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Master of Arts in Research Psychology

Self-Efficacy, Metacognitive Awareness, Working Memory, and Academic Performance in a Research Methods Course

A research report submitted in partial fulfilment of the requirements for the degree of Masters in Psychology in the Faculty of Humanities, University of Witwatersrand, Johannesburg, March 2013.

Masters in Psychology: Research Report

Self-Efficacy, Metacognitive Awareness, Working Memory and Academic Performance in a Research Methods Course

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Acknowledgements:

Firstly, I would like to thank my supervisor, Nicky Israel, for her constant support and guidance. Her knowledge and advice has helped me not only in my academic career, but in my life as well. The write up of this thesis would not have been possible without all her help and encouragement. Nicky has been a mentor throughout my postgraduate years, and I am eternally grateful to have worked with such a remarkable scholar. Thank you for believing in me.

I would like to thank Enid Schutte for allowing me to lecture her class, I will never forget that experience, and I would like to thank her for all the support she showed me whilst collecting my data. I want to thank the wolf pack of the Masters class for all their support and all the fun times we had during this tough year, we made it!

I would also like to thank my family and friends, whose constant encouragement and understanding helped me through the toughest times. I would especially like to thank my mother and father for all their support, and for putting up with my stressed states. Thank you Dad for allowing me to print thousands of pages without complaint, your generosity will never be forgotten. Thanks Mom and Dad, I love you.

Above all, I would like to thank God for carrying me through this journey and for providing me with the opportunity to learn. " I will give you thanks, for you answered me; you have become my salvation"- Psalm 118: 21.

<u>Self-Efficacy, Metacognitive Awareness, Working Memory and Academic Performance in a Research Methods Course</u>

Research is vital in Psychology, as well as the social sciences, as it is a tool for creating knowledge through the interpretation and manipulation of empirical data, and thus furthering understanding in a field (Barak, 1998; Bridges, Gillmore, Pershing, & Bates, 1998; VanderStoep & Shaughnessy, 1997). Self-efficacy, metacognitive awareness, and working memory are essential to explore in relation to academic performance in research methods courses such as RDA IIA, as these skills are needed in the different components of these types of courses and are likely to play a role in predicting academic performance (Alloway, 2006; Bandura, 1993; Payne & Israel, 2010; Zulkiply, Kabit, & Ghani, 2008). Self-efficacy, metacognitive awareness, and working memory are also all potentially susceptible to intervention, and therefore exploring and establishing relationships between these variables could improve ways to teach and help students achieve academically. Therefore, this study aimed to examine the relationships between academic self-efficacy, metacognitive awareness, working memory, and academic performance on the RDA IIA module overall and for different components.

The sample consisted of 95 students who had completed RDA IIA at the University of the Witwatersrand. The instrumentation used consisted of a brief demographic questionnaire, an adapted Academic Self-Efficacy Scale, the Metacognitive Awareness Inventory, and three working memory tasks assessing verbal, spatial, and numerical working memory. Academic self-efficacy related to and predicted performance in the research component of the course, and also predicted final RDA IIA mark. Metacognitive awareness did not relate to or predict any aspect of RDA IIA performance, except for a significant positive correlation between declarative knowledge and research mark. The working memory total and mental counters task related to and predicted all aspects of RDA IIA performance; the verbal task related to research mark but had no predictive role in RDA IIA performance; and lastly, the spatial task did not relate to or predict any aspects of RDA IIA performance. The results of the study contribute to a better understanding of the factors relating to and predicting RDA IIA performance; and these findings may lead to the development of more effective intervention programmes to assist students in improving their research methodology marks.

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Chapter 1: Literature review

This chapter will introduce the importance of research methods, as well introducing the important concepts relating to academic performance in research methodology courses. The concepts related to academic performance which are discussed in detail include: academic self-efficacy, metacognitive awareness, and working memory, as well as the links between these three constructs. This chapter then briefly discusses the current study, which includes the research questions under investigation.

Introduction

Research is vital in psychology, as well as the social sciences, as it is a tool for creating knowledge through the interpretation and manipulation of empirical data, and thus furthering understanding in a field (Barak, 1998; Bridges, Gillmore, Pershing, & Bates, 1998; VanderStoep & Shaughnessy, 1997). Therefore, teaching both qualitative and quantitative research methods at a tertiary level, as well as both qualitative analytic techniques and statistics, is critical in order to allow students to understand published scientific articles and to assist them in conducting research to further their disciplines (Barak, 1998; VanderStoep & Shaughnessy, 1997). It is for this reason that the majority of universities, both local and international, now offer compulsory research methodology and analytic courses, however these are usually considered extremely difficult by students, particularly those focused on quantitative methods and statistics (Murtonen & Lehtinen, 2003; Wagner, Garner, & Kawulich, 2011). These courses are regarded as difficult as students are faced with material they consider both uninteresting and hard to comprehend, especially in relation to methodology; in addition, many students experience mathematical or statistical anxiety in relation to studying quantitative analysis (Benson & Blackman, 2003; Bridges et al., 1998).

At the University of the Witwatersrand, a compulsory research course for psychology students (Research Design & Analysis IIA (RDA IIA)) is taught at the second year level, with a fairly large number (approximately twenty-five percent on average) of students failing each year (Laher, Israel, & Pitman, 2007; Payne & Israel, 2010). It is therefore important to investigate factors that may play a role in predicting academic outcomes in this course specifically and in methodology courses more generally in order to better understand how to develop effective interventions to reduce failure rates, as the cost of failure in higher education is very high both financially and socially (Carmichael & Taylor, 2005). The current study seeks to investigate self-efficacy, metacognitive awareness, and working memory as possible factors related to academic performance in the RDA IIA course in line with this outcome.

Self-efficacy is important to explore in university students as it has been found to affect both motivation and learning (Van Dinther, Dochy, & Segers, 2011). It has also been identified as a predictor of RDA IIA performance in previous research (Payne & Israel 2010). It is therefore an important variable to investigate in relation to academic performance in RDA IIA, particularly as it can potentially be developed in students through interventions designed to assist them to focus on the necessary associated knowledge and skills; such interventions within higher education have been shown to be successful in the past (Freudenberg, Camero, & Brimble, 2011; Gist & Mitchell, 1992; Van Dinther et al., 2011). Confirming whether self-efficacy plays a role in predicting RDA IIA performance is therefore important as it may identify additional ways to assist students who could potentially benefit from intervention.

Similarly, metacognition is believed to predict academic performance generally, as a number of studies have shown that students who have good metacognitive awareness have received better academic results than students with poorer metacognitive awareness (Coutinho, 2007). It is therefore important to study metacognition as a potential factor; if it does play a role students with poor metacognitive awareness can be identified and provided with metacognitive training, which has been shown to improve academic outcomes and learning (Coutinho, 2007; 2008; Nietfeld & Schraw, 2002). Metacognitive awareness and training have also been found to improve self-efficacy in several studies (Schmidt & Ford, 2003). However, the literature on the relationship between metacognitive awareness and academic performance is not clear as some studies have suggested there is no relationship between them, and the role of metacognitive awareness in predicting RDA IIA performance has not been previously explored (Sperling, Howard, Miller, & Murphy, 2002). Therefore, investigating this construct in terms of its relationship to RDA IIA performance and in a South African context is important as it may also assist to identify means to help students better understand how to improve their performance.

Working memory is an important factor in relation to academic performance, as all cognitive tasks require memory, which is essential in the learning process (Aguirre-Perez, Otero-Ojeda, Pliego-Rivero, & Ferreira-Martinez, 2007). Working memory is not merely a placeholder for intelligence (although it is closely linked); it is a distinct cognitive skill that affects academic achievement in its own right (Alloway & Alloway, 2010). There is evidence that suggests that working memory can be improved through intervention and practicing certain tasks such as anagram tasks, listening span tasks, reading span tasks, and grid tasks (Autin & Croizet, 2012; Nutley, Söderqvist, Bryde, Humphreys, & Klingberg, 2010). Thus it is valuable to study in relation to RDA IIA performance as it is potentially open to intervention if found relevant.

Therefore it is important to study self-efficacy, metacognition, and working memory as these constructs have previously been found to predict academic performance, and they can potentially be improved through intervention. With regards to RDA IIA, if these concepts are found to play a role in predicting academic performance, interventions that take these factors into account can be developed in order to assist students to improve these skills and therefore possibly their overall academic performance. If relationships exist between these concepts and RDA IIA performance, these relationships could also possibly apply to methodology courses in general, and therefore, could be used for general intervention. This study therefore aims to examine the relationships between self-efficacy, metacognitive awareness, working memory, and academic performance in RDA IIA, as well as whether self-efficacy, metacognitive awareness, and/ or working memory play a role in predicting students' academic performance in RDA IIA.

It is recognized that, as with academic performance generally, there are a high number of other factors that could determine RDA IIA performance (Payne & Israel, 2010;

Riaz Ahmad, Khalid Pervaiz, & Aleem, 2010). The intention of the study is therefore to explore the potential role these factors might play in predicting RDA IIA performance rather than examining them as exclusive predictors.

Research methods

It is vital in the social sciences, particularly in the field of psychology, to conduct and analyse research in order to further the discipline. The fundamental skills necessary to conduct and analyse research, both quantitatively and qualitatively, are taught at most universities (Payne & Israel, 2010; Wagner et al., 2011). Research is the sole focus of certain postgraduate degrees and is also necessary for postgraduate students completing degrees in other fields such as counselling, clinical, and organisational psychology (Vittengl et al., 2004; Wagner et al., 2011).

At an undergraduate level, quantitative research methods courses tend to focus on teaching students how to conduct research, including types of experimental and non-experimental design, sampling strategies, ethics, and hypothesis testing; and statistics courses, which are closely linked, teach students how to conduct effective quantitative data analyses in research (Barak, 1998; VanderStoep & Shaughnessy, 1997). In general, at an undergraduate level, qualitative methods courses serve as an introduction to concepts regarding qualitative methods, data collection, transcriptions, and qualitative analyses (Mitchell, Friesen, Friesen, & Rose, 2007).

A study conducted by VanderStoep and Shaughnessy (1997) found that research methodology courses improved students' ability to think critically and develop general reasoning skills, which are not only important for success at university, but are also vital in real-life situations. In Barak's (1998) review of the literature, he identified nine reasons for the importance of teaching research methods to counselling students in university, which were: i) understanding published research reports; ii) conducting research; iii) effective communication with professionals in the field; iv) developing scientific skills such as writing and reporting; v) developing an interest in or appreciation for research; vi) developing confidence and a perceived sense of self-efficacy when applying research; vii) developing approaches to counselling; viii) establishing validity of the profession; and, ix) learning how to do therapy through investigation. Therefore, it is important to study research methods as one is able to learn how to conduct effective research, understand and critically evaluate published reports, and develop knowledge to further the understanding of a discipline.

Quantitative research methodology and statistic courses are, however, typically considered extremely difficult by students, as they have a high cognitive load, include challenging statistical language, and are generally considered unappealing; they therefore tend to have a high failure rate among university students (Laher et al., 2007; Murtonen & Lehtinen, 2003). Qualitative methods courses are also very challenging for students, as they do not usually offer a 'step-by-step' set of skills (as statistics does) and require a lot of critical input (Mason, 2002). A study conducted by Murtonen and Lehtinen (2003), which asked open-ended questions regarding difficulties experienced in studying research methods, found that the five main problems students were faced with were: i) superficial teaching; ii) linking methodology theory to its practice: iii) difficulty and unfamiliarity with the work content and concepts; iv) understanding and integrating parts of scientific research; and v) negative attitudes towards course work. With reference to the negative attitude towards course work, Vittengl et al. (2004) reported that undergraduates also showed a low to moderate interest in psychological research. This could contribute to the negative attitude that students have regarding studying research. Nevertheless, these courses are extremely important for students in the social sciences, and therefore, emphasis has been placed on them, with many universities making them compulsory modules (Murtonen & Lehtinen, 2003; Wagner et al., 2011).

The University of the Witwatersrand in Johannesburg offers one such undergraduate course, called Research Design and Analysis IIA. This module consists of a statistics component as well as a research design component that covers elements of both quantitative and qualitative research theory and psychometrics, and runs for the first semester of the academic year (Laher et al., 2007). The statistics component covers both descriptive and inferential statistical procedures, specifically hypothesis testing; while the research design component covers the basics of experimental and quasi-experimental design; basic concepts in qualitative research, and fundamental psychometric theory, including reliability, validity, bias and fairness, and issues of testing in South Africa.

The final RDA IIA mark consists of an exam mark and a year mark, which contain separate marks for each component. The examination in statistics includes short, open-ended theoretical questions as well as calculation questions; while the research design exam includes both multiple-choice and open-ended questions. Both exams are partly open-book, as students are permitted to bring in self-developed notes of a certain length. The year mark is calculated based on test performance, which consists of only multiple-choice questions for research design and open-ended calculation and short theory questions for statistics. RDA IIA is a compulsory course for undergraduate students who wish to major in psychology, and therefore a large number of students register for the course (Laher et al., 2007). Despite a number of intervention efforts, such as the tutorial programme and creating research design, psychometrics, and 'basic maths for stats' workbooks, there is still a relatively high failure rate for the course (Laher et al., 2007).

Due to the importance of research for psychology students, particularly those intending to study postgraduate degrees in psychology, it has become essential to identify factors that play a part in determining students' performance in research methods courses such as RDA IIA. This could contribute to developing effective interventions to assist students to find ways to improve their performance and allow teaching staff to identify ways to reduce the failure rate and improve interest.

Factors affecting academic performance

From a review of the literature, factors that affect academic performance in higher education can broadly be divided into four categories, namely academic, psychosocial, cognitive, and demographic. These four categories are based on the categories used by McKenzie and Schweitzer (2001). In their review of the literature, academic predictors included previous academic performance and study skills; psychosocial predictors included quality of the university system, personality, satisfaction with the university, finance, and social support; cognitive factors included self-efficacy and attributional style; and lastly demographic factors included age and employment responsibility (McKenzie & Schweitzer, 2001). These categories are not complete and more factors may be included in each category, as will be discussed below.

With regards to academic factors, previous academic performance and approaches to learning have been found to be a strong predictor of academic performance in various studies (Diesth, Pallesen, Brunbary, & Larsen, 2010; Karemera, Reuben, & Sillah, 2003; McKenzie & Schweitzer, 2001). Psychosocial predictors can further be divided into individual factors, environmental factors, and lecturer characteristics. Individual factors, students' effort, personality, perceived stress, motivation, and test anxiety have also been found to affect academic performance in university (Bandura, 1997; Diseth et al., 2010; Furnham, Chamorro-Premuzic, & McDougall, 2003; Lievens, Coetsier, De Fruyt, & De Maeseneer, 2002; Talib & Sansgiry, 2011). Environmental factors that have previously been found to predict or relate to academic performance have been the learning or university context, integration into university, adequacy of library services, and out-of-class experiences (Diseth et al., 2010; Karemera et al., 2003; McKenzie & Schweitzer, 2001). Lecturer characteristics such as regularity, punctuality, planning, delivery, and professionalism have also been found to affect student's academic performance (Riaz Ahmad et al., 2010; Yin Fah & Osman, 2011).

Certain cognitive factors that have been found to influence or predict academic performance have been self-efficacy, intelligence, metacognition, and working memory (Aguirre-Perez et al., 2007; Colom, Escorial, Shih, & Privado, 2007; Coutinho, 2007; McKenzie & Schweitzer, 2001; Zajacova, Lynch, & Espenshade, 2005). Lastly demographic factors such as levels of education, gender, social and cultural background, and employment responsibilities have also been found to play a role in determining academic performance (Furnham et al., 2003; McKenzie & Schweitzer, 2001). In South Africa, predictors or correlates of academic performance that have been previously identified include English language proficiency, self-efficacy, and demographic variables such as socioeconomic status, age, and family environment (Molefo, 2000; Stephen, Welman, & Jordaan, 2004; Van der Westhuizen, de Beer, & Bekwa, 2011).

Of the numerous factors identified, some can be changed through intervention (such as approaches to learning, test anxiety, and motivation) and some cannot be changed through intervention (such as personality and previous academic achievement). It is therefore important to explore those factors that can be changed through intervention generally and it is also important to explore which factors predict research methods course performance specifically, in order to make the interventions as relevant as possible.

In quantitative research methods courses, previous research has indicated that statistical anxiety plays a large part in predicting academic performance (Bridges et al., 1998; Onwuegbuzie & Wilson, 2003). This is in relation to the quantitative aspect of research methods however there appears to be extremely limited research exploring factors predicting academic performance in qualitative methods and research design courses. Research exploring factors predicting academic performance on research methods courses in the South African context also appears very limited. One such study, conducted by Payne and Israel (2010), looked specifically at the RDA IIA course.

Payne and Israel (2010) investigated whether or not certain intrinsic student factors predicted performance on the RDA IIA course. The factors investigated were various demographic factors, cognitive learning style, learning strategies, statistics anxiety, and motivation. Certain aspects of motivation (intrinsic motivation and task value) and statistical anxiety were found to be related to performance in RDA IIA, but were not found to be predictive of performance. Age, secondary school performance, help-seeking, reflective learning style, and self-efficacy were found to be both related to and predictive of RDA IIA performance in the specific sample used.

The current study aims to build on the work of Payne and Israel (2010) by studying additional factors that could play a role in predicting academic performance for RDA IIA. The factors explored in the current study are in line with the theory of self-regulated learning, which states that learning is controlled by three related factors: cognitive, metacognitive, and motivational (Winne, 1995). The study therefore explored self-efficacy (motivational factor), metacognitive awareness (metacognitive factor), and working memory (cognitive factor) as predictors of academic performance.

Self-efficacy

According to Bandura (1994), "…perceived self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (p. 3). Simply, self-efficacy is a person's belief in his or her own ability or competence. It is important to note that self-efficacy is not concerned with the actual skills a person possesses, but rather with how useful they perceive their skills to be (Bandura, 1986). These beliefs are said to govern people's feelings, thoughts, motivation, perseverance, decisions, and behaviour (Bandura, 1977; 1994). Individuals are more likely to persevere in and choose activities in which they feel they are competent and avoid those in which they feel they are not competent, thus showing how self-efficacy influences the components outlined above (Van Dinther et al., 2011). Self-efficacy is therefore important as it determines which activities people choose to do, how much effort they put into these activities, and their persistence in the activity (Bandura, 1989; Schunk, 1991).

Self-efficacy represents a core component of Bandura's Social Cognitive Theory (SCT). This theory assumes a wider view of human agency (which is defined as acting with intention), as humans do not live in isolation but have a number of interacting factors that determine their actions (Bandura, 1997). Social cognitive theory states that "…human functioning is explained in terms of a model of triadic reciprocality in which behaviour, cognitive and other personal factors, and environmental events all operate as interacting determinants of one another" (Bandura, 1986, p. 18). This suggests that human agency is reciprocally caused when behaviour, cognition (other personal factors), and environmental factors interact bi-directionally (Bandura, 1989; 1997). The strength that these determinants exert on human agency is not equal, but varies for different tasks (Bandura, 1997). Self-efficacy represents one of the 'cognitive and other personal factors' in this theory (Di Iorio, 1997).

Perceived self-efficacy is a fundamental part of social cognitive theory as it can act upon the other determinants and is said to be highly predictive of actual behaviour (Bandura, 1997). Outcome expectancies (the perception of possible consequences of behaviour), as well as self-efficacy expectancies, are thought to lead to an individual's ultimate behaviour (Schwarzer, Mueller, & Greenglass, 1999). Individuals with a high sense of self-efficacy will confront challenging tasks with a positive outlook in their abilities, which will result in greater achievement, stress reduction, and a lower vulnerability to depression (Bandura, 1994). On the other hand, individuals with low self-efficacy avoid challenging tasks and choose to focus on the negative aspects they possess, thus they are vulnerable to increased stress and depression (Bandura, 1994).

According to this theory, an individual can develop a sense of self-efficacy through four main sources. The first is through 'enactive mastery experience', which involves previous performance accomplishments or failures that increase or decrease perceived self-efficacy (Bandura, 1977; 1994; 1997). The second source is through 'vicarious experience', which involves appraising one's abilities in comparison to those of others and modelling or observing others who have desired skills (Bandura, 1977; 1994; 1997). The third source is through verbal or social persuasion in which the individual is persuaded verbally by significant others that they possess certain skills to achieve their desired goals thus instilling a high sense of self-efficacy; however, a low sense of self-efficacy can be instilled if a significant other expresses doubts (Bandura, 1977; 1994; 1997). The last source of developing self-efficacy is through 'physiological and affective states' in which individuals rely on somatic indicators such as arousal or emotional states when judging their abilities (Bandura, 1977; 1994; 1997). These four sources are then integrated and only become instructive of self-efficacy when they are cognitively processed through reflexive thought (Bandura, 1997).

Self-efficacy plays an important role in anxiety and depression, and is therefore an important concept to study with regards to the academic environment (Bandura, 1997). According to Bandura (1997), "Efficacy beliefs should be measured in terms of particularized judgments of capability that may vary across realms of activity, under different levels of task demands within a given activity domain, and under different situational circumstances" (p. 42). Due to this, it is of vital importance to look at academic self-efficacy instead of general self-efficacy when conducting research in academic settings, as self-efficacy varies across domains.

Academic self-efficacy refers to an individual's belief in their ability to perform certain academic tasks at particular levels (Schunk, 1991). The concept of academic self-efficacy is important in relation to academic performance as students with a high sense of academic self-efficacy perform better on academic measures than students with a low sense of academic self-efficacy (Schunk, 1989). There are three key ways in which efficacious beliefs contribute to the development of cognitive abilities that affect academic performance, namely: students' self-efficacy beliefs in an academic subject, lecturers' self-efficacy beliefs to motivate students to learn, and the collective efficacy that the subject can foster academic achievement (Bandura, 1997). Self-efficacy beliefs have been shown to predict interest and positive attitudes in a mathematical subject whereas skills in the subject did not (Bandura, 1997). Students were shown to perform poorly if they had skills but lacked interest or positive attitudes, stressing the importance of self-efficacy in the academic environment (Bandura, 1997).

With regards to learning in an academic environment, Schunk (1989) states "…self-efficacy for learning involves assessing what will be required in the learning context and how well one can use one's knowledge and skills to produce new learning" (p. 180). This has been supported by previous studies in which self-efficacy has been shown to influence motivation and cognition in the academic environment (Bandura, 1993; Schunk, 1991; Van Dinther et al., 2011).

Numerous studies have shown that both general and academic self-efficacy, whether directly or indirectly, contribute to predicting academic performance (Carmichael & Taylor, 2005; Pajares, 1996; Zimmerman, Bandura, & Martinez-Pons, 1992). Brown, Lent, and Larkin (1989) found that a sense of self-efficacy had facilitative effects on academic performance and persistence whereas Gore (2006) found that academic self-efficacy was a weak predictor of performance. In the case of the Gore (2006) study, academic self-efficacy was measured at the beginning of the first semester, which could have affected the level of self-efficacy in students, as they had not experienced failures or successes, which lead to the development of self-efficacy. Self-efficacy has also been found to predict mathematical achievement, which links to calculation requirements in the RDA IIA statistics component (Pajares & Graham, 1999; Stevens, Olivarez, Lan, & Tallent-Runnels, 2004).

Given the available literature, it appears that academic self-efficacy should have positive effects on all the components of RDA IIA performance. In the research conducted by Payne and Israel (2010), it was found that academic self-efficacy was a predictor of RDA IIA academic performance. Although this finding was an important initial one, this result would need to be duplicated and validated using different measures and samples to establish with more certainty the role academic self-efficacy might play in predicting RDA IIA performance. In addition, it is unclear as to which components of RDA IIA performance are affected by academic self-efficacy, as the majority of the reviewed studies focus on overall academic performance. As discussed, self-efficacy has an effect on statistics performance and therefore it is hypothesised that self-efficacy will play a part in predicting the statistics component of RDA IIA (Pajares & Graham, 1999; Stevens et al., 2004). In theory, academic self-efficacy should also relate to better performance on the research design component. Self-efficacy has been shown to play a role in anxiety (Bandura, 1997); students with lower self-efficacy will have higher anxiety, which may result in reduced performance, affecting all components of RDA IIA performance, and therefore self-efficacy is expected to play a role in predicting academic performance.

Metacognitive awareness

Metacognition is concerned with an individual's knowledge about his or her own cognitive processes (Flavell, 1976; Schraw & Dennison, 1994). Amongst the first definitions of metacognition was Flavell's (1976) in which he referred to metacognition as being "…the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects or data on which they bear, usually in the service of some concrete goal or objective" (p. 232). Metacognition can therefore be seen as knowledge about one's cognition and the monitoring of that cognition. Metacognition is thus a complex construct as it consists of both metacognitive skills and metacognitive awareness, and the available literature is difficult to interpret as the term 'metacognition' is used interchangeably to refer to both or either of these (cf. Coutinho, 2007; Topcu & Yilmaz-Tuzun, 2009; Zulkiply, Kabit, & Ghani, 2008).

Schraw and Dennison (1994) define metacognitive awareness as referring "…to the ability to reflect upon, understand, and control one's learning" (p. 460). Their account divides metacognitive awareness into two components, which themselves further divide into subcomponents.

The first component of metacognitive awareness is *knowledge of cognition,* which includes declarative, procedural, and conditional knowledge (Schraw & Dennison, 1994). Declarative knowledge includes knowing about the self and about strategies or factors that influence performance, and is therefore a more factual type of knowledge

(Schraw & Dennison, 1994; Schraw & Moshman, 1995; Zulkiply et al., 2008). Procedural knowledge includes knowing how to use these strategies and conditional knowledge includes knowing when, how, and why to implement these strategies (Schraw & Dennison, 1994; Schraw & Moshman, 1995; Zulkiply et al., 2008). These three types of knowledge are believed to assist the reflective aspect of metacognition (Schraw & Dennison, 1994).

The second component of metacognitive awareness is the *regulation of cognition,* which is further subdivided into five subcomponents, which include: planning, information management strategies, comprehension monitoring, debugging strategies, and evaluation (Schraw & Dennison, 1994). Planning is used prior to learning, and refers to setting goals and selecting strategies or resources; information management strategies refer to the structure of skills and strategies which are used to effectively process information such as organizing, summarizing, elaborating and so forth; comprehension monitoring refers to the assessment of learning or strategy use; debugging strategies refer to the strategies that are used to correct errors in comprehension and performance; and lastly, evaluation refers to the evaluation of performance and the effectiveness of the strategy used after learning has occurred (Topcu & Yilmaz-Tuzun, 2009; Zulkiply et al., 2008). These subcomponents are believed to assist in the control of learning (Schraw & Dennison, 1994). People with high levels of metacognitive skills are usually strong in this component of metacognition (Zulkiply et al., 2008).

Metacognitive awareness is believed to be very important in the academic environment, as numerous studies have shown that metacognitive awareness is a strong predictor for academic performance in various subjects (Coutinho, 2007; Topcu & Yilmaz-Tuzun, 2009; Zulkiply et al., 2008). Although Zulkiply et al. (2008) found that metacognitive awareness is correlated with academic performance; they also found that regulation of metacognition was more highly related to academic performance than knowledge of metacognition. Sungur and Senler (2009) found that Turkish high school students generally used declarative and conditional knowledge more than they used procedural knowledge in their academic environment. This study also found that the majority of students used debugging strategies rather than the other regulation of cognition strategies (Sungur & Senler, 2009). It is important to note that this study was conducted on high school students, and age differences with regards to metacognition have been found; metacognitive awareness has been shown to increase in higher levels of study (Zulkiply et al., 2008). Therefore it is important to study metacognition with regards to higher education.

In Bandura's (1997) review of metacognition and academic performance, it is suggested that failures in performance do not always arise from a lack of knowledge, but often arise from a flawed use of cognitive and metacognitive strategies. According to Zulkiply et al. (2008), metacognitive awareness allows students to be self-reflective about their cognitive learning processes, which ultimately benefits the student. Everson and Tobias (1998) further explain this concept with regards to learning in college by stating:

> "…learning in classrooms or other structured training environments is often dynamic, with knowledge and information being acquired and updated frequently. Clearly, those who accurately distinguish between what they have already mastered and what is yet to be learned have an advantage in these situations, since they can be more strategic and effective learners" (p. 66).

Similarly, Gettinger and Seibert (2002) highlight the importance of study skills (with metacognitive skills being one of the four study skills observed) to achieve academically. Gettinger and Siebert (2002) further highlight that metacognitive ability allows students to adjust their studying according to the task difficulty, and to effectively allocate time and strategies wisely depending on task difficulty. Therefore this further emphasises the importance of regulating cognition and being metacognitively aware in higher education.

There have, however, been conflicting results regarding the relationship between metacognitive skills and academic performance. For example, Coutinho (2006) found no relationship between metacognitive awareness and academic performance in a sample of undergraduate students at the Northern Illinois University. It is therefore important to study whether there is a relationship between metacognitive awareness and academic performance at the tertiary level. The link between metacognition and academic performance is also a highly under-researched topic in the South African context.

Although metacognition is important regarding academic performance, it is specifically likely to be important in research design courses such as RDA IIA as it has been shown to enhance critical thinking (Magno, 2010). Critical thinking is essential in these courses, as students need to engage with the coursework at a deep level and need to think analytically in order to turn the theory of research into practice (Laher et al., 2007). This may be particularly important in research design and psychometrics, as students are required to interpret and understand the theory, and apply this theory to examples. Metacognitive awareness has also been found to be highly correlated with problem-solving, which is essential in RDA IIA and research courses generally, however this study was conducted on children (Sperling et al., 2002). It is therefore important to explore the role metacognitive awareness might play in predicting performance in university research courses, such as RDA IIA. In addition, it would be important to establish which components of RDA IIA performance metacognitive awareness plays a part in predicting.

The studies reviewed in this section used either overall academic performance or tests of general ability as a proxy of academic performance. The study conducted by Zulkiply et al. (2008) was the only study reviewed that found an association between metacognition and performance on exams. As shown above, the critical thinking and problem-solving aspects of metacognition may lead to increased academic performance in the statistics and research components of RDA IIA. This may also lead to increased academic performance on RDA IIA final mark.

Working memory

Working memory is a system that allows for the temporary storage and manipulation of incoming information, which is needed in order to accomplish complex cognitive tasks such as comprehension, reasoning, arithmetic, and learning (Baddeley, 1992; 2007). Working memory functions as a "mental workspace" that is used during everyday activities that require processing and storage simultaneously and is vital for higher-level cognition (Alloway, 2006, p. 134; Lépine, Barrouillet, & Camos, 2005). Working memory has a limited capacity, and has certain functions such as focusing attention or facilitating the conscious rehearsal of incoming information or information stored in long-term memory (Colom, Rebollo, Palacios, Juan-Espinosa, & Kyllonen, 2004). According to the model proposed by Baddeley and Hitch (1974), working memory consists of three components: the central executive, the visuospatial sketchpad, and the phonological loop (Baddeley, 1986; 1992).

The central executive is known as the attentional controlling system, responsible for decision-making, maintaining goals, and language comprehension (Baddeley, 1992; McCabe, 2008). The phonological loop and the visuospatial sketchpad are believed to be subordinate to the central executive, and are specialized for verbal and visual information respectively (Aguirre-Perez et al., 2007). The phonological loop is used for storing and rehearsing speech-based information, which is needed for language acquisition (Baddeley, 1992; 2007). The visuospatial sketchpad has a similar function to the phonological loop, however; it involves the manipulation of visual images (Baddeley, 1992). Baddeley (2000) included another component in the model called the episodic buffer. The episodic buffer is a temporary storage system, which is able to integrate information from various sources (Baddeley, 2000). The episodic buffer is also under the control of the central executive (Baddeley, 2000). This buffer can create new cognitive representations when integrating information, and can therefore facilitate problem solving (Baddeley, 2000).

Working memory can be structured along two facets, much like the structure of intelligence (Oberauer, Sub, Schulze, Wilhelm, & Wittmann, 2000). These two facets are the function facet and the content facet, with each facet having three categories (Oberauer et al., 2000). The function facet is involved with the three main functions of working memory, which are: simultaneous storage and manipulation, supervision or executive control, and coordination (Oberauer et al., 2000). The content facet includes the nature of the task material: numerical, spatial, and verbal (Oberauer et al., 2000). In this study, the three categories of the content facet will be assessed.

Working memory has been linked to intelligence, as there is a high correlation between these two constructs, which would suggest shared cognitive mechanisms; however the cause and exact nature of this relationship are unknown (Colom et al., 2010). It is widely established that there are different aspects of intelligence (see Carroll, 1993; Horn, 1976). For the purposes of working memory and its link to intelligence, four aspects of intelligence will be discussed: General intelligence (g), fluid intelligence (Gf), crystallized intelligence (Gc), and general visual perception (Gv).

General intelligence (g) or Spearman's g (g) is a general factor of intelligence that is common to all tests of ability (Carroll, 1993). Gf refers to one's ability to solve problems in which prior knowledge or experience is of no use; and includes logical and general reasoning, judgement, planning, and integrative processes (Carroll, 1993; Horn, 1976; Johnson & Bouchard, 2005). Gc refers to established knowledge that has been gained by education or experience; and includes verbal knowledge and numerical ability (Carroll, 1993; Horn, 1976; Johnson & Bouchard, 2005). Lastly, Gv involves spatial orientation, visualization, scanning, and perceptual speed (Carroll, 1993).

Conway, Kane, and Engle (2003) and Sub, Oberauer, Wittmann, Wilhelm, and Schulze (2002) showed that working memory and g are not the same construct, but are highly related. Various other studies have found structural coefficients between working memory and g ranging from 0.86 to 0.96, showing that working memory capacity is 'almost' perfectly predicted by g (Colom, Abad, Rebollo, & Shih, 2005; Colom & Shih, 2004; Colom et al., 2004). Colom, Flores-Mendoza, and Rebollo (2003) found a correlation of 0.70 between working memory and fluid intelligence (Gf). Similarly, Conway, Cowan, Bunting, Therriault, and Minkoff (2002) found that working memory capacity was the best predictor of Gf in their sample of young adults in comparison to short-term memory capacity and processing speed.

Mackintosh and Bennett (2003) measured verbal, spatial, and numerical working memory and suggested that even though working memory may be a general ability, it is also partly domain-specific with these domains corresponding to Gc, Gv and Gf respectively. This study also found that performance on a reasoning test was most strongly related to the Mental Counters task which measured numerical working memory, although reasoning was also related to verbal and spatial working memory (Mackintosh & Bennett, 2003). A seminal paper by Kyllonen and Christal (1990) suggested that working memory capacity is vital for an individual's information processing system. These authors found structural coefficients of 0.80 to 0.88 between working memory and reasoning ability, which is an aspect of intelligence, and vital for academic achievement (Kyllonen & Christal, 1990).

Working memory is extremely important for learning, as any cognitive tasks require memory, and cognition is vital in order for successful learning to take place (Aguirre-

Perez et al., 2007). Various studies have shown that working memory capacity is related to academic performance, with a diminished working memory capacity resulting in lower academic achievement (Aguirre-Perez et al., 2007; Gathercole, Pickering, Knight, & Stegmann, 2004; Owens, Stevenson, Norgate, & Hadwin, 2008). Working memory capacity has also been shown to relate to language comprehension and note-taking, which lead to increased academic performance (Kiewra & Benton, 1988; MacDonald, Just, & Carpenter, 1992).

Owens et al. (2008) looked at the three components of working memory and found that verbal working memory and the central executive were more strongly related to academic performance than spatial working memory. In contrast, a study conducted by Aronen, Vuontela, Steenari, Salmi, and Carlson (2005), showed that good spatial working memory was associated with academic success at school however this study was conducted on a sample of six- to thirteen-year-old students. In order to clarify these findings in a South African university context, more research will need to be done.

Working memory assists in successful mental arithmetic, mathematics, and reading ability (Alloway, 2006; Daneman & Carpenter, 1980). These abilities are essential in RDA IIA (and statistics courses generally) as mathematical and mental arithmetic skills are necessary in statistics and reading ability is essential in the research design and psychometrics components as well as the statistics component. Therefore exploring the role of working memory capacity in predicting performance in RDA IIA is vital. It is also important to explore which components of working memory play a part in predicting the components of RDA IIA performance.

The reviewed studies that used academic performance as a variable either used overall academic performance, teacher reported academic performance, or standardized measures of academic performance such as standard assessment tests and tests of cognitive ability. It is therefore unclear how working memory would affect specific components of academic performance. With regards to RDA IIA, it is hypothesized that working memory would link to all aspects of RDA IIA performance (final mark, statistics mark, and research mark), as working memory is used in language comprehension, note-taking, and maths and reading ability - which are essential for comprehension and studying in general (Alloway, 2006; Daneman & Carpenter, 1980; Kiewra & Benton, 1988; MacDonald et al., 1992).

Academic self-efficacy, metacognitive awareness, and working memory

Research has shown that academic self-efficacy, metacognitive awareness, and working memory are related to each other, and can be used together when predicting and explaining academic performance. These relationships are discussed below, and then linked to the theory of self-regulated learning.

Previous research suggests that self-efficacy may affect academic performance when combined with other factors; including working memory and metacognition (Hoffman & Schraw, 2009; Hoffman & Spatariu, 2008; Landine & Stewart, 1998). Hoffman and Schraw (2009) showed that high working memory capacity and self-efficacy beliefs in students were related to improved problem solving. This study also showed that high self-efficacy related to increased problem solving ability; and concluded that high self-efficacy can compensate for low working memory capacity with regards to problem solving ability (Hoffman & Schraw, 2009). This is vital because problem solving is a critical element in performing effectively in research courses such as RDA IIA.

With regards to self-efficacy and metacognition, Landine and Stewart (1998) showed that a positive relationship existed between metacognition, self-efficacy, and motivation. Similarly, Downing (2009) found that metacognition was used as a coping strategy and that when an individual failed in their coping it led to decreased self-efficacy, which ultimately had a negative effect on learning. A study conducted on metacognition, self-efficacy, and academic performance by Coutinho (2008) found that self-efficacy fully mediated the relationship between metacognition and performance. The author suggested that students who have effective metacognitive use also have high self-efficacy in their abilities, which leads to successful performance (Coutinho, 2008).

Bandura (1997) indirectly accounts for this observed relationship between metacognition and self-efficacy through his concept of self-regulation. Self-regulation is necessary in academia as it is essential for students to regulate their own learning (Bandura, 1997). Metacognition is a component of self-regulation as metacognition is used when individuals select appropriate strategies, correct their deficits, and reflect on their way of thinking (Bandura, 1997). These individuals however need a sense of self-efficacy in order to apply their knowledge and skills persistently and effectively, in order to successfully achieve - this can be gained through metacognitive processes (Bandura, 1997).

There is also a possible relationship between metacognitive awareness and working memory, for example, Touron, Oransky, Meier, and Hines (2010) found that metacognitive monitoring (and strategic behaviour) influenced the performance of working memory tasks positively. This relationship however requires further research.

As mentioned previously, the theory of self-regulated learning can account for the possible relationships between self-efficacy, metacognitive awareness, and working memory, as well as their relationships with academic performance, as self-regulated learners are better learners and perform better on tasks (Schraw, Crippen, & Hartley, 2006). Self-regulated learning refers to one's ability to comprehend and monitor their learning environment (Schraw et al., 2006). Self-regulated learning theory states that learning is controlled by a number of interacting factors that fall broadly into three categories, namely cognitive, metacognitive, and motivational components (Winne, 1995). The cognitive component of self-regulation includes the "skills necessary to encode, memorise and recall information", which is in some way dependent on working memory capacity (Schraw et al., 2006, p. 112). The metacognitive component includes how students plan and monitor their learning through their knowledge and regulation of cognition (Schraw et al., 2006). Lastly, the motivational component includes a student's motivation to learn, which is governed by their self-efficacy beliefs (Schraw et al., 2006). This theory therefore stresses the importance of studying self-efficacy, metacognition, and working memory with regards to academic performance.

The current study

As above, it can be argued that self-efficacy, metacognitive awareness, and working memory are essential to explore in relation to academic performance in research methods courses such as RDA IIA, as these skills are needed in the different components of this course and are likely to play a role in predicting academic performance. These concepts are also associated as working memory and self-efficacy are affected by metacognitive awareness, and can both be improved through metacognitive restructuring (Autin & Croizet, 2012; Bandura, 1997). Self-efficacy, metacognitive awareness, and working memory are all potentially susceptible to intervention, and therefore exploring and establishing relationships between these variables could improve ways to teach and help students achieve academically.

Therefore, this study aimed to examine the relationships between academic self-efficacy, metacognitive awareness, working memory, and academic performance on the RDA IIA module overall and for different components. The research questions to meet the aims of the study were:

1) What is the nature of the relationships between academic self-efficacy and academic performance on the RDA IIA module (final mark, statistics mark, and research mark)?
2) What is the nature of the relationships between metacognitive awareness and academic performance on the RDA IIA module (final mark, statistics mark, and research mark)?
3) What is the nature of the relationships between working memory and academic performance on the RDA IIA module (final mark, statistics mark, and research mark)?
4) To what extent is multicollinearity between the three key independent variables a concern?
    a) What is the nature of the relationships between academic self-efficacy, metacognitive awareness, and working memory?
    b) To what extent do the metacognitive awareness subscales relate to each other?
    c) To what extent do the working memory tasks relate to each other?
5) To what extent do academic self-efficacy, metacognitive awareness, and working memory predict academic performance on the RDA IIA module (final mark, statistics mark, and research mark)?

As the study was correlational in nature there were no design-based independent or dependent variables (Babbie, 2008). However, statistically, the study focused on predicting academic performance as an outcome, therefore, this acted as the criterion variable (or statistical dependent variable), and academic self-efficacy, metacognitive awareness, and working memory acted as the predictors (or statistical independent variables) (Hair, Black, Babin, & Anderson, 2009).

Chapter 2: Methodology

Design

This study was non-experimental, exploratory, and correlational in nature (Babbie, 2008). This research design is advantageous as it can illuminate real-life phenomena well, and is open, flexible, and shows the strength and direction of the relationships between variables; however, it does not allow for causal conclusions to be drawn (Durrheim, 1999; Smith & Mackie, 2000; Tredoux, 1999). The study was also measurement-based; two questionnaires with Likert-type scales and three memory tasks were used. The use of questionnaires is advantageous as they are time and cost effective and can be administered to a large group of participants (Babbie, 2008; Rubin & Babbie, 2008). Memory span tasks have been the central method used to assess working memory, and are therefore the most advantageous way to estimate working memory capacity (McCabe, 2008). Due to the use of closed-ended, Likert-type scales and the nature of the memory tasks, the study was also quantitative in nature. Quantitative research is critiqued as there is a limited understanding of the individual's subjective experience and view of an individual's context (Creswell & Plano Clark, 2010). The purpose of this research, however, is one of assessing relationships and not the subjective experiences of these, and therefore fits the quantitative paradigm.

Sample

The available population for this study was undergraduate students who had been registered for the RDA IIA course at the University of the Witwatersrand within a three-year timeframe of the study taking place. The participants in this study either completed their RDA IIA module during the first or second semester in 2011, or in the first semester of 2012. This could have affected the way in which the participants answered the self-report questions due to maturation effects, and thus participants from 2011 might have been more metacognitvely aware, might have had a better developed working memory, and/or might have had an increased (or decreased) self-efficacy resulting from past experiences.

Non-probability, purposive sampling was used as the study was seeking a particular sample based on a certain characteristic (being an RDA IIA student). It was also volunteer-based (non-probability, convenience sampling) as students had the choice as to whether to participate in the study or not. Non-probability sampling is advantageous as it is convenient and economical; however, it is limited as probability cannot be established and therefore the findings lack high generalisability (Salkind, 2010).

The original sample consisted of 113 undergraduate students. In this sample, two participants were still completing RDA IIA; four participants' student numbers could not be found or were incorrect; four participants indicated that they had not done RDA IIA; and one participant had completed RDA IIA in 2006 (despite the sample requirements being clearly explained). These eleven participants were therefore excluded from the study. Furthermore, seven of the participants did not respond sufficiently to the Likert-type questions and were therefore excluded from the final analysis. Thus the final sample size for analysis was 95.

The mean age for the final sample was 20.74 years with a range of 18 to 32 years and it consisted of 85 (89.47%) female and 10 (10.53%) male students. The majority of the sample identified themselves as White (n=40 (42.11%)), followed by Black (n=32 (33.68%)), Indian (n=16 (16.84%)), Coloured (n=4 (4.21%)), Asian (n=2 (2.11%)) and other (n=1 (1.05%). 89.36% (n=84) of the sample belonged to the Faculty of Humanities, 8.51% (n=8) to the Faculty of Science and 2.13% (n=2) to the Faculty of Commerce. The majority of the sample was English-speaking (n=57 (61.29%)) and were first-time RDA IIA students (n=86 (92.47%)). 50.54% (n=47) of the sample attended a private high school as compared to a government high school. 73 students had completed RDA IIA in 2012 and 22 had completed RDA IIA in 2011.

Data from the original sample of 113 were used in order to assess the reliability of the scales and the working memory tasks. This sample was distributed as follows: The mean age for the sample was 20.73 years with a range from 18 to 32 years. The sample consisted of 1.82% (n=2) Asian students, 30.91% (n=34) Black students, 3.64% (n=4) Coloured students, 16.36% (n=18) Indian students, 46.36% (n=51) White students and 0.91% (n=1) indicating other. 96 (87.27%) students were female, 14 (12.73%) male and 3 students did not indicate gender. The majority of the sample was English-speaking (n=70 (64.81%)), from the faculty of Humanities (n=98 (89.91%)) and were first-time RDA IIA students (n=95 (93.14%)).

Measures

The measures used in the study were compiled in a questionnaire pack. The questionnaire pack contained a cover page requesting the participant's student number and the year in which they completed RDA IIA (please refer to Appendix D), followed by a demographic questionnaire (please refer to Appendix E). After the demographic questionnaire, the questionnaire pack contained an adapted academic self-efficacy scale based on the General Self-Efficacy Scale by Schwarzer and Jerusalem (1995) and the Academic Self-Efficacy Scale by Klobas, Renzi, and Nigrelli (2007) (please refer to Appendix F), the Metacognitive Awareness Inventory by Schraw and Dennison (1994) (please refer to Appendix G) and answer sheets for the working memory tasks (please refer to Appendix H). Working memory was assessed using three group-administered tasks similar to the tasks used by Mackintosh and Bennett (2003).

Self-developed demographic questionnaire: A brief demographic questionnaire was developed in order to obtain information such as: age, gender, race, faculty, home language, repeating or non-repeating RDA IIA student, and type of school attended (private or government-based education). These variables were used to describe the demographic characteristics of the sample.

Adapted academic self-efficacy scale: In order to assess participants' academic self-efficacy, an adapted version of the General Self-Efficacy Scale (GSE) by Schwarzer and Jerusalem (1995), similar to the adaptation made by Jungert and Gustafson (2009), was used.

The first part of the adapted scale consisted of items taken from the original GSE with very minor changes to make these items more suitable for the academic context. This adapted GSE was a 10-item self-report questionnaire scored on a four-point scale. The four-point scale response items were: '1- Not at all true', '2- Hardly true', '3- Moderately true' and '4- Exactly true'. This yielded scores between 10 and 40, with higher overall scores indicating higher self-efficacy. The internal consistency reliability of the original GSE (Cronbach Alpha) has been reported as between 0.75 and 0.91 (Scholz, Dona, Sud, & Schwarzer, 2002; Wu, 2009). The scale has also been shown to work effectively in cross-cultural contexts and has proven construct validity (Luszczynska, Scholz, & Schwarzer, 2005; Schwarzer et al., 1999). As the scale was adapted slightly in the current study, the extent to which the scale remained internally consistent in the study was included in the analysis, although such adaptations are commonly made and have been shown to have minimal psychometric implications (Jungert & Gustafson, 2009; Schwarzer & Jerusalem, 1995).

The second part of the adapted scale consisted of certain items from the Academic Self-Efficacy Scale developed by Klobas et al. (2007). These 10 items were assessed on a seven-point Likert-type scale ranging from 1 (I am definitely not able to do this) to 7 (I am definitely able to do this). The internal consistency of this scale has been reported as 0.84 (Cronbach Alpha), which shows good internal consistency (Klobas et al., 2007). As the scale was adapted slightly in the current study, the extent to which the scale remained internally consistent in the study was included in the analysis.

Metacognitive awareness inventory: The Metacognitive Awareness Inventory (MAI) by Schraw and Dennison (1994) was used to assess participants' metacognitive awareness. This 52-item instrument contains 17 items measuring knowledge of cognition and 35 items measuring regulation of cognition. These items can be further divided into eight subscales measuring: declarative knowledge (8 items); procedural knowledge (4 items); conditional knowledge (5 items); planning (7 items); information management strategies (10 items); comprehension monitoring (7 items), debugging strategies (5 items); and evaluation (6 items).

The original response format for the MAI was 'True-False' however it has since been used with different types of response formats (Bendixon & Hartley, 2003; Kauffman, 2004; Kincannon, Gleber, & Kim, 1999; Schraw & Dennison, 1994). In the present study, participants were asked to answer on a five-point Likert-type scale (1= Never true of me; 2= Seldom true of me; 3= Sometimes true of me; 4= Very often true of me; 5= Always true of me). This gave each participant an individual score for each component of metacognitive awareness as well as for each further subcomponent. Higher scores indicated higher metacognitive awareness.

Zulkiply et al. (2008) found that the overall scale had a high internal consistency (Cronbach Alpha of 0.89). The 'knowledge of cognition' subscale also had a high Cronbach Alpha (0.79), as did the 'regulation of cognition' subscale (0.84). In the

Turkish version of the MAI, item-total correlations ranged between 0.35-0.65, and the test-retest reliability coefficient was 0.95, and the authors concluded that the MAI was a valid and reliable instrument (Akin, Abaci, & Cetin, 2007). Young and Fry (2008) showed support for the convergent validity of the MAI as it relates to the academic environment. The MAI can therefore be considered a reasonably valid and reliable instrument to use in an academic setting.

Working memory tasks: Whilst self-efficacy and metacognitive awareness were assessed through self-report scales, working memory is a cognitive ability and was therefore assessed through tasks (McCabe, 2008). These tasks typically assess the number of correctly remembered stimuli, which require participants to simultaneously process and store information (Nutley et al., 2010; Turley-Ames & Whitfield, 2003).

A pilot test was undertaken in order to assess the difficulty of the tasks created and to assess the length of the tasks. This pilot was carried out using five university students. The students indicated that the tasks were of moderate difficulty and that they could not concentrate properly as the tasks were too long. The results of this pilot will be discussed further with regards to each task.

The mental counters task. This task requires participants to store and continually revise three different numbers. Performance on this task has been highly correlated with measures of fluid intelligence (Larson & Saccuzzo, 1989). The version of the task used was based on the method used by Mackintosh and Bennett (2003).

In the study task, there were three counters each represented by a horizontal bar, all appearing next to one another. In each trial, there were five or six moves with only one counter changing per move. Each new slide contained one move. At the beginning of a new trial, the three counter values were set to zero. With each subsequent slide, a move was represented. A move consisted of an ‘x’ either above or below a counter line. If the ‘x’ was the above that line, one needed to be added to the counter, and if the ‘x’ was below the counter line, one needed to be subtracted from the counter. At the end of each trial, the participants wrote down the cumulative total of all three counters.

Each slide was shown for one second with a 0.2 second interval between slides, presented using a PowerPoint presentation. Initially, there were 10 trails of five counter moves and 10 trials of six counter moves, making a total of 20 trails. During the pilot testing, students' results for this task were on average 50.6 out of 60. However, the participants indicated that the task was too long and that they had difficulty focusing and maintaining attention. It was decided to cut the five counter moves by one low difficulty trial and by one moderate difficulty trial. The low difficulty item was chosen as all the students responded correctly to this item suggesting it added no variance to the measure. The moderate difficulty item was chosen as students responded with two correct counters out of the three. The same process was applied to the six counter moves. The final Mental Counters task used therefore consisted of eight trials of five counter moves and eight trials of six counter moves, making a final total of 16 trails. Maximum and minimum counter values were set at +3 and -3. A score of one was given for each correctly identified counter, yielding a maximum score of 48. In order to ensure that participants understood the task, a practice round was first administered.

Verbal working memory task: To assess verbal working memory, a reading span test is typically used (Baddeley, Logie, Nimmo-Smith, & Brereton, 1985; Daneman & Carpenter, 1980). The version used in this study was the method used by Mackintosh and Bennett (2003). The test originally contained 12 groups of sentences, each of which contained a subject, object and verb. The sentences either made sense i.e. "the man drove the car" or were nonsense i.e. "the book ate an apple". These groups of sentences were originally divided as follows: five groups of three sentences, five groups of four sentences and two groups of five sentences (this totalled 45 sentences, 23 of which made sense and 22 of which were nonsense). After the pilot testing, this task was cut down as participants felt it was too long and they lost concentration. On average, the students scored 23.2 out of 45 for this task. One three-sentence group and one four-sentence group were cut out for the final task; these were randomly chosen. The final task therefore comprised of four groups of three sentences, four groups of four sentences and two groups of five sentences, totalling 10 groups. The total number of sentences was 38, 20 of which made sense and 18 of which were nonsense. The sentences in each group were presented to participants in a random order. The groups were also presented in a random order within length groups (i.e. the four groups of three sentences were randomly presented; followed by the four groups of four sentences and then the two groups of five). In order to ensure the participants processed the sentences, after the sentence was read out, they were asked whether the sentence made sense or not.

After each group of sentences was read out, the participants were required to recall either the subject or the object of each sentence in the order they were presented in each group. The participants were given 15 seconds for the three sentences group; 20 seconds for the four sentences group; and 25 seconds for the five sentences group to write down the correct answers. Recall of subject or object was randomized. Participants' performance was assessed using the number of items recalled in the correct order, therefore giving a maximum score of 38. A practice round was first administered to the participants to ensure that they understood what was required of them when completing this measure.

Spatial working memory task: The spatial span task that was used was the adapted version used by Mackintosh and Bennett (2003). This task used 3x3 grid 'noughts-and-crosses' games, projected in front of the classroom. A PowerPoint presentation with these tasks was prepared prior to the group session. Each slide consisted of a 3x3 grid, with a blank grid slide representing the start of a new game. Each blank grid slide was followed by either three or four slides (depending on whether the game was a three- or four-move game) depicting a pair of moves in a noughts-and-crosses game. Slides were shown for one second each with a 0.2 second interval between slides presented using a PowerPoint presentation. There were originally 8 three-move games and 12 four-move games; however, the pilot testing revealed that there were too many items; therefore two three-move games and two four-move games were removed. The games removed were a low difficulty and moderate difficulty game from the three-move and four-move group. The average score in the pilot was 42.6 out of 60. The final task was comprised of 6 three-move games and 10 four-move games. This yielded a total of 16 games administered.

Participants were required to remember previous moves in order to write down the winning line from each game on the blank grids provided on the answer sheet. Participants were informed that the winning line could only be deduced from the final slide of the game, and that the winning line could either be horizontal, vertical or diagonal. Ten seconds were given between each game in order for the participants to write down the winning line.

Participants' performance was measured by counting how many fully accurate winning lines were remembered, giving a score of three for each. Therefore for this task a maximum score of 48 could be obtained. A practice set was administered first to ensure participants understood what was required of them.

Multicollinearity assessment: The metacognitive awareness subscales were all highly and significantly correlated with each other, which indicated that the subscales overlapped and were highly inter-related, and therefore only the total metacognitive awareness score was used in data analysis. Another reason for the scales all relating to each other could be due to response sets, where students get tired (as the inventory is long), and therefore answer randomly or in sets (Murphy & Davidshofer, 2005).

The three subscales of the working memory tasks (mental counters, verbal task, and spatial task) all positively and significantly correlated to the working memory total, which is expected as these subscales were measures of working memory. Other positive and significant correlations were with the spatial task and mental counters and verbal task respectively. This could indicate that the spatial task would need some revisions and it appears to be related to all aspects of working memory, which may indicate it is not measuring spatial working memory sufficiently.

Procedure

Firstly, permission was obtained from the University of the Witwatersrand Human Research Ethics Committee in order to conduct the research (Ethics Protocol Number: MPSYC/12/003 IH) (please refer to Appendix I). Permission was then requested from the head of the psychology department and the relevant course coordinators and lecturers (please refer to Appendix A) to approach students in their second or third year lectures in order to invite participants to volunteer for the study.

Once permission had been obtained, students were approached in lectures by the researcher, who verbally invited students to participate in the study and briefly explained the nature of participation. If the students were approached in RDA IIA lectures, the lecturer was asked to leave the lecture theatre. As the research supervisor was also a lecturer on the RDA IIA course, there was no mention of the supervisor by name during this initial approach. During this time, specific times were discussed with the students in order for them to attend the group testing. The students were given a written invitation describing details of the study (please refer to Appendix B). This invitation also contained the times of the group sessions students were required to attend, or alternatively, if the students were unable to attend at those times, the option was given to set up an alternative time through the contact details provided.

Participants who decided to attend a group session, or had set up an alternative time with the researcher, were given a participant information sheet (please refer to Appendix C) with a brief description of the study, emphasising that participation was voluntary, anonymous, and that it would in no way affect their course marks at the university. Students were also informed that they would have the right to decline participation in the study without any consequences.

During the group session, the questionnaire pack was handed out, with the first page of the pack requesting the participant's student number (in order to access their RDA IIA marks) and year they completed RDA IIA, followed by the demographic questionnaire, the adapted Academic Self-Efficacy Scale, the Metacognitive Awareness Inventory, and the working memory task answer sheets. Each questionnaire pack was labelled with a randomly assigned three-digit participant number on each page. The researcher explained how to complete the working memory tasks and, using a projector in front of the classroom, administered the working memory tasks. The group testing tested between one and sixty individuals at a time, and the researcher used spotters in groups larger than twenty in order to check that the participants were working individually and not receiving outside help or writing down answers during the tasks and not after the tasks as was required. The working memory tasks took approximately 25 minutes to complete. The rest of the questionnaire was then completed taking approximately 20-25 minutes of the group session.

The questionnaire was returned immediately to a box in the front of the classroom. In order for anonymity of the participants' data to be ensured, the page requesting student number on the first page of the questionnaire pack was removed by the student and placed in a separate box at the time of return. This page contained the student number and randomly assigned participant number; it was not processed by the researcher but was used by a third party to link the student number to the participant's RDA mark from a spreadsheet provided listing marks by student number only for the relevant years. Once the marks were linked and coded in Excel, the column containing the student number was deleted and the researcher received a list containing only the participant number and mark. Therefore, the researcher did not have any access at all to student numbers, but only randomly assigned participant numbers. The student's name was not recorded at any point and the marks were captured by student number only; the third party saw the student number and RDA IIA mark, but had no access to the rest of the data, thus ensuring anonymity.

Once the study was completed, a summary of the results was published on the RDA IIA notice board in the psychology department for student debriefing. The researcher also provided contact details if further detail or information was requested. It was emphasized that no individual feedback was possible.

Ethics

In order to obtain informed consent, a letter was given to the participants explaining the nature of the study (please refer to Appendix C). The issues covered in this letter included that participation was completely voluntary, and that students would remain anonymous and participation would in no way affect their university life negatively or their marks in any way. Participant numbers were linked to each student number by an independent third party in order to ensure that the researcher did not have direct access to the participants' marks. The first page of the questionnaire pack with the participants' student number on it was maintained by the research supervisor in a sealed envelope, and upon completion of the study was destroyed.

Data was collected and stored in a secure and anonymous manner in a locked room. The actual questionnaires will be destroyed once the research (including potential publication) is complete. An electronic database of the results coded by participant number only will be maintained permanently. Once the results were analysed and reported on, the students were debriefed through a summary of results being posted on the RDA IIA noticeboard in the psychology department. Students also had the option of contacting the researcher (contact details given) if any issues arose or information was needed. It was emphasised to students that no individual feedback could be provided due to the anonymous nature of the data. Students were also informed that there were no risks or direct benefits to participation, although they may have gained experience regarding research by participating in the study; however the letter included references for referral to free educational counselling (the Counselling and Careers Development Unit and Emthonjeni Centre at the University of the Witwatersrand) if any distress was experienced as a result of participation.

Data analysis

Once the data had been collected, it was captured into Excel and analysed using SAS Enterprise Guide version 4.3 (SAS, 2012).

Internal consistency reliability: In order to establish the internal consistency of the scales and their subscales (the degree to which the items in a scale and subscale relate or correlate to each other), Cronbach Alpha coefficients were calculated (Murphy & Davidshofer, 2005). Cronbach Alpha coefficients were calculated for the two adapted self-efficacy scales and the total self-efficacy scale; for the total MAI scale and all subscales (knowledge of cognition and regulation of cognition and their component scales); and for the total working memory score as well as for the mental counters task, spatial task, and verbal task.

Summary statistics: Descriptive and summary statistics (mean, standard deviation, minimum, maximum, and frequencies) were used in order to describe the sample and the basic data obtained. Tests for normality (Kolmogorov-Smirnov tests) were then conducted on the data to assess whether or not the data was normally distributed in order for parametric tests to be used. These statistics were calculated for all of the key interval variables in the study (all measures of academic self-efficacy, metacognitive awareness, working memory, and academic performance). As the majority of the data was normally distributed, parametric tests were run, namely Pearson's correlations and multiple regressions.

Correlations: In order to answer the research questions, Pearson's Correlation Coefficients were used. A correlation shows the relationship between variables, and was therefore be used in answering the first five research questions (Howell, 2008).

Correlations were used to establish relationships between: academic self-efficacy and performance on the RDA IIA module; metacognitive awareness and performance on the RDA IIA module; working memory and performance on the RDA IIA module; academic self-efficacy, metacognitive awareness and working memory; the metacognitive awareness subscales; and the working memory tasks. The strength of the Pearson's correlation coefficient were interpreted as stronger as it approached one, and weaker as it was closer to zero (Howell, 2008).

Multiple Regressions: Multiple regressions provide an indication of the extent to which a set of predictor variables relate to and can therefore be used to predict a criterion variable (Howell, 2008). Multiple regression analyses were used to assess the sixth research question as to whether the three predictor variables (academic self-efficacy, metacognitive awareness, and working memory) predicted overall and component academic performance on the RDA IIA module (the criterion variable) (Hair et al., 2009). Multicollinearity, which is the extent to which an independent variable in the regression is related to the other independent variables in the same regression, was also assessed, as multicollinearity may be problematic (Hair et al., 2009).

The additional analyses of the demographic variables that were collected would have been extremely interesting however this was not technically possible due to the small sample size and degree of variation in the sample.

Chapter 3: Results

This chapter discusses the results obtained from the analyses described in Chapter Two. Cronbach Alpha Coefficients are reported to establish the internal consistency reliability of the scales, their subscales, and the working memory tasks. The results of the distribution analysis are discussed in order to assess normality to establish whether parametric analyses can be run to answer the research questions. Correlational analyses and multiple regressions are discussed in order to answer the research questions.

Internal consistency reliability

The internal consistency reliability of the adapted Academic Self-Efficacy Scale was assessed together with each of the two original adapted sets of items from the General Self-Efficacy Scale and the Academic Self-Efficacy Scale. These results are depicted in Table 1 as follows.

Table 1: Cronbach Alpha Coefficients for Academic Self-Efficacy

Scale	**Cronbach Alpha**
Adapted GSES items	0.82
Adapted ASES items	0.88
Adapted Academic Self-Efficacy Scale	0.89

These Alpha coefficients indicated high internal consistency reliability for both sets of items ($\alpha = 0.82$ and $\alpha = 0.88$ respectively) and the overall adapted Academic Self-Efficacy Scale ($\alpha = 0.89$), suggesting the measure was internally consistent in the study.

The internal consistency reliabilities for the Metacognitive Awareness Inventory and its subscales are shown in Table 2 as follows.

Table 2: Cronbach Alpha Coefficients for Metacognitive Awareness

Scale / Subscale	**Cronbach Alpha**
Declarative Knowledge	0.80
Procedural Knowledge	0.74
Conditional Knowledge	0.63
Knowledge of Cognition	0.89
Planning	0.68
Information Management Strategies	0.75
Comprehension Monitoring	0.72
Debugging Strategies	0.71
Evaluation	0.71
Regulation of Cognition	0.92
Metacognitive Awareness Inventory Total	0.95

The internal consistencies of the total scale and the two major subscales (Knowledge of Cognition and Regulation of Cognition) were excellent ($\alpha = 0.95$, 0.89, and 0.92 respectively). The remaining subscales of this inventory were acceptable, ranging from 0.63, which indicates low-moderate internal consistency, to 0.80, which indicates high internal consistency.

Lastly, the internal consistency reliabilities of the working memory tasks are shown in Table 3 as follows. The Mental Counters Task and the Working Memory Total had excellent internal consistency reliability ($\alpha = 0.94$ and $\alpha = 0.90$ respectively), the Verbal Task had acceptable internal consistency reliability ($\alpha = 0.72$), and the Spatial task had moderate internal consistency reliability ($\alpha = 0.68$).

Table 3: Cronbach Alpha Coefficients for Working Memory

Scale	**Cronbach Alpha**
Mental Counters Task	0.94
Verbal Task	0.72
Spatial Task	0.68
Working Memory Total	0.90

Summary statistics and normality

Basic summary statistics that were obtained for each variable in the study are provided in Table 4 as follows. These statistics include the mean, standard deviation, minimum, maximum, and the median of each variable. The variables summarized in the table include: the adapted Academic Self-Efficacy Scale and its components, the Metacognitive Awareness Inventory and its subscales, the working memory tasks and their totals, and the academic marks used in the analyses.

In order to assess normality, distribution analyses were conducted. This consisted of running Kolmogorov-Smirnov tests to assess the normality of the data, as well as examining histograms for each variable. The results of the Kolmogorov-Smirnov tests are given in Table 5 as follows. These indicated that data from both sets of items adapted to assess academic self-efficacy, as well as the data from the total Adapted Self-Efficacy Scale used in the study, were normally distributed. The Metacognitive Awareness Inventory Total scores were also normally distributed, as was data for the Declarative Knowledge, Information Management Strategies, and Regulation of Cognition subscales. With regards to the working memory tasks, the total working memory scores and the Verbal Task scores were normally distributed, as were all the academic marks used in the analyses.

When examining the histograms for the data (please refer top Appendix J), it became clear that the majority of the scales identified as skewed in the Kolmogorov-Smirnov tests were only slightly skewed, and could be deemed sufficiently normally distributed to support the proposed parametric analysis, particularly given the size of the sample which met the requirements for Central Limit Theorem (Howell, 2008). The Mental Counters and Spatial tasks were fairly heavily skewed, thus although the same argument related to Central Limit Theorem regarding using parametric analyses applied, these results were interpreted with particular caution.

Table 4: Summary Statistics

Variable	Mean	Standard deviation	Minimum	Maximum	Median
Adapted GSES items	30.79	3.79	16.00	40.00	31.00
Adapted ASES items	48.83	9.56	29.00	66.00	50.00
Adapted Academic Self-Efficacy Scale	79.62	11.81	52.00	106.00	80.00
Metacognitive Awareness Inventory Total	194.77	22.69	141.00	238.00	192.00
Declarative Knowledge	31.47	4.09	23.00	40.00	32.00
Procedural Knowledge	15.48	2.31	7.00	20.00	15.00
Conditional Knowledge	19.20	2.58	12.00	25.00	19.00
Knowledge of Cognition	66.16	7.96	47.00	85.00	66.00
Planning	24.38	3.89	15.00	33.00	25.00
Information Management Strategies	38.75	4.66	28.00	48.00	38.00
Debugging Strategies	20.16	2.84	11.00	25.00	20.00
Comprehension Monitoring	24.58	3.99	14.00	34.00	24.00
Evaluation	20.75	3.72	9.00	29.00	20.00
Regulation of Cognition	128.61	15.86	94.00	160.00	127.00
Mental Counters Task	27.31	12.19	0.00	48.00	29.00
Verbal Task	19.28	5.63	4.00	31.00	19.50
Spatial Task	28.50	8.26	0.00	45.00	30.00
Working Memory Total	75.09	20.14	17.00	116.50	77.50
Final Mark	67.69	11.78	40.00	95.00	69.00
Statistics Mark	61.40	15.58	22.00	94.67	60.33
Research Mark	66.94	11.63	38.33	96.33	67.00

Table 5: Kolmogorov-Smirnov (K-S) statistic and p-values for Academic Self-Efficacy, Metacognitive Awareness, Working Memory and Marks

Subscale	**K-S statistic**	**K-S p-values**
Adapted GSES items	0.0816	0.1195*
Adapted ASES items	0.0644	>0.1500*
Adapted Academic Self-Efficacy Scale	0.0598	>0.1500*
Metacognitive Awareness Inventory Total	0.0867	0.0786*
Declarative Knowledge	0.0792	0.1470*
Procedural Knowledge	0.1224	<0.0100
Conditional Knowledge	0.1033	0.0138
Knowledge of Cognition	0.0949	0.0345
Planning	0.0970	0.0259
Information Management Strategies	0.0901	0.0566*
Debugging Strategies	0.0998	0.0202
Comprehension Monitoring	0.0945	0.0360
Evaluation	0.1059	<0.0100
Regulation of Cognition	0.0892	0.0619*
Mental Counters Task	0.1132	<0.0100
Verbal Task	0.0793	0.1460*
Spatial Task	0.1089	<0.0100
Working Memory Total	0.0732	>0.1500*
Final Mark	0.0723	>0.1500*
Statistics Mark	0.0691	>0.1500*
Research Mark	0.0680	>0.1500*

*indicates a p-value above the significance level

Correlations

Pearson's Correlation Coefficients were calculated between RDA IIA marks (final mark, statistics mark, and research mark) and total academic self-efficacy, total metacognitive awareness, knowledge of cognition and its subscales, regulation of cognition and its subscales, the mental counters task, the verbal task, the spatial task, and total working memory scores.

Academic self-efficacy and RDA IIA performance. The results indicated that overall academic self-efficacy was significantly, positively, and weakly related to the mark obtained for research (r = 0.226; p = 0.0275). Surprisingly, academic self-efficacy was not significantly related to the final overall mark for RDA IIA or the statistics component of the course. Please refer to Table 6.

Table 6: Pearson's correlation coefficients for academic self-efficacy

	Final Mark	**Statistics Mark**	**Research Mark**
Academic Self-efficacy	0.197	0.138	0.226
Total	*0.0557*	*0.1841*	*0.0275**

* indicates significance

Metacognitive awareness and RDA IIA performance. It was highly surprising that total metacognitive awareness was not significantly related to any of the components of RDA IIA performance (please refer to Table 7). None of the regulation of cognition subscales were significantly related, and neither were the knowledge of cognition subscales, other than a significant, weak, positive correlation between declarative knowledge and research mark (r = 0.204; p = 0.0479). As procedural knowledge, conditional knowledge, knowledge of cognition, planning, debugging strategies, comprehension monitoring, and evaluation were not normally distributed, Spearman's correlations were run on these tasks as a precautionary measure. These results followed the same pattern as the results for the Pearson's correlations (please refer to Table 8 in Appendix K for the analysis).

Working memory and RDA IIA performance. The results shown in Table 9 indicate that the working memory total was positively and significantly (weak to moderate correlation) related to all aspects of academic performance: final mark (r = 0.305; p = 0.0026); statistics mark (r = 0.278; p = 0.0064); and research mark (r = 0.346; p = 0.0006). The mental counters task followed the same pattern as all components were significantly and positively (moderate correlations) related to the task: final mark (r = 0.321; p = 0.0015); statistics mark (r = 0.308; p = 0.0024); and research mark (r = 0.356; p = 0.0004). The verbal task was only significantly (positive and weak) related to research mark (r = 0.231; p = 0.0244) and, surprisingly, was

Table 7: Pearson's correlation coefficients for metacognitive awareness

	Final Mark	Statistics Mark	Research Mark
Metacognitive	-0.009	-0.081	0.051
Awareness Total	*0.9323*	*0.4340*	*0.6217*
Declarative Knowledge	0.094	-0.006	0.204
	0.3654	*0.9578*	*0.0479**
Procedural Knowledge	0.057	-0.033	0.146
	0.5833	*0.7529*	*0.1579*
Conditional Knowledge	-0.023	-0.099	0.070
	0.8287	*0.3389*	*0.5027*
Knowledge of	0.058	-0.045	0.170
Cognition	*0.5799*	*0.6686*	*0.1004*
Planning	-0.000	-0.031	-0.005
	0.9982	*0.7654*	*0.9657*
Information	-0.006	-0.067	0.054
Management Strategies	*0.9564*	*0.5205*	*0.6039*
Debugging Strategies	-0.119	-0.178	-0.056
	0.2498	*0.0840*	*0.5885*
Comprehension	0.016	-0.036	0.018
Monitoring	*0.8809*	*0.7266*	*0.8593*
Evaluation	-0.095	-0.109	-0.090
	0.3586	*0.2918*	*0.3878*
Regulation of Cognition	-0.042	-0.094	-0.012
	0.6897	*0.3655*	*0.9103*

* indicates significance

not related to the final mark or statistics mark. Lastly, the spatial task was not significantly related to any of the components. As the mental counters and spatial tasks were not normally distributed, Spearman's correlations were run on these tasks as a precautionary measure. These results followed a very similar pattern to the Pearson's correlation coefficient results (please refer to Appendix K for the analysis).

Table 9: Pearson's correlation coefficients for working memory

	Final Mark	Statistics Mark	Research Mark
Mental Counters Task	0.321	0.308	0.356
	*0.0015**	*0.0024**	*0.0004**
Verbal Task	0.164	0.101	0.231
	0.1135	*0.3317*	*0.0244**
Spatial Task	0.160	0.154	0.161
	0.1217	*0.1366*	*0.1201*
Working Memory Total	0.305	0.278	0.346
	*0.0026**	*0.0064**	*0.0006**

* indicates significance

Academic self-efficacy, metacognitive awareness, and working memory. Before the key predictors (academic self-efficacy, metacognitive awareness, and working memory) were entered into multiple regressions, they were correlated with each other in order to establish which variables were highly related and should not be entered into the same regression equation due to multicollinearity concerns (Hair et al., 2009).

As shown in Table 10 as follows, academic self-efficacy and the subscales of working memory were not significantly related, indicating that they could be entered into the same regression equation.

As shown in Table 11 as follows, all aspects of self-efficacy were significantly and positively (moderate to strong correlations) related to all aspects of metacognitive awareness. This indicated that these variables were fairly highly inter-related and therefore should not be entered into the same regression equation due to the high degree of shared variance (Mason & Perreault, 1991).

Table 10: Pearson's correlation coefficients for working memory and academic self-efficacy

	Adapted GSES items	Adapted ASES items	ASE Total
Mental Counters	0.044	0.022	0.032
	0.6736	*0.8325*	*0.7594*
Verbal Task	-0.014	-0.053	-0.047
	0.8901	*0.6108*	*0.6484*
Spatial Task	0.090	-0.112	-0.062
	0.3870	*0.2788*	*0.5506*
Working Memory Total	0.059	-0.047	-0.019
	0.5682	*0.6477*	*0.8520*

* indicates significance

Lastly, as shown in Table 12 as follows, metacognitive awareness and the working memory tasks were not significantly related for most aspects, except for significant, weak, negative correlations between comprehension monitoring and mental counters ($r = -0.239$; $p = 0.0196$); comprehension monitoring and spatial task ($r = -0.239$; $p = 0.0196$); comprehension monitoring and working memory total ($r = -0.289$; $p = 0.0045$); evaluation and spatial task ($r = -0.240$; $p = 0.0192$); and evaluation and working memory total ($r = -0227$; $p = 0.0268$).

In summary, the results from these correlations indicated that academic self-efficacy could be entered into a regression equation with working memory but not with metacognitive awareness. Metacognitive awareness could be entered into a regression equation with working memory however due to certain significant correlations the degree of multicollinearity was assessed in each case.

Table 11: Pearson's correlation coefficients for metacognitive awareness and academic self-efficacy

	Adapted GSES items	Adapted ASES items	ASE Total
Metacognitive Awareness	0.447	0.611	0.638
Total	<0.0001*	<0.0001*	<0.0001*
Declarative Knowledge	0.365	0.619	0.618
	0.0003*	<0.0001*	<0.0001*
Procedural Knowledge	0.344	0.503	0.518
	0.0006*	<0.0001*	<0.0001*
Conditional Knowledge	0.304	0.612	0.592
	0.0028*	<0.0001*	<0.0001*
Knowledge of Cognition	0.386	0.663	0.660
	0.0001*	<0.0001*	<0.0001*
Planning	0.380	0.372	0.423
	0.0001*	0.0002*	<0.0001*
Information Management	0.387	0.514	0.540
Strategies	0.0001*	<0.0001*	<0.0001*
Debugging Strategies	0.302	0.362	0.389
	0.0029*	0.0003*	<0.0001*
Comprehension Monitoring	0.386	0.496	0.525
	0.0001*	<0.0001*	<0.0001*
Evaluation	0.375	0.471	0.501
	0.0002*	<0.0001*	<0.0001*
Regulation of Cognition	0.446	0.524	0.581
	<0.0001*	<0.0001*	<0.0001*

* indicates significance

Table 12: Pearson's correlation coefficients for metacognitive awareness and working memory

	Mental Counters	**Verbal Task**	**Spatial Task**	**Working Memory Total**
Metacognitive	-0.154	-0.064	-0.147	-0.171
Awareness Total	*0.1354*	*0.5385*	*0.1559*	*0.0967*
Declarative Knowledge	-0.041	-0.039	-0.067	-0.063
	0.6937	*0.7044*	*0.5179*	*0.5420*
Procedural Knowledge	-0.092	0.073	-0.038	-0.051
	0.3734	*0.4796*	*0.7177*	*0.6249*
Conditional Knowledge	-0.097	-0.058	-0.128	-0.128
	0.3479	*0.5755*	*0.2159*	*0.2173*
Knowledge of	-0.080	-0.018	-0.087	-0.089
Cognition	*0.4441*	*0.8644*	*0.4021*	*0.3926*
Planning	-0.087	-0.098	-0.144	-0.139
	0.4020	*0.3440*	*0.1639*	*0.1788*
Information	-0.123	-0.002	-0.048	-0.094
Management Strategies	*0.2355*	*0.9870*	*0.6460*	*0.3627*
Debugging Strategies	-0.104	-0.029	-0.003	-0.072
	0.3182	*0.7792*	*0.9739*	*0.4868*
Comprehension	-0.239	-0.165	-0.239	-0.289
Monitoring	*0.0196**	*0.1099*	*0.0198**	*0.0045**
Evaluation	-0.191	-0.048	-0.240	-0.227
	0.0637	*0.6472*	*0.0192**	*0.0268**
Regulation of	-0.181	-0.083	-0.166	0.201
Cognition	*0.0793*	*0.4267*	*0.1071*	*0.0510*

* indicates significance

Metacognitive awareness subscales. The metacognitive inventory and its subscales were all highly significantly and positively related to each other (please refer to Table 13 in Appendix L). This confirmed that the subscales could not be entered into the same regression equation simultaneously due to the high degree of shared variance; thus only the total score for metacognitive awareness was used in the regression analyses. As indicated in the above analysis, the metacognitive awareness total could also not be entered into a regression with academic self-efficacy; therefore the metacognitive awareness total was used with working memory to predict academic performance.

Working memory subscales. As shown in Table 14 in Appendix L, for the working memory tasks, all the tasks showed highly significant, positive correlations with the working memory total (mental counters ($r = 0.849$; $p = <0.0001$); verbal task ($r = 0.566$; $p < 0.0001$); and spatial task ($r = 0.800$; $p < 0.0001$)). The spatial task also showed highly significant, positive correlations with mental counters ($r = 0.458$; $p < 0.0001$) and the verbal task ($r = 0.402$; $p < 0.0001$). The spatial task was therefore significantly related to all the other tasks. The only tasks not significantly correlated with each other were the mental counters and verbal task. These results suggested that only the working memory total or each individual component should be entered into a single regression equation to avoid issues related to multicollinearity. As the previous analyses indicated, the working memory total also needed to be entered into separate regression equations with academic self-efficacy and total metacognitive awareness.

Multiple regression analyses

Academic self-efficacy and working memory as predictors. For the first set of multiple regression analyses, academic self-efficacy and working memory total were used as the predictor variables, with the criterion variables being the three different components of academic performance for RDA IIA (final mark, statistics mark, and research mark).

Predicting final mark: The overall model for predicting final mark was significant ($F_{(2;92)} = 7.14$; $p = 0.0013$). The coefficient of determination for the overall model was $r^2 = 0.1344$ indicating that 13.44% of the variation in final mark was explained by academic self-efficacy and total working memory. Table 15 as follows shows each of the variables entered into the multiple regressions. The results indicated that academic self-efficacy ($p = 0.0392$) and working memory total ($p = 0.0020$) both significantly predicted final mark in RDA IIA and that working memory was the slightly stronger predictor.

Table 15: Multiple regression analysis with academic self-efficacy and total working memory predicting final mark

Variable	Parameter Estimate	t-value	p-value	Standardized Estimate
Intercept	38.007	4.25	<0.0001*	0
Academic self-efficacy	0.202	2.09	0.0392*	0.2030
Working memory total	0.181	3.19	0.0020*	0.3092

* indicates significance

Predicting statistics mark: The overall model for predicting statistics mark was significant ($F_{(2;92)} = 4.97$; $p = 0.0089$). The coefficient of determination for the overall model was $r^2 = 0.0976$, indicating that only 9.76% of the variation in statistics mark was explained using working memory total and academic self-efficacy as predictors. Table 16 shows each of the variables entered into the multiple regressions. The results indicated that only working memory total ($p = 0.0057$) significantly predicted statistics mark in RDA IIA.

Table 16: Multiple regression analysis with academic self-efficacy and total working memory predicting statistics mark

Variable	Parameter Estimate	t-value	p-value	Standardized Estimate
Intercept	29.543	2.40	0.0183*	0
Academic self-efficacy	0.192	1.44	0.1526	0.1429
Working memory total	0.221	2.83	0.0057*	0.2806

* indicates significance

Predicting research mark: The overall model for predicting research mark was significant ($F_{(2;92)} = 9.96$; $p = 0.0002$). The coefficient of determination for the overall model was $r^2 = 0.1740$ indicating that 17.40% of the variation in research mark was explained using working memory total and academic self-efficacy as predictors. Table 17 shows each of the variables entered into the multiple regressions. The results indicated that academic self-efficacy ($p = 0.0158$) and working memory total ($p = 0.0004$) both significantly predicted research mark in RDA IIA.

Table 17: Multiple regression analysis with academic self-efficacy and total working memory predicting research mark

Variable	Parameter Estimate	t-value	p-value	Standardized Estimate
Intercept	33.470	3.88	0.0002*	0
Academic self-efficacy	0.229	2.46	0.0158*	0.2330
Working memory total	0.203	3.70	0.0004*	0.3506

* indicates significance

Therefore, in summary, total working memory significantly predicted all components of RDA IIA performance (final mark, statistics mark, and research mark), whereas academic self-efficacy only significantly predicted the final mark and research mark. The total proportion of variance explained in the models was low, ranging from approximately 9% to approximately 17%.

Metacognitive awareness and working memory as predictors. For the second set of multiple regression analyses, metacognitive awareness and working memory total were used as the predictor variables, with the criterion variables being the three different components of academic performance (final mark, statistics mark, and research mark).

Predicting final mark: The overall model for predicting final mark was significant ($F_{(2;92)} = 4.84$; $p = 0.0101$). The coefficient of determination for the overall model was $r^2 = 0.0952$ indicating that 9.52% of the variation in final mark was explained by the model. Table 18 as follows shows each of the variables entered into the multiple regressions. The results indicated that working memory total ($p = 0.0025$) significantly predicted final mark in RDA IIA and that metacognitive awareness did not significantly predict academic performance, which was a surprising result.

Table 18: Multiple regression analysis with metacognitive awareness total and total working memory predicting final mark

Variable:	Parameter Estimate	t-value	P value	Standardized Estimate
Intercept	49.422	4.18	<0.0001*	0
Metacognitive awareness total	0.023	0.45	0.6571	0.0448
Working memory total	0.183	3.11	0.0025*	0.3130

* indicates significance

Predicting statistics mark: The overall model for predicting statistics mark was significant ($F_{(2;92)} = 7.02$; $p = 0.0015$). The coefficient of determination for the overall model was $r^2 = 0.1324$ indicating that 13.24% of the variation in statistics mark was explained by the model. Table 19 shows each of the variables entered into the multiple regressions. The results indicated that only working memory total ($p = 0.0080$) significantly predicted statistics mark in RDA IIA.

Table 19: Multiple regression analysis with metacognitive awareness total and total working memory predicting statistics mark

Variable:	Parameter Estimate	t-value	P value	Standardized Estimate
Intercept	50.036	3.11	0.0025*	0
Metacognitive awareness total	-0.024	-0.34	0.7341	-0.0346
Working memory total	0.214	2.68	0.0080*	0.2719

* indicates significance

Predicting research mark: The overall model for predicting research mark was significant ($F_{(2;92)} = 3.91$; $p = 0.0235$). The coefficient of determination for the overall model was $r^2 = 0.0783$ indicating that 7.83% of the variation in research mark was explained by this model. Table 20 shows each of the variables entered into the multiple regressions. The results indicated that working memory total ($p = 0.0004$) significantly predicted research mark in RDA IIA and that metacognitive awareness did not.

Table 20: Multiple regression analysis with metacognitive awareness total and total working memory predicting research mark

Variable:	Parameter Estimate	t-value	P value	Standardized Estimate
Intercept	39.705	3.47	0.0008*	0
Metacognitive awareness total	0.058	1.16	0.2506	0.1140
Working memory total	0.211	3.71	0.0004*	0.3656

* indicates significance

On all aspects of academic performance (final mark, statistics mark, and research mark), working memory total was a significant predictor, whereas metacognitive awareness was not significant. This confirmed the findings from the correlational analysis shown in Table 7, and indicated that metacognitive awareness was not a significant predictor of academic performance in RDA IIA.

Academic self-efficacy and components of working memory as predictors. A further set of regressions were run using academic self-efficacy, mental counters, verbal task, and spatial task as predictor variables, with the criterion variables being the three different components of RDA IIA academic performance (final mark, statistics mark, and research mark). This was done in order to unpack which aspects of the working memory tasks significantly predicted academic performance. Due to concerns regarding multicollinearity as a result of the significant correlations between the working memory subscales, the condition index was assessed for each analysis. In each case this was found to be below 30, which indicated that multicollinearity was not a substantial problem.

Predicting final mark: The overall model for predicting final mark was significant ($F_{(4;90)} = 3.98$; $p = 0.0051$). The coefficient of determination for the overall model was $r^2 = 0.1502$ indicating that 15.02% of the variation in final mark was explained by the working memory tasks and academic self-efficacy. Table 21 (please refer to Appendix M) shows each of the variables entered into the multiple regression. The results indicated that only mental counters significantly predicted final mark in RDA IIA ($p = 0.0083$). In this regression equation, academic self-efficacy did not predict final mark as it did when it was entered into a regression with the working memory total. The verbal and spatial tasks were also not significant predictors, which suggested that the mental counters task played a large part in the predictive role of the working memory total.

Predicting statistics mark: The overall model for predicting statistics mark was significant ($F_{(4;90)} = 2.88$; $p = 0.0269$). The coefficient of determination for the overall model was $r^2 = 0.1136$ indicating that 11.36% of the variation in statistics mark was explained by the model. Table 22 (please refer to Appendix M) shows each of the variables entered into the multiple regression. The results indicated that only mental counters significantly predicted statistics mark in RDA IIA ($p = 0.0112$).

Predicting research mark: The overall model for predicting research mark was significant ($F_{(4;90)} = 5.84$; $p = 0.0003$). The coefficient of determination for the overall model was $r^2 = 0.2061$ indicated that 20.61% of the variation in research mark was explained by the model. Table 23 (please refer to Appendix M) shows each of the variables entered into the multiple regression. The results indicated that mental counters ($p = 0.0020$) and academic self-efficacy ($p = 0.0213$) significantly predicted research mark in RDA IIA, with mental counters being a stronger predictor.

Therefore, in summary, the mental counters task significantly predicted all components of RDA IIA performance (final mark, statistics mark, and research mark), whereas academic self-efficacy only significantly predicted research mark. The verbal and spatial tasks did not significantly predict academic performance on any components of academic performance. This suggests that the mental counters task played a large part in the predictive power of the working memory total as it followed the same pattern of significance. The proportion of variance explained ranged from approximately 11% to approximately 20%.

Chapter 4: Discussion

Reliability of the instruments

The results of the internal consistency calculations for the adapted Academic Self-Efficacy Scale indicated that the adapted scale had high internal consistency reliability and appeared to be useful in measuring academic self-efficacy in a South African university sample. This adapted academic self-efficacy scale combined the Schwarzer and Jerusalem (1995) and Klobas et al. (2007) scales, and showed a higher level of internal consistency reliability than each scale had on its own. The items taken from the Schwarzer and Jerusalem (1995) scale also represented more general or broad self-efficacy beliefs, while those taken from Klobas et al. (2007) were more task-specific and related directly to the process of learning. It is thus possible that the combined scale better represented more and different aspects of academic self-efficacy and therefore could be more useful for assessment purposes than either scale on its own. The adapted scale could thus potentially be very useful for measuring academic self-efficacy in subsequent studies, although further validation will be required.

With regards to the Metacognitive Awareness Inventory and its subscales, the knowledge of cognition and regulation of cognition subscales, as well as the Metacognitive Awareness Inventory total, had high internal consistency reliability, suggesting that the scale was reliable in measuring metacognitive awareness in this study. This confirms previous research findings (c.f. Akin et al., 2007; Zulkiply et al., 2008). There is limited evidence regarding the use of this scale in a South African context, and internationally, the scale has been used with various response formats. In this study, the five-point Likert-type response format was used to increase the range of possible answers and showed high reliability, which may indicate that the five-point Likert-type response format that was used instead of the True/False response format was reliable and can be used in subsequent studies, although this would require further validation in a South African context.

Lastly, the mental counters task and total working memory score showed extremely high internal consistency reliability, which indicated that these measures could potentially be used in developing a standardized measure for assessing working memory in a group context. Working memory is typically measured using individual tasks and testing (Alloway & Alloway, 2010), and therefore group testing of working memory could increase the number of participants assessed, thus increasing the possibilities for research. The verbal task and spatial task showed satisfactory reliability, and these two tasks could potentially be revised in order to improve their reliability. Possible reasons for the lower reliability of these two tasks could potentially be the effect of random responses, as students may have thought the tasks were confusing or difficult and therefore guessed their answers or answered randomly (Murphy & Davidshofer, 2005). Other potential reasons could be a student's momentary distraction, test-wiseness (general skills of test taking), or motivational factors for participating in the research (Murphy & Davidshofer, 2005).

Descriptive statistics

The adapted Academic Self-Efficacy Scale had a normal distribution, which indicated that the majority of the students reported average scores on this scale, with a few students scoring in the high and low regions. As academic self-efficacy is developed through previous accomplishments or failures, it was expected that a university sample would generally have high levels of self-efficacy (possibly producing a negatively skewed distribution), as the accomplishment of getting into university would increase their self-efficacy (Bandura, 1977; 1994; 1997). However as these students were in their second and third year of study perhaps their failures or successes during their first year at university determined their current academic self-efficacy, resulting in a normal distribution.

The Metacognitive Awareness Inventory total, the Knowledge of Cognition subscale, and the Regulation of Cognition subscale had normal (or fairly normal) distributions. This indicated that the majority of the students reported average levels of metacognitive awareness, with a few students scoring in the high and low regions. This is not an unexpected finding in a normal university sample as these students were in second and third year and may have developed a certain degree of metacognitive awareness through their first year of university. In order to develop metacognitive awareness, it is important to be aware of the nature of the task or academic environment, and therefore, having completed first year, the student has learnt the nature of university and the assessments, and thus may develop their metacognitive awareness further (Wade & Reynolds, 1989).

The working memory total and verbal task were normally distributed as indicated by the Kolmogorov-Smirnov values. Although the Kolmogorov-Smirnov values for the spatial task indicated that the task was not normally distributed, the histogram showed that the distribution was fairly normal except for a few outliers in the lower ranges. These outliers were students who had left out the task or had only answered a few of the questions, and therefore the task could be seen as normally distributed for those students who completed it. The mental counters task was heavily negatively skewed, which could be due to students who had only answered the first three counters or students who had completely left out the mental counters section. Potential reasons for this could be that the task was too hard, the students had lost interest in participating, or the students were too tired to participate. The histogram showed many students scored above the average, which could indicate that the task was too easy, or that these students showed a well-developed numerical working memory. The reason is unclear as to why the mental counters task was skewed, and therefore future research should investigate these reasons in order to improve the task. Future research may also investigate whether numerical working memory is actually more developed in a university population when compared to the general population, as university students may be more capable than the general population due to the nature of university study (Clouston, Kuh, Herd, Elliot, Richards, & Hofer, 2012).

The relationship between academic self-efficacy and RDA IIA performance

It was expected that academic self-efficacy would link to all aspects of academic performance, as numerous studies have supported the role of self-efficacy in predicting academic performance and mathematical achievement (Brown et al., 1989; Carmichael & Taylor, 2005; Pajares, 1996; Pajares & Graham, 1999; Stevens et al., 2004; Zimmerman et al., 1992). Previous research has found significant correlations between self-efficacy and academic performance linked to students' motivation and goal-setting in the academic environment (c.f. Carmichael & Taylor, 2005; Zimmerman et al., 1992). For RDA IIA, the marks also depend largely on open-book assessments. These types of assessment require students to be more proactive in their preparation if they wish to perform well (Agarwal, Karpicke, Kang, Roediger, &

McDermott, 2008; Feller, 1994), which is in line with those students with higher levels of self-efficacy performing better.

The results of the current study, however, indicated that only research mark was significantly and positively correlated with academic self-efficacy, and not statistics or final mark. Although previous research has established relationships between academic self-efficacy and academic performance, the measures of academic performance these authors used were more general and not specifically related to performance on a research methodology course.

Although an expected result, the finding that academic self-efficacy and research mark were related may potentially be explained by the nature of the compulsory tutorials students have to attend for RDA IIA. The majority of these tutorials are focused on statistics and not on research. Students may then feel the need to study more for research as there is less support, and they are required to work independently. Students who study and work more for a particular section become more competent and not only perform better, but also their self-efficacy is maintained through their increasing competence (Schunk, 1991). Students need a high sense of self-efficacy in order to work independently, as students who are better able to "assess what will be required" and "use one's knowledge and skills to produce new learning" will be able to work independently and perform better (Schunk, 1989, p. 180; Yong, 2010). Working independently is not as necessary for the statistics component, as there is a higher level of support provided, thus possibly making self-efficacy and working independently less important with regards to this component.

Despite this, the finding that statistics mark and academic self-efficacy were not significantly related was unexpected (Pajares & Graham, 1999; Stevens et al., 2004). The reason for this is unknown however a possibility could be that statistical anxiety plays a larger role in performance in statistics than academic self-efficacy. Statistical anxiety has previously been shown to be a strong predictor of statistics performance, affecting time and effort spent learning (Keeley, Zayac, & Correia, 2008; Macher, Paechter, Papousek, & Ruggeri, 2012; Perepiczka, Chandler, & Becerra, 2011). Anxiety may also reduce students' beliefs in their own abilities and therefore their perceived level of self-efficacy, and this is especially likely with RDA IIA, as statistical and research methods courses typically give students high levels of anxiety

(Bandura, 1997; Benson & Blackman, 2003, Bridges et al., 1998; Brightwell, Daniel, & Stewart, 2004; Theophilides & Dionysiou, 1996).

Another possible reason for a lack of a relationship between academic self-efficacy and statistical performance may have been an issue related to the measure used. The instrument assessed academic self-efficacy in relation to the general academic environment; perhaps a more specific measure assessing statistical self-efficacy would have provided a more appropriate indication of self-efficacy in relation to statistics performance. When answering the questions, students may have thought generally about their belief in their capabilities at university, which could potentially differ from their beliefs in their statistical capability.

Relationship between metacognitive awareness and RDA IIA performance

Contrary to what was expected, there were no significant correlations between the metacognitive awareness subscales or the overall score and RDA IIA performance components other than a significant positive relationship between declarative knowledge and research mark. As previously described, declarative knowledge includes knowing about the self and about strategies or factors that influence performance (Schraw & Dennison, 1994; Schraw & Moshman, 1995). This may be particularly important to research methodology with regards to the multiple-choice nature of the assessments, which are not used in the statistical assessments. Answering multiple-choice questions successfully involves using highly specific strategies, with some strategies working better than others (Heller, Levin, & Goransson, 2002; Kogut, 2011). Declarative knowledge involves factual knowledge about different kinds of strategies for certain tasks, which is particularly important as multiple-choice questions involve highly specific knowledge about the desired strategy (Heller et al., 2002; Kohut, 2011; Schraw & Dennison, 1994).

It is highly surprising that no other significant correlations were found between the different aspects of metacognitive awareness and components of RDA IIA performance. These results are contradictory with regards to previous research, which established that there were positive relationships between metacognitive awareness and academic performance (c.f. Rahman, Jumani, Chaudry, Hasan Chisti, & Abbasi, 2010; Zulkiply et al., 2008). This result is, however, in line with Coutinho (2006) who found no relationship between metacognitive awareness and academic performance.

Coutinho (2006) provided a possible reason for the lack of a relationship by suggesting that perhaps the actual work was too difficult for students to solve or work through, and therefore even students with good metacognitive awareness realised this and lost interest in working through the problem.

Other possible reasons for a lack of a relationship may be technical. Although the Metacognitive Awareness Inventory showed good or acceptable internal consistency reliabilities in previous studies as well as the current study, there could have been measurement issues with this inventory, which led to the failure to establish significant relationships. It is well-known that metacognitive awareness is a difficult concept to measure (Schraw, 2000). Certain issues pertaining to the measurement of metacognition include: difficult questions which may not be understood, questions that are ambiguous or too similar, answering in a social desirable manner, and the fact that certain metacognitive concepts may not be accessible to consciousness (Baker & Cerro, 2000).

Other possible issues with assessing metacognitive awareness could have been that: the majority of the Metacognitive Awareness Inventory subscales were not normally distributed, which was not unexpected as university students are expected to show higher levels of metacognitive awareness (Zulkiply et al., 2008); all the subscales were highly correlated with each other; the inventory was too long resulting in fatigue and response sets; and perhaps the wording of the inventory was not relevant to South Africa (possible cultural bias) (Murphy & Davidshofer, 2005). All of these issues may have led to the inaccurate measurement of metacognitive awareness, leading to the unexpected results found in the current study. In addition, it is possible that the sample was not large enough to show a relationship between metacognitive awareness and RDA IIA performance (Hair et al., 2009). Although all of the above are possible explanations, the reasons for the lack of a relationship between metacognitive awareness and RDA IIA performance are unclear and should be studied further.

Relationship between working memory and RDA IIA performance

The mental counters task and working memory total were significantly and positively related to all of the components of RDA IIA performance. The mental counters task has previously been found to be associated with fluid intelligence, as well as being strongly related to reasoning ability (Larson & Sacuzzo, 1989; Mackintosh & Bennett, 2003). This is particularly important to all aspects of academic performance because fluid intelligence includes concepts such as reasoning, judgement, planning, and integrative processes, which are all essential for successful studying and understanding (Carroll, 1993; Horn, 1976; Johnson & Bouchard, 2005).

The finding that total working memory was associated with all aspects of RDA IIA performance was expected and confirmed previous research (c.f. Aguirre-Perez et al., 2007; Gathercole et al., 2004). Working memory may be correlated to all aspects of academic performance as it is essential in language comprehension, reading ability and note-taking, which lead to successful learning and performance (Daneman & Carpenter, 1980; Kiewra & Benton, 1988; MacDonald et al., 1992). Working memory is also essential in mental arithmetic and mathematics, and therefore the correlation between working memory and statistics mark was expected and confirmed (Alloway, 2006).

A surprising finding was that the verbal task was only positively and significantly related to research mark, and not related to final or statistics mark. It was expected that the verbal task, which assesses verbal working memory, would be related to all aspects of academic performance as it is essential for language and sentence comprehension and production, which is needed in the academic field (Acheson & MacDonald, 2009; Caplan & Waters, 1999; Daneman & Carpenter, 1980). This could be due to the research section involving more verbal content (such as having to read passages and interpret the content) than the statistics section, therefore potentially explaining the lack of a relationship with statistics performance.

The finding that the spatial task was not significantly related to any aspects of RDA IIA performance is contradictory with the literature reviewed which states that a good spatial memory is associated with improved academic performance (Aronen et al., 2005; Dumontheil & Klingberg, 2012; Giofrè, Mammarella, Ronconi, & Cornoldi, 2013; McLean & Hitch, 1999). A possible reason for the lack of a relationship could potentially be problems with the spatial task (such as it being too easy or too difficult); in addition, the omission of certain items and biased responding might have influenced the outcome leading to non-significance. These possibilities should be further explored in order to improve the task.

Relationships between academic self-efficacy, metacognitive awareness, and working memory

Correlations between the three main predictor variables were run in order to assess the degree of multicollinearity between them. Previous research has found relationships between these variables however the majority of these relationships were not direct correlations or included mediation models (c.f. Coutinho, 2008; Hoffman & Schraw, 2009; Landine & Stewart, 1998; Touron et al., 2010). According to the theory of self-regulated learning, these three concepts work together in influencing academic performance, however, these three concepts are not necessarily related to one another (Schraw et al., 2006).

There were no significant correlations between working memory and academic self-efficacy, which was unexpected as working memory and academic self-efficacy have previously been shown to work together in problem solving (Hoffman & Schraw, 2009; Shell et al., 2010). Perhaps students with a high academic self-efficacy had reduced anxiety and increased motivation and therefore performed better regardless of their working memory ability. The study conducted by Hoffman and Schraw (2009) offers support for this possible reason, as these authors found that a higher self-efficacy compensated for low working memory ability.

There were very few significant correlations between metacognitive awareness and working memory. Touron et al. (2010) did find a relationship between these two concepts, however, they found that metacognitive monitoring and specifically strategic behaviour were related to working memory, as opposed to metacognitive awareness.

It is also possible that measurement issues could explain the lack of significant correlations between working memory and metacognitive awareness. The working memory tasks estimate working memory ability whereas the Metacognitive Awareness Inventory assesses students' perceptions of their own metacognitive awareness. Metacognitive awareness was therefore not directly observable, and students may have misjudged their abilities in this area.

There were, however, significant correlations between academic self-efficacy and metacognitive awareness, which is in line with previous research (Downing, 2009). A possible explanation for this may be that students' knowledge of their own cognitive processes (metacognitive awareness) assists in the development of their academic self-efficacy. Therefore, if a student perceives their cognitive processes to be high, it may lead them to believe more in their capabilities, leading to an increased academic self-efficacy, which explains the significant positive relationship.

Academic self-efficacy and working memory as predictors of RDA IIA performance

The results of the multiple regressions conducted indicated that the working memory total predicted all components of RDA IIA performance (final mark, statistics mark, and research mark). These results were expected and supported previous studies exploring academic performance and working memory (MacDonald et al., 1992; Owens et al., 2008). As mentioned, working memory has been linked to intelligence and is vital for successful learning as learning requires cognitive tasks performed by working memory, which could explain the predictive role it plays in relation to RDA IIA performance (Aguirre-Perez et al., 2007; Colom et al., 2010).

Possible reasons for the predictive role that working memory plays in relation to research mark could be the relationship working memory has with reasoning ability (Kyllonen & Christal, 1990). Reasoning ability would be vital in answering the multiple-choice questions and application sections of the assessments in the research component. Also, working memory has been linked to reading ability, language comprehension, and note-taking, which would also be important to the research component as these skills are necessary in the application and interpretation of questions in the assessments (Daneman & Carpenter, 1980; Kiewra & Benton, 1988; Kyllonen & Christal, 1990; MacDonald et al., 1992). It was expected that working memory would play a predictive role in statistics performance, as working memory is essential in mathematics and successful mental arithmetic, which is vital for statistics (Alloway, 2006).

Academic self-efficacy only predicted final and research mark, and did not predict statistics mark. It was expected that academic self-efficacy would play a role in predicting research mark, due to the previous correlations established in this study and the nature of the tutorials as discussed previously.

It was unexpected that academic self-efficacy did not play a role in predicting statistics mark. Perhaps statistical anxiety played a larger role than academic self-efficacy in this study, which is contrary to other findings such as Zare, Rastegar, and Hosseini (2011), who found that statistical self-efficacy was a larger predictor than statistical anxiety. As mentioned previously, perhaps a measure specifically assessing statistical self-efficacy would have resulted in a significant prediction. Also, there may be other factors that play a greater role in predicting statistical performance than academic self-efficacy. The statistical components of the courses are typically perceived as difficult and involve more understanding of the basic statistical concepts, whereas the research component involves slightly more studying and remembering of the concepts (Murtonen & Lehtinen, 2003). Statistical performance may therefore rely more on cognitive ability (such as working memory) than motivational components (such as academic self-efficacy).

It is recognized that, as with academic performance generally, there are a lot of other factors that could determine RDA IIA performance (Payne & Israel, 2010; Riaz Ahmad et al., 2010). Therefore, the explanatory power of the models for predicting RDA IIA performance using academic self-efficacy and total working memory (ranging between approximately nine percent and approximately seventeen percent) were relatively high considering the number of additional factors that could have played a role in predicting academic performance. There is, however, a great deal left unexplained, and future research should look into which other factors predict RDA IIA performance in order to intervene and improve overall performance.

Metacognitive awareness and working memory as predictors of RDA IIA performance

The results of the multiple regressions conducted with metacognitive awareness and working memory predicting aspects of RDA IIA performance were all significant models, with only working memory total being a significant predictor. Working memory appears to be an important predictor of academic performance in RDA IIA, as it was significant across all the multiple regressions conducted with academic self-efficacy and metacognitive awareness. Possible explanations for this predictive role were explained in the previous section; these include the link between working memory and reasoning ability, reading ability, language comprehension, note-taking, mathematics, and mental arithmetic (Alloway, 2006; Daneman & Carpenter, 1980; Kiewra & Benton, 1988; Kyllonen & Christal, 1990; MacDonald et al., 1992).

The finding that metacognitive awareness was not a significant predictor of academic performance was surprising, and is contrary to the findings described in the review of the literature (c.f. Coutinho, 2007; Topcu & Yilmaz-Tuzun, 2009).

Previously, Coutinho (2006) found that metacognition was not related to academic performance. This author provided a possible explanation for the lack of a relationship, which was that perhaps the problems the students had to solve were too difficult. Students with good metacognitive awareness realized that the problems were too difficult and therefore gave up on solving them, which led to a decrease in performance (Coutinho, 2006). Another possible reason for a lack of relationship between metacognitive awareness and academic performance could be that the students had no motivation in the subject, despite a high metacognitive ability, ultimately leading to them giving up, which negatively affected their performance (Bandura, 1997). These issues of motivation are particularly important with respect to RDA IIA, as it is a compulsory course that students do not necessarily choose to register for, which may lead to them being de-motivated (Laher et al., 2007). Anxiety could also have led to decreased performance despite good metacognitive awareness. Lastly, as previously mentioned, measurement issues with the Metacognitive Awareness Inventory could have prevented the predictive role of metacognitive awareness being accurately measured.

In summary, the predictive role of working memory total with regards to performance on RDA IIA was further reinforced in these sets of regressions. The predictive power of the regressions ranged between approximately six percent and approximately thirteen percent, which is lower than the previous regressions conducted with academic self-efficacy and working memory total, however, they are still generally high considering the number of additional factors affecting academic performance. There is, however, a large proportion of the variation in academic performance unexplained which could be explored in future research.

Academic self-efficacy and components of working memory as predictors of RDA IIA performance

The results of the multiple regressions conducted using academic self-efficacy, the mental counters task, the verbal task, and the spatial task to predict the components of RDA IIA performance were all significant. The mental counters task predicted all components of RDA IIA performance (final mark, statistics mark, and research mark); however the verbal and spatial tasks did not significantly predict any of the components of RDA IIA performance.

As the verbal and spatial tasks were not significant predictors of academic performance, this suggests that the mental counters task played a large part in the predictive role of the working memory total. A possible reason for this relationship is that the mental counters task did not only need numerical working memory to effectively complete the task, but also drew on verbal and spatial working memory, as previous research has shown that certain tasks overlap and require resources from the different components of working memory (DeStefano & LeFevre, 2004; Oberauer et al., 2000; Raghubar, Barnes, & Hecht, 2010). As the task was complex and difficult to understand, the students would have needed to use their verbal working memory in order to understand the task; and as the task was administered on a screen with constantly changing slides, the students would have needed to use their spatial working memory in order to keep up with the slideshow. This finding is in accordance with a review of fourteen data sets containing three thousand one hundred young adults conducted by Kane, Hambrick, and Conway (2005). These authors found strong correlations between working memory capacity and fluid intelligence/ reasoning factors (the mental counters task has previously been found to be strongly associated with reasoning ability or fluid intelligence), indicating that these constructs shared fifty percent of their variance (Engle, 2002; Kane et al., 2005; Mackintosh & Bennett, 2003; Stauffer, Ree, & Carretta, 1996; Yuan, Steedle, Shavelson, & Oppezzo, 2006).

It was expected that the mental counters task, which is a measure of numerical working memory, would predict all aspects of RDA IIA performance, as numerical working memory is related to fluid intelligence, which is vital for effective performance (Carroll, 1993; Mackintosh & Bennett, 2003). It was not expected that the verbal task and the spatial task would not predict academic performance, as it has been previously established that verbal and spatial working memory are vital in academic performance (Owens et al., 2008; Aronen et al, 2005). Possibly the tasks used in this study did not effectively measure the verbal and spatial working memory constructs despite their acceptable internal consistency reliability. Further research should investigate these tasks to assess their validity.

When academic self-efficacy was placed in a regression analysis with the components of working memory instead of the working memory total, it stopped predicting final mark. It is unclear why this is the case; however it could potentially be due to multicollinearity effects despite the condition index. These set of regressions predicted between approximately eleven percent and approximately twenty percent of the dependent variable, which is fairly high considering the number of additional factors that could have played a role in predicting academic performance.

In summary, this section discussed the results of the study, as well as discussing possible reasons for these results. In all sets of regressions, working memory (or components of working memory) was a stronger predictor of RDA IIA performance than academic self-efficacy. The results of this study could therefore suggest that the cognitive components of the self-regulated learning theory are more closely linked to academic performance than the motivational and metacognitive components; which is contradictory to the studies reviewed that found motivational or metacognitive components to be more closely linked to academic performance (Cheng, 2011; Kosnin, 2007; Pintrich & De Groot, 1990; Zusho & Pintrich, 2003).

Chapter 5: Conclusions, strengths and limitations, and directions for the future

Conclusions

In conclusion, the academic self-efficacy scale, the metacognitive awareness inventory, working memory total, and mental counters task showed high internal consistency reliability, which suggests that these measures were internally consistent and measured effectively. The verbal task showed acceptable reliability and the spatial task showed moderate reliability, and these should potentially be revised in future research. Validity and bias should be assessed further in order to check whether all the scales measured what they claimed to, and whether these measures are appropriate in a South African sample (Murphy & Davidshofer, 2005).

Academic self-efficacy was significantly and positively related to research mark, and predicted both the research mark and the final mark for RDA IIA. It was suggested that the reason for this was the nature of the tutorials, and that self-efficacy affects motivation, cognition, and anxiety (Bandura, 1993; 1997; Schunk, 1989; 1991; Van Dinther et al., 2011; Yong, 2010). Given this finding, it may be possible to assist students who are struggling with the research component to perform better by offering training in self-efficacy. In this study, self-efficacy did not relate to or predict statistics performance, perhaps due to statistical anxiety and statistical self-efficacy playing a larger role in performance (Keeley et al., 2008; Macher et al., 2012; Peperpiczka et al., 2011; Zare et al., 2011). This finding may also be context-dependent or a characteristic of the sample used.

Metacognitive awareness showed no significant correlations or predictions in relation to RDA IIA performance, other than a significant and positive relationship between declarative knowledge and research mark. A possible reason for this relationship was the multiple-choice nature of the assessment for the research component (Heller et al., 2002; Kogut, 2001; Schraw & Dennison, 1994). Possible reasons for the lack of significant relationships or predictions could be students finding the work too difficult or lacking motivation, and more technical issues regarding the measurement, including the measurement being too long, the data not being normally distributed, and the test potentially being biased in a South African context (Bandura, 1997;

Coutinho, 2006; Murphy & Davidshofer, 2005). Other technical issues that may explain the lack of significance could be: difficulty in the measurement, social desirability, response sets, small sample size, and ambiguous questions (Baker & Cerro, 2000; Hair et al., 2009). Whilst in this study metacognitive awareness did not play a role in relation to RDA IIA performance, other aspects of metacognition, such as metacognitive skills, might play a role, and should therefore be explored further.

Working memory and the mental counters task (numerical working memory) were related to and predicted all aspects of RDA IIA performance. This was expected as mental counters and working memory have been linked to fluid intelligence, reasoning ability, language comprehension, reading ability, note-taking, mental arithmetic, and mathematical ability, which are all vital for RDA IIA (Alloway, 2006; Daneman & Carpenter, 1980; Kiewra & Benton, 1988; Kyllonen & Christal, 1990; Larson & Sacuzzo, 1989; MacDonald et al., 1992; Mackintosh & Bennett, 2003). The verbal task only significantly and positively related to research mark, which could be due to the amount of verbal content in the research component. The spatial task did not relate to any aspect of RDA IIA performance, which could be due to problems with the task. The verbal and spatial tasks did not predict any aspects of performance, which could be due to problems with the tasks or biased responding, and therefore, these tasks would potentially need to be revised. Given these results, it may be useful to provide interventions aimed at improving numerical working memory for students who are struggling with overall RDA IIA performance.

Therefore, the results of this study contribute to a better understanding of the factors relating to and predicting RDA IIA performance; and research methodology courses generally, and these findings may lead to the development of more effective intervention programmes to assist students in improving their research methodology marks.

Strengths and limitations

There were several limitations in this study, which related to the measures and the sample used. Firstly, the sample size was small and was a convenience sample based on volunteers, which limits the generalisability of the results (Hair et al., 2009). This is important as the sample used may not be representative of the university population, and therefore the results cannot necessarily be generalised to other universities (Hair et al., 2009).

Secondly, the measures used to assess academic self-efficacy and metacognitive awareness were self-report, which raises a range of possible issues such as students being unable to recall information or responding in a socially desirable way (Murphy & Davidshofer, 2005). This could affect the results, as students may not be answering truthfully or may be answering randomly, and therefore their results might not be a true reflection of their actual levels of self-efficacy or metacognitive awareness.

Thirdly, the measure of academic self-efficacy may have been too general, and perhaps specific measures (such as statistical self-efficacy) should have been used to provide a more appropriate indication of self-efficacy in relation to statistics performance (Pajares, 1996). As discussed previously, when answering the questions, students may have thought generally about their belief in their capabilities at university, which could potentially differ from their beliefs in their statistical capability.

Lastly, the verbal and spatial tasks did not show good internal consistency reliability, which may have affected the results and their interpretation. The validity of these tasks was also not measured and therefore it is uncertain whether the tasks were measuring what they were supposed to measure (Murphy & Davidshofer, 2005). This could have affected the interpretation of the analyses, and therefore the results should be interpreted with caution.

Despite these limitations, the study did offer numerous strengths. The high internal consistency reliability of the adapted Academic Self-Efficacy Scale, the Metacognitive Awareness Inventory, the mental counters task, and the working memory total indicate that these measures may be used with a certain degree of confidence and further developed for standardization in the South African context. Working memory tasks are also typically measured individually either on computer or using pen-and-paper format, and therefore it is extremely time-consuming to get a large sample (Alloway & Alloway, 2010). The group tasks and sessions used in this study were thus beneficial as they allowed for multiple individuals to be assessed at the same time, which was less time-consuming and could expand possibilities for future research.

The results of this study help to better understand the factors related to and involved in predicting performance on RDA IIA. The results of the study are also highly beneficial as they can be used to guide future research and intervention for RDA IIA. These results could also potentially be expanded to other research methodology courses in other disciplines and across South African universities.

Directions for future research

Future research may aim to explore the verbal and spatial working memory tasks in order to improve their reliability and predictive power. Future research should also explore the possible reasons the tasks did not produce significant results, and potentially these tasks should be revised. Further validation of all the scales used should be conducted, particularly regarding using these scales in a South African context. This is important as once revised and validated, the scales can be used with greater confidence in subsequent studies, and greater inferences can be made.

Future research may also explore the reasons for the skewness of the mental counters task, and whether numerical working memory is higher in a university population than in the general population. This is interesting to investigate, as the results could be used to categorise university student samples, and compare the university population to the general population. These results will help researchers to better understand the university population. Also, reasons as to why there was no relationship or prediction between metacognitive awareness and performance should be explored. It may be interesting for researchers to assess whether metacognitive skills rather than metacognitive awareness predict academic performance. This research would assist in the development of appropriate interventions for students with poor academic performance.

Other interesting research may also look into whether there is a difference in overall statistical self-efficacy and general academic self-efficacy. Also, there may be other factors that play a greater role in predicting statistical performance than academic self-efficacy, and therefore this is important to explore. These two research ideas would assist researchers in developing appropriate interventions and teaching methods for statistics courses.

This research report adds to the existing literature regarding factors affecting RDA IIA performance, and future research could use these findings to guide their study, possibly exploring other factors affecting performance. This research can also be used to guide the development and evaluation of interventions designed to improve performance for RDA IIA and other research methods courses.

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Appendix A: Information Letter for Heads of Department, Course Co-ordinators and lecturers

Psychology
School of Human & Community Development
University of the Witwatersrand
Private Bag 3, WITS, 2050
Tel: (011) 717 4500 Fax: (011) 717 4559

To the Head of Department/Course Co-ordinator/Lecturer

My name is Stephanie Da Costa Leite, and I am conducting research at the University of the Witwatersrand in partial fulfilment of the requirements to obtain a Masters degree in Psychology. My research is aimed at exploring whether self-efficacy, metacognitive awareness and working memory play a part in predicting academic performance in RDA IIA.

Participation in this study involves completing a questionnaire with three parts, as well as completing three tasks. The questionnaire will take approximately 20-25 minutes to complete, and the tasks will take approximately a further 25-30 minutes. Participation in the study is completely voluntary and there will be no negative consequences if students elect not to participate.

I am requesting permission to approach students currently or previously registered for RDA IIA during lectures at a convenient time for approximately five minutes, in order to explain the nature of my study and set up times when participants could meet to take part in the study. Ethical issues will be explained to the students. The testing will occur at a later stage and therefore minimal lecture time will be used.

The University of the Witwatersrand Human Research Ethics Committee has been notified of the nature of the study, and permission has been granted. If you have any questions, please feel free to contact me or my supervisor (details below). Your assistance in granting permission for me to organise times to approach students would be greatly appreciated.

Kind Regards

Stephanie Da Costa Leite
(082) 850 0167
sdacostaleite@gmail.com

Supervisor: Nicky Israel
(011) 717 4557
Nicky.Israel@wits.ac.za

Appendix B: Participant Invitation

Participant Invitation

My name is Stephanie Da Costa Leite, and I am conducting research at the University of the Witwatersrand in partial fulfilment of requirements in order to obtain a Masters degree in Psychology. My research is aimed at exploring whether or not self-efficacy, metacognitive awareness and working memory play a part in predicting academic performance in RDA IIA.

Participation in this study involves completing a questionnaire with three parts, as well as completing three tasks during a group session.

The group times are:

Wednesday 1st August: 8:30-9:30, 10:00-11:00, 13:15-14:15, 14:20-15:20

Thursday 2nd August: 8:30-9:30, 10:00-11:00, 13:15-14:15

Friday 3rd August: 10:00-11:00, 13:15-14:15

Monday 6th August: 8:30-9:30, 11:00-12:00

Tuesday 7th August: 13:15-14:15

Wednesday 8th August: 8:30-9:30, 10:00-11:00, 13:15-14:15, 14:20-15:20

Thursday 9th August: 8:30-9:30, 10:00-11:00, 13:15-14:15

Friday 10thAugust: 10:00-11:00, 13:15-14:15

Monday 13th August: 8:30-9:30, 11:00-12:00

Tuesday 14th August: 13:15-14:15

Wednesday 15th August: 8:30-9:30, 10:00-11:00, 13:15-14:15, 14:20-15:20

Venue: U346 (Umthombo Building, 3rd Floor- Next to computer lab)

If you are unable to attend these group sessions please feel free to contact the researcher and set up alternative times.

Stephanie Da Costa Leite
082 850 0167
sdacostaleite@gmail.com

Appendix C: Participant Information Sheet

Psychology
School of Human & Community Development
University of the Witwatersrand
Private Bag 3, WITS, 2050
Tel: (011) 717 4500 Fax: (011) 717 4559

Dear current or previous RDA IIA student,

My name is Stephanie Da Costa Leite, and I am conducting research at the University of the Witwatersrand in partial fulfilment of requirements in order to obtain a Masters degree in Psychology. My research is aimed at exploring whether or not self-efficacy, metacognitive awareness and working memory play a part in predicting academic performance in RDA IIA.

Participation in this study involves completing a questionnaire with three parts, as well as completing three tasks. The questionnaire will take approximately 20-25 minutes to complete, and the tasks will take approximately a further 25-30 minutes. Participation in this research is completely voluntary and it will not affect your courses at the university or your marks in any way at all. You are free to refuse to take part in this study with no negative consequences.

As part of the study, you will be asked to provide your student number in order to allow access to your RDA IIA marks. This will be done by asking you to complete the page at the start of the pack that contains the request for your student number, the year in which you completed the RDA IIA course and a randomly assigned participant number that appears on each page of the questionnaires. You will be asked to detach this page and return it separately. A list of the RDA IIA marks by student number only for each relevant year will be obtained and your mark will be linked to your student number and participant number by a third party. The third party will then delete the student number. The researcher will therefore never have direct access to your student number and the third party will have no access to the rest of your data. In this way, your anonymity will be maintained.

There are no foreseeable risks or benefits (although experience in research will be obtained) to completing the questionnaire, but if anything in the questionnaire upsets you or you would like to discuss anything further, please contact: The Wits CCDU centre on 011-717-9140 and the Emthonjeni centre on 011-717-4513.

Once the study is complete (December 2012), a summary of the results will be posted on the RDA noticeboard on the Mezzanine level of the Psychology department next to U4 – you can also email me for a summary of the results. Please note that it will not be possible to provide detailed individual feedback as your responses are anonymous. If you have any questions, please feel free to contact me or my supervisor (details below).

Thank you for considering participation in this study,
Kind Regards

Stephanie Da Costa Leite
(082) 850 0167
sdacostaleite@gmail.com

Supervisor: Nicky Israel
(011) 717 4557
Nicky.Israel@wits.ac.za

Appendix D: Request for permission to access student number and RDA IIA marks

Participant number:__________________

As part of this study, you are asked to provide your student number below in order to allow a third party to access your RDA IIA marks by student number only. Please note that:

- you will be asked to detach this sheet and return it separately from the questionnaires
- the list of RDA IIA marks from the Department will be obtained using a list by student number only and matched to your student number and randomly-assigned participant number by a third party
- at no point will your name be linked to your student number
- the researcher will obtain a list of your marks recorded next to your randomly-assigned participant number only and will not have access to your student number
- the third party will have no access to the rest of your data
- the sheet containing your student number and participant number will be stored in a secure location during the study and destroyed once the research is complete

If you agree to provide your student number and the year/s in which you completed RDA IIA for the purposes of accessing your RDA IIA mark for this study as per the conditions outlined above, please complete the section below:

Student number:

Year/s in which RDA IIA was completed (please tick the appropriate box):

YEAR	SEMESTER I	SEMESTER II
2012		
2011		
2010		

Appendix E: Demographic questionnaire

Demographic questionnaire

Participant Number: ___________

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

Age (in years):______

Gender:

Male	Female

Race:

Asian	Black	Coloured	Indian	White	Other:

If other, please specify:___________________________

Faculty:

Commerce	Health Science	Humanities	Science	Other

If other, please specify: _________________________

Home Language:_______________________________

RDA IIA:

First-time Student	Repeating Student

Type of high school:

Private	Government

Appendix F: General Self-Efficacy Scale

Please rate (as honestly as possible) the following statements from 1 (Not at all True) to 4 (Exactly true). Please mark your answer with a cross.

	Question	**Not at all True**	**Hardly True**	**Moderately True**	**Exactly True**
1	I can always manage to solve difficult study-related problems if I try hard enough.				
2	If someone opposes me in an academic context, I can find the means and ways to get what I want.				
3	It is easy for me to stick to my aims and accomplish my academic goals.				
4	I am confident that I could deal efficiently with unexpected events in relation to my studies.				
5	Thanks to my resourcefulness, I know how to handle unforeseen situations in relation to my studies.				
6	I can solve most study-related problems if I invest the necessary effort.				
7	I can remain calm when facing difficulties because I can rely on my coping abilities in relation to my studies.				
8	When I am confronted with a problem, I can usually find several solutions in relation to my studies.				
9	If I am in trouble in relation to my studies, I can usually think of a solution.				
10	I can usually handle whatever comes my way in relation to my studies.				

Please rate (as honestly as possible) the following statements from 1 (I am definitely NOT able to do this) to 7 (I am definitely able to do this). Please mark your answer with a cross.

	Question	**1** I am definitely NOT able to do this	**2**	**3**	**4**	**5**	**6**	**7** I am definitely able to do this
1	Soon after the end of a lesson, I am able to remember most of the key concepts.							
2	I can understand most of the key concepts covered in my course.							
3	I am able to explain to my fellow students, in a way they can understand most of the key concepts covered in a course.							
4	After sitting an exam, I am able to remember most of the key concepts covered in the course.							
5	When I find something new about a topic that I am studying, I am usually able to connect it with other things that I know about the topic.							
6	Even when I haven't participated in a lesson, I can usually understand the concepts covered in the lesson by reading a textbook.							
7	It is usually easy for me to understand new information, even on a topic that does not interest me very much.							
8	Soon after the end of a lesson, I am usually able to distinguish the most important concepts from concepts of less importance.							
9	I usually find it easy to join a group of fellow students to study or complete course activities.							
10	I am usually able to help other students solve problems based on concepts described in a lesson.							

Appendix G: Metacognitive Awareness Inventory

Please rate (as honestly as possible) the following statements from 1 (Never true of me) to 5 (Always true of me). Please mark your answer with a cross.

Question	**Never true of me**	**Seldom true of me**	**Sometimes true of me**	**Very often true of me**	**Always true of me**
1. I ask myself periodically if I am meeting my goals.					
2. I consider several alternatives to a problem before I answer.					
3. I try to use strategies that have worked in the past.					
4. I pace myself while learning in order to have enough time.					
5. I understand my intellectual strengths and weaknesses.					
6. I think about what I really need to learn before I begin a task					
7. I know how well I did once I finish a test.					
8. I set specific goals before I begin a task.					
9. I slow down when I encounter important information.					
10. I know what kind of information is most important to learn.					
11. I ask myself if I have considered all options when solving a problem.					
12. I am good at organizing information.					
13. I consciously focus my attention on important information.					
14. I have a specific purpose for each strategy I use.					
15. I learn best when I know something about the topic.					
16. I know what the teacher expects me to learn.					
17. I am good at remembering information.					

Question	Never true of me	Seldom true of me	Sometimes true of me	Very often true of me	Always true of me
18. I use different learning strategies depending on the situation.					
19. I ask myself if there was an easier way to do things after I finish a task.					
20. I have control over how well I learn.					
21. I periodically review to help me understand important relationships.					
22. I ask myself questions about the material before I begin.					
23. I think of several ways to solve a problem and choose the best one.					
24. I summarize what I've learned after I finish.					
25. I ask others for help when I don't understand something.					
26. I can motivate myself to learn when I need to					
27. I am aware of what strategies I use when I study.					
28. I find myself analysing the usefulness of strategies while I study.					
29. I use my intellectual strengths to compensate for my weaknesses.					
30. I focus on the meaning and significance of new information.					
31. I create my own examples to make information more meaningful.					
32. I am a good judge of how well I understand something.					
33. I find myself using helpful learning strategies automatically.					
34. I find myself pausing regularly to check my comprehension.					
35. I know when each strategy I use will be most effective.					

Question	Never true of me	Seldom true of me	Sometimes true of me	Very often true of me	Always true of me
36. I ask myself how well I accomplish my goals once I'm finished.					
37. I draw pictures or diagrams to help me understand while learning.					
38. I ask myself if I have considered all options after I solve a problem.					
39. I try to translate new information into my own words.					
40. I change strategies when I fail to understand.					
41. I use the organizational structure of the text to help me learn.					
42. I read instructions carefully before I begin a task.					
43. I ask myself if what I'm reading is related to what I already know.					
44. I re-evaluate my assumptions when I get confused.					
45. I organize my time to best accomplish my goals.					
46. I learn more when I am interested in the topic.					
47. I try to break studying down into smaller steps.					
48. I focus on overall meaning rather than specifics.					
49. I ask myself questions about how well I am doing while I am learning something new.					
50. I ask myself if I learned as much as I could have once I finish a task.					
51. I stop and go back over new information that is not clear.					
52. I stop and re-read when I get confused.					

Appendix H: Memory Task Answer Sheet

Mental Counters:

1. ____ ____ ____
2. ____ ____ ____
3. ____ ____ ____
4. ____ ____ ____
5. ____ ____ ____
6. ____ ____ ____
7. ____ ____ ____
8. ____ ____ ____
9. ____ ____ ____
10. ____ ____ ____
11. ____ ____ ____
12. ____ ____ ____
13. ____ ____ ____
14. ____ ____ ____
15. ____ ____ ____
16. ____ ____ ____

Verbal Task:

Group 1:

1. ________________________
2. ________________________
3. ________________________
4. ________________________
5. ________________________

Group 2:

1. ________________________
2. ________________________
3. ________________________
4. ________________________
5. ________________________

Group 3:
1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. ___________________________

Group 4:
1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. ___________________________

Group 5:
1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. ___________________________

Group 6:
1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. ___________________________

Group 7:
1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. ___________________________

Group 8:
1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. ___________________________

Group 9:

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________
5. ____________________________

Group 10:

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________
5. ____________________________

Spatial Task:

1.

2.

3.

4.

5.

6.

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11.

12.

13.

14.

15.

16.

Appendix I: Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (SCHOOL OF HUMAN & COMMUNITY DEVELOPMENT

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: MPSYC/12/003 IH**
PROJECT TITLE:	Self-Efficacy, Metacognitive Awareness, Working Memory and Academic Performance in a Research Methods Course
INVESTIGATORS	Da Costa Leite Stephanie
DEPARTMENT	Psychology
DATE CONSIDERED	04/05/12
DECISION OF COMMITTEE*	Approved

This ethical clearance is valid for 2 years and may be renewed upon application

DATE: 20 June 2012

CHAIRPERSON K. Cockcroft
(Professor K Cockcroft)

cc Supervisor: Ms. N Israel
Psychology

DECLARATION OF INVESTIGATOR (S)

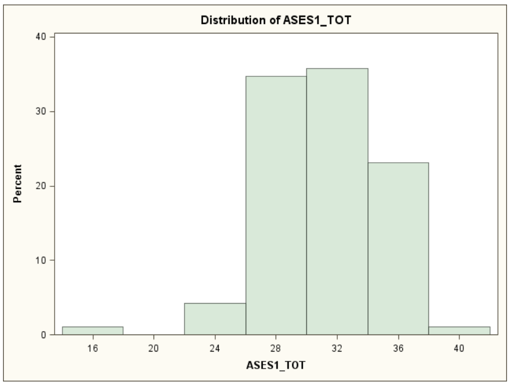
To be completed in duplicate and **one copy** returned to the Secretary, Room 100015, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure, as approved, I/we undertake to submit a revised protocol to the Committee.

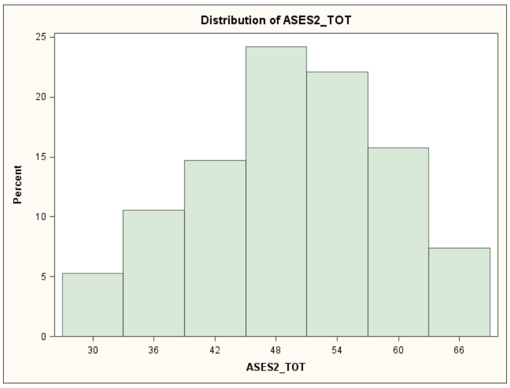
This ethical clearance will expire on 31 December 2014

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

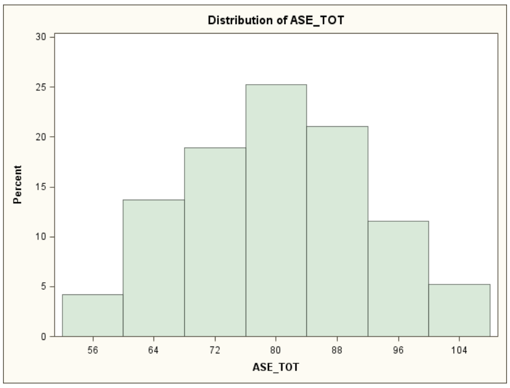
Appendix J: Histograms



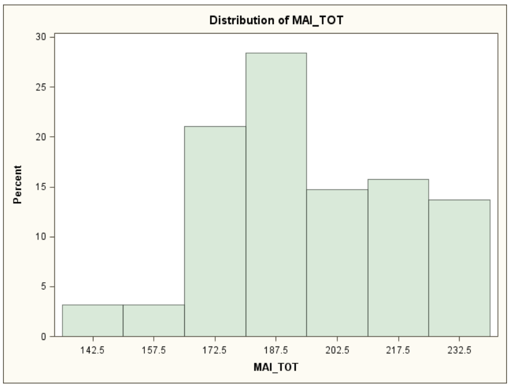
Histogram 1: Distribution analysis for adapted GSES items



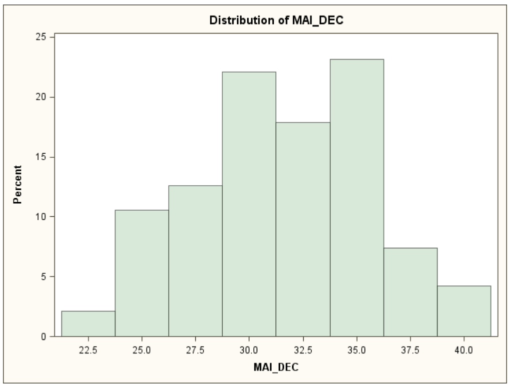
Histogram 2: Distribution analysis for adapted ASES items



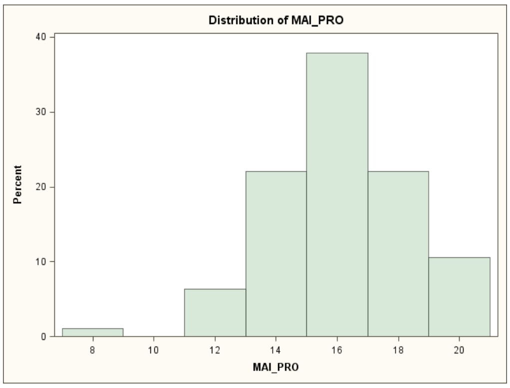
Histogram 3: Distribution analysis for adapted academic self-efficacy scale



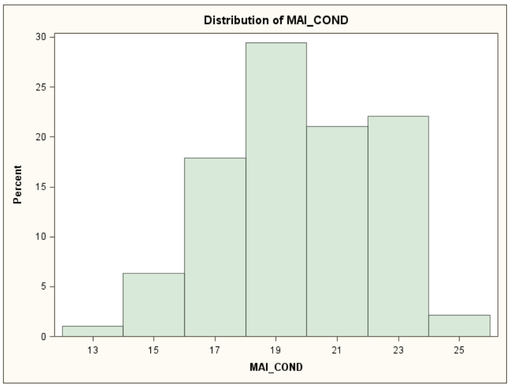
Histogram 4: Distribution analysis for MAI *total*



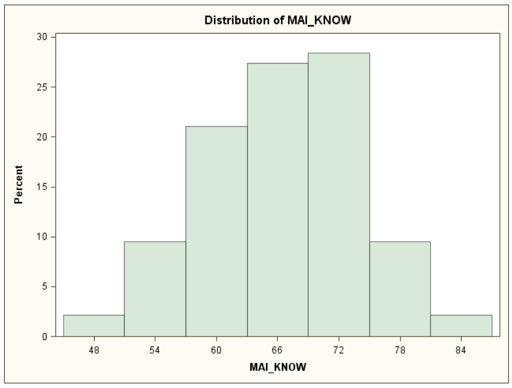
Histogram 5: Distribution analysis for declarative knowledge



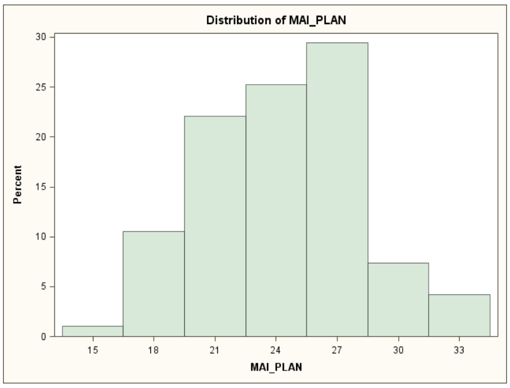
Histogram 6: Distribution analysis for procedural knowledge



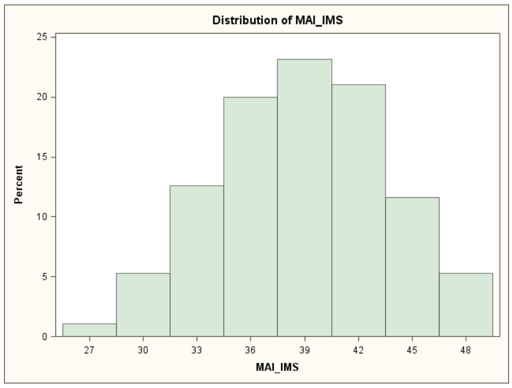
Histogram 7: Distribution analysis for conditional knowledge



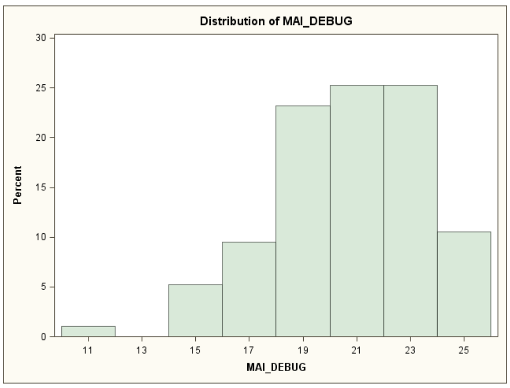
Histogram 8: Distribution analysis for knowledge of cognition



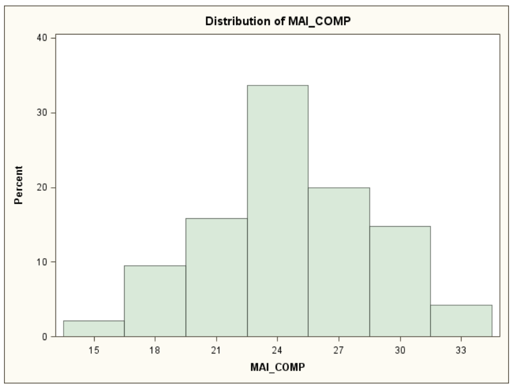
Histogram 9: Distribution analysis for planning



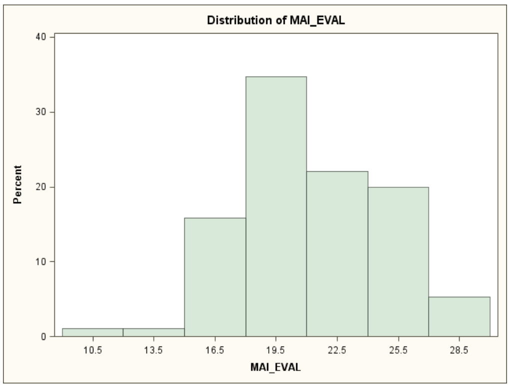
Histogram 10: Distribution analysis for IMS



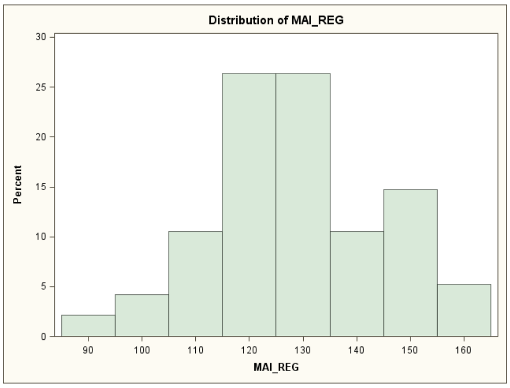
Histogram 11: Distribution analysis for debugging strategies



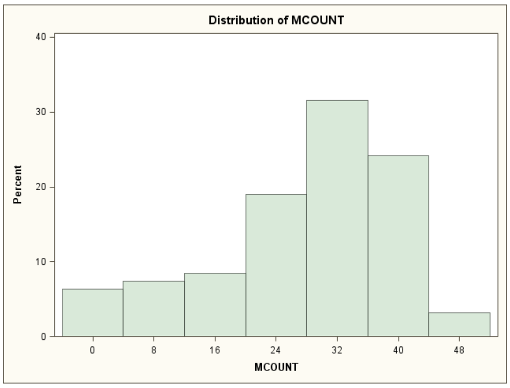
Histogram 12: Distribution analysis for comprehension monitoring



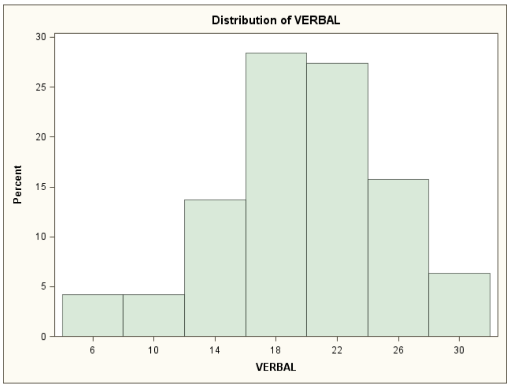
Histogram 13: Distribution analysis for evaluation



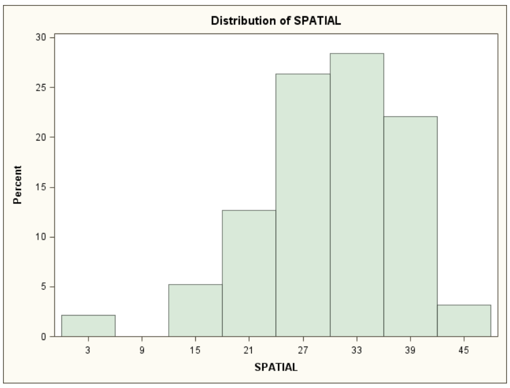
Histogram 14: Distribution analysis for regulation of cognition



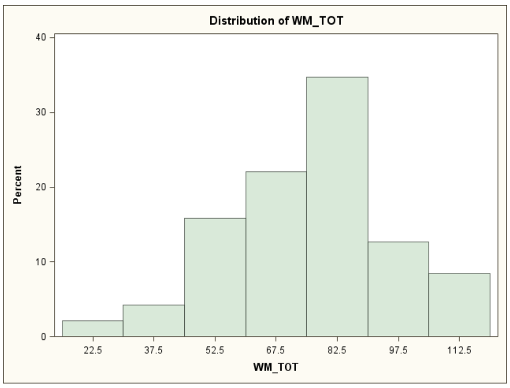
Histogram 15: Distribution analysis for mental counters task



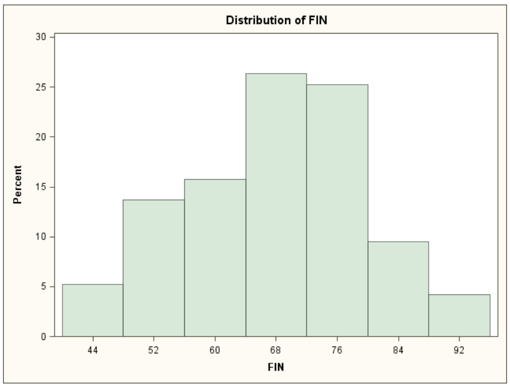
Histogram 16: Distribution analysis for verbal task



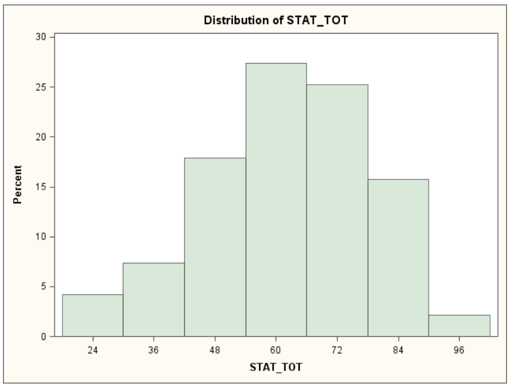
Histogram 17: Distribution analysis for spatial task



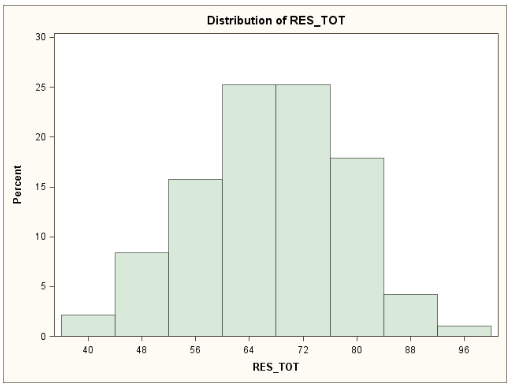
Histogram 18: Distribution analysis for working memory total



Histogram 19: Distribution analysis for final mark



Histogram 20: Distribution analysis for statistics mark



Histogram 21: Distribution analysis for research mark

Appendix K: Spearman's Correlations

Table 8: Spearman's correlation coefficients and p-values (p-values shown in italics)

	Final Mark	**Statistics Mark**	**Research Mark**
Procedural Knowledge	0.076	-0.016	0.178
	0.4635	*0.8772*	*0.0837*
Conditional Knowledge	0.013	-0.073	0.104
	0.8971	*0.4800*	*0.3139*
Knowledge of Cognition	0.082	-0.023	0.200
	0.4311	*0.8248*	*0.0525*
Planning	0.027	0.010	0.020
	0.7963	*0.9271*	*0.8501*
Debugging Strategies	-0.108	-0.187	-0.016
	0.2970	*0.0702*	*0.8810*
Comprehension Monitoring	0.021	-0.040	0.025
	0.8381	*0.7029*	*0.8110*
Evaluation	-0.046	-0.082	-0.041
	0.6582	*0.4263*	*0.6906*
Mental Counters Task	0.343	0.339	0.359
	*0.0007**	*0.0008**	*0.0004**
Spatial Task	0.084	0.063	0.108
	0.4183	*0.5460*	*0.2965*

* indicates significance

Appendix L: Subscale correlations

Table 13: Pearson's correlation coefficients and p-values for metacognitive awareness subscales (p-value is shown in italics) Note: *indicates significance

	M.A. Total	Dec. Know	Pro. Know	Cond. Know	Know Cogn	Plan	I.M.S	Debug Strat	Comp. Monit.	Eval	Reg. Cogn
M.A Total	1.000	0.818 *<0.0001* *	0.795 *<0.0001* *	0.782 *<0.0001* *	0.905 *<0.0001* *	0.797 *<0.0001* *	0.881 *<0.0001* *	0.687 *<0.0001* *	0.821 *<0.0001* *	0.823 *<0.0001* *	0.977 *<0.0001* *
Declarative Knowledge	0.818 *<0.0001* *	1.000	0.640 *<0.0001* *	0.694 *<0.0001* *	0.925 *<0.0001* *	0.581 *<0.0001* *	0.670 *<0.0001* *	0.485 *<0.0001* *	0.554 *<0.0001* *	0.598 *<0.0001* *	0.706 *<0.0001* *
Procedural Knowledge	0.795 *<0.0001* *	0.640 *<0.0001* *	1.000	0.661 *<0.0001* *	0.834 *<0.0001* *	0.603 *<0.0001* *	0.669 *<0.0001* *	0.507 *<0.0001* *	0.579 *<0.0001* *	0.594 *<0.0001* *	0.742 *<0.0001* *
Conditional Knowledge	0.782 *<0.0001* *	0.694 *<0.0001* *	0.661 *<0.0001* *	1.000	0.872 *<0.0001* *	0.534 *<0.0001* *	0.631 *<0.0001* *	0.475 *<0.0001* *	0.540 *<0.0001* *	0.616 *<0.0001* *	0.682 *<0.0001* *
Knowledge Cognition	0.905 *<0.0001* *	0.925 *<0.0001* *	0.834 *<0.0001* *	0.872 *<0.0001* *	1.000	0.647 *<0.0001* *	0.743 *<0.0001* *	0.551 *<0.0001* *	0.628 *<0.0001* *	0.680 *<0.0001* *	0.793 *<0.0001* *
Planning	0.797 *<0.0001* *	0.581 *<0.0001* *	0.603 *<0.0001* *	0.534 *<0.0001* *	0.647 *<0.0001* *	1.000	0.670 *<0.0001* *	0.394 *<0.0001* *	0.678 *<0.0001* *	0.563 *<0.0001* *	0.816 *<0.0001* *
I.M.S	0.881 *<0.0001* *	0.670 *<0.0001* *	0.669 *<0.0001* *	0.631 *<0.0001* *	0.743 *<0.0001* *	0.670 *<0.0001* *	1.000	0.688 *<0.0001* *	0.621 *<0.0001* *	0.643 *<0.0001* *	0.888 *<0.0001* *
Debugging Strategies	0.687 *<0.0001* *	0.485 *<0.0001* *	0.507 *<0.0001* *	0.475 *<0.0001* *	0.551 *<0.0001* *	0.394 *<0.0001* *	0.688 *<0.0001* *	1.000	0.460 *<0.0001* *	0.479 *<0.0001* *	0.706 *<0.0001* *
Comp. Monitoring	0.821 *<0.0001* *	0.554 *<0.0001* *	0.579 *<0.0001* *	0.540 *<0.0001* *	0.628 *<0.0001* *	0.678 *<0.0001* *	0.621 *<0.0001* *	0.460 *<0.0001* *	1.000	0.753 *<0.0001* *	0.859 *<0.0001* *
Evaluation	0.823 *<0.0001* *	0.598 *<0.0001* *	0.594 *<0.0001* *	0.616 *<0.0001* *	0.680 *<0.0001* *	0.563 *<0.0001* *	0.643 *<0.0001* *	0.479 *<0.0001* *	0.753 *<0.0001* *	1.000	0.837 *<0.0001* *
Regulation Cognition	0.977 *<0.0001* *	0.706 *<0.0001* *	0.742 *<0.0001* *	0.682 *<0.0001* *	0.793 *<0.0001* *	0.816 *<0.0001* *	0.888 *<0.0001* *	0.706 *<0.0001* *	0.859 *<0.0001* *	0.837 *<0.0001* *	1.000

Table 14: Pearson's correlation coefficients and p-values for working memory tasks (p-value is shown in italics)

	Mental Counters Task	**Verbal Task**	**Spatial Task**	**Working Memory Total**
Mental Counters Task	1.000	0.200	0.458	0.849
		_0.0515_	_<0.0001*_	_<0.0001*_
Verbal Task	0.200	1.000	0.402	0.566
	_0.0515_		_<0.0001*_	_<0.0001*_
Spatial Task	0.458	0.402	1.000	0.800
	_<0.0001*_	_<0.0001*_		_<0.0001*_
Working Memory Total	0.849	0.566	0.800	1.000
	_<0.0001*_	_<0.0001*_	_<0.0001*_	

*indicates significance

<u>Appendix M: Multiple Regression Analyses with components of working memory and academic self-efficacy predicting RDA IIA performance</u>

Table 21: Multiple regression analysis with the components of working memory and academic self-efficacy predicting final mark

Variable	Parameter Estimate	t-value	p-value	Standardized Estimate
Intercept	40.315	4.30	<0.0001*	0
Mental Counters	0.286	2.70	0.0083*	0.2958
Verbal Task	0.246	1.11	0.2706	0.1177
Spatial Task	-0.016	-0.09	0.9259	-0.0109
Academic self-efficacy	0.019	1.97	0.0517	0.1925

* indicates significance

Table 22: Multiple regression analysis with the components of working memory and academic self-efficacy predicting statistics mark

Variable	Parameter Estimate	t-value	p-value	Standardized Estimate
Intercept	34.074	2.64	0.0097*	0
Mental Counters	0.3770	2.59	0.0112*	0.2899
Verbal Task	0.1244	0.41	0.6848	0.0442
Spatial Task	0.0221	0.10	0.9236	0.0115
Academic self-efficacy	0.1759	1.31	0.1921	0.1310

* indicates significance

Table 23: Multiple regression analysis with the components of working memory and academic self-efficacy predicting research mark

Variable	Parameter Estimate	t-value	p-value	Standardized Estimate
Intercept	35.338	3.94	0.0002*	0
Mental Counters	0.3213	3.18	0.0020*	0.3368
Verbal Task	0.4086	1.93	0.0572	0.1978
Spatial Task	-0.0836	-0.52	0.6017	-0.0594
Academic self-efficacy	0.2177	2.34	0.0213*	0.2211

* indicates significance

Appendix N: Supervisor Agreement

SUPERVISOR – SUPERVISEE AGREEMENT

Supervisor: NICKY ISRAEL

Supervisee: STEPHANIE DA COSTA LEITE

1. The supervisor and supervisee will meet for supervision at least:

1 times a month.

If any of these meetings are cancelled the reason will be documented.

2. The supervisor will undertake to read and comment on any drafts within 3 weeks of receipt. If workload or absence makes this impossible, this will be clearly conveyed to the supervisee and a realistic time frame negotiated.

3. The supervisee will undertake to keep the supervisor regularly informed of her/his progress, and of any absences from university.

Signed on date 7/02/2012

Supervisor: ____________ Supervisee: ____________

PUBLICATION AGREEMENT

The University's Policy on Intellectual Property (S2002/2150A) specifies that research carried out under supervision of an employee of the university belongs to the university. However, copyright of the thesis or report belongs to the student for 24 months after submission. Thereafter copyright reverts to the University. Thus, it is advisable for students to work on publishing their research as soon as possible. It is also important for student and supervisor to negotiate on how this work will take place, and the order of authorship.

The paper to be submitted for publication will be worked on by:

____

The authors of the paper will be (in specified order):

1. ____________________ 2. ____________________

3. ____________________ 4. ____________________

Signed on date ____________________

Supervisor: ____________________ Supervisee: ____________________

16. STATEMENT OF PRINCIPLES FOR POSTGRADUATE SUPERVISION

IN A CONTEXT OF ACADEMIC FREEDOM AND WITHIN A FRAMEWORK OF INDIVIDUAL AUTONOMY AND THE PURSUIT OF KNOWLEDGE THIS AGREEMENT IS WRITTEN IN THE BELIEF THAT THERE IS A RECIPROCAL RELATIONSHIP AND MUTUAL ACCOUNTABILITY BETWEEN SUPERVISOR AND STUDENT.

THE SUPERVISOR AND THE STUDENT:

1. Will establish agreed roles and clear processes to be maintained by both parties. In the case of joint supervision everyone's role needs to be clarified.
2. Will meet regularly and as frequently as is reasonable to ensure steady progress towards the completion of the proposal, research report, or dissertation or thesis. This time varies but the normal minimum requirement for face-to- face contact, spread across each year of registration is: 10 contact hours for an Honours project, 15 contact hours for a Masters by research report and 24 contact hours for a Masters by dissertation and a PhD.
3. Will keep appointments, be punctual and respond timeously to messages.
4. Will keep one another informed of any planned vacations or absences as well as changes in his or her personal circumstances that might impact on the work schedule. Unplanned absences or delays should be discussed as soon as possible and arrangements should be made to catch up lost time.
5. Will ensure that research on animal or human subjects is conducted according to the procedures and the requirements of the relevant University Ethics committee.
6. Will together complete progress reports on the research project, as requested by each Faculty Graduate Studies Committee.

THE SUPERVISOR:

1. Undertakes to provide guidance for the student's research project in relation to the design and scope of the project, the relevant literature and information sources, research methods and techniques and methods of data analysis.
2. Has a responsibility to be accessible to the student.
3. Will be prepared for meetings with the student. This includes being up-to-date on the latest work in his/her area of expertise.
4. Will expect written work as jointly agreed, and will return that work with constructive criticism within a timeframe (a suggestion of 2-4 weeks) jointly agreed at the outset of the research.
5. Will provide advice that can help the student to improve his/her writing. This may include referrals for language training and academic writing. The supervisor will provide guidance on technical aspects of writing such as referencing as well as on discipline specific requirements. Detailed correction of drafts and instruction in aspects of language and style are not the responsibility of the supervisor.
6. Will support the student in the production of a research report, dissertation or thesis. Provision should be allowed for adequate, mutually respectful, discussion around recommendations made.
7. Will assist with the construction of a written time schedule which outlines the expected completion dates of successive stages of the work.
8. Will ensure the student has the opportunity to present work at postgraduate/ staff seminars/national/international conferences as appropriate.
9. Will assist with the publication of research articles as appropriate.
10. Will discuss the ownership of research conducted by the student in accordance with the University guidelines and rules on intellectual property, co-authorship and copyright.
11. Will ensure that the research is conducted in accordance with the University's policy on plagiarism.
12. Will ensure that the student is made aware in writing of the inadequacy of progress and/or of any work where the standard is below par. Acceptability will be according to criteria previously supplied to the student.
13. Has a duty to refuse to allow the submission of sub-standard work for examination, regardless of the circumstances. If the student chooses to submit without the consent of the supervisor, then this should be clearly recorded and the appropriate procedures followed.

THE STUDENT:

1. Undertakes to work independently under the guidance of the supervisor. This includes reading widely to ensure that the literature pertinent to his/her chosen topic has been identified and consulted.
2. Is obliged to make appointments to see the supervisor and will arrange meeting times well in advance.
3. Will think carefully about how to derive maximum benefit from these contact sessions by planning what he/she wants in these sessions.
4. Should submit written work for discussion with the supervisor well in advance of a scheduled meeting. The kind and frequency of written work should be agreed with the supervisor at the outset of the research.
5. Undertakes to submit written work that is relatively free of basic spelling mistakes, incorrect punctuation and grammatical errors. Responsibility for the accuracy of language, the overall structure and coherence of the final research report, dissertation or thesis rests with the student.
6. Undertakes to heed the advice given by the supervisor and to engage in discussion around suggestions made. Ultimately the student has to take responsibility for the quality and presentation of the work.
7. Should strive, within reasonable bounds, to maintain a focus on his/her research area and to work within the agreed time schedule.
8. Will prepare material for presentations at seminars and conferences.
9. Undertakes to submit papers for publication.
10. Agrees to honour agreements about ownership of the research and in accordance with the University's guidelines and rules in relation to co-authorship, copyright and intellectual property.
11. Will ensure that the work contains no instances of plagiarism and that all citations are properly referenced and that the list of references is accurate, complete and consistent.
12. Agrees to work in accordance with the criteria of acceptability as supplied by the supervisor.
13. Undertakes not to place the supervisor under undue pressure to submit work for examination until the supervisor is satisfied that it has reached an acceptable level of quality.

I confirm that I have read and understood this statement and agree to be guided by its principles

Name of student : STEPHANIE DA COSTA LEITE

Student's signature :

Name of Supervisor : NICKY ISRAEL

Supervisor's signature :

Name of Co-Supervisor : N/A

Co-Supervisor's signature :

The broad area of study is: ACADEMIC PERFORMANCE & FACTORS AFFECTING

Provisional submission date is: 31 JAN 2013

Degree : MA PSYCHOLOGY (C+R)

School : HUMAN & COMMUNITY DEV

Faculty : ARTS/HUMANITIES

Date : 7/02/2012

Specific agreements pertaining to: ownership and joint publication, funding, etc. may be attached and signed.

GRIEVANCE PROCEDURES. It should be acknowledged that during the course of the research, both students and supervisors can feel aggrieved. In this event, matters should be dealt with as swiftly as possible by the parties involved and, if necessary, the appropriate Postgraduate Coordinators and Committees. There is, in addition, a University Grievance Policy to help guide deliberations. It is available on www.wits.ac.za/prospective/postgraduate.