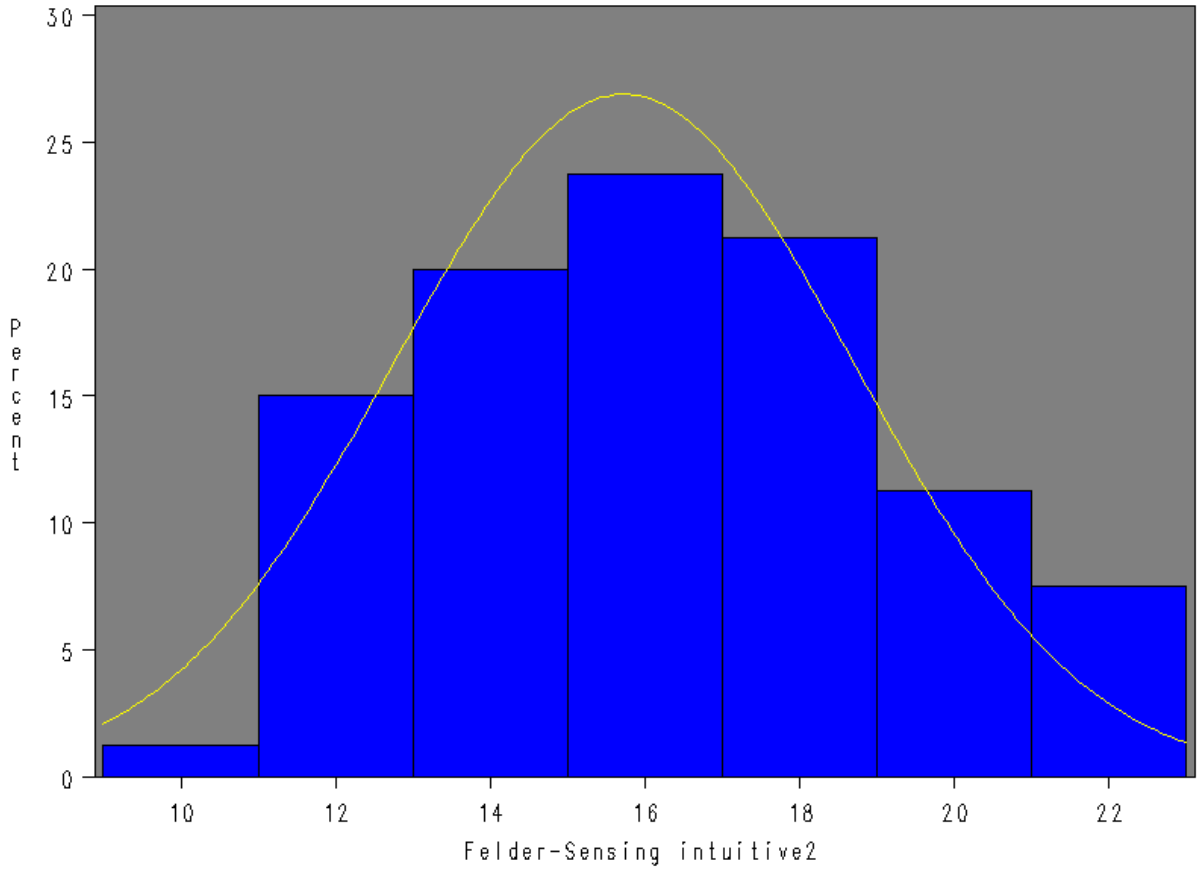
Goodness-of-Fit Tests for Normal Distribution				
Test		**Statistic**	**p Value**	
Kolmogorov-Smirnov	**D**	0.12494044	**Pr > D**	0.020

Statistics anxiety



Goodness-of-Fit Tests for Normal Distribution				
Test		**Statistic**	**p Value**	
Kolmogorov-Smirnov	**D**	0.11004714	**Pr > D**	0.018

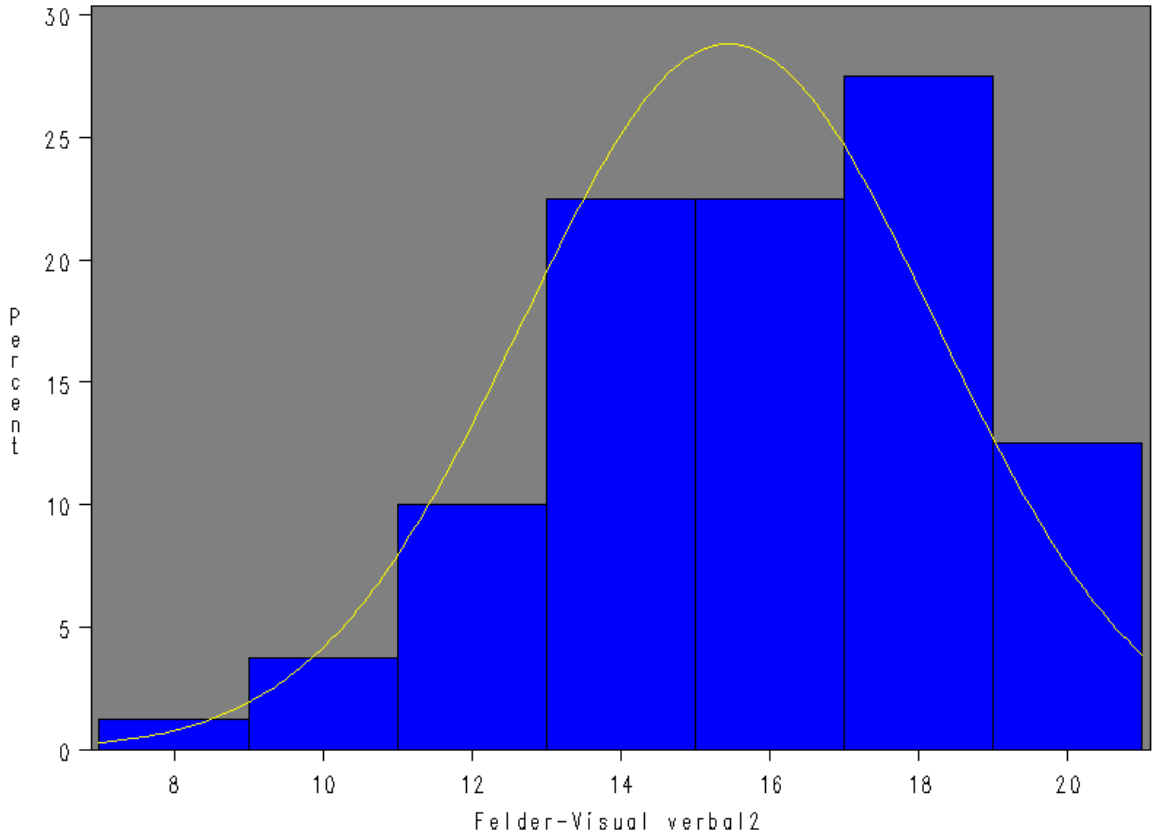
Felder Sensing intuitive



Goodness-of-Fit Tests for Normal Distribution

Test		Statistic		p Value
Kolmogorov-Smirnov	D	0.10821732	Pr > D	0.021

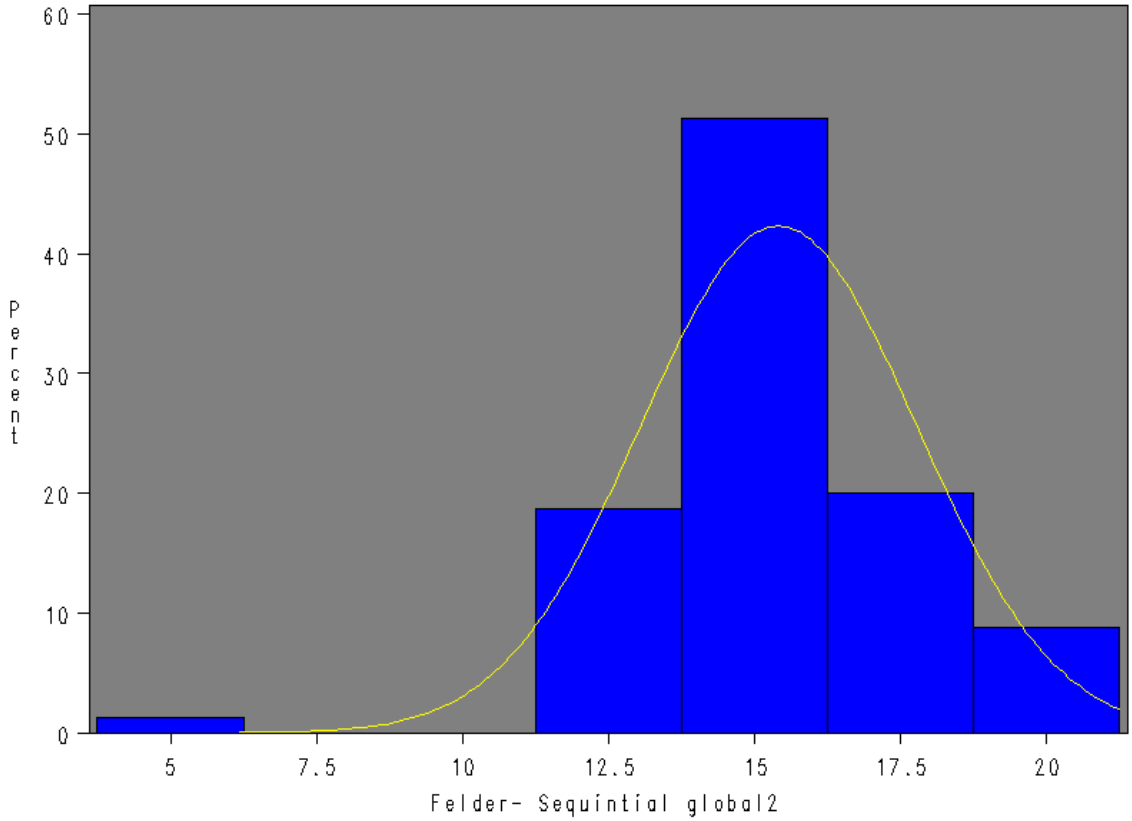
Felder-Visual Verbal



Goodness-of-Fit Tests for Normal Distribution

Test		Statistic		p Value
Kolmogorov-Smirnov	D	0.11216908	Pr > D	0.014

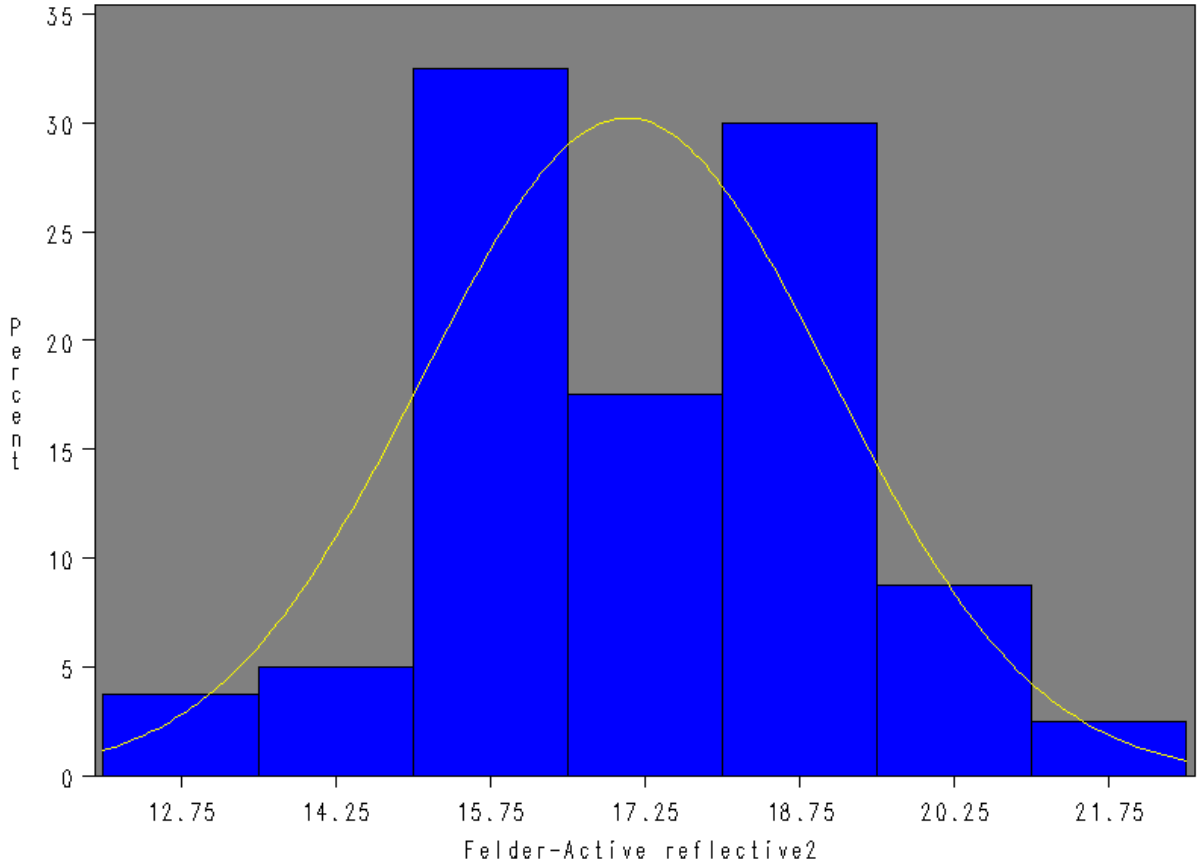
Felder- Sequential Global



Goodness-of-Fit Tests for Normal Distribution

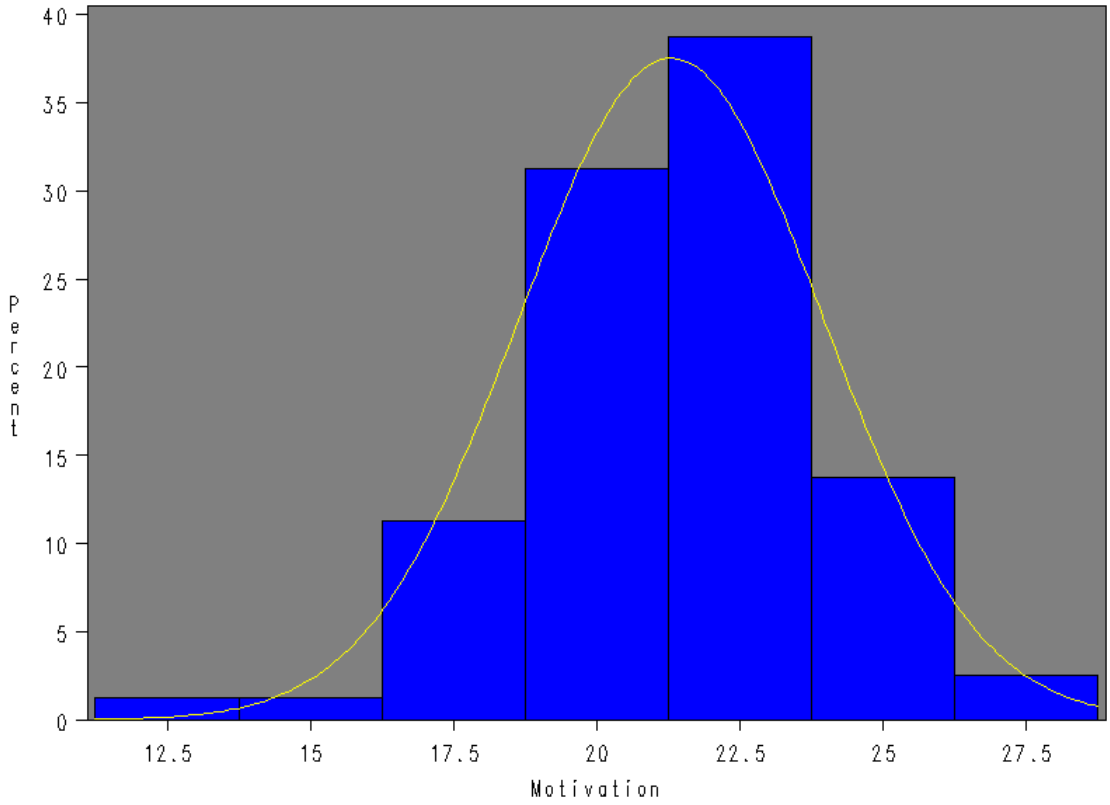
Test		Statistic		p Value
Kolmogorov-Smirnov	D	0.14836357	Pr > D	<0.010

Felder- Active Reflecive



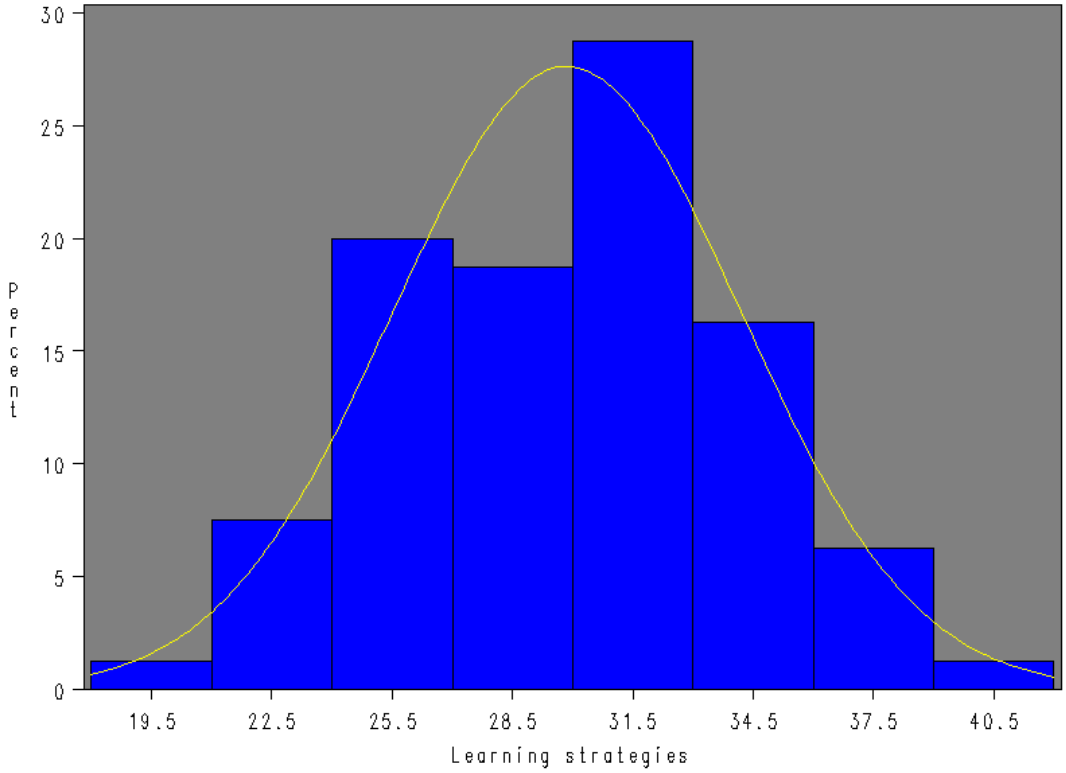
Goodness-of-Fit Tests for Normal Distribution				
Test		**Statistic**	**p Value**	
Kolmogorov-Smirnov	**D**	0.11895954	**Pr > D**	<0.010

MSLQ- Motivation subscale



Goodness-of-Fit Tests for Normal Distribution				
Test		**Statistic**	**p Value**	
Kolmogorov-Smirnov	**D**	0.07445543	**Pr > D**	>0.150

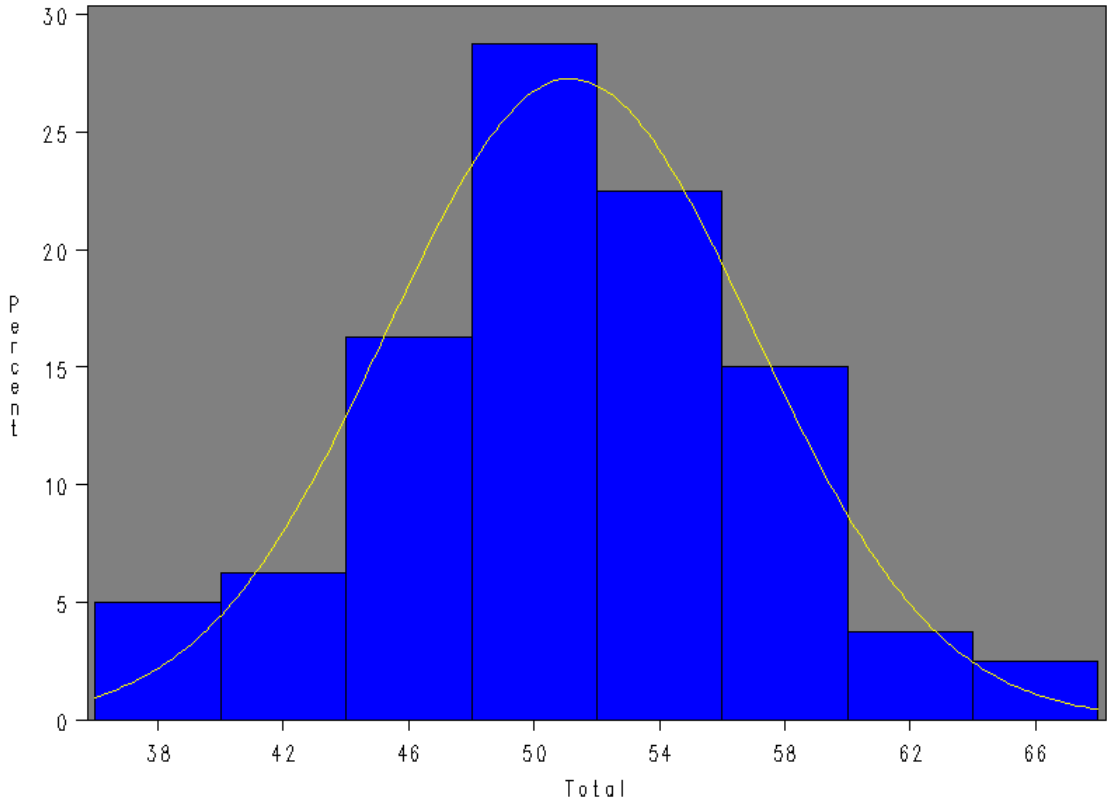
MSLQ- Learning Strategies subscale



Goodness-of-Fit Tests for Normal Distribution

Test		Statistic		p Value
Kolmogorov-Smirnov	D	0.05392850	Pr > D	>0.150

MSLQ- Scale Total



Goodness-of-Fit Tests for Normal Distribution				
Test		**Statistic**	**p Value**	
Kolmogorov-Smirnov	**D**	0.05741707	**Pr > D**	>0.150

Appendix G Ethics clearance certificate