

**A Mixed Methods Investigation of Students' Attitudes towards Statistics and Quantitative
Research Methods: A Focus on Postgraduate Psychology
Students at a South African University**

A thesis submitted in fulfilment of the requirements for the degree of

Master of Arts in Psychology

of

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by

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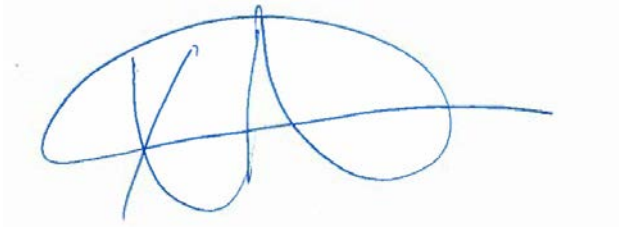
ABSTRACT

Many University programs offer a course in either basic or intermediate statistics as part of the degree requirements prior to graduation (McGrath, Ferns, Greiner, Wanamaker & Brown, 2015). These statistics or quantitative research methods courses are integral in helping students gain vital skills in analysing quantitative data. Research (Schau, Stevens, Dauphinee, & Del Vecchio, 1995) does however indicate that most students have a perfunctory disposition towards these courses. My study sought to particularly investigate attitudes towards statistics and quantitative research methods amongst a sample of 61 postgraduate Psychology students at Rhodes University undertaking a 'Quantitative Research Methods' course as part of their degree offering. A mixed methods approach was used to investigate students' attitudes towards statistics and quantitative research methods. The Survey of Attitudes Toward Statistics (SATS-36) (Schau, 2003) captured student's attitudes towards statistics using a Likert Scale instrument; whereas detailed qualitative interviews accentuated findings from the SATS-36. Key quantitative findings from the SATS-36 including students' perceptions of statistics being a difficult course as well as students having a low affect towards statistics are detailed. Key qualitative findings related to why students experience statistics anxiety such as students' (1) fear of failing statistics, (2) The late introduction of statistics in the Psychology curriculum, and (3) The role of educator/s in alleviating or promoting feelings of statistics anxiety are noted. The significance of these findings as well as the contributions of the study to the teaching and learning of statistics and quantitative research methods courses at Rhodes University are explored, in light of other studies on the topic of statistics anxiety and attitudes towards statistics/ quantitative research methods.

Keywords: 'Attitudes towards statistics', statistics anxiety, postgraduate students, mixed methods, SATS-36, qualitative interviews.

Declaration of Originality

I, the undersigned, hereby declare that the work contained in this thesis is my own work, unless otherwise referenced. It has not been previously submitted at any other university for the purposes of fulfilment of a degree.

A handwritten signature in blue ink, consisting of several overlapping loops and a long horizontal stroke extending to the right.

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LIST OF ACRONYMS & NOTES

SATS - 28: Survey of Attitudes Toward Statistics 28

SATS - 36: Survey of Attitudes Toward Statistics 36

IAT: Implicit Association Test

SPSS: Statistical Package for the Social Sciences

SATS-M: Survey of Attitudes toward Statistics Model

STARS: Statistics Anxiety Rating Scale

MPS: Multidimensional Perfectionism Scale

SAS: Statistics Attitude Survey

ATS: Attitudes Toward Statistics

SAM: Statistics Anxiety Measure

Please note: Following guidelines from the literature on the topic of statistics anxiety, the terms ‘statistics’ and ‘quantitative research methods’ are used interchangeably in this research study.

Please note: Following guidelines from the literature (c.f. Chew & Dillon, 2014) the terms ‘statistics anxiety’ and ‘attitudes towards statistics’ are used interchangeably in this research study.

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DEDICATION

I dedicate this to my late grandparents, Vuyiswa and Phindile Ngantweni, who invested in my education.

CHAPTER 1

INTRODUCTION

1.1 Context and Rationale

Knowledge construction and conducting academic research have become an integral aspect of higher education training and academic development (Vessuri, 2008). By and large, within the broad domain of ‘academic research’, the bases of investigation, and knowledge production fall within two didactic modes of investigation, namely quantitative and qualitative research methodologies (Creswell, 2003; Gelo, Braakman & Benetka, 2008; Gower, 1997). Quantitative research methods in their philosophical nature, are guided by a positivist framework that relies on statistical or quantitative measurements to quantify data and thus make empirical deductions about phenomena (Gelo et al., 2008). While quantitative research methods are associated with a positivist framework of analysis, a constructionist or interpretive framework guides qualitative research (Creswell, 2003). According to Bishop (2015), the constructionist or interpretive framework of investigation adopts a relativist belief that holds the notion that the only way the world around us can be analysed, is through conceptual frameworks adopted by an individual (Bishop, 2015). As such, the constructionist or interpretivist approach acknowledges perspectives such as culture, relative truth and historical context as integral to knowledge production. From this perspective, it can be inferred that the qualitative approach is informed by subjective modes of what constitutes reality (Bishop, 2015).

Emerging from the above, many higher education curriculum programs require students to undertake both quantitative and qualitative research methodology courses as a fulfilment of their undergraduate or postgraduate qualifications (McGrath, Ferns, Greiner, Wanamaker & Brown, 2015; Perlman & McCann, 1999). A number of researchers (e.g., Griffith, Adams, Gu, Hart & Nichols-Whitehead, 2012; Onwuegbuzie, Leech, Murtonen & Tahtinen, 2010; Onwuegbuzie & Wilson, 2003; Schau, Stevens, Dauphinee, & Del Vecchio, 1995) seem to indicate that a number of students, particularly tend to have a perfunctory disposition towards quantitative research method courses. With a specific reference to the social sciences, research (e.g., Orel & Khavenson, 2013; Onwuegbuzie et al., 2010) indicates that students in this discipline of study tend to find quantitative research methods courses difficult, and sometimes irrelevant to their degree component. Many of the researched students are said to experience a type of anxiety

commonly known as ‘statistics anxiety’ (Onwuegbuzie et al., 2010). In this sense, statistics anxiety refers to the anxiety that students experience when they encounter statistics or quantitative research courses in their course offerings (Onwuegbuzie, DaRos & Ryan, 1997).

1.2 Statement of the Problem and Research Objectives

While the majority of the existing literature (e.g., Ali & Iqbal, 2012; Ashaari, Judi, Mohamed & Wook, 2011; Hamid & Sulaiman, 2014) considers statistics anxiety amongst undergraduate social science majors, there continues to be a dearth of research on understanding the phenomenon amongst postgraduate social science students and more particularly, amongst postgraduate Psychology students (Please see e.g., Evans, 2007; Koh & Zawi, 2014; Papanastasiou & Zembylas, 2008). It is important to study attitudes towards statistics, as a growing body of literature (e.g. Freng, Webber, Blatter, Wing & Scott, 2011; Gal, Ginsburg & Schau, 1997; Murtonen, 2005; Ramirez et al., 2012; Rosli & Maat, 2017) shows that attitudes towards statistics are a key predictor of performance in quantitative research method courses and overall attainment of University degrees. To date, a review of the literature shows that there is limited documentation within the South African context of literature investigating attitudes towards statistics amongst postgraduate students, especially Psychology students, where statistics and quantitative research method courses are a key offering in this discipline of study. To address the above gap, some research has been emerging at Rhodes University to study postgraduate students’ attitudes towards statistics and quantitative research methods. For the sake of brevity, few studies are listed below. de Wet (2015) conducted a study amongst Rhodes University Psychology students taught statistics (quantitative research methods) either through blended learning¹ or through traditional learning². de Wet measured attitudes amongst these two groups using the Survey of Attitudes Towards Statistics (SATS-36) (Schau, 2003) and found that although students taught using hybrid learning showed more positive attitudes towards statistics, there were no significant overall differences between the two groups ($p = 0.75$).

¹ This was a 2015 Honours in Psychology group who were taught statistics through an online learning software called STATISTICA supported by podcast lectures.

² This group was a 2015 Third Year Psychology group who were taught statistics mainly through face-to-face interaction with the teacher. Both these classes were taught by the same instructor, the research supervisor of this project, Mr. Sizwe Zondo.

Another study by Machangane (2014) which investigated students' implicit and explicit attitudes towards quantitative and qualitative research methods using the Implicit Associations Test (IAT; Greenwald, Banaji, Nosek, 2003), found that there were no significant differences between students' implicit and explicit attitudes towards quantitative research methods or qualitative research methods courses (IAT D600; $p = 0.07$). This is to say that students did not show a specific preference or bias towards either one of these methodologies.

A study by Nohenda (2015) found that the use of computer software amongst Rhodes University students (i.e. STATISTICA, TIBCO, 2018) slightly decreased statistics anxiety and improved the learning of statistics in some students, but not amongst others. This study by Nohenda (2015) details that the use of statistics software in the teaching and learning of statistics is important as it has the potential to motivate students to learn, understand the statistical outputs produced by the computer software, and thereby improving understanding of statistics. Another study worth mentioning is that by Parker (2017). Parker conducted a meta-analysis (fixed model) on student's attitudes towards quantitative research methods and found that students' attitudes towards the *value*³ of statistics, was directly related to whether they achieved high academic success in quantitative research courses (denoted by mark) or not ($r = 0.18$, $p < 0.05$). Although the overall meta-analysis effect ($r = 0.18$) was small, the study found that students' views and attitudes towards the value of statistics and quantitative research methods courses has an impact on their performance in quantitative research methods courses. It is important to note that due to the limited number of studies specifically focusing on postgraduate Psychology students, the meta-analysis by Parker (2017) included studies from other social science disciplines and adjunct medical specialties.

Lastly, my⁴ previous Honours research study (Ngantweni, 2015) found no statistically significant differences on students' attitudes towards statistics and quantitative research methods based on the variables of age, race or gender.

³ The *value* of statistics is an attitude component within the Survey of Attitudes Towards Statistics (SATS-36) scale. This scale is expounded on later in the thesis.

⁴ Ngantweni, X. (2015). *Understanding students' attitudes towards statistics: A focus on postgraduate psychology students* (Unpublished Honours thesis). Rhodes University, Grahamstown, South Africa.

1.2.1 Response to the Statement of the Problem

As previously noted, research indicates that social science students have a perfunctory disposition towards quantitative research method courses. That being said, all the above cited studies (both Rhodes University studies and other main stream studies on the subject (e.g., Hilton, Schau, & Olsen, 2004; Onwuegbuzie, et al, 2010; Rwodzi, Rugaranganda & Manatsa, 2013) continue to employ quantitative research method as its method of investigating students' attitudes towards statistics. While these studies provide insights into the perfunctory dispositions of students towards statistics, limited qualitative and mixed methods research studies exist on the topic of statistics anxiety amongst social science students (Griffith, Adams, Gu, Hart & Nichols-Whitehead, 2012; Malik, 2015).

My current Masters research study thus sought to introduce a mixed methods analysis of understanding postgraduate Psychology students' attitudes towards statistics. Particularly, it focused on the differences of attitudes towards statistics between General Psychology and Organisational Psychology students. It was envisaged that this mixed methods approach would (1) enhance the scarce body of literature regarding attitudes towards statistics in a South African context and (2) introduce a mixed method analysis of understanding postgraduate Psychology student's attitudes towards statistics and quantitative research methods. It is worth noting that to date, only one research study has employed a mixed method design to analyse students' attitudes towards statistics and quantitative research methods, that being the study by Griffith, Adams, Gu, Hart and Nichols-Whitehead (2012). My research thus sought to expand on the study by Griffith et al. (2012), by employing a mixed methods approach to study postgraduate Psychology students' attitudes towards statistics and quantitative research methods. Qualitative research has often been criticized for lacking objectivity, while quantitative research has been said to lack participants' voice. The mixed methods design was particularly important for my study as it increased the validity of the findings by having an additional data source.

1.3 Research Methods, Procedure and techniques

Mixed methodology design was used to achieve the aims of my study. In this manner, mixed methods refers to the combining of quantitative and qualitative research approaches to address a

research problem. The Survey of Attitudes Toward Statistics 36 (SATS-36) was used to collect quantitative data from Rhodes University post-graduate students who had completed the '2015/2016 Honours in Research Methodology' course offered at Rhodes University. A total of 56 participants completed the SATS-36. The Statistical Package for the Social Sciences 24 (SPSS 24) (IBM, 2017) software was used to aid statistical analysis. Quantitative data was analysed using descriptive statistics as well as inferential statistics. Qualitative data was collected by means of interviews. A total of five participants were interviewed. Nvivo 11 (QSR International, 2015), a qualitative data analysis software was used to organise and structure the qualitative data. Thematic analysis was used to examine and record patterns within the data, thereby generating themes. Convenience sampling was used to recruit participants to take part in the interview phase of my analysis. Lastly, my study employed a sequential explanatory mixed method approach to data analysis.

1.4 Thesis structure

In Chapter 1 (the current chapter), I present the context, rationale, and significance of my study as well as an overview of methodology used in my research. Chapter 2 is a review of the key literature on students' attitudes towards statistics. In Chapter 3, I detail and describe the research design, methods, data collection techniques and ethical issues relevant to my study.

Chapter 4 consists of quantitative results, namely an analysis of the SATS-36 scores.

Chapter 5 consists of qualitative results and the analysis of student interviews.

Chapter 6 discusses the key findings relevant to my study as well emerging recommendations for further research.

1.5 Summary

This study sought to investigate attitudes towards statistics amongst a sample of postgraduate Psychology students. A mixed methods approach was utilised to explore the interface between attitudes towards statistics amongst postgraduate Psychology students enrolled in 'General Psychology' and 'Organisational Psychology'. Results from the quantitative analysis of the study indicated that (1) postgraduate Psychology students have a positive attitude towards the *effort* ($M=6.3$; $SD=0.65$), *value* ($M=4.44$; $SD=0.74$), *cognitive competence* ($M=4.58$; $SD=0.81$), and *interest* components ($M=4.23$; $M=1.39$) of the SATS-36. Further analysis indicated that students

have a neutral attitude towards the *difficulty* ($M=3.79$; $SD=0.69$) and *affect* ($M=3.98$; $SD=1.03$) components of the SATS-36. (2) Comparative analysis indicated no statistically significant differences between students enrolled in General Psychology or Organisational Psychology streams on the SATS ($p > 0.05$). The limitations of the comparative analysis, mainly in light of the unequal sample sizes between the two groups is discussed. Lastly, (3) no statistically significant differences in attitudes towards statistics were noted between the Rhodes University student sample, and the North America student population on attitudes towards statistics⁵.

With regard to the qualitative findings, three main themes emerged from the analysis, namely; (1) students' 'fear of failure' as driving statistics anxiety; (2) 'the teaching style and role of the lecturer' to either heighten or decrease statistics anxiety and lastly, (3) the 'late introduction to statistics courses' as a key variable explaining statistics anxiety amongst postgraduate Psychology students at Rhodes University.

⁵ The logic of this analysis is further provided in the thesis.

CHAPTER 2

LITERATURE REVIEW

2.1 The Nature of Knowledge

Before detailing the value and nature of quantitative research methods and statistics for University education, it is worth exploring the ‘nature of knowledge’ and its relevance to methods of investigation. The subsequent sections (a) present the nature of knowledge, (b) define Quantitative Psychology and (c) present students’ attitudes towards Quantitative Psychology. The section ends by presenting the research objectives emerging from the reviewed literature.

The Collins English dictionary (2008) describes knowledge as (1) the state of knowing, (2) awareness, consciousness or familiarity gained by experience or learning, and (3) specific information about a subject. From the second definition, it can be inferred that knowledge has a subjective, qualitative nature gained by experience. The third definition further suggests that knowledge has an objective quality, one independent of experience. Knowledge, according to Nakkeeran (2010), can further be described as information, facts or skills about a certain reality or phenomenon (e.g., the existence of the cosmos). Knowledge in this sense enables an understanding of the world, thus allowing individuals to live as members of society. Nakkeeran (2010), further notes that it is through knowledge that individuals within a society are able to make predictions, see patterns and make decisions about phenomenon. From the above, it suffices to say that knowledge is gained through a combination of experience, reasoning and the observation of patterns and regularity of phenomenon under investigation.

In addition to the above, Nakkeeran, (2010) states that knowledge often has an element of ‘truth’ associated to it. In this manner, if something is conceived as knowledge, it often has ‘truth’ embedded within it. Stated differently, if something is ‘true’, it becomes a form of knowledge. Researchers (e.g., Tomela, 2008, 2010) do however caution against approaches that claim all-encompassing ‘truths’, especially in disciplines such as the social sciences.

Nakkeeran (2010) for instance notes that in practice, not all forms of knowledge can be tested for truth or falsehood. In comparing the hard and social sciences for instance, the hard sciences have mathematical laws with a high degree of certainty that govern diverse field such as astronomy

and physics, whereas in the social sciences, such levels of ‘truth’ and certainty are not always feasible (Nakkeeran, 2010; Tomela, 2008). It thus stands to reason that while in the natural sciences for example, there might be a commonality of the understanding of ‘truth’ and ‘reality’, within the social sciences the nature and methods of understanding ‘truth’ and reality may be flexible and sometimes, discursive in nature. It can thus be said that the nature of knowledge varies across disciplines. Below, Basil Bernstein’s analysis of the structure of knowledge will be discussed, leading to the ‘nature of knowledge’ as applied in the discipline of Psychology.

2.2 Basil Bernstein

Bernstein, a key theorist in the ‘sociology of knowledge’ proposes that knowledge can be understood as an interrelated association between three ‘pedagogic devices’, namely, (a) the ‘production of knowledge’, (b) the ‘reconstruction of knowledge’, and (c) the ‘reproduction of knowledge’ (Bernstein, 2003; Singh, 2002). Key to my analysis is how ‘knowledge production’ is linked to ‘epistemological access’ (Boughey, 2005; Bernstein, 2003) allowing a member of society to be a part of a ‘knowledge community’ (e.g., Sociology, Psychology etc.). Stated differently, Bernstein argues that the ‘pedagogic device’ is a way in which knowledge is structured and framed within a discipline and how this influences the ‘pedagogic practice’ thereof (Singh, 2002). In other words, ‘knowledge production’ is a systematic endeavour in which particular knowledges are valued and formulated into a discipline’s curricula, classroom discourse and course evaluation (Singh, 2002).

From the above, it emerges that what knowledges are valued, is discipline specific. This specificity allows for empowerment and epistemic access into a discipline of study (Singh, 2002). Knowledges are thus classified and framed in each discipline in order to shape subjectivities and enable commonality of shared knowledge in that discipline of study (Wheelahan, 2005). According to Gower, (1997), both positivist and interpretivist views of knowledge are key to the study of Psychology as a University discipline of study. In the below section, I briefly expound on the value of ‘positivism’ and ‘interpretivism’ as key systems of thought that enable ‘epistemological access’ into the discipline and study of Psychology as a field of study (Gower, 1997). I highlight the above in order to lay a foundation for why Quantitative Research Methods and Qualitative Research Methods courses are taught at most Psychology Departments around the world.

2.2.1 Positivism

The term 'positivism' is said to have been developed by Auguste Comte. Bryant (1985) notes that Comte never wrote about 'positivism' per se, but rather the 'positive method' or 'positive philosophy'. According to Bryant (1985), Comte believed that observation and reason were the best methods of understanding human behaviour, and as such, true knowledge was derived through observation and experience. The evolution of the term 'positivism' has since been associated with empirical forms of experimentation and quantification to produce knowledge (Gower, 1997). Moreover, according to this paradigm, knowledge and hypotheses can be quantified and measured in order to achieve objective reality of a phenomenon (Thomas, 2010). Proponents of the positivist method further argue that the scientific method can be utilised to study societies by applying observable laws to the social sciences (Martineau, 1858). According to Gower (1997), the positivist approach adopted from David Hume and August Comte has greatly influenced disciplines such as Psychology where quantitative research method and statistics courses are a key component of 'knowledge production' that Psychology students are required to master in order to gain access into this discipline of study (Gower, 1997).

2.2.2 Interpretivism

Another paradigm of knowledge acquisition and knowledge production within Psychology is interpretivism. According to Vosloo (2014), interpretivism, is a philosophical paradigm that seeks to arrive at a subjective understanding of an individual's experiences of reality. In such a view, humans make sense of their worlds by interpreting and rationalising their daily interactions and thus constructing knowledge (Babbie & Mouton, 2008). To highlight the interpretivist view, Thomas (2010) writes:

“Interpretive paradigm is underpinned by observation and interpretation, thus to observe is to collect information about events, while to interpret is to make meaning of that information by drawing inferences or by judging the match between the information and some abstract pattern. It attempts to understand phenomena through the meanings that people assign to them” (p.296).

From the above, Thomas (2010) notes that interpretivism, as opposed to positivism, attempts to explain and understand reality from the lens of the individual's subjective experience.

According to Yu (2006), quantitative methods are underpinned by a positivist paradigm, while qualitative methods are underpinned by an interpretivist paradigm (Thanh & Thanh, 2015). As noted in the objectives of my study, I have adopted a mixed methods design in order to introduce a mixed methods analysis of understanding postgraduate Psychology students' attitudes towards statistics. A combined methods therefore represents a developing field in social science methodology. There has been broad agreement (e.g. Creswell, Plano-Clark, Gutmann & Hanson, 2003; Onwuegbuzie & Leech, 2005; Tashakkori & Teddlie, 2003) that the use of multiple methods with complementary strengths and weaknesses can add value to research.

In the next section I specifically focus on the nature of 'Quantitative Psychology' which is a key component of Psychology. Thereafter, I focus on student's attitudes towards quantitative research method courses that are offered in most Psychology departments.

2.3 Quantitative Psychology as Knowledge

According to Toomela (2010), to understand quantitative psychology, one needs to distinguish between (1) the structural-systemic approach based on Aristotelian thinking and (2) the associative-quantitative approach based on the Cartesian-Humean framework. The former aims to understand the causes of studied phenomena, while the latter seeks to understand cause-effect relationships between events. These two epistemologies are explained in further detail below.

Structural-systemic approach

As mentioned above, the structural-systemic approach adopts an Aristotelian type of thinking. Aristotle strongly believed that to know causes one ought to explain the reasoning behind the cause (Toomela, 2010). He distinguished between four kinds of causes, namely, material, formal, efficient, and final cause. The structural-systemic approach maintains that there are universal principles in the world, that understanding the world can go beyond appearances, allowing for the study of not only relationships between events, but also the quality of the phenomenon under study (Toomela, 2012). To achieve its aims, the structural-systemic approach employs qualitative methods as its main approach to data analysis (Toomela, 2012).

Associative-quantitative approach

While the structural-systemic approach adopts four kinds of causes, the associative-quantitative approach only adopts one, efficient causality (Toomela, 2010). Hume held that the causal relation comprises of three factors, namely, (1) contiguity of cause and effect, (2) priority in time of cause to effect, and (3) the connection between cause and effect. Hume considered the relationship between cause and effect to be the most important, as it was the criteria of differentiating between causal and non-causal relations (Toomela, 2010). As the name suggests, the associative-quantitative approach follows the quantitative methodology, relying on statistical data to derive conclusions about phenomena. It is on the associative-quantitative approach that 'Quantitative Psychology' finds its roots. Most Universities around the world, thus offer quantitative research methods courses based on this approach.

2.4 Role and Value of Statistics and Quantitative Research Methodology in Psychology

Based on the above, it is worth noting that the importance of the quantitative approach and statistics in everyday life cannot be understated. A practical use of statistics in everyday life includes assistance to identify patterns in crime rates, the spread of diseases and other factors such as population growth (Chew and Dillon, 2014). Within the discipline of Psychology, a key aspect of psychological research involves measuring and observing social phenomena. Through psychological measurement, values and scores are produced allowing for the testing and verification of hypothesis (Mc Mahon, 2010). In explaining the importance of statistics and quantitative methods in psychology, Mc Mahon (2010) maintains that since psychology is the scientific study of human behaviour, its capacity, amongst other things, includes designing surveys, conducting experiments, and analysing empirical data. This analysis can then be generalized to the population in the form of descriptive or inferential statistics (Mc Mahon, 2010).

In spite of the above, many theorists (e.g. Michell, 1999; Tomela, 2008) criticize the quantitative method employed in Psychology and other social science courses and state that this method of analysis and scrutiny often ignores the ontological (the kind of information encoded in quantitative variables representing mental phenomena) and epistemological (the way in which the information sheds light on the relationship between these mental phenomena) nature of

variables under study (Gelo et al., 2008). The concern of these critics is that without a clear understanding of the kind of information encoded in a variable, events and their relationships cannot be interpreted meaningfully by the quantitative method (Gelo et al., 2008). In spite of the above concern, statistics and quantitative research methods courses continue to be a key component of the curriculum of Psychology and allow students to gain access into the academic community of Psychology.

As a brief summary, the above sections have covered the nature of knowledge, and have sought to highlight the importance of statistics and quantitative research methods in the social sciences, and particularly in psychology. The section has particularly illustrated the Aristotelian and Humean epistemologies and their distinct understanding of knowledge and causality. In the subsequent sections, I introduce the phenomenon of ‘statistics anxiety’ and psychology student’s perceptions of quantitative research courses.

2.5 Student Attitudes Towards Statistics and Quantitative Research Methods in Psychology

2.5.1 Conceptual Framework of Statistics Anxiety

Emerging from the above, a number of researchers have studied students’ attitudes towards statistics and quantitative methods. At a conceptual level, various viewpoints have been derived to define ‘statistics anxiety’ and ‘attitudes towards statistics’. In this section, I firstly conceptualize the term, ‘attitude’, and relate this term to ‘statistics anxiety’. Thereafter, I conceptualise the term ‘anxiety’ and relate this to ‘statistics anxiety’. Drawing from these two definitions, I then provide a working conceptual framework for ‘statistics anxiety’ and how it relates to students undertaking statistics and quantitative research method courses.

Chaiklin (2011) defines an ‘attitude’ as a learned tendency that evaluates things, or situations in a certain manner. In this sense, evaluations can either be negative or positive, and can encompass objects, events, people and general issues (Chaiklin, 2011). Moreover, an ‘attitude’ or a set of attitudes can be viewed as a reaction towards a thing, phenomenon or event, and can encompass cognitive, affective and/or behavioral components (Ostrom, 1969). The cognitive component of an attitude consists of one’s thoughts and beliefs about a phenomenon or event. The *affective* component refers to the emotive aspect of the event or phenomenon. Lastly, the behavioral component involves how the attitudes influences an individual’s behaviour. Similarly,

Eagly and Chaiken (1993) conceptualise an attitude as a “psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour” (p. 1). Lastly, Ashaari et al. (2011) state that an attitude can be viewed as a mental condition within a person. As such, attitudes are shaped through experience, and affect a person’s reaction towards something (Ashaari et al., 2011).

Applying the above insights, an ‘attitude’ towards statistics can be defined as “a multidimensional construct representing students’ learned pre-dispositions to respond positively or negatively to statistics” (Emmioglu & Capa-Aydin, 2012, p. 95). Moreover, according to Vanhoof et al., (2011), an attitude towards statistics can be described as a “multidimensional concept referring to distinct, but related dispositions pertaining to favourable or unfavorable responses with regard to statistics and statistics learning” (p.35). It is important to highlight the multidimensional nature of attitudes towards statistics as depicted in the below conceptual model developed by Ramirez, Schau, and Emmioglu, (2012).

According to Ramirez et al.’s (2012) model (Figure 2.1), students’ attitudes towards statistics are a result of multiple factors including (a) student’s personal characteristics (e.g., temperament) and (b) previous achievement and related experiences at University level. At a more immediate personal level, characteristics such as *affect* (students’ negative or positive attitudes towards statistics), *cognitive competence* (students’ perceived intellectual ability to do statistics), *value* (student’s perceived worth and value of statistics to their degree), *difficulty* (students’ perceived difficulty of statistics), *interest* (students’ interest in statistics) and *effort* (the amount of effort student place into learning statistics) all determine attitudes towards statistics and achievement in these courses. Through the development of my thesis and when addressing antecedents to statistics anxiety, the below conceptual framework that defines students’ attitudes towards statistics will be referred upon.

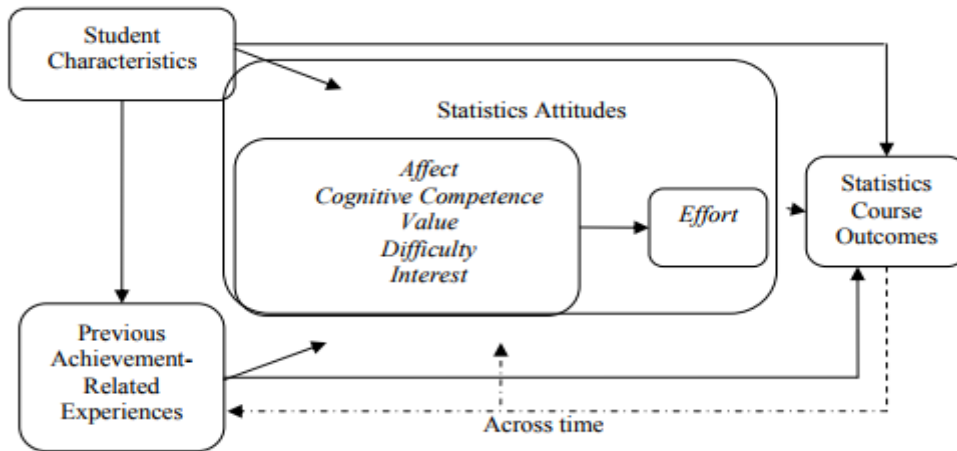


Figure 1. Students' Attitudes Toward Statistics - Model (SATS-M)

Figure 2.1 Students' attitudes toward statistics –Model

2.5.2 Anxiety and an Overview of Statistics Anxiety

Having explained what constitutes an 'attitude', and how this links to attitudes towards statistics, it is worth explaining the terms 'anxiety' and in so doing, provide an overview of the term 'statistics anxiety'. An 'anxiety' according to Rector and colleagues refers to feelings of unease, worry and/or fear (Rector, Bourdeau, Kitchen, & Joseph-Massiah, 2008). Similarly, Rachman (2004) describes 'anxiety' as "a tense, unsettling anticipation of a threatening, but vague event; a feeling of uneasy suspense" (p.3). Within the statistics literature, the concept 'statistics anxiety' appears to be an all-encompassing term. Due to the variegated nature of the term 'statistics anxiety' most structural equation models⁶ (e.g., Benson, 1989; Chi, 1998; Hilton, Schau, & Olsen, 2004; Ncube & Moroke, 2015; Roberts, & Bilderback, 1980) measure latent constructs, (e.g., *interest*, *value*, *difficulty*) as contributing to the term 'statistics anxiety'. Similar to attitudes towards statistics, the term 'statistics anxiety' relies on manifest indicator variables to capture its essence.

⁶ A structural equation model is a multivariate statistical analysis technique mostly use in behavioral sciences. It is used in the analysis of structural relationships between measured variables and latent constructs, and combines factor analysis and regression (Hox & Bechger, 1998).

Due to the various manifest indicator variables (e.g., *interest*, *value*, *difficulty*) that encompass the term ‘statistics anxiety’, various definitions have been suggested in the literature. For example, Zeidner (1991) defines statistics anxiety as extensive worry, characterised by intrusive thoughts that lead to mental disorganisation when individuals are exposed to statistical content. Onwuegbuzie and Wilson (2003) define statistics anxiety as attitudes that evoke anxiety in the form of worry, tension, and doubt when working with information related to statistics concepts or the analysis of statistical information. More germane to my research, Hanna and Dempster, (2009) define statistics anxiety as a certain feeling of anxiety that students experience when they come across statistics content or problems related to statistics. Hanna and Dempster, (2009) (and others, e.g., Macher et al., 2012; Papanastasiou & Zembylas, 2008) trace this reaction to the fact that students suddenly find themselves faced with new concepts and new material that they previously never faced or did not take a liking to, and this triggers a responses of anxiety (Papanastasiou & Zembylas, 2008).

To briefly summarize, the previous sections have defined the terms ‘attitudes towards statistics’ and ‘statistics anxiety’. It is however important to note that the above terms, ‘attitudes towards statistics’ and ‘statistics anxiety’ are often used interchangeably in the literature as there is no clear distinction between the two (Chew & Dillon, 2014). Throughout my study, the two terms will thus be used interchangeably. In the subsequent sections, I explore some factors that have been identified and discussed in the literature as contributing to statistics anxiety amongst students. The statistics literature (e.g. Onwuegbuzie & Wilson, 2003,) refers to these factors as ‘antecedents of statistics anxiety’. These antecedents are reviewed in the below sections.

2.6 Antecedents to Statistics Anxiety

Onwuegbuzie and Wilson (2003) speak of antecedents to statistics anxiety. The above authors categorize antecedents⁷ of statistics anxiety into (a) *situational* (factors that surround the stimulus), (b) *dispositional* (factors brought by an individual to a certain setting), and (c) *environmental* antecedent (factors that can influence levels of statistics anxiety that are part of

⁷ An antecedent is something that logically precedes another. In the case of statistics anxiety, this would refer to an individual’s perceptions and behaviours towards statistics.

the person or environment). Below, I explicate on what these antecedents entail and provide a review of the literature on each of these antecedents to statistics anxiety.

2.6.1 Situational Antecedens

Onwuegbuzie & Wilson (2003) define situational antecedents, as variables that are related to the stimulus, in this case, statistics. Such variables include (i) the role of mathematics in statistics education, (ii) prior knowledge of statistics before taking a statistics course, (iii) teacher's instructional style to teach statistics, and lastly, (iv) the status of the statistics course (whether it is compulsory or not). With reference to (i) the role of mathematics in statistics education, researchers (e.g., Fonteyne et al., 2015; Zeidner, 1991) have found that a positive correlation exists between mathematical literacy and statistics achievement. Zeidner, (1991) for example found that students' basic mathematical skills, were a key predictor to statistics anxiety. Zeidner (1991) specifically found that prior experiences of performing poorly in math and low math self-efficacy were highly correlated to increased levels of statistics anxiety. Similarly, Macher, Paechter, Papousek and Ruggeri (2012) in their study found that high levels of mathematics anxiety were directly correlated to compromised performance in a statistics course ($r = 0,28; p < 0.05$), leading to heightened levels of statistics anxiety. Similar findings have been noted elsewhere between the relationship of mathematics and statistics anxiety (e.g., Aksentijevic, 2015; Paechter, Macher, Martskvishvilli, Wimmer, Papousek, 2017). From the above, we can conclude that there is a relationship between the situational antecedent, mathematics education and statistics anxiety, with low math self-efficacy related to heightened levels of statistics anxiety.

With regard to the relationships between (ii) prior knowledge of statistics and statistics anxiety, different findings have been reported in the literature. For example, Roberts and Saxe (1982) found a significant correlation between prior knowledge of statistics and statistics anxiety. That is to say, students' attitudes towards statistics were significantly positive, when students had previously taken some form of statistics courses (e.g., basic introduction to statistics), than when they had not taken these prior statistics courses. These findings are similar to those by Trimarco (1997) who found that students who had prior knowledge of statistics, reported lower levels of statistics anxiety. Similarly, Onwuegbuzie and Wilson (2003) found that prior statistical

knowledge and experience with statistical content was linked to decreased levels of statistics anxiety. The bulk of the literature (e.g., Chew & Dillon, 2013; Smith & Martinez-Moyano, 2012) suggests that earlier exposure to statistics content leads to decreased levels of statistics anxiety, and suggests a relationship between prior exposure to statistics and statistics anxiety.

Lastly, with regard to (iii) teacher's instructional style and statistics anxiety, various findings have been noted within the literature. For example, in a study by Wei and Mei, (2005) who investigated the relationship between students' statistics anxiety and the teaching strategies employed by the instructor to teach statistics, it was found that the instructor's attitude towards the subject of statistics was a key determining factor in students' perceived attitudes towards statistics and their subsequent anxiety levels towards the subject. Pang and Tang, (2005) particularly found that if an instructor is attentive, well organised and provides clear to understand material to students, their subsequent anxiety towards statistics decreases, leading to better learning outcomes.

Similarly, Field (2009) (2010) and Neumann, Hood, and Neumann (2009) found that instructor's (1) use of humor, (2) the extent to which an instructor enjoys what he or she teaches, (3) and focusing on core concepts underlying statistics, encouraged students' learning and reduced students' levels of statistics anxiety. With that being said, although the lecturer's role is important in determining student's learning and subsequent levels of statistics anxiety, it is important to note, as highlighted by Murtonen (2005), that the learning of statistics and quantitative research methods is largely driven by the emotional and motivational factors that the student brings, more than the innovative teaching style of the instructor (Murtonen, 2005).

2.6.2 Dispositional Antecedents

In a comprehensive review of literature pertaining to statistics anxiety, Onwuegbuzie and Wilson (2003) define dispositional antecedents as factors brought to the teaching and learning setting by the individual student. Such factors include, but are not limited to perfectionism, procrastinating statistics assignments, and self-efficacy.

One example of a study investigating the relationship between perfectionism and statistics anxiety is a study by Onwuegbuzie and Daley (1999). Onwuegbuzie and Daley (1999) in their study, sought to investigate the relationship between statistics anxiety and perfectionism. In their

study, perfectionism was described as the “tendency to set and pursue unrealistically high goals and standards for oneself” (Onwuegbuzie & Daley, 1999, p. 1089). The researchers recruited 107 students who were registered in graduate-level research methodology courses and were administered the Statistics Anxiety Rating Scale (STARS) as well as the Multidimensional Perfectionism Scale (MPS). The researchers found that post-graduate students who maintained a perceived necessity to reach expectations and standards recommended by significant others (e.g., spouses, teachers, or family) experienced higher levels of ‘statistics anxiety’⁸.

In a similar study observing students from non-statistical disciplines (i.e., social sciences) taking an introductory research methodology course, Onwuegbuzie (1997) found that self-oriented perfectionists (those who tend to set high standards for themselves) and socially prescribed perfectionists (those who believe that their lecturers or classmates have set unrealistic standards for them to achieve), experienced higher than normal levels of statistics anxiety. For the self-oriented group, quantitative research methods anxiety was found to be due to the student’s desire of wanting to produce perfect proposals as part of the quantitative research course; whereas for the socially prescribed group, quantitative research anxiety was due to their views of how their quantitative research course proposals would be graded.

Another study examining dispositional antecedents on statistics anxiety as a study by Onwuegbuzie (2004) who examined the relationship between procrastination and statistics anxiety amongst graduate students. Onwuegbuzie (2004) found that the reason students procrastinate studying for statistics exams and submitting statistics assignments, was directly related to student’s fear of failing statistics courses. The study by Onwuegbuzie (2004) further found that a majority of students experience interpretation anxiety related to statistics as well as fear asking for help from their instructors. The study by Onwuegbuzie (2004) further noted that students who experienced heightened levels of statistics anxiety were more likely to procrastinate and delay either learning or submitting statistics related assignments.

⁸ This anxiety was specifically associated with test and class anxiety. These participants further reported a fear of asking for help, and anxiety interpreting the meaning and application of statistics values/outputs from calculations (Onwuegbuzie and Daley, 1999).

2.6.3 Environmental Antecedents

Lastly, environmental antecedents refer to events that cannot be changed and that have occurred previously (Onwuegbuzie and Wilson, 2003). Examples of environmental antecedents to statistics anxiety include antecedents such as gender, age and race (Onwuegbuzie & Wilson, 2003).

With regard to gender, mixed findings have been reported within the literature, with some research (e.g., Benson, 1989; Benson & Bandalos, 1989; Cruise & Wilkins, 1980; Onwuegbuzie, 1998; Vahedi, Farrokhi & Bevrani, 2011) reporting higher levels of statistics anxiety amongst women, with other studies (e.g., Mandap, 2016) report higher levels of statistics anxiety amongst males. In their study Rodarte-Luna and Sherry (2008) found that while males were likely to experience higher levels of statistics anxiety, females were more likely to use strategies that resulted in low statistics anxiety (Bui & Alfaro, 2011). It is however interesting to note that females who procrastinated statistics assignments experienced statistics anxiety level similar to their male counterparts (Rodarte-Luna & Sherry, 2008). Other studies (e.g., Eduljee & LeBourdais, 2015; Hsiao & Chiango, 2011; Papanastiou & Zembylas, 2008) report no differences between male and female students with regard to attitudes towards statistics and statistics anxiety.

Similarly, mixed findings have been reported with regard to age. Bell (2003) for example found that ‘non-traditional students’ (students aged 25 and above), experienced higher levels of statistics anxiety when it came to writing statistical tests, compared to ‘traditional student’ groups. A similar study by Bui & Alfaro (2011) found that ‘traditional students’, (defined as students aged 25 and below) obtained higher marks in statistics courses compared to non-traditional students (mean scores). The authors conclude that perhaps the differences in attitudes towards statistics could be attributed to non-traditional students’ being absent from school for a much longer period before enrolling in a statistics course. Similar findings with regard to older students reporting higher levels of statistics anxiety have been reported in studies by Chi (1998), Onwuegbuzie (1998) and Demaria-Mitton (1987). It is however to note that the above trends are not consistent within the statistics literature (Ngantweni, 2015).

Lastly, with regard to race, racial differences in statistics anxiety have been noted in the North American context. For example, in a study by Onwuegbuzie (1999), it was found that African-

American students experienced higher levels of statistics anxiety compared to Caucasian-American students. The researcher explained that the variance in statistics anxiety scores may be due to the study not taking into account socioeconomic factors that could have had an impact in African-America students' perceived experiences of general anxiety, regardless of their levels of statistics anxiety. My previous Honours study, Ngantweni, (2015), did not find any differences in statistics anxiety based on race, gender or age within a Rhodes University student's sample of study.

2.7 Statistics anxiety among Postgraduate Psychology students

The majority of the above cited studies, (e.g., Papanastasiou & Zembylas, 2008; Rwodzi, Ruparanganda & Manatsa, 2013; Zimprich, 2012) all continue to focus on undergraduate students taking either Introductory or Intermediate statistics/quantitative research method courses. To date, there continues to be a dearth of research on attitudes towards statistics and quantitative research methods among postgraduate students. Table 2.1 shows a display of a sample of studies conducted amongst undergraduate and postgraduate students found and included in my literature review.

Table 2.1 Undergraduate and Postgraduate studies on attitudes towards statistics

Undergraduate Studies	Postgraduate Studies
Ali, A. Z., & Iqbal, F. (2012). Statistics anxiety among psychology graduates: An analysis	Coetzee, S., & van der Merwe, P. (2010). Industrial psychology students' attitudes towards statistics
Ashaari, N. S., Judi, H. M., Mohamed, H., & Wook, M.T. (2011). Student's attitude towards statistics course	Koh, D., & Zawi, M.K. (2014). Statistics anxiety among postgraduate students
Baloglu, M. (2003). Individual differences in statistics anxiety among college students.	Rosli, M. K., & Maat, S. M. (2017). Attitude towards statistics and performance among post-graduate students.
Bell, J.A. (2003). Statistics anxiety: The non-traditional student	
Bui, N.H., & Alfaro, M.A. (2011). Statistics anxiety and science attitudes: age, gender, and ethnicity factors	
Chew, K. H. P., & Dillon, D. B. (2013). Individual differences in statistics anxiety among students in Singapore	
Chiou, C. C., Wang, Y. M., & Lee, L. T. (2014). Reducing statistics anxiety and	

enhancing statistics learning achievement: Effectiveness of a one-minute strategy	
Dauphinee T. L., Schau, C., & Stevens, J. J. (1997). Survey of attitudes toward statistics: Factor structure and factorial invariance for women and men	
Eduljee, N.B., & LeBourdais, P. (2015). Gender differences in statistics anxiety with undergraduate college students	
Emmioglu, E., & Capa-Aydin, Y. (2012). Attitudes and achievements in statistics: a meta-analysis study	
Evans, B. (2007). Student attitudes, conceptions, and achievement in introductory undergraduate college statistics	
Fonteyne L., De Fruyt F., Dewulf N., Duyck W., Erauw K., Goeminne K., Lammertyn, J., Marchant, T., Moerkerke, B., Oosterlinck, T., & Rosseel, Y. (2015). Basic mathematics test predicts statistics achievement and overall first year academic success	
Gordon, S. (2004). Understanding students' experiences of statistics in a service course	
Hamid, H. S. A., & Sulaiman, M. K. (2014). Statistics anxiety and achievement in a statistics course among psychology students	
Hanna, D., & Dempster, M. (2009). The effect of statistics anxiety on students' predicted and actual test Scores	
Homnik, C., & Luik, P. (2017). Adapting the Survey of Attitudes towards Statistics (SATS-36) for Estonian Secondary School Students	
Hsiao, T-Y., & Chiang, S. (2011). Gender differences in statistics anxiety among graduate students learning English as a foreign language	
Khavenson, T., Orel, E., & Tryakshina, M. (2012). Adaption of survey of attitudes towards statistics (SATS 36) for Russian sample	
Lalayants, M. (2012). Overcoming graduate students' negative perceptions of statistics	
Macher, D., Paechter, M., Papousek, I., and Ruggeri, K. (2012). Statistics anxiety, trait	

anxiety, learning behaviour, and performance	
Macher, D., Paechter, P., Papousek, I., Ruggeri, K., Freudenthaler, H.H., & Arendasy, M. (2012). Statistics anxiety, State anxiety during an examination, and academic achievement	
Malik, S. (2015). Undergraduates' statistics anxiety: a phenomenological study.	
Mandap, C. M. (2016). Examining gender differences in statistics anxiety among college students	
Mji, A. (2009). Differences in university students' attitudes and anxiety about statistics	
Ncube, B., & Moroke, N. D. (2015). Students' perceptions and attitudes towards statistics in South African university: an exploratory factor analysis approach	
Onwuegbuzie, A. J. (2004). Academic procrastination and statistics anxiety	
Onwuegbuzie, A. J., & Daley, C.E. (1998). Age-related differences in timed examinations	
Onwuegbuzie, A. J., & Daley, C.E. (1999). Perfectionism and statistics anxiety	
Onwuegbuzie, A. J., DaRos, D., & Ryan, J. (1997). The components of statistics anxiety: a phenomenological study	
Onwuegbuzie, A.J. (1995). Statistics test anxiety and women students	
Onwuegbuzie, A.J. (1999). Statistics anxiety among African-American graduate students: an affective filter?	
Onwuegbuzie, A.J., & Seaman, M. (1995). The effect of time and anxiety on statistics achievement.	
Orel, E., & Khavenson, T. (2013). Attitudes towards statistics in social science students: Operationalization and measurement	
Pang, W., & Tang, M. (2005). Students' perceptions on factors of statistics anxiety and instructional strategies.	
Papanastasiou, E.C., & Zembylas, M. (2008). Anxiety in undergraduate research methods courses: Its nature and implications	

Perepiczka, M., Chandler, N., & Becerra, M. (2011). Relationship between graduate students' statistics self-efficacy, statistics anxiety, attitude towards statistics, and social support	
Rwodzi, M., Ruparanganda, F., & Manatsa, P, (2013). University students' attitudes quantitative research methods: A Comparative/Contrastive Analysis	
Summers, J. J., Waigandt, A., & Whittaker, T. A. (2005). A comparison of student achievement and satisfaction in an online versus a traditional face-to-face statistics class	
Walsh, J. J., & Ugumba-Agwunobi, G. (2002). Individual differences in statistics anxiety: The roles of perfectionism, procrastination and trait anxiety	
Williams, A. S. (2013). Worry, intolerance of uncertainty, and statistics anxiety	
Zeidner, M. (1991). Statistics and mathematics anxiety in social sciences students- some interesting parallels	
Zimprich, D. (2012). Attitudes towards statistics among Swiss psychology students	

Few studies (e.g. Coetzee & van der Merwe, 2010; Koh & Zawi, 2014) have focused on psychology postgraduate students' attitudes towards statistics. The studies by Coetzee & van der Merwe, (2010) as well as Koh & Zawi, (2014) are highlighted below. The study by Coetzee & van der Merwe, (2010) focused on a sample of South African postgraduate students registered for an Industrial Psychology degree. The study by Coetzee and van der Merwe (2010) discovered that while students found statistics to be technical, most students reported having a positive attitude towards statistics and could see the value and need for the subject to their degree. Moreover, Coetzee and van der Merwe (2010) found that older students (27 years and above) found the statistics course to be less difficult than their counterparts. The above finding by Coetzee and van der Merwe (2010) are of importance to me, as the Rhodes University Psychology Department currently offers statistics courses to a combined class of Industrial and 'General' psychology students. Further investigation (e.g., website searches) on the above seems to suggest that most Universities offer distinct quantitative research methods courses to Organisational and General Psychology students.

To date, Rhodes University has been considering separate statistics/quantitative research methods streams for Industrial and 'General' psychology students based on the 'perceived different needs' of Industrial and 'General' psychology students (Personal communication with Honours coordinator and considerations from colloquiums on the teaching and learning of quantitative research methods to Psychology students). It would thus be important for my purposes to investigate if significant differences exist in attitudes towards statistics between Industrial and 'General' Psychology students within a Rhodes University student sample. Pursuing this investigation is important as it will aid in the teaching and learning of statistics/quantitative research methods courses at the Rhodes University department of Psychology.

Koh and Zawi (2014) conducted a study which aimed to understand postgraduate psychology students' level of statistics anxiety. The study looked at factors associated with statistics anxiety among postgraduate students, namely: (1) anxiety towards statistics class activities, (2) attitudes towards statistics and mathematics, and (3) expected levels of performance in a statistics class. The instrument used in this study was the Statistics Anxiety Measure (SAM). Koh and Zawi, (2014) found that postgraduate students had moderate levels of anxiety towards statistics class activities. Although no significant differences were found between males and females regarding levels of statistics anxiety, it was noted that, compared to females, male students viewed statistics in a more negative light. Moreover, the study noted that most students reported having the *cognitive competence* as well as the cognitive ability to perform well in statistics courses.

2.8 South African Studies on Statistics Anxiety

As noted above, few studies have explored the concept of 'statistics anxiety' within a South African context, with the majority of studies being North America studies. In addition to the above mentioned study by Coetzee and van der Merwe (2010), Mji (2009) conducted a study in which he sought to investigate whether or not there were sex differences in student's attitudes towards statistics. The study comprised of students who had no prior extensive experience in taking mathematics and statistics course. Participants for the study were students enrolled in either Taxation, Marketing or Accounting courses at a vocational technology institution. Two measures used in the study, the *Statistical Anxiety Rating Scale* and the *Attitudes Toward Statistics Questionnaire*, indicated that there were no significant sex differences in relation to

student's attitudes towards statistics. It was however reported that students taking Taxation reported negative attitudes towards statistics than their counterparts majoring in Accounting and Marketing courses. The researcher especially noted that one of the major limitations of their study was an overreliance on unpublished studies as well as lack of contextualised studies with which to compare their South African sample with. Another study by Ncube, and Moroke, (2015) sought to investigate students' perceptions and attitudes towards statistics using a confirmatory exploratory factor analysis. The study found that "students' perceived academic and professional relevance of statistics relates to their statistics proficiency" (p.231). In other words, students who reported a low self-perception in statistics were likely to develop a negative attitude towards the course. In summary, very few South African studies exist investigating the phenomenon of attitudes towards statistics/quantitative research methods amongst postgraduate students, especially postgraduate Psychology students.

2.9 Review of existing measurement of statistics anxiety

Having provided a context to statistics anxiety as well as a review of the literature on attitudes towards statistics, it is worthwhile at this juncture to explore the instruments used to measure statistics anxiety. Due to the fluid definition and nature of 'attitudes towards statistics' and 'statistics anxiety', a number of instruments have been employed to measure attitudes towards statistics anxiety. A review of the literature seems to suggest that the most commonly used instruments to measure the phenomenon of statistics anxiety include the 'Statistics Attitude Survey' (SAS) (Roberts & Bilderback, 1980), the 'Statistics Anxiety Rating Scale' (STARS) (Cruise & Wilkins, 1980), the 'Survey of Attitudes Toward Statistics Scale' (SATS) (Schau, 1992; 2003), the 'Attitudes Toward Statistics' scale (ATS) (Wise, 1985) as well as the 'Statistics Anxiety Measure' (SAM) (Earp, 2007). Below I describe the SAS as well as the SATS, which I use in my data collection.

The SAS is an inventory of 34 questions related to various situations requiring statistical input, such as doing statistics homework or studying for a statistics test and subsequent accompanying levels of statistics anxiety (Roberts & Bilderback, 1980). This measure was adopted from the STARS and was created as a way of providing a brief and focused measure of statistics anxiety. The STARS was initially adopted using a five point Likert scale, in which participants rate the

level of anxiety they would feel in each situation (e.g., test anxiety, class anxiety, and fear of statistics teachers) (Sandoz et al., 2017).

The Survey of Attitudes Towards Statistics (SATS) was created by Candace Schau. Two versions of instruments exist. The initial version, the SATS-28, included 28 items, subdivided into four scales (Schau, 1996); whereas the updated SATS-36 consists of 36 items, subdivided into six scales (Carnell, 2008; Schau, 2003) (these scales are explained in my methods section). According to Tempelaar, Van der Leoff and Gijsselaers (2007), the updated version of the SATS (SATS-36) has allowed for a more comprehensive measurement of attitudes towards statistics (Tempelaar et al., 2007).

As noted by Gal & Ginsberg, (1994) and later by Mji (2009) the key limitation of the above instruments is that these scales (1) use Likert type assessments, (2) tend to be similar in what they measure (i.e., attitudes and anxiety towards statistics), and that (3) the scales only tend to differ in the number of items (questions) on each of the dimensions of ‘statistics anxiety’ (e.g., number of questions measuring *affect* versus number of questions measuring the perceived *value* of statistics). Gal and Ginsberg, (1994), particularly note that the major shortcoming of these instruments is that they generate responses that are not explained, particularly because these answers are measured by Likert-type items and are not developed further by qualitative analysis to gain greater insight into the various phenomenon that underpin statistics anxiety. As such the above measurements, although valuable in that they produce scores that allow for (a) simple reporting, (b) are convenient and quantifiable, they often lack in-depth qualitative enquiry.

2.10 Summary of Reviewed Literature and Link to Research Objectives

This chapter reviewed literature related to statistics anxiety and students’ attitudes towards statistics. It emerged that in many undergraduate and postgraduate social science courses, quantitative research methods and statistics courses, have become a mandatory part of the requirement for the fulfilment of these degree. It was specifically noted that most students experience anxiety when completing these courses. Antecedents to statistics anxiety were noted and these included dispositional, situational and environmental predictors of statistics anxiety (Onwuegbuzie and Wilson (2003). Lastly, various measurements of attitudes towards statistics

such as the SAS (Roberts & Bilderback, 1980), and the SATS (Schau, 2003) were briefly reviewed.

Key gaps in the literature were identified and these stem from the fact that (a) the bulk of the research on attitudes towards statistics and quantitative research methods courses mainly focuses on undergraduate students in North American institutions (USA). Limited literature speaks directly to the South African context. Thus, as part of my research, I am interested in analyzing differences between a sample of South African students and the US undergraduate student population on attitudes towards statistics/quantitative methods. The aim of this investigation is to ascertain how the South African sample compares to other students in North American institutions in relation to attitudes towards statistics.

Related to the above, (b) there continues to be a dearth of research investigating postgraduate Psychology students' attitudes towards statistics and quantitative research methods; particularly (c) differences in attitudes towards statistics between General and Organisational Psychology students. The third limitation is particularly important for this study as both General and Organisational Psychology students at Rhodes University sit in a combined class for their postgraduate statistics courses. Based on the limitations identified in (c) I am interested in assessing whether teaching quantitative methods in separate streams, as opposed to a combined class would be of any value. Lastly, it was noted that (d) the majority of the studies utilize Likert type instruments to assess attitudes towards statistics. These instruments inherently have limitations and need to be augmented by qualitative modes of enquiry.

2.11 Research Objectives emerging from Summary:

Based on the above summary, my main research goals are:

1. To understand postgraduate Psychology students' attitudes towards statistics in a South African sample using the SATS-36.
 - a) This objective stems from findings within the literature (e.g., Evans, 2007; Koh & Zawi, 2014; Papanastasiou & Zembylas, 2008) which notes that there is a dearth of research on attitudes towards statistics and the quantitative research methods amongst postgraduate students. Although this dearth is widespread, my study will seek to

- investigate statistics anxiety within a South African context, in so doing, add to the scarce body of literature on the topic of attitudes anxiety in postgraduate students.
- b) Linked to the above, is an investigation of whether there are significant differences between postgraduate Organisational Psychology and General Psychology students' attitudes towards statistics.
2. Identify if attitudes towards statistics differ significantly between a South African sample and student population studies in the North American context.
- c) This objective stems from the realisation that much of the literature on attitudes towards statistics and quantitative research methods stems from the North American context. It is therefore worthwhile to investigate whether differences exist between the South African student sample and student population studies from the North American context. This will guide future research on the topic in the sense that there will be documented literature comparing South African students to students from other contexts.
3. Introduce a qualitative analysis investigating into students' attitudes towards statistics.
- d) This objective stems from the recommendation by Griffith, Adams, Gu, Hart and Nichols-Whitehead (2012) who recommend that investigation on student's attitudes towards statistics could be better served by conducting research that incorporates both standardised Likert instruments assessments (such as the SATS) with qualitative methods of enquiry.

CHAPTER 3

RESEARCH METHODOLOGY AND RESEARCH DESIGN

3.1 Research Design

The methodological framework that guided my study was based on ‘pragmatism’. Pragmatism is a paradigm that combines quantitative and qualitative approaches. Pragmatists are of the opinion that multiple paradigms can be employed to address a research problem (Barnes, 2012; Creswell & Plano-Clark, 2007). As such, pragmatists adopt a stance that both subjective and objective reality, if used in a logical manner, allows for a richer understanding of a particular phenomenon under investigation (Barnes, 2012).

Following the pragmatist school of thought, my study employed a mixed methods research design. My mixed method design took the form of a sequential explanatory mixed methods design. Tashakkori & Creswell, (2007) define, mixed methods research as “research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches in a single study” (p.4). Mixed methods research is premised on the idea that the combination of qualitative and quantitative approaches provide a better understanding of the research compared to either approach in isolation (Creswell & Plano Clark, 2007).

Briefly, in order to ascertain the value, emergence and significance of mixed methods, it is necessary to have an understanding of the history and philosophy that influenced the social sciences. According to Teddlie & Tashakkori, (2009) the history and philosophy of the social sciences refers to the roots or ideas that guide the quest for knowledge in human sciences (Teddlie & Tashkkori, 2009). Early Greek philosophers such as Socrates, Aristotle, and Plato used observational techniques more than 25 centuries ago (Teddlie & Burke Johnson, 2009). These early pioneers agreed to some extent that truth could be discovered through priori reasoning which is to say that knowledge is based on self-evident truths (Teddlie & Burke Johnson, 2009). One of the key philosophers, Plato, is largely credited as an advocate for the

deductive method⁹, as he believed that such methods provided certainty. Plato dismissed inductive methods as being based on mere belief rather than experimental fact (Teddlie & Burke Johnson, 2009). On the contrary, Aristotle, with an interest in diverse disciplines, including metaphysics, ethics, politics, and psychology, valued the observation and explanation of entities in the social world in which people exist (Teddlie & Burke Johnson, 2009). Aristotle is said to have employed both inductive and deductive reasoning in his work, and is said to have laid the foundations for mixed methods research (Teddlie & Burke Johnson, 2009). As such, Aristotle stressed the importance of combining deductive and inductive approaches in order to gain an extensive grasp of a particular subject matter.

Considerably, a number of researchers in the social and health sciences have embraced mixed methods designs in their studies due to its 'transformative potential' (Barnes, 2012, p. 467). The transformative potential of mixed methods, at least in a South African context, is the potential of the design to use mixed methods to *expand* on our understanding of complex issues related to topics as diverse as race and identity (e.g., Van Ommen & Painter, 2005), intergroup contact (e.g., Dixon & Durrheim, 2003), and sexual harassment (e.g., Van Wijk, Finchilescu, Tredoux, 2009) to name a few studies that have employed this design. Through mixed method designs, the above named studies have been able to uncover unexpected findings that have necessitated further research on these complex topics. The other 'transformative potential' of mixed methods designs is the strength of this design to *develop* locally relevant measurement instruments (Chirawodza, et al., 2009). Chirawodza, et al., (2009) found that in employing the mixed method approach, in their local South African research, they were able to overcome the limitations inherent in each of the designs and thus arrive at a richer nuance of a subject area.

From above, it can be noted that the mixed method design allows researchers to ground their premises on both qualitative and quantitative paradigms, in so doing, capturing a detailed and informed perspective of a particular research situation (Ivankova, Creswell & Stick, 2006). Since various understanding of 'mixed methods designs' exist (Creswell, 2007), my study is interested in mixed methods purely as a 'mix' of quantitative and qualitative methods to answer the research question. In this manner, quantitative research is interested in understanding 'how

⁹ Deductive reasoning refers to a process in which conclusions are based on premises that are assumed to be true (Johnson-Laird, 2006)

much' of something there is, whereas qualitative research is concerned with qualifying the entity (Gelo et al., 2008). Stated differently, quantitative methods seek objective reality by making comparisons, predictions and inferences, whereas the qualitative method seeks to understand reality as being socially and psychologically constructed (Gelo et al., 2008).

Specific to psychology, the integration of the inductive-subjective approach (qualitative approach) with a deductive-objective approach (quantitative approach) (Morgan, 2007) has meant that these approaches “accommodate scientific rigor and theory alongside uncertainty and instability (Evans et al., 2011, p.277). To a large extent, this integrative approach, according to Creswell (2007), is purely guided by pragmatism, that states that a research problem ought to be addressed in its social and historical context, as opposed to simply, its method of investigation (Creswell, 2007).

To summarise, the strength of mixed methods designs lies in its ‘transformative potential’ and the ‘pragmatic’ approach that states that knowledge is both constructed, and based on objective reality (Johnson & Onwuegbuzie, 2004). My research study is thus framed and guided by this perspective investigate the research problem. In the subsequent section, I outline the mixed method approach I utilized in my research study.

3.1.1 Mixed Methods Designs

Variants of mixed method designs exist, and for the purposes of my research, as opposed to a concurrent triangulation mixed method design, my research design was a sequential explanatory mixed methods design. As explained by Creswell & Plano Clark (2007), a sequential explanatory mixed methods design involves two phases: phase one is the collection and analysis of quantitative results to inform phase two, which is the collection of qualitative data to answer the research question. Stated differently, the sequential explanatory mixed methods design seeks to explain or enhance quantitative results by conducting qualitative research on a sample of participants (Creswell & Plano Clark (2007). The quantitative aspect of this research involved examining scores and results of participants’ attitudes towards statistics using the SATS-36 (Schau, 2003). The second phase, the qualitative analysis sought to build on the quantitative findings. The latter phase of the sequential explanatory mixed methods design, thereof seeks to refine, expand, and develop on the statistical results by exploring participant’s views in more

depth (Creswell & Plano Clark, 2007, Doyle, Brady & Bryne, 2009; Johnson & Onwuegbuzie, 2004). This mixed method approach thus leads to a robust analysis taking advantage of the strength of each method in order to understand the participants' attitudes towards statistics and quantitative research methods. The implementation of my sequential explanatory mixed methods design is further explained below.

3.2 Setting

My research was conducted amongst students taking the 2015 and 2016 Honours in Quantitative Research Methods course. The 2015/16 Honours in Quantitative Research Methods course is a term long course, offered over a 6 week period at Rhodes University. The general content covered in the course includes: Seminar 1: Descriptive statistics, probability concepts, confidence intervals, and normal distribution. Seminar 2 to Seminar 6 cover intermediate statistical content, namely Analysis of Variance (ANOVA), Multivariate Analysis of Variance (MANOVA) and Regression (Linear and Logistic). The overall objective of the course is 'to help students develop skills in null hypothesis significance testing (NHST), and fitting statistical models to the data in order to answer your research question/hypothesis' (Rhodes University, 2017). Within any given year, approximately 50 students are enrolled for the Psychology Honours course offered at the University. The course is compulsory for all students enrolled for the Honours in either General Psychology¹⁰ and/or Industrial Psychology¹¹ degree.

With specific reference to the 2015/2016 Honours in Quantitative Research Methods course, six contact theoretical seminars and six practical seminars are offered during the 6-week period. Each theoretical seminar is accompanied by a practical seminar where students apply the theoretical knowledge acquired during seminars. The practical component requires students to answer various statistical questions using STATISTICA™ software (TIBCO, 2018). With regard to the practical seminars, these sessions take place in a computer laboratory at the University and are taught by the lecturer in charge of the theoretical seminars¹², and two fellow lecturers in the department. An example of a statistics practical exercise that would accompany the course can

¹⁰ This is a course that provides in-depth study for student interested in careers in Clinical, Counselling and/or Research Psychology.

¹¹ The course provides an in-depth study for students interested in a career in Industrial Psychology.

¹² Mr Sizwe Zondo, the research supervisor of this project.

be found on Appendix A. At the end of the course, all students submit one practical report that combines all six practical sessions for assessment. At the end of the semester, all students undertake a four-hour seat down exam.

3.3 Participants

Quantitative Phase: Quantitative data for my research study was collected in two phases. Since this was an ongoing research study from my 2015 Honours research project¹³, I used 29 participants from my Honours study whose data was in an already existing datafile stored by my research supervisor. In my first year of Masters studies, I collected data from a further 27 participants registered for the 2016 Honours in Psychology Degree. All in all, purposive, non-probability sampling was used to recruit a total of 56 participants for the quantitative phase of my sequential explanatory analysis.

Inclusion and exclusion criteria for quantitative phase

The inclusion criteria for selecting participants for the quantitative phase was (1) being a postgraduate (Honours) Psychology student enrolled in either the 2015 or 2016 ‘Honours in Quantitative Research Methods’ course offered at Rhodes University; (2) participants must have attended or done half the coursework of the above mentioned course and (3) participants must have completed the practical component of the course. A total of 56 students out of the 70 recruited met the inclusion criteria for the study.

Qualitative Phase: In the second qualitative phase, I used convenience sampling to recruit five participants to participate in the interview phase of my study. These five participants were selected on the basis that they were conveniently available at the time of the research. All these participants were Rhodes University Psychology students who had previously enrolled for either the ‘2015/2016 Honours in Quantitative Research Methods’ course offered at the University. Table 3.1 below provides details of the individuals who participated in the qualitative segment of the study.

¹³ Ngantweni, X. (2015). *Understanding students’ attitudes towards statistics: A focus on postgraduate psychology students* (Unpublished Honours thesis). Rhodes University, Grahamstown, South Africa.

Table 3.1 Participants' Demographics

Qualification	Pseudonym	Psychology Type	Previous Exposure to Statistics/Quantitative Methods
Bachelor of Social Sciences	Noma	Organisational	Yes
Bachelor of Social Sciences	Akha	General	Yes
Bachelor of Arts	Zinzi	General	Yes
Bachelor of Arts	Ntombi	General	Yes
Bachelor of Social Sciences	Siwe	General	Yes

Inclusion and exclusion criteria for the qualitative phase

The inclusion criteria for selecting participants for the qualitative phase was similar to the quantitative phase. As such, participants should have (1) being a postgraduate (Honours) Psychology student enrolled in either the 2015 or 2016 'Honours in Quantitative Research Methods' course offered at Rhodes University; (2) participants must have attended or done half the coursework of the above mentioned course and (3) participants must have completed the practical component of the course. Students who did not meet the inclusion criteria were not invited to the study.

3.4 Materials and Units of Analysis

For the quantitative phase, a *Demographic Questionnaire* (Appendix B) was administered to acquire information regarding the participants', gender, age, psychology type¹⁴, and levels of previous exposure to statistics before taking the 'Quantitative Research Methods' course. The Demographic Questionnaire was administered online using Survey Monkey (Survey Monkey Inc., 2013).

The *Survey of Attitudes Towards Statistics* (SATS-36) (Schau, 2003) (Appendix C) was administered to participants in order to acquire information regarding their attitudes towards statistics. The SATS-36 consists of 36 items measured on a seven point Likert scale ranging from strongly disagree to strongly agree (Vanhoof, Kuppens, Sotos, Verschaffel & Onghena, 2011). The instrument has six subscales and these include *affect* which measures negative and positive feelings that students have towards statistics. *cognitive competence* measures attitudes about participants' perceived intellectual knowledge and cognitive skills to succeed in statistics. *Difficulty* taps into attitudes concerning how difficult students perceive statistics to be. *Value* looks students perceived value and worth of statistics to their degree. *Interest* seeks to understand students' perceived level of interest in statistics. The last attribute, *effort*, seeks to ascertain the amount of effort students put into learning statistics (Vanhoof et al., 2011).

In the SATS-36, higher scores indicate a positive attitude toward that subscale. In scoring the SATS-36, responses for negatively worded items were reverse scored¹⁵. In total, 19 of the negatively worded items in the SATS-36 were reverse scored. Regarding the validity and reliability of the SATS-36, Emmioglu and Capa-Aydin (2012), state that the SATS has good psychometric properties including "high internal consistency values for all components" (Emmioglu & Capa-Aydin, 2012, p. 96). A perusal of the literature on attitudes toward statistics shows that the SATS is the most widely used instrument in assessing attitudes toward statistics due to its strong internal consistency which ranges from $\alpha = 0.72$ to $\alpha = 0.94$ (Hilton, Schau & Olsen, 2004). In a local South African study, Coetzee and van der Merwe (2010) confirmed the reliability and validity of the SATS for a South African context.

¹⁴ General Psychology or Organisational Psychology.

¹⁵ An example of a negative worded item from the scale was: 'I feel insecure when I have to do statistics' and 'I have trouble understanding statistics because of how I think'.

Permission to use the SATS-36 was granted by the creator of the instrument, Professor Schau (Please see Appendix D). Similar to the Demographic Questionnaire, the SATS-36 was administered online and was constructed using Survey Monkey (Survey Monkey Inc., 2013).

For the qualitative phase: Materials included a tape recorder, specifically an audio tape recorder, and an interview guide which consisted of questions to be addressed during the interview (Taylor, Bogdan, & DeVault, 2016) (see Appendix E). The recording of the interview was only done if the participant felt comfortable being recorded and once they had signed the consent forms (Appendix F). Qualitative data was collected through open-ended questions. According Coolican, (2014) this type of interview technique allows for the production of richer, fuller and more realistic information. As opposed to the SATS- 36, the units of analysis for my qualitative analysis were the narratives (words) put forward by student participants. The narratives were analysed and coded using Nvivo (QSR International, 2015) in order to look for similarities and differences in the way that participants talk about their attitudes towards statistics and quantitative research methods.

3.4 Procedure

Since this study used the sequential explanatory mixed methods approach, procedural requirements specific to this mixed methods were adopted, namely guidelines around (a) the implementation of the study, (b) the integration of the quantitative and qualitative approaches, and (c) priority (Ivankova et al., 2006). I expand on the above sequence in the below section.

Implementation : Implementation refers to whether the quantitative and qualitative data collection and analysis come in sequence, or concurrently (Creswell, 2003). A sequential explanatory design, also known as the explanatory design, consists of two phases. This design (as shown in Figure 3.1), begins with the collection and the analysis of quantitative data, followed by the collection and analysis of qualitative data (Creswell & Plano-Clark, 2007). The qualitative part of the study is designed in such a way that it connects to the results in the quantitative phase.

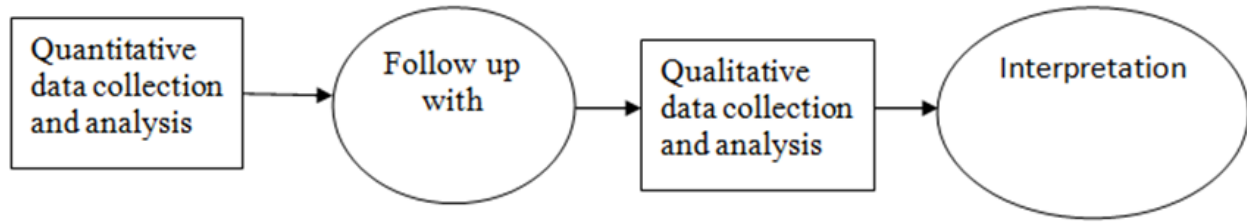


Figure 3.1: Sequential Explanatory Design

The decision to follow the quantitative-qualitative sequence in my study was to gain an in-depth analysis of results emerging from the SATS-36 on students' overall attitudes towards statistics/quantitative methods. For my quantitative data collection, participants were sent an email inviting them to take part in the study (Appendix G). A link leading to the online version of the Demographic Questionnaire and the SATS-36 was included in the email. Students who showed interest in taking part were requested to follow the link and complete the survey. The SATS-36 and Demographic Questionnaire took about 15 minutes to complete. Results of the survey were sent to my email inbox via Survey Monkey. Once the above was complete, data collection for the qualitative phase commenced.

Five Psychology Honours students were recruited based on availability (convenience sampling). The researcher met with each of the five participants individually. All interviews took place in a seminar room at the Rhodes University Department of Psychology. Before commencing each interview, participants were requested to sign a participant consent form (Appendix F) acknowledging that they understood the nature of the research, and that they could be audio recorded (Appendix H). Interviews lasted between 15-20 minutes each. The interviews were semi-structured, allowing participants to answer questions in as much detail as they could. Such a structure allowed the researcher to adjust questions and change the direction of the interview according to what was being discussed. Participants were thanked for their participation and dismissed from the venue once this data completion phase was complete.

Integration: Integration refers to the stage where the mixing or integration of the quantitative and qualitative methods occurs (Creswell, 2003). For a mixed methods study to be considered mixed, integration is essential. In my study, I connected the quantitative and qualitative methods in the Discussion chapter of my study.

Lastly, **priority** refers to which approach, quantitative or qualitative (or both), gets more weight or attention in the data collection and data analysis phase (Creswell, 2003). In my sequential explanatory design, the data analysis (expanded below) was weighted equally, with a slightly more focus on qualitative findings than quantitative findings.

3.5 Data Analysis

Quantitative Data: Descriptive statistics and inferential statistics (Independent T-Test and One sample Z-test analysis) were carried out to analyse the SATS-36 scores as per my three research objectives related to my quantitative analysis. Where necessary, all negatively worded questions of the SATS were reverse scored as per instruction of the SATS-36 scoring manual. In all SATS-36 analysis, the dependent variables were the mean scores of the subcomponents of the SATS-36, namely the mean scores of: *affect*, *cognitive competence*, *value*, *difficulty*, *interest*, and *effort*. All continuous data were analysed using the Statistical Package for the Social Sciences, Version 24 (SPSS 24) (IBM, 2017). Table 3.2 shows the key variables used in for my quantitative analysis.

Table 3.2 Description of Variables in Quantitative Analysis

Variable Name	Information	How it was calculated/coded	Scale
Affect	SATS subcomponent	Mean of 5 questions	Continuous on the interval of 7: Quantitative
Cognitive competence	SATS subcomponent	Mean of 6 questions	Continuous on the interval of 7: Quantitative
Value	SATS subcomponent	Mean of 9 questions	Continuous on the interval of 7: Quantitative

Difficulty	SATS subcomponent	Mean of 8 questions	Continuous on the interval of 7: Quantitative
Interest	SATS subcomponent	Mean of 4 questions	Continuous on the interval of 7: Quantitative
Effort	SATS subcomponent	Mean of 4 questions	Continuous on the interval of 7: Quantitative
Psychology Type	Demographic	Dichotomous: Categorical	Nominal

Qualitative Data: Nvivo (QSR International, 2015), was used to organise and structure the qualitative data into relevant emerging themes from the interviews. Nvivo is a Computer Assisted Qualitative Data Analysis Software (CAQDAS) that aids in the analysis of qualitative data. The strength of Nvivo is that the researcher can organise the data into codes and memos that assist in the analysis of themes based on a particular topic (Saldana, 2009). Below I expound on how I processed my qualitative data.

Qualitative Data: Data Processing

The recorded data from my interviews were carefully transcribed and focused coding was used to organise the data. Organising or processing the data involved identifying codes (termed ‘nodes’ in the Nvivo software) that occurred frequently within the data. Data was sorted into the relative codes and comparisons were made to refine the data. In this manner, codes were defined as labels of segments of data. Codes occurring frequently were combined and made into themes. The initial coding of my interview data yielded 20 codes that were further refined into categories, and themes (Saldana, 2009). A sample of my nodes and coding system can be found on Appendix I.

Qualitative Data: Main analysis

The main analysis was done using thematic analysis, a qualitative data analysis method used for identifying, exploring and understanding patterns within data (Braun & Clarke, 2006). In this sense, a theme is defined as ideas or experiences that appear repeatedly as the participant verbalizes their thoughts (Braun & Clarke, 2006). This method of analysis was deemed suitable as it is flexible and does not depend on a particular theoretical framework to guide its implementation. According to Braun and Clarke, (2006) flexibility in thematic analysis allows for the production of rich and detailed data to emerge from the analysis.

3.6 Ethical Considerations

The study was of low-risk and the participants were not harmed in any way. Participation in the study was anonymous and voluntary. Participants were afforded the right to withdraw from the study at any point even after giving consent. Since this study involved psychology students, consent was sought from the Registrar's Office to recruit student participants (Appendix J). Psychology students were then invited to partake in the research via email. The email was sent by the principal researcher. After review from the Registrar's Office, final ethical clearance for my study was granted by the Psychology Departments' Research projects and Ethics Review Committee (RPERC) (Appendix K).

CHAPTER 4

QUANTITATIVE RESULTS

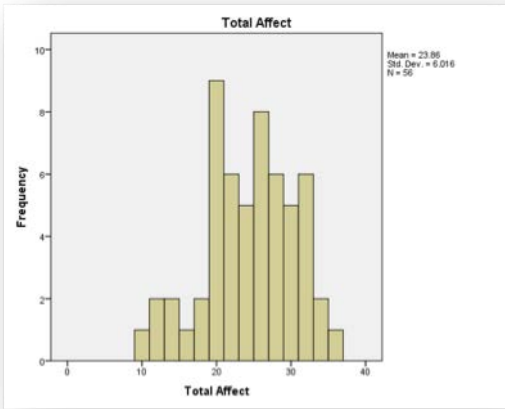
4.1 Quantitative analysis

A total number of 56 students completed the SATS-36 survey. All participants had enrolled for an Honours Degree in Psychology either during the 2015 or 2016 academic year. Regarding the variable 'Psychology Type', 14 participants were registered as Organisational Psychology major students, while 42 participants were registered as General Psychology major students.

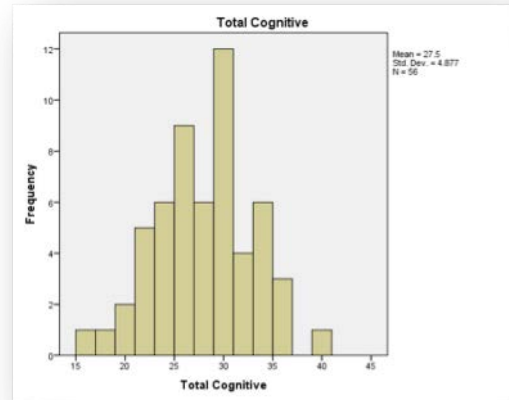
4.1.1 Objective 1 Analysis: (a) Distributions of the SATS-36 and Descriptive Statistics

To start my analysis of attitudes towards statistics, I first completed descriptive statistics in the form of histograms (Figure 4.1) and relevant measures of central tendency (mean) and measures of variability (standard deviation) (Table 4.7) of SATS-36 scores. The below descriptive statistics represent combined SATS-36 scores from both Organisational and General Psychology students. It is of importance to note that the histogram distribution, calculation of total scores, as well the calculation of mean scores on each of the SATS-36 dimensions (i.e., *Affect, cognitive competence, value, difficulty, interest, effort*) follows recommendation and guidelines provided by the creator of the SATS-36, Candace Schau (2003). As such, total mean scores indicate the total score on each component, divided by the number of questions on that component, whereas mean scores indicate attitudes- whether positive, negative or neutral. Further guidelines provided by Schau (2003) indicate that the mean scores are the most effective scores of measuring attitudes towards statistics amongst any given sample of research (Please see Letter of Correspondence: Appendix D).

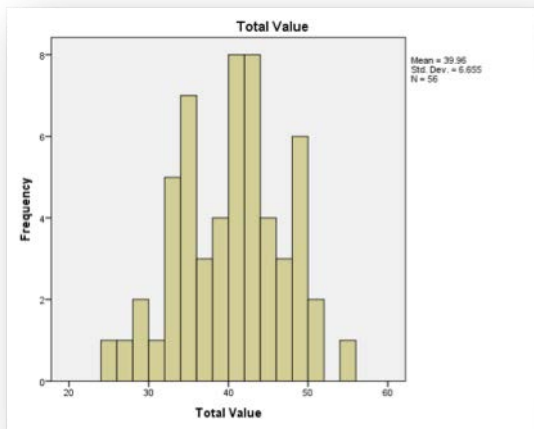
Histogram of Affect



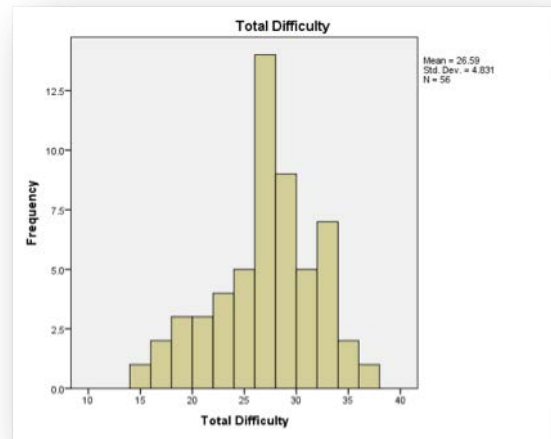
Histogram of Cognitive Competence



Histogram of Value



Histogram of Difficulty



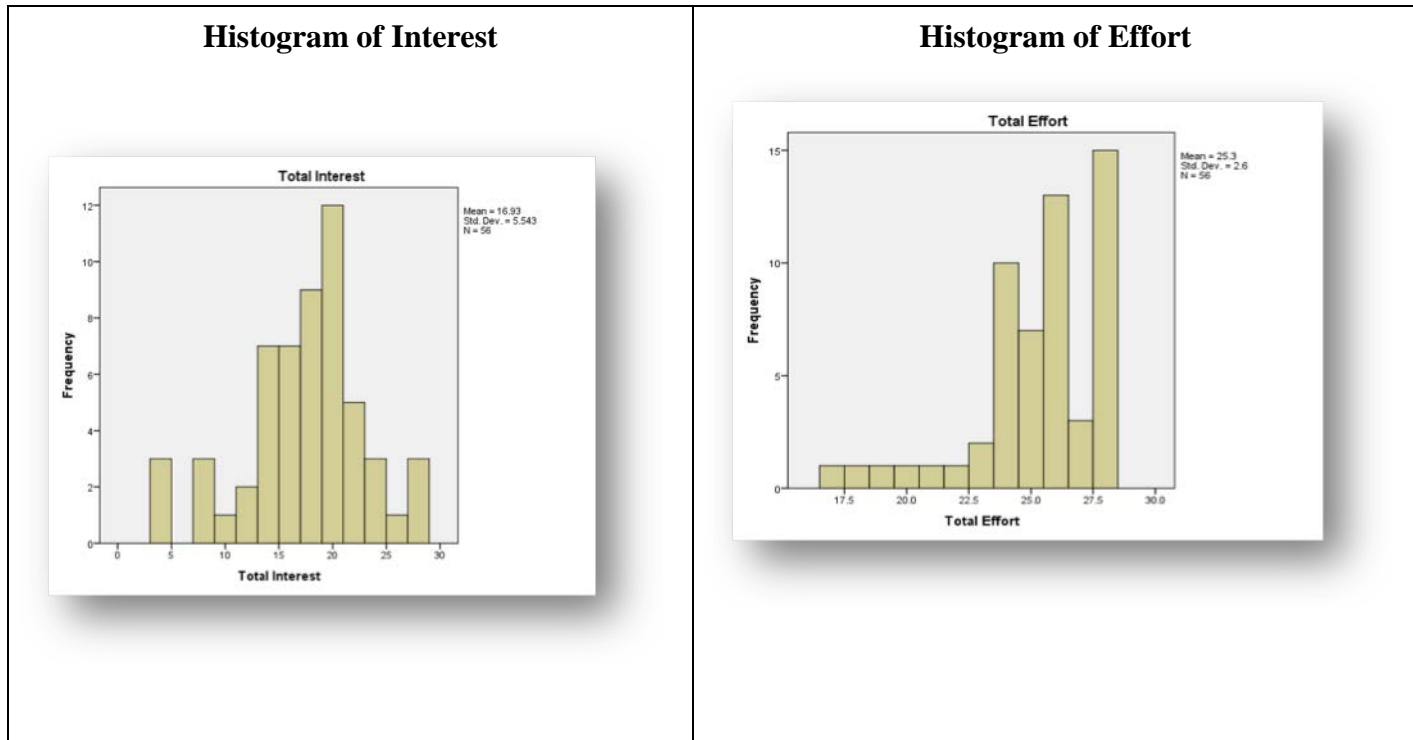


Figure 4.1 Descriptive statistics in the form of histograms

Objective 1: Analysis of Histogram Distributions

Figure 4.1 represents the histogram distribution of the various dimensions of the SATS-36. The distribution of *affect* is unimodal and shows a non-symmetric distribution. The *affect* component of the SATS-36 measures students' feelings, positive or negative in relation to statistics. A mean of 3.95 shows that students had a slightly positive feeling towards learning statistics. The distribution of *cognitive competence* appears to show a normal distribution. This component assesses students' perceived views regarding their intellectual ability to solve statistical problems. Students seem to have positive attitudes with regard to this dimension ($M = 4.76$). It should however be noted that this distribution seems to suggest that a number of students do not perceive themselves as having the *cognitive competence* to do well in statistics. The distribution of the *value* component is shown as multimodal. A number of students seem to believe that statistics is valuable, useful and relevant, while others perceive statistics to be irrelevant, and perhaps of not a major value to their studies. The distribution of *difficulty* is non-symmetric and skewed towards the left. This distribution suggests that student slightly perceived

statistics to be a difficult subject to grasp. The distribution of *interest* is non-symmetric and slightly skewed towards the left suggesting that the majority of students found statistics to be interesting, and were willing to learn the subject. Lastly, the distribution of *effort* is non-symmetric and skewed to the left suggesting that students place considerable effort on learning and understanding statistical content. Additionally, a mean of 6.31 indicates that the majority of students dedicated time to learning statistics. Below I further expand on the descriptive statistics of my sample as it refers to the SATS.

Objective 1: Analysis of Mean Scores on Each of the SATS-36 Dimensions

Table 4.1 shows the results from the affective attitude component of the SATS. The data seems to suggest that participants indicated a positive attitude for items 4, and 15, ($M = 4.04$), ($M = 4.41$). Participants showed a neutral attitude to items 18, 19, 28 ($M = 3.86$), ($M = 3.55$) and ($M = 3.98$). Most importantly for our analysis, the overall mean for *Affect* was $M = 3.95$ ($SD = 1.74$), indicating that students in general, indicated a slightly positive disposition towards learning statistics as a subject. The total mean score of 23.68 (as shown in Figure 4.1), is the total score of all questions measuring the affective component of the SATS-36.

	Strongly Disagree	Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Agree	Strongly Agree	Total	Mean
3 I like statistics	10.71% 6	14.29% 8	16.07% 9	14.29% 8	28.57% 16	16.07% 9	0% 0	56	3.84
4 I feel insecure when I have to do statistics problem	8.93% 5	17.86% 10	17.86% 10	8.93% 5	16.64% 11	16.07% 9	10.71% 6	56	4.04
15 I get frustrated going over statistics in class	5.36% 3	7.14% 4	25% 14	8.93% 5	16.64% 11	25% 14	8.93% 5	56	4.41
18 I am under stress during statistics class	7.14% 4	16.64% 11	23.21% 13	7.14% 4	21.43% 12	14.29% 8	7.14% 4	56	3.86
19 I enjoy taking statistics courses	10.71% 6	16.07% 9	23.21% 13	16.07% 9	23.21% 13	10.71% 6	0	56	3.55
28 I am scared by statistics	7.14% 4	16.64% 11	16.07% 9	10.71% 6	17.86% 10	14.29% 8	14.29% 8	56	3.98

Table 4.1: Affective Attitude Component

	Strongly Disagree	Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Agree	Strongly Agree	Total	Mean
5 I do not have trouble understanding statistics because of how I think	0% 0	12.5% 7	21.42% 12	17.86% 10	21.42% 12	21.42% 12	5.36% 3	56	4.34
11 I know what is happening in statistics course	0% 0	5.36% 3	28.57% 16	7.14% 4	23.21% 13	23.21% 13	12.5% 7	56	4.68
26 I do not make math errors very often in statistics	0% 0	8.93% 5	32.14% 18	5.36% 3	23.21% 13	21.42% 12	8.93% 5	56	4.43
31 I can learn statistics	0% 0	1.79% 1	0% 0	8.93% 5	21.42% 12	44.62% 25	23.21% 13	56	5.77
32 I understand statistics equations	1.79% 1	7.14% 4	21.42% 12	10.71% 6	42.86% 24	12.5% 7	3.57% 2	56	4.38
35 I do not find it difficult to understand statistical concepts	3.57% 2	16.07% 9	28.57% 16	7.14% 4	30.36% 17	10.71% 6	3.57% 2	56	4.96

Table 4.2: Cognitive Competence Component

Table 4.2 shows the results of items under the cognitive competency attitude. A positive response was shown towards all items (5- $M=4.34$); (11- $M=4.68$); (26- $M=4.43$); (32- $M=4.38$), particularly item 31 with a mean of 5.77. Most importantly for our analysis, the overall mean for *cognitive competence* was $M = 4.76$ ($SD = 1.41$), indicating that students, in general felt that they had the cognitive reserves to perform well in statistics. The total mean score of 27.5 (as shown in Figure 4.1), is the total score of all items under the *cognitive competence* component.

	Strongly Disagree	Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Agree	Strongly Agree	Total	Mean
7 Statistics is not worthless	1.79% 1	8.93% 5	7.14% 4	7.14% 4	17.86% 10	28.57% 16	28.57% 16	56	5.30
9 Statistics should be a required part of my professional training	3.57% 2	7.14% 4	5.36% 3	10.71% 6	37.5% 21	17.86% 10	17.86% 10	56	4.96
10 Statistical skills will make me more employable	0% 0	5.36% 3	26.79% 15	41.07% 23	8.93% 5	7.14% 4	10.71% 6	56	4.18
13 Statistics is useful to the typical profession	0% 0	7.14% 4	10.71% 6	12.5% 7	19.64% 11	28.57% 19	16.07% 9	56	5.11

16 Statistical thinking is applicable in my life outside my job	0% 0	12.5% 7	10.71% 6	26.79% 15	23.21% 13	17.86% 10	8.93% 5	56	4.5
17 I use statistics in m everyday life	28.57% 16	21.43% 12	12.5% 7	14.29% 8	21.43% 12	1.79% 1	0% 0	56	2.30
21 Statistics conclusions are rarely presented in everyday life	0% 0	7.14% 4	16.07% 9	26.79% 15	17.86% 10	10.71% 6	21.43% 12	56	4.46
25 I will have no application for statistics in my profession	16.07% 9	12.5% 7	14.29% 8	16.07% 9	19.64% 11	19.64% 11	1.79% 1	56	3.77
33 Statistics is relevant in my life	5.36% 3	8.93% 5	7.14% 4	23.21% 13	25% 14	17.86% 10	12.5% 7	56	4.57

Table 4.3: Value Component

Regarding value of statistics, Table 4.3, indicates that students had a positive attitude towards this attribute as shown by items 7 ($M=5.3$), 9 ($M=4.96$), and 13 ($M=5.11$). A neutral attitude was shown for item 25 ($M= 3.77$). A negative attitude was shown for item 17 ($M= 2.3$). Most importantly for our analysis, the overall mean for *value* was $M = 4.35$ ($SD = 1.58$), indicating that students see the value of statistics for their education and training as Psychology students. The total mean score of 39.96 (as shown in Figure 4.1), is the total score of all items under the *value* component.

	Strongly Disagree	Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Agree	Strongly Agree	Total	Mean
6 Statistics formulas are easy to understand	1.79% 1	26.79% 15	26.79% 15	14.29% 8	23.21% 13	5.36% 3	1.79% 1	56	3.54
8 Statistics is not a complicated subject	8.93% 5	12.5% 7	21.43% 12	12.5% 7	16.07% 9	25% 14	3.57% 2	56	4.04
22 Statistics is a subject quickly learned by most people	16.07% 9	35.71% 20	23.21% 13	5.31% 3	12.5% 7	3.57% 2	3.57% 2	56	2.88
24 Learning statistics requires a great deal of discipline	0% 0	1.79% 1	3.57% 2	10.71% 6	28.57% 16	32.14% 18	23.21% 13	56	5.55
30 Statistics involves massive computations	5.36% 3	10.71% 6	30.36% 17	10.71% 6	21.43% 12	14.29% 8	7.14% 4	56	4.04
34 Statistics is highly technical	8.93% 5	37.5% 21	25% 14	16.07% 9	8.93% 5	0% 0	3.57% 2	56	2.91

36 Most people have to learn a new way of thinking to do statistics	10.71% 6	16.07% 9	17.86% 10	26.78% 15	14.29% 8	14.29% 8	0% 0	56	3.60
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Table 4.4: Difficulty Component

In terms of the *difficulty* component, students displayed a highly positive response for item 24 ($M=5.55$) and 30 ($M= 4.04$). A neutral response was displayed for items 6 ($M= 3.54$) and 36 ($M=3.6$). A negative response was displayed for items 22 ($M=2.88$) and 34 ($M=2.91$). Most importantly for our analysis, the overall mean for *difficulty* was $M = 3.79$ ($SD =1.49$), indicating that students generally viewed statistics as a somewhat difficult course to master. The total mean score of 26.57 (as shown in Figure 4.1), is the total score of all items under the *difficulty* component.

	Strongly Disagree	Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Agree	Strongly Agree	Total	Mean
12 I am interested in being able to communicate statistical information with others	16.64% 11	17.86% 10	3.57% 2	19.64% 11	23.21% 13	10.71% 6	5.36% 3	56	3.61
20 I am interested in using statistics	12.5% 7	12.5% 7	16.07% 9	16.07% 9	28.57% 16	7.14% 4	7.14% 4	56	3.61

23 I am interested in understanding statistical information	5.36% 3	5.36% 3	7.14% 4	16.07% 9	37.5% 21	23.21% 13	5.36% 3	56	4.66
29 I am interested in learning statistics	7.14% 4	3.57% 2	3.57% 2	16.07% 9	35.71% 20	26.79% 15	7.14% 4	56	4.79

Table 4.5: Interest Component

Table 4.5 shows the mean score for the *interest* component. A neutral response was shown for items 12 ($M= 3.61$) and 30 ($M=3.61$). Students showed a slightly positive attitude for items 23 ($M=4.66$) and 29 ($M = 4.79$). Most importantly for our analysis, the overall mean for *interest* was $M = 4.17$ ($SD = 1.66$), which indicated a positive valence of students having an interest in the subject of statistics. The total mean score of 16.93 (as shown in Figure 4.1), is the total score of all items under the *interest* component.

	Strongly Disagree	Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Agree	Strongly Agree	Total	Mean
1 I completed all of my statistics assignments	0% 0	0% 0	0% 0	1.79% 1	1.79% 1	19.64% 11	76.79% 43	56	6.64
2 I worked hard in my statistics course	0% 0	0% 0	1.79% 1	0% 0	25% 14	37.5% 21	35.71% 20	56	6.05

14 I studied hard for every statistics test	0%	1.79%	3.57%	7.14%	14.29%	37.5%	35.71%	56	5.89
	0	1	2	4	8	21	20		
27 I attended every statistics class session	0%	0%	3.57%	0%	3.57%	14.29%	78.57%	56	6.64
	0	0	2	0	2	8	44		

Table 4.6: Effort Component

Lastly, in terms of the *effort* component, most responses in this component were, highly positive (e.g., 1: $M= 6.64$; 2: $M=6.05$; and 14: $M=5.89$). Most importantly for our analysis, the overall mean for *effort* was $M = 6.31$ ($SD = 0, 88$), which indicated that students place a great deal of effort into achieving in their statistics course. The total mean score of 25.3 (as shown in Figure 4.1), is the total score of all items under the *effort* component.

Table 4.7 Summary statistics for SATS scores

SATS-36 Subcomponent	Combined Class Mean (SD)	Organisational Psychology Mean (SD)	General Psychology Mean (SD)
Affect	$M=3.95$ $SD=1.75$	$M=3.74$; $SD=1.06$	$M= 4.05$; $SD= 1.0$
Cognitive Competence	$M=4.76$; $SD=1.41$	$M=4.31$; $SD=0.72$	$M=4.68$; $SD=0.83$
Value	$M=4.35$; $SD=1.58$	$M=4.3$; $SD=0.89$	$M= 4.46$; $SD= 0.69$
Difficulty	$M=3.79$; $SD=1.49$	$M=3.74$; $SD=0.78$	$M=3.82$; $SD= 0.67$
Interest	$M=4.17$; $SD=1.66$	$M=4.57$; $SD=1.39$	$M=4.12$; $SD=1.38$
Effort	$M=6.31$; $SD=0.88$	$M=6.27$; $SD=0.88$	$M=6.35$; $SD=0.57$

From the above summary statistics, it can be noted that (1) students find the statistics course difficult to grasp, and (2) students seem to have a low *affect* when it comes to statistics courses. These two points will be discussed further in the Qualitative section. Most importantly, the

standards deviations above indicate that the values in the data set are close to the mean of the data set.

Objective 1 : (b) Comparative Analysis

In this analysis, I was interested in comparing the mean SATS-36 scores of the General Psychology students to the Organisational Psychology students group. Levene's Test of equality of variances revealed that equal variances was assumed ($p = 0.18$). It was hypothesised that there would be significant mean differences on the SATS-36 scores between the two groups.

Independent Samples T-tests Analysis

Table 4.8 : Comparison between Organisational and General Psychology students on attitudes towards statistics

Component	<i>t value</i>	<i>df</i>	<i>p value</i>	Cohen's d
Affective	-1.03	54	0.97	-0.31
Cognitive Competence	-1.47	54	0.44	-0.45
Value	-0.39	54	0.25	-0.12
Difficulty	-0.03	54	0.20	-0.01
Interest	1.06	54	0.69	0.32
Effort	-0.04	54	0.19	0.01

Table 4.8 shows that there were no statistically significant differences between Organisational Psychology and General Psychology students with regard to attitudes towards statistics as measured by the SATS-36 ($p > 0.05$). The above finding indicate that General and Organisational Psychology students do not differ in any of the components of the SATS-36. My hypothesis was thus rejected. It is however interesting to note that Organisation Psychology students scored higher in most of the components of the SATS-36 than their General Psychology counterparts.

Objective 2

In my last quantitative analysis, I was interested in finding out whether there were significant differences in attitudes towards statistics (as measured by the SATS-36) between my sample of interest (Rhodes University students) and data from the USA student population (Schau & Emmioglu, 2012). The hypothesis was that the sample and the student population would have different attitudes towards statistics. Since SPSS does not have an in-built option for conducting a Z-test, I downloaded a z-test syntax (Appendix L) from how2stats.com. I copied the provided syntax to SPSS and inserted the below four values, namely:

- a) Sample Size (56)
- b) Sample Mean (4.56)
- c) Population Mean (4.63)
- d) Population Standard Deviation (1.18)

Results from the syntax revealed the below results.

Table 4.9: 2015/2016 Honours in Research Methods SATS-36 sample and the USA population SATS scores.

Z Statistic	P value	Cohen's d
-0.44	0.66	-0.06

With regard to Objective 3, a One Sample Z -test was run to determine whether differences exist between the scores of all components of the SATS-36, of the Rhodes University sample (n=56) and the USA student population (n= 2200). The population was a group of 2200 students enrolled for introductory statistics service courses around the United States (Schau & Emmioglu, 2012). As indicated by Table 4.9, no statistically significant differences were observed between the South African sample and the USA student population mean, $Z = -0.44 = p > 0.05$.

CHAPTER 5

Objective 3: QUALITATIVE RESULTS

Five participants (Noma, Akha, Zinzi, Ntombi, Siwe) were interviewed for the qualitative phase of the study. Prior to enrolling for the Rhodes University ‘Honours in Quantitative Research Methods’ course, all participants indicated having encountered statistics as a subject of study, either during high school mathematics, or through the Rhodes University 3rd Year research methods course. It is worth mentioning that all participants in this phase of the study were from a social sciences background, and as such, had completed undergraduate modules offered in this discipline of study. Our previous research at Rhodes University (e.g. Ngantweni, 2015; de Wet 2015) has shown that most Honours students taking the ‘Honours in Quantitative Research Methods’ module have a pure social science background and have had a limited encounter with statistics. This finding is in line with the claim made by Chew and Dillon (2014) that students in non-mathematical disciplines such as the social sciences tend to have a negative experience with the subject of statistics as the subject forms a small segment of their degree and is viewed as an unnecessary addition to their curriculum and degree offering. Of the five participants interviewed, one was an Organisational Psychology student, while the remaining four were General Psychology students.

In my analysis of the qualitative data, as it relates to statistics anxiety and attitudes towards statistics, three main themes emerged from the interviews. These themes were namely, (1) the fear of failing statistics leading to statistics anxiety, (2) the late introduction to statistics courses that lead to statistics anxiety, and lastly, (3) the role of educator(s) as a factor in either alleviating or fostering a sense of statistics anxiety. Table 5.1 shows the categories that were used to derive my key themes. All categories were derived from similarities of thoughts and ideas captured during the coding process of the interviews. As per the guidelines of thematic analysis, my categories later provided the emergence of my themes (Taylor, Bogdan & DeVault, 2016). In the subsequent sections, I analyse and discuss the emergent themes from my interview in sections 5.1 (Fear of failure), 5.2 (Late introduction to statistics) and 5.3 (The role of the educator in the teaching and learning of statistics).

Fear of failure	Late introduction to statistics	The role of the educator/s in the teaching and learning of statistics
I failed it before	Would be useful to have an undergraduate kind of foundation	Depends who's teaching it
I panic a little bit because I've had the experience of not doing well in it	having to calculate anything at such a late stage is concerning	I think the lecturer also makes a very huge difference
I was scared that I was going to fail it again	First year would be the most useful time to teach statistics again in 3 rd . year and not to just bombard 3 rd . year students with statistics	I have certain people that shouldn't teach stats I would really appreciate it if certain departments would assign someone who is really skilled
Failing again because I failed before	Unnecessary anxiety that can be alleviated by teaching stats at earlier stages	Skilled in teaching certain sections, so knowing it shouldn't be enough
I think failing was also my worry	The stage in which it is taught so, teaching stats at 3 rd . year, at Honours is no longer sustainable	The person who taught us at honors was, not only knew it but also, like, was skilled enough to teach it

Like I really wanted to pass	If we introduce stats that late in life, we are just creating unnecessary spaces of anxiety	From the lecturer's side, to understand that it's not going to be easy for everyone
A subject where it is easy to fail	It would have been nice to be taught basic stats like in first year as something we do	He's very knowledgeable in the subject and he was able to explain how to do certain things and explain things clearly
I didn't want to fail it.	Like first year, second year, we do like a bit of basic stats	You need to have somebody that can actually adequately explain statistics
I thought I would fail	When we get to Honours at least we have a good foundation, you know, unlike feeling pressured to learn these concepts at once	We really need to be looking at lecturers that can firstly, identify or suss out the general state of mind of students
	Be like sort of conditioned into stats so that it becomes less of a challenge when we get to Honour's level.	The lecturer should be looking at is thoroughly teaching concepts
	3 rd year stats does not prepare us for what, for honours	

	Making sure we are better equipped to handle stats at postgrad level.	sometimes you would find that the lecturers were assisting lots of students at once
	Worried that stats in psych is not taught from 1 st year if I had done stats from 1 st year I wouldn't be anxious	Lecturers shouldn't be like no I taught you this at a seminar, they should help and it would be better.
	I don't think this would be the case if they had done statistics before.	They should make themselves more available to the students
		they must reply to our emails if we have questions related to stat
		Being patient enough to know that it's not going to be easy for everyone.

Table 5.1 Categories and Themes Emerging From Interviews

5.1 Fear of failure

Introduction

“It’s a subject where it is easy to fail... it is just hard and makes me nervous...a week or [two] into the course I was anxious again because it started to get deep, and again I thought I would fail...the first thing is difficulty. The most comments I have ever heard about stats is that it’s difficult” (Ntombi).

“I went into the course scared thinking I would fail”. (Ntombi).

“I failed it before, I panic a little bit because I’ve had the experience of not doing well in it...it was the lowest mark I got so it gives me a bit of anxiety” (Noma).

“I had a lot of anxiety because I was scared that I was going to fail it... I think I was just scared” (Noma).

“I think failing was also my worry especially when we were writing that statistics test, that’s when it really showed me how much it was a challenge” (Siwe).

Walsh & Ugumba-Agwunobi (2002) state that the fear of failing statistics courses is a major source of statistics anxiety for most students. The above assertion is in line with Onwuegbuzie et al. (1997) who found that statistics anxiety is intricately linked to failure anxiety. In this sense, failure anxiety is the fear of being negatively evaluated in statistics assessments such as in examinations, tests, or practical assignments. More intricately, failure anxiety is related to study anxiety and test anxiety (Onwuegbuzie, 2000), meaning that the fear of failure can have an influence on performance. Onwuegbuzie (2004) further notes that students’ fear of failing a statistics course explained at least 49% of the variance in ‘statistics anxiety’ in their study. In my current study, a significant proportion of participants showed evidence of failure anxiety. Ntombi and Noma, for example state that the driving source of their anxiety towards statistics was the perception that statistics is difficult and they feared they would not perform optimally in the course, leading to the fear of failure.

Pan and Tang (2005) note that previous failure in statistics courses is also a major contributing factor to statistics anxiety. In a study investigating factors that contribute to statistics anxiety, participants in Pan and Tang (2005)’s study revealed that the fear of assessment and the fear of failing the course heightened statistics anxiety. Recommendations from the study by Pan and Tang, included that lecturers consider doing away with assessments in order to allow learners to

concentrate on learning the foundations of the course, rather than the outcomes of course evaluation (Pan & Tang, 2005). Noma's comment that she experienced high levels of anxiety because she thought she would fail the assessment confirms that the fear of failure increases statistics anxiety amongst participants.

It is worth noting that most social science students, view statistics and quantitative research methods as difficult and 'deep' courses which often lead to the perception that the course is difficult to master (Schraw, 2007). The fear of failure theme can be said to be related to the difficulty component of the SATS-36. In the SATS-36, participants in my study showed a slightly negative response ($M = 3.79$) towards this component of the scale, suggesting that students viewed statistics to be slightly difficult. Pan and Tang (2005) note that statistics anxiety is prevalent in students from a social science background, as statistics anxiety is fueled by the misconception that students from the social sciences have limited background in mathematics courses and lack the necessary training to perform well in statistics courses (Pan & Tang, 2005). In my study, Ntombi states that for her and other students from the social sciences, statistics can be a difficult course to master, and this is in line with the above assertion by Pan and Tang (2005).

Similarly, Lim (2009) links the fear of failure to defence pessimism. Lim (2009) describes that learners tend to use defence pessimism as a cognitive strategy to protect the self by setting "expectations lower than realistic estimates" (p.318). This is to say that, students in this case, mentally play through all the bad permutations that might happen and push themselves to work hard so as to decrease anxiety levels. In further explaining defence pessimism, Schraw (2007) reports that students approach difficult tasks with the mentality that he or she will fail. In the above quotations, we can see that anxious learners use defence pessimism as a way of managing their anxiety. It is however worth noting that the fear of failure sometimes yields positive results as it has the potential to influence or motivate a student to do well (Lim, 2009; Marcher et al. (2015). As such the above findings that statistics is a difficult course can also be a motivation for students to succeed in the course.

Assessment and the fear of failure

Particularly of interest to my findings is the link between to the fear of failure, course assessment and statistics anxiety. During the 2015/16 academic period, the assessment criteria used to

evaluate course achievement was in the form of (a) practical mark, (b) tests and (c) exams. Both the test and exam assessments were in the form of multiple choice format (communication with research supervisor and teacher of the course). It is a possibility that this form of assessment led to much anxiety, and intolerance of uncertainty. Williams (2013) links students' intolerance of uncertainty, to heightened worry, leading to heightened levels of statistics anxiety. Williams (2013) defines the intolerance of uncertainty, as a characteristic that influences how an individual will respond to a situation that is deemed to have an uncertain outcome. As such, responses to uncertainty can have a cognitive, emotional, or behavioral effect, as individuals who cannot tolerate uncertainty, (as in multiple choice formats) can experience such assessments as stressful leading to the fear of failure. An intolerance of uncertainty, as it relates to statistics anxiety and assessment can be noted in Zinzi's claims that the multiple-choice questions and answers all looked the same, leading to the intolerance of uncertainty, which led to worry and anxiety. Zinzi states:

“...that [exam structure] made me anxious but I guess what alleviated my anxiety, in terms of how the questions were phrased, I did notice that the lecturer sort of like asked questions that was in line with the genealogy of how he taught the course, so I would know that I wouldn't give, for example, an ANOVA answer when I'm talking about ANCOVA or regression”. (Zinzi)

Similarly, Siwe mentioned that in her Honours year of statistics, she had expected a take home examination but instead wrote a 'normal' timed examination. She explains:

“When we got to the exam, because we had a take home exam [the previous year], they [anxiety levels] were high, very high. I think it is because in take home, you have your own space and your own time to work through the exam but if you are timed, you have to rush rush rush, and like it was a nice exam, it wasn't hard cause I had practiced but I just feel like if we got a take home exam, it would have been much more simpler”.

It does appear from the literature that the assessment type utilised by lecturers has an effect on students' levels of statistics anxiety. The above mentioned response by Siwe regarding take home exams for statistics courses is in line with a study by Onwuegbuzie and Seaman (1995). Onwuegbuzie and Seaman (1995) found that students who wrote seated statistics examination reported higher levels of statistics test anxiety, and lower performance in the test, than students given the same test in an untimed conditions. Stated differently, exam performance decreased and statistics anxiety increased in timed exam conditions. The finding by Onwuegbuzie and

Seaman (1995) is consistent with that by Onwuegbuzie and Daley (1998) who found that timed statistics exams heightened statistics anxiety and decreased exam performance. It is however worth noting that the study by Onwuegbuzie and Daley (1998) found a link between examination taking strategies and exam success in statistics courses, with students who had better exam management strategies, performing better than those without exam management skills, even in untimed exam conditions.

It can be argued that a move towards take home examinations would be beneficial in decreasing students' levels of statistics anxiety. Lopez, Cruz, Sanchez and Fernández (2011) believe that unlike in traditional exams where students are timed and have limited time to complete the assessment, take home exams can provide students with more time to solve complex questions and deepen the learning of statistical content¹⁶.

Interpretation anxiety and the fear of failure.

The last subtheme related to the 'fear of failure' is interpretation anxiety (e.g., Onwuegbuzie, 2004; Williams, 2010). Interpretation anxiety is defined as the amount of anxiety students experience when having to interpret statistical information or arrive at logical interpretation and conclusions based on statistical outputs (Williams, 2010, 2013). Onwuegbuzie (2004), particularly notes that most students who report low levels of perceived scholastic competence, also report high levels of statistics interpretation anxiety and heightened levels of statistics anxiety. In my study, interpretation anxiety seems to be a major concern to postgraduate participants. Akha, Siwe and Ntombi below state that the inability to grasp statistical concepts and to apply statistical theory to interpret data, heightened their levels of anxiety and led to perceptions of failure. Akha notes,

“I think grasping the concepts fully and I think failing was also my main worry especially when we were writing the stats test... Understanding those concepts fully and just being able to apply them was the main factor for me”.

Ntombi and Siwe mentioned that interpreting graphs, choosing the correct statistics test to use and interpreting data triggered their anxiety. Siwe states:

¹⁶ Although it has been argued that take-home exams are beneficial and aid learning (e.g., Entwistle, 1988; Lopez et al. 2011) this mode of assessment has since been discontinued at Rhodes University due to students soliciting external assistance with Quantitative Research Methods take home exams .

“This thing where you know what test to use but you don’t know if it’s the right test to do for a particular scenario [caused worry]”.

Ntombi mentioned that she

“...had difficulties in interpreting graphs and it was, I think, after the first prac [statistical practical] that I was able to do so”.

It can be noted that from the above assertions, interpretation of statistical data seems to be a significant factor in students’ sense of statistics anxiety.

Conclusion

From the above section, it appears that the fear of failure is a major contributing factor to students’ perceived levels of statistics anxiety. Moreover, it appears that the fear of failing statistics courses is related to perceptions around (a) the difficulty of the course, (b) the types of assessment utilised by educators to assess the outcomes of the course, as well as students’ anxiety around the interpretation of statistical outputs. From the above analysis, it is not very clear what role individual characteristics such as student’s motivation and self-efficacy play in the fear of failure. In relation to perceptions around the difficulty of statistics, it is a possibility that, perhaps when faced with difficult tasks such as statistics, students tend to concentrate more on their fears, and the possibility of failing, instead of focusing their attention on strategies that can help them do well in the course (Bandura, 1994). This understanding is explored more in my Discussion section.

5.2 Late introduction to statistics

Introduction

“It would have been [better] to be taught statistics like in first year...like first year, second year, we do like a bit of statistics so that when we get to Honours at least we have a good foundation, you know” (Akha).

“It would be useful to have an undergraduate kind of foundation because we get to Honours and it’s a lot...naturally the concept of having to calculate anything at such a late stage is concerning” (Zinzi).

“Teaching statistics at third year, at Honours, is no longer sustainable because both of those years are quintessential in terms of finishing their actual qualification. So if we introduce statistics later in life, we are just creating unnecessary spaces of anxiety” (Zinzi).

According to Forte (1995), there are many factors that contribute to student’s anxiety. These factors include little, to no previous exposure to mathematic, late-in-career introduction to quantitative analysis and anti-quantitative bias. Many of the participants in my research study were dissatisfied with the stage at which the learning of statistics was introduced. At Rhodes University, Psychology students are introduced to the subject of statistics and quantitative research methods in the third year of their undergraduate studies. The Honours year builds from the foundations taught at the third year level¹⁷. In relation to the late introduction to statistics, Zinzi notes that:

“I do think that possibly in the first year would be the most useful time to teach statistics and again in third year and not to just bombard third year students with statistics. This is the year people are supposed to be finishing undergrad and they’re not sure that they’re going to finish and they’re anxious. Unnecessary anxiety can be alleviated by teaching statistics at earlier stages in varsity”.

In support of Zinzi’s statement, Akha states,

“It would have been nice to be taught basic stats like in first year, as something we do, like, as part of the courses that we do as in like in psychology, you know like we do this in cognitive and all those things but we do stats throughout the

¹⁷ <https://www.ru.ac.za/psychology/>

course. First year, second year, we do like a bit of basic stats so that when we get to Honours at least we have a good foundation, you know, unlike feeling pressured to learn these concepts at once, but rather, be like sort of conditioned into stats so that it becomes less of a challenge when we get to Honours level”.

Ntombi further maintained that the late introduction to statistics means that students are not equipped with the necessary knowledge required for statistics at postgraduate level. She says,

“At undergrad, the statistics we did was pretty basic, like correlation, chi square, measures of central tendency. When we get to Honours it’s like a huge jump from what we covered in third year, so I would say third year statistics does not prepare us for what, for Honours and I think that is something the department should look into, like making sure we are better equipped to handle statistics at postgrad level”.

Smith and Martinez-Moyano (2012), note that statistics anxiety can be reduced with the introduction of pre-course training. This, they argue, would assist in ensuring that by the time students take the statistics course, their levels of anxiety would have decreased. Also, by having pre-course training, statistics courses could follow a two-part sequence in which students are taught the basics of research design, followed by the statistics course. The above suggestion by Smith and Martinez-Moyano (2012) is similar to that suggested by Strasser & Ozgur (1995) who state that it should be a requirement for students to take more than one statistics course, as this will allow lecturers to spend more time on complicated statistical topics.

Participants (i.e., Zinzi, Akha) also felt that the statistics course at Honours level felt rushed, that their anxiety would have been alleviated if the course was more spaced out at earlier levels, allowing for a lengthy time to be spent on the subject. Following suggestions by Smith and Martinez-Moyano (2012), the Rhodes University Psychology department has since implemented some quantitative research methods techniques into its Psychology 1 course. One of these methods includes the ‘One Minute Paper Strategy’ developed by Chiou, Wang and Lee (2014) and colleagues. In its implementation, students taking Psychology 1 are gradually introduced to journal articles that use quantitative research methods. For example, whilst teaching Biological Psychology, students might be introduced to a paper on ‘The hypothalamus and its role in sexuality’. From this prescribed reading, students will be asked to reflect on a statistical

technique reported in the prescribed reading, such as: ‘An independent samples t-test found a significant difference between the experimental group ($M = 6.9$ $SD = 1.2$) and the control group ($M = 1.2$ $SD = 6.9$) on activation of the hypothalamus to sexual content, $t(13) = 2.3$, $p = 0.01$ ’¹⁸. The lecturer concerned would then briefly (for one minute), explain the t test design and its relevance. It is hoped that this ‘One-minute Paper Strategy’ will gradually introduce students to basic statistical concepts and thus increase students’ motivation to learn statistics.

Conclusion

From the above analysis, it is clear that the late introduction to statistics heightens students’ levels of statistics anxiety (Forte, 2005; Onwuegbuzie & Wilson, 2003). Particularly of note from this section of the analysis is that anxiety can be reduced with the introduction of statistics at earlier levels of the psychology degree. Some of the findings arising from this section of my results are revisited in my Discussion section.

¹⁸ Personal communication with the lecturer, who is also the supervisor of this research project.

5.3 The Role of the Educator/s in the Teaching and Learning of Statistics

Introduction

“I would really appreciate it if departments would assign someone who is skilled, but also skilled in teaching, so knowing it shouldn’t be enough” (Noma).

“Understand that it is not going to be easy for everyone especially because sometimes they expect that because you did statistics at university level, it’s like you can grasp things but that’s not always the case” (Noma).

“Depends on who’s teaching it... I think the lecturer makes a huge difference and if I could think about the psychology department at Rhodes, I have certain people that should not teach statistics” (Noma).

According to Tishkovskaya and Lancaster (2012), with the increase of university programs that offer statistics education, there has also been an increase in attention given to the teaching and learning of statistics or statistical education. This has come with the realisation that statistics is amongst the most important courses offered at universities around the world. Tishkovskaya and Lancaster (2012) believe that there is a need for the improvement of how statistics is taught so as to address students’ attitudes towards statistics. Lalayants (2012) further notes that the manner in which statistics is taught plays an important role in the learning processes and subsequently, affects students’ attitudes towards the course. Particularly of importance to statistics anxiety, is findings by researchers (e.g., Pan & Tang, 2005; Williams, 2010) who note that (a) the teacher’s proximity to students, (b) his/her attitude towards statistics (c) as well as his/her teaching style play a pivotal role in decreasing or heightening students’ levels of statistics anxiety.

Lecture Proximity and Statistics Anxiety

Green et al. (2015), note that students consider the teaching style of the lecturer to be more important than their knowledge of the course content. In a similar manner, Pan and Tang (2005) add that the lecturer’s attitude, and deliverance of the content is a key determinant of students’ attitudes towards quantitative method courses. Pan and Tang (2005) further note that it is very important for a lecturer to take note of the concerns and worries that students have so as to help students learn statistics effectively. In relation to the above, participants note:

“You need to have somebody that can actually adequately explain statistics, so it’s not enough that just because one passed statistics before, [one] cannot then

give the task of teaching statistics to that person on grounds that they have done it before. So, we really need to be looking at lecturers that can, firstly, identify the general state of mind of students, so how they're generally feeling about statistics" [Zinzi].

"[Lecturers] should make themselves more available to students and they must reply to our emails if we have questions" [Siwe].

The above comment by Zinzi is related to a study by Williams (2010) who investigated the relationship between instructor immediacy¹⁹ and statistics anxiety. Williams (2010) holds that instructors have an influence on students' perceived levels of statistics anxiety and that by having close proximity to students, and being aware of student' anxiety could enhance the learning experience and decrease worry. Malik (2015), further notes that the lecturer's comments, feedback and levels of criticism can further heighten student's feelings of statistics anxiety. Malik (2015), elaborates that the teacher's lack of availability and offering of extra assistance is a key factor in students' anxiety levels and this is pointed out by one of the participants, Siwe above.

From the findings of Malik (2005) and Williams (2010), it is integral to note the teacher's proximity levels in either aiding or alleviating students' experiences of statistics anxiety. This findings is in line with Vygotsky's (1987) zone of proximal development. The concept of 'zone of proximal development' stems from the idea that individuals tend to learn best when they work collaboratively, and by working collaboratively with more skilled individuals, they are able to learn new concepts and skills (Shabani, Khatib & Edadi, 2010). It is thus important for academics teaching statistics courses to be mindful of students' need for proximity and assistance with courses such as statistics in order to foster student confidence and enhance the learning of the course.

Lecturer's Teaching Method and Statistics Anxiety

"If introductory statistics courses were to incorporate examples of how statistical principles such as the law of large numbers can be applied to judgements in everyday life, we have no doubt that such courses would have a more far-

¹⁹ This refers to a set of behaviours that reduce the perceived distance between the instructor and students (Williams, 2010). In other words, bringing the students and the instructor closer.

reaching effect on the extent to which people think statistically about the world”
(Fong, Krantz, & Nisbett, 1986, p. 282)

From the above quotation from Fong and colleagues, it is important to note that various lecturers use different types of teaching styles. The Honours in Quantitative Research Methods at Rhodes University is taught by a single lecturer²⁰, with occasional guest lectures invited to teach various aspects of the course. As expected, various lecturers use different teaching methods to teach the course material. In relation to the literature on statistics anxiety, various teaching strategies have been suggested to reduce statistics anxiety including the use of concepts maps (Chiou, 2008; Chiou, 2009; Daley, 2004) humor (Field, 2016; Schacht & Stewart, 1990), collaborative learning (Gorvine, & Smith, 2014), and applying statistics in practical settings (Stallings, 1993; Thompson, 1994; Pan & Tang, 2005). Participants in the current study further suggested that to aid learning and to reduce statistics anxiety, lectures should be able to provide students with relevant practical examples to aid the learning of the course. For instance, Zinzi states:

“What I am saying is that the lecturer should be looking at thoroughly teaching concepts, so for example teaching, when we are talking about variables right, and obviously variable is an English word and it talks about things that vary. Things as fundamentally foundational as that are what’s important, so what do we mean by variables, and giving practical examples so that students can actually work with this because the moment we give examples that are only found in theoretical, or not even necessarily theoretical, but in terms of, can they be identified in real life?”

The above quote by Zinzi is of importance in conveying statistical concepts to students. According to Smith and Martinez-Moyano (2012), the teaching of statistics has for a long time focused on the physical aspects of understanding statistics, and has, to a large extent, ignored the possibility of introducing the subject to students’ everyday interactions. As such, students have not been able to engage with statistics in a meaningful manner (Calderwood, 2002; Zanakis & Valenzi, 1997). This assertion is maintained by others (e.g., Hommik & Luik, 2017; Lawson, Schwiers, Doellman, Grady, & Kelhofer 2003; Zewotir & North, 2011), who suggest that for students to succeed in statistics courses, these courses ought to be contextualised, made relevant to student’s everyday life. The above can best be achieved by lectures reimagining the teaching and pedagogical practices utilized to teach subjects such as statistics.

²⁰ The supervisor of this thesis.

Conclusion

Researchers (e.g., Green et al. 2015; Malik, 2015; Pan & Tang, 2005; Williams, 2010), highlight the lecturer's role in either enhancing or impeding the learning of statistics. The above results indicate that students are cognizant of the role that the lecturer plays in their learning as well as on their levels of statistics anxiety. The implication of the findings emerging from this theme and the aforementioned subthemes are discussed in the subsequent Discussion chapter.

CHAPTER 6

DISCUSSION

6.1 Introduction

Research (e.g., Griffith et al., 2012; Onwuegbuzie, Leech, Murtonen & Tahtinen, 2010) seems to suggest that students tend to have a perfunctory disposition towards quantitative research method courses, in spite of the intrinsic value offered by these courses. The primary purpose of my research study was to investigate the nature of student's attitudes towards statistics by conducting a mixed methods analysis of the phenomenon. As such, my study expands on the work by Griffith et al. (2012) who investigated student's attitudes towards statistics using a mixed method approach. As noted by Griffith et al., the mixed method approach has the potential to provide rich data on the phenomenon of statistics anxiety. As opposed to Griffith's study which investigated statistics anxiety amongst undergraduate students, my research study sought to investigate the phenomenon amongst postgraduate Psychology students. In the subsequent sections, I will (a) summarize the results of my findings, (b) discuss ways in which these findings fit and extend the literature in statistics anxiety, (c) explore modes of reducing statistics anxiety in light of my findings; (d) consider some methodological limitations that could have affected my findings, (e) note the general limitations of my study, and finally, (f) highlight the significance of my study in light of the literature on the subject of study.

6.2 Summary of Quantitative Results and Link to Existing Literature

Embedded within the nexus of 'statistics anxiety' and 'attitudes towards statistics', my thesis sought to explore three specific objectives related to statistics anxiety amongst postgraduate Psychology students. These objectives aimed to: (1) explore the nature of statistics anxiety amongst postgraduate Psychology students as measured by the SATS-36 as well as explore the 'type of Psychology' (General Psychology or Industrial Psychology) one is registered in and subsequent attitudes towards statistics. (2) To assess if differences exist between my sample of study and the general North American (US) student population on attitudes towards statistics as measured by the SATS-36. In addition to the above quantitative analysis, I also sought to understand the (3) qualitative nature of students' attitudes towards statistics in order to arrive at a

'richer' understanding of the subject under discussion. Findings and discussion of my quantitative and qualitative analysis are provided in the subsequent sections.

6.2.1 Objective 1 : (a) Descriptive Analysis

Research (e.g. Evans, 2007; Koh & Zawi, 2014; Papanastasiou & Zembylas, 2008) indicates that there continues to be a dearth of research on attitudes towards statistics focusing on postgraduate students. The majority of the studies (e.g., Papanastasiou & Zembylas, 2008; Rwodzi, Ruparanganda & Manatsa, 2013; Zimprich, 2012) in the field of statistics and attitudes towards statistics focus on undergraduate students' attitudes towards statistics. With this in mind, the first objective of my study was to investigate the nature of statistics anxiety among postgraduate Psychology students using the SATS-36. Based on the literature on the topic of statistics anxiety, I anticipated that postgraduate students would have negative attitudes towards statistics and quantitative research methods.

Results from the study indicated that with regard to the six components of the SATS-36, students showed a positive valence with regard to the *effort* they place into learning statistics ($M=6.31$; $SD=1.75$). A positive attitude was also indicated with regard to the *value* of statistics for their degree ($M=4.35$; $SD=1.58$). Furthermore, students reported to having the *cognitive competence* to do well in statistics ($M=4.76$; $SD=0.81$). They also reported having an *interest* in statistics ($M=4.17$; $M=1.66$). Participants did however indicate a low *affect* towards statistics as a subject of study ($M=3.95$; $SD=1.75$) and reported statistics to be a difficult ($M=3.79$; $SD=1.49$) subject to study.

The above results from my study were similar to those in the literature. Schau and Emmioglou (2012) assessed students' attitudes when they entered a statistics course, and studied how their attitudes changed or stayed the same over time. Results indicated that with regard to the difficulty component, students believed that statistics was not going to be easy nor difficult. In other words, they showed a neutral attitude and this attitude did not change after completion of the course. Similar to my study, Schau and Emmioglou (2012) reported that students showed a 'somewhat' positive attitude in the *value*, *cognitive competence*, *effort* and *interest* components of the SATS. Similar to my findings, Coetzee and Van der Merwe (2010) found that Psychology students were interested in learning statistics and believed that statistics courses were worth studying even though they perceived statistics as a difficult subject. Similarly, Sloomaeckers

(2012) found that although students reported being interested in statistics, this was largely influenced by how much the material was taught by the lecturer of the course.

Slightly different to my findings, Pierce (2006) found that students showed a neutral attitude towards statistics on all six components of the SATS. In analysing pre-test scores, Pierce (2006) found that students believed that they could learn statistics, even though they reported the course to be difficult. Students also maintained that although they had a neutral *interest* and *affect* towards statistics, this did not necessarily equate to overall negative attitudes towards statistics. With regard to *cognitive competence*, students in my study reported a positive attitude towards this component, indicating that they felt that they had a high level of confidence and were capable of doing well in statistics. To mention other findings in relation to these components of the SATS, Ramirez et al. (2012) found that students with experience in statistics reported positive attitudes on the *cognitive competence* measure of the SATS. Vanhoof et al., (2011) further found that when students reported negative attitude towards the perceived difficulty of statistics, the less perceived *cognitive competence* they also reported. This latter finding seems to contradict my findings where students reported a high level of *cognitive competence*.

6.2.2 Objective 1: (b) Comparative Analysis

Objective 1, (comparative analysis) investigated the effect of ‘type of Psychology’ on students’ attitudes towards statistics. To date, no published literature exists in the South African context, investigating differences between postgraduate Organisational and General Psychology students’ attitudes towards statistics and quantitative research methods. The reason for pursuing this objective, at least at Rhodes University is that both General Psychology and Industrial Psychology are registered in the same Department (Psychology) yet pursue different degrees and modules. In a study by Coetzee and van der Merwe, (2010) focusing on Organisational Psychology students', attitudes towards statistics, the authors report that students found statistics to be a technical and complicated subject. It is however important to note that students showed interest in the subject and believed that it was valuable to their studies. Similar findings (e.g. Mills, 2004; Onwuegbuzie, 2004) indicate that Industrial Psychology students tend to have positive attitudes towards statistics, rather than a negative one. Similarly, Griffith et al., (2012) found that most ‘general’ psychology students had a negative attitude towards statistics. Participants from the above study by Griffith et al., (2012) indicated that statistics was a very

important subject and added value to their future career. Based on the above, I expected the attitudes of the two groups to be different. The reason for pursuing this analysis was based on the lack of research that explores differences between Organisational and General Psychology students. More importantly, at Rhodes University, these two classes seat in a combined Quantitative Methods Course, as such I was interested in investigating whether it would be of any value to offer the course separately the for the two streams. It is important to note that my analysis included none equal group sizes, and as such, the below results need to embedded within that limitation.

Descriptive statistics indicated that with regard to the *affect* component, compared to Organisational Psychology students (M=3.74), General Psychology students (M=4.05) had a higher score on the SATS. This finding indicates that in terms of how students feel about statistics, General Psychology students have a more positive attitude towards statistics compared to their counterparts. With regard to *cognitive competence*, compared to Organisational Psychology students (M=4.31), General Psychology students (M=4.68) scored slightly higher on this component of attitudes towards statistics. This shows that General Psychology students do not doubt their intellectual knowledge and skills when it comes to statistics.

With regard to the *value* of statistics, compared to Organisational Psychology students (M=4.3), General Psychology students (M=4.46) scored slightly higher on this measure. These findings show that General Psychology and Organisational Psychology students more or less, hold positive attitudes with regards to the extent to which they perceive statistics to be useful, relevant and worthy for their personal and professional degrees. With regard to the *difficulty* of statistics, compared to Organisational Psychology students (M=3.74), General Psychology students (M=3.82) scored slightly higher on this component. The results indicate that in terms of the difficulty of statistics as a subject of study, both groups have a neutral attitude towards this component of the SATS.

With regard to *interest* in statistics, compared to General Psychology students (M=4.12), Organisational Psychology students (M=4.57) had a slightly higher score, indicating in general they had a higher level of individual interest in statistics as a course of study. Lastly, with regard to *effort*, compared to General Psychology students (M=6.35), Organisational Psychology

students ($M=6.27$) scored slightly lower than their counterparts. This suggests that both groups had a highly positive attitude with regards to the amount of work they expend on learning statistics.

Overall, the basic summary and results from the Independent Samples T-Test indicated that there were no statistically significant differences between the two groups in any of the components of the SATS-36 ($p > 0.05$). That is to say students did not differ in the way in which they feel about statistics, their attitudes about their intellectual knowledge in relation to statistics, their attitudes about the usefulness and value of statistics, their attitudes about the difficulty of statistics as a course, their interest in statistics, and the amount of work they put in to learn statistics were generally the same.

6.2.3 Objective 2

Objective 2 was to investigate whether differences exist between the Rhodes University sample and the United States student population. The population of interest was a group of 2200 students who were enrolled for introductory statistics courses in the United States (Schau & Emmioglu, 2012). Findings from my study indicated that there were no statistically significant differences between the Rhodes University sample and the population, indicating that the two groups hold the same attitudes towards statistics. This finding is of importance because it compares students from different contexts on attitudes towards statistics. The significance of this finding for attitudes towards statistics is that it has added to the scarce body of literature relating to an exploration of differences in the attitudes towards statistics of students from diverse contexts.

Objective 3: Qualitative Analysis

6.3 Qualitative Analysis: Main Findings & Link with Existing Literature

Qualitative data was analysed using thematic analysis, a method of examining data by recording patterns within datasets (Braun & Clarke, 2006). Three themes emerged from the qualitative analysis, namely: (a) The fear of failing statistics, (b) late introduction to statistics, and (c) the role of the lecturer in promoting or alleviating statistics anxiety. The bulk of the discussion related to these themes was discussed under my qualitative findings. In this section, I discuss the implications of these findings for the setting in which my research was conducted.

Student attitudes towards statistics are important in that they play a key role in influencing the learning process (Mills, 2004). Many postgraduate students in the social sciences are required to take a course in statistics. Often, these students have limited to no background in statistics from their undergraduate degree (Pan & Tang, 2004). As such, most postgraduate students often enter postgraduate statistics courses with a fear of failing. Related to the fear of failing, Pan and Tang (2004) note that statistics anxiety is not always due to a lack of statistical background, more often than not, the fear is based on students' misperceptions about statistics being a difficult subject to grasp. It is important to note that findings from my quantitative and qualitative analysis seem to be contradictory. Since all interviewed students were from a social sciences background, participants believed that they were not equipped with the necessary skills to master statistics. In other words, they doubted their *cognitive competence*, leading to heightened levels of statistics anxiety. It is however evident that in the SATS-36, students reported having the *cognitive competence* to do well in statistics. These contradictory findings are worth exploring in further research. It is without doubt that teaching statistics at an earlier period within the Psychology degree could decrease the fear of failing postgraduate statistics courses (Roberts et al., 1997). From the first theme, it is clear that there is a link between the fear of failure, early exposure to statistical education and statistics anxiety.

A possible application at Rhodes University and elsewhere, would be students' early exposure to statistics, and even earlier exposure to understanding key statistical concepts and how to interpret statistical data statistical outputs from software such as SPSS and STATISTICA. Early exposure to statistics how thus decrease interpretation anxiety, heighten cognitive competency, and decrease statistics anxiety (Forte, 2005; Kruger, 1987; Taylor, 1990; Williams 2010). Based on findings from this study, the Rhodes University Department of Psychology is on advanced discussions to review its curriculum and implement foundational statistics courses to its First Year Introductory Psychology course beginning from the 2020 academic calendar (Correspondence with research supervisor).

Lastly, the teaching style and role of the educator emerged as an important theme in alleviating or heightening students' sense of anxiety about statistics. Findings from the interviews indicated that students expected to be taught by individuals who not only knowledgeable in the subject, but was skilled enough to teach it. This finding speaks to diverse variables including (a) the teaching

style of the educator(s) and (b) how the educator relays complex information to students. Findings emerging from my study include the fact that in order to reduce statistics anxiety, educators can implement novel teaching techniques such as using humor to teach statistics (Schacht & Stewart, 1990) as well as (b) emphasizing the relevance and value of the subject to social science students and (c) encouraging students to ask to speak about their worries and concerns as well as being encouraged to ask questions (Wilson, 1996). The majority of these approaches are already being undertaken in the teaching and application of the courses within the department.

6.4 Convergence and Divergence of Quantitative and Qualitative Findings

With regard to students' attitudes towards statistics, the most important finding was that there is convergence between quantitative and qualitative analysis regarding students' feelings concerning statistics (*affect*), and the difficulty that student experience with statistics (*difficulty*). Similar to the quantitative findings, the qualitative data seems to confirm that students had a slightly negative attitude towards statistics. Students seem to indicate that statistics was a complicated subject, and one they feared failing. The fear of failure theme that emerged from the qualitative findings is related to the *difficulty* component of the SATS. Of divergence, the finding that students reported having the *cognitive competence* to do well in statistics as measured by the SATS, however the qualitative findings seem to indicate otherwise.

In terms of students' attitudes about the worth of statistics (*value*), level of interest in statistics (*interest*), and the amount of work students expend to learn statistics (*effort*), both quantitative and qualitative results seem to suggest that that participants had a positive attitude with regard to the above components. A limitation of my study is that it did not directly interview participants on each of the components of the SATS-36, but on aspects that were directly related to difficulty and *affect* components of the SATS.

6.5 Methodological Considerations affecting Interpretation

Mixed methods research is important as it adds value that qualitative or quantitative research, by themselves cannot provide. This type of research provides strengths that balance the weaknesses of either research method (Creswell & Plano Clark, 2007). The use of this method does however have its benefits and challenges. For instance, the mixed method approach aided my research in

that it allowed me to compare results from quantitative and qualitative data. As such, I was able to use qualitative data to help explain quantitative findings. This method was helpful considering that the number of postgraduate students, especially postgraduate psychology students at Rhodes University tend to be generally low, I anticipated that if I only employed quantitative methods, the results would not yield any significant differences.

One of the challenges of using the mixed method approach is the vast number of designs and suggestions on how to conduct and execute mixed methods research (Creswell, 2008). With regard to the sequential explanatory design approach that I utilized, various executing techniques have been suggested. Beside the fact that my data collection took a substantial period of time to complete (due to two separate data collection phases) there were major difficulties on how to correctly apply the sequential explanatory design. For example, although I used guidelines from the American Psychological Association (APA) on how to conduct a sequential explanatory mixed design, the sequence on how to correctly identify key findings from the quantitative findings to explore in the qualitative interviews was a challenge. Analysis from the SATS initially did not show clear points of interest to explore in the qualitative interviews. At some instances, the quantitative data from the SATS appeared contradictory, making it difficult to create focus areas for my interviews. At a closer analysis, I think my study would have benefitted from conducting a purely qualitative study, and not a mixed approach study.

6.6 Limitations and Suggestions for Future Research

Sample Size and Analysis: The main limitation is my study was the small sample size for my quantitative analysis. A small sample size is, however, unavoidable considering that postgraduate psychology classes tend to be small. My research would have benefited from a larger sample that could have yielded clearer results on the SATS that would have guided my qualitative analysis. Linked to the above, was the lack of equal sample sizes in my comparative analysis of Organisational and General Psychology students on the SATS. To address the above noted limitation, future research studies could benefit from collating data from various meta-analysis on the various components of the SATS (e.g., *value*, *interest* etc.) for Organisational and General Psychology' students, accompanied by in depth qualitative interviews. Future research could also benefit from collecting more data on the SATS for Psychology postgraduate students, and

identifying clear trends from bigger samples on attitudes towards statistics and quantitative research methods. Future research could also take samples from various universities to increase the number of postgraduate students who participate in research.

Instrumentation : One further limitation of my study was an overreliance on post SATS-36 scores only. The reason that this is a limitation is because the SATS-36 has pre and post versions of the test, and the author of the instrument, Schau (2003) mentions that to gain useful data, the SATS is best administered at least twice. This is to say, there should be a pre and post test administered on students' attitudes towards statistics. To address the above shortcoming, future research should perhaps seek to investigate how students' attitudes towards statistics change over time, using pre and post versions of the SATS-36. This method was employed by Schau and Emmioglu (2012) who found that on average, students enter introductory statistics course with neutral (*affect, difficulty*), and positive (*cognitive competence, value, interest, effort*) attitudes towards statistics. These attitudes do however change overtime, (*value, interest, effort*) or sometimes stay the same (*affect, cognitive competence, difficulty*). This approach for future research would assist in determining why some attitude towards statistics change, while others do not.

6.7 Significance of the study

The current study adds to the findings from my Honours study. My current study is significant in that it sought to contribute to the field of statistics anxiety by particularly investigating postgraduate Psychology students within a South African context. With the call to contextualise and decolonize the South African academic curriculum, findings from this study could be used to improve the teaching and learning of statistics and quantitative research methods amongst South African students. Additionally, in order to gain a more nuanced understanding of Psychology student's attitudes towards statistics, the study added a qualitative component to a topic that is mainly investigated using quantitative measures. My study has thus attempted to add to the literature on attitudes towards statistics amongst postgraduate students by implementing a mixed method design to the topic. What the mixed method approach revealed is that there are places of convergence and divergence in students' attitudes towards statistics anxiety.

6.8 Reflexivity

Lastly, at this juncture, it is a worthy consideration to be a reflective practitioner of my work as suggested by Alvesson and Skoldberg, (2009) and others who partake in mixed methods analysis. The term reflexivity is often used vaguely among researchers, however, I take reflexivity to mean responsiveness to the researcher's position and influence in data collection, analysis and interpretation (Alvesson & Skoldberg, 2009). Being a postgraduate Psychology student myself, I was overwhelmed by the statistics course. Coming from a social sciences background, I did not think that I would cope with taking the course. Conversations with my classmates revealed that almost everyone was overwhelmed by the course and many were grappling with statistical concepts and techniques. I thought it would be worthwhile to investigate postgraduate students' attitudes towards statistics considering that there is limited literature in the South African context investigating such a phenomenon.

As a researcher, the most important thing to do was to acknowledge every students' voice and to be mindful that the assumptions I had about my participants could be proven wrong. Based on the conversation I had with my fellow classmates, I assumed that most students' would have a negative attitude towards statistics, considering how they always complained about the course. I was surprised to hear that some of the students had a positive to moderate attitude towards statistics.

Detaching myself from the interviews was difficult considering that I am also a student who comes from a social sciences background and experienced some level of statistics anxiety. I was careful not to lead the discussion, but to rather let the participants speak for themselves. I, however, sometimes found myself sharing my own experiences of taking statistics as a course. Perhaps this was because I knew most of the participants on a personal level, and so the interview felt more like a conversation instead of a formal method of data collection. The process of coding my data taught me what it means to be concise and accurate when looking for themes. I was careful to detach my own interpretations, and to let the data speak for itself. Furthermore, conducting this research took me through the experiences of students when beginning and completing a statistics course. It allowed me to have a deeper understanding of what it means to be a student from the social sciences and have no statistical background.

Lastly, in terms of balancing qualitative and quantitative analysis of my results, my inclination and priority in my data analysis seems to have largely been concentrated on the qualitative aspect of the analysis. The shortcomings of this concentration might have been linked to the topic under investigation, students' perceptions and attitudes towards statistics. It is not clear how this latter reflection and prioritization could have affected the analysis and findings of my study.

6.9 Summary and Conclusion

Statistics and quantitative research method courses continue to be a valid degree offering at University levels. However, to improve the teaching and learning of these courses to social science students, research investigating attitudes towards statistics is important. My study sought to understand the phenomenon among a group of postgraduate Psychology students. This study found relevant information regarding postgraduate students' attitudes towards statistics. Although no significant differences were found on attitudes towards statistics based on 'Psychology type', my sample of interest and the US studies, the study made a contribution in employing a qualitative aspect to understanding the phenomenon of statistics anxiety amongst postgraduate students. It is hoped that future studies can add to these preliminary findings on student attitudes towards statistics so as to aid in the teaching and learning of relevant subject, not only to Rhodes University students, but to other Psychology students undertaking statistics and quantitative research methods courses.

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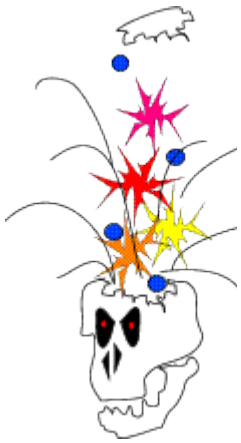
Appendix A

EXAMPLE OF STATISTICS PRACTICAL EXERCISE INCLUDING MIND MAP

2015-2018

Rhodes University
Research Methods
Mr Sizwe Zondo

How do I interpret
b values?



OUTCOME_i = MODEL + ERROR_i



REGRESSION
ANCOVA
CORRELATION
MODERATION
MULTILEVEL MODEL
T-TEST
MEDIATION

What are the
assumptions of parametric
data?



FACTORIAL ANOVA MIND MAP²¹

²¹ Acknowledgement for **all** Mind Maps that appear on this document go to Professor Andy Field, *Discovering Statistics Using SPSS* (2017)



FACTORIAL ANOVA

EXERCISE 1

THE PARLOTONES



FRESHLY GROUND



OR MI CASA



I have always been interested in the study of music (musicology) and music research in general. Something that has always fascinated me is whether people of different ages enjoy listening to the same kind of music. I arbitrarily chose three South African music bands (**variable = music**) and rated how much people love these music bands (**variable = liking**) (this was measured out of a score of 100) and whether people of different age groups (**variable = age**) have different inclinations or attitudes towards the above music bands. It was decided that “young” people would be people under the age of 40, those above 40 years were coded as “old”. There were 45

“young” people in the study and 45 “old” people. I further split the groups into smaller groups of 15 and each group was assigned to either listen to Mi Casa, The Parlotones or Freshly Ground.

1. Run **assumptions** on the data (use Levene’s Test) to assess if there any violations on the data. Report on the p , and analyse this output.

(2)

2. Produce **Descriptive Statistics** and comment on these statistics (use your graph output to assist you further).

(5)

3. State the **null and alternative hypothesis** for this research study. (4)

4. Conduct a two way independent ANOVA on the data. (2)

5. Comment and interpret on:

a. The **main effect** for **music** (integrate your descriptive statistics onto your analysis).
What is your conclusion regarding this hypothesis? (4)

b. The **main effect** for **age** (integrate your descriptive statistics onto your analysis).
What is your conclusion regarding this hypothesis?

(4)

c. The **interaction** of **music and age** (integrate your descriptive statistics onto your analysis). What is your conclusions regarding this hypothesis? (4)

6. Conduct **post hoc analysis** on the data and comment on these. (10)

Exercise 1 Total Marks = 35

Appendix B
DEMOGRAPHIC QUESTIONNAIRE

GENDER

Man	
Woman	
Gender non-conforming	
I prefer not to be classified by my gender	

PLEASE INDICATE PSYCHOLOGY TYPE

General Psychology	Organisational Psychology

PREVIOUS EXPOSURE TO STATISTICS/QUANTITATIVE METHODS

Yes	No
-----	----

Appendix C

SURVEY OF ATTITUDES TOWARD STATISTICS

Please indicate your response for **strongly disagree** to **strongly agree**

The survey should take you less than 20 minutes to complete.

Please aim to be as honest as possible in your responses.

1. Affective Component

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
I like statistics							
I don't feel intimidated when asked to solve statistical problems							
I don't feel disappointed when reviewing the answers for my statistics test in class							
I don't feel stressed in my statistics class							
I enjoy taking statistics courses							
I am not afraid of statistics							

2. Cognitive Competence Component

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
I do not face problems in statistics because of my thinking style							
I know what is happening in statistics							
I don't make conceptual and calculation errors very often in statistics							

I understand statistics equations							
I don't find it hard to understand statistical concepts							
I can learn statistics							

3. Value Component

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
Statistics is not worthless							
Statistics should be a required part of my professional training							
Statistical skills will make me more employable							
Statistics is useful to the typical professional							
Statistical thinking is applicable in my life outside my job.							
I use statistics in my everyday life							
Statistics conclusions are rarely presented in everyday life							
I will have no application for statistics in my profession							
Statistics is relevant in my life							

4. Difficulty Component

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
Statistics formulae are easy to understand							
Statistics is not a difficult course							
Statistics can be quickly learned by most people							
Learning statistics does not require discipline							
Statistics is not too technical							
It needs least requisite a new way of thinking to study statistics							
Statistics does not involve too much calculation							

5. Interest Component

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
I am interested in talking about statistical information with other people							
I am interested in using statistics							
I am interested in understanding statistical information							
I am interested in learning statistics							

6. Effort Component

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
I have finished all my statistics assignments							
I have strived for excellence in statistics course							
I have studied hard for each statistics test							
I have attended all lectures in the statistics course							

Appendix D

PERMISSION TO USE THE SURVEY OF ATTITUDES TOWARD STATISTICS

• **RE: Permission to use the SATS-36 from Candace**

Dear Xolelwa,

Your study sounds very interesting and certainly is needed. Since I expect that you don't have funding, you can use the SATS free for one year. At the end of your year, contact me again if you would like to continue to use my measure. I do require that you send/e-mail me a copy of anything you write that includes information about your use of the SATS. Also, when you use the SATS or write about it, you need to indicate that I hold the copyright.

You need to use all of the items that comprise each attitude component on the SATS (and I encourage you to use the other items too). If you want to omit or change any of those items, you will need to contact me again. Scores from the SATS attitude components using all of the items have been carefully validated on postsecondary students with a wide variety of characteristics taking statistics in a large number of institutions both within and outside of the US. That validation work does not apply to altered items, individual items or to incomplete components. Also, it is not appropriate to use a "total" attitude score. You are welcome to change the demographic and academic items to fit your circumstances.

You can find references and scoring information on my web site. I have attached the pretest and posttest versions of the SATS.

I wish you the best of luck with your work.

Candace

Candace Schau, PhD
CS Consultants, LLC
505-292-3567

www.evaluationandstatistics.com

Appendix E
INTERVIEW QUESTIONS

- Before taking the statistics course, did you have any background in statistical education?
- Before taking the statistics course, did you have any background in mathematics/arithmetic?
- When you hear the word ‘statistics’, what is the first thing that comes to mind?
- Often students who enroll for an Honours degree in psychology come from a social sciences background. Do you come from social sciences background? If so, what feelings did you experience when you first had to take a statistics course?
- In your own experience, how difficult was the material covered in the statistics course? Explain challenges you have been faced with?
- Have you been able to complete all your statistics tasks? If not, what has hindered the completion of the said tasks?
- In your own opinion, do you think that statistics is a complicated subject? Why? Why not?
- Do you communicate statistical information with others?
- How often do you use statistics in your everyday life?
- At the time you took the statistics course, how would you have described your stress levels?
- Given a chance, how likely is it that you would consider taking another course in statistics?
- In the career path you hope to follow when you finish school, how much do you think you will use statistics?
- How do you think statistics can be taught better at the undergraduate/postgraduate level?
- During your studies, what do you think made you most anxious about statistics?
- What do you think would decrease your anxiety levels and make you enjoy statistics?
- What do you think lecturers could do to minimise statistics anxiety?

Appendix F

INTERVIEW CONSENT FORM

**RHODES UNIVERSITY
DEPARTMENT OF PSYCHOLOGY**

**AGREEMENT BETWEEN STUDENT RESEARCHER AND
RESEARCH PARTICIPANT**

Updated 26 January 2011

I (participant's name) _____ agree to participate in the research project of Ms Xolelwa Ngantweni on 'A mixed method investigation into students' attitudes towards Statistics: A focus on Psychology postgraduate students.

I understand that:

1. The researcher is a student conducting research as part of the requirements for a Master's degree at Rhodes University. The primary supervisor may be contacted on 046 603 8503 (office) or s.zondo@ru.ac.za.
2. The researcher is interested in studying students' attitudes toward statistics and aims to expand on previous findings on her Honours research. The researcher is interested in understanding both qualitative and quantitative attitudes towards statistics.
3. In addition to completing the SATS-36 survey questions, my participation might also involve being invited to participate in a personal interview. The interview component will take 10-15 minute to complete.
4. I may be asked to answer questions of a personal nature, but I can choose not to answer any questions about aspects of my life which I am not willing to disclose.

5. I am invited to voice to the researcher any concerns I have about my participation in the study, or consequences I may experience as a result of my participation, and to have these addressed to my satisfaction.

6. I am free to withdraw from the study at any time – however I commit myself to full participation unless some unusual circumstances occur, or I have concerns about my participation which I did not originally anticipate.

7. The report on the project may contain information about my personal experiences, attitudes and behaviours, but that the report will be designed in such a way that it will not be possible to be identified by the general reader.

Signed on (Date): _____

Participant: _____

Researcher: Ms Xolelwa Ngantweni

Signed on (Date):

Appendix G

RECRUITMENT ADVERTISEMENT

Dear Psychology Honours Class

My name is Xolelwa Ngantweni, a Master's by Thesis student in the Department of Psychology. This is to kindly request your participation in my research that looks into student's attitudes towards statistics. My research topic is 'A mixed method investigation into students' attitudes towards statistics: A focus on Psychology postgraduate students'. This research aims to expand on previous findings on understanding students' attitudes towards statistics; and seeks to include a qualitative analysis component in addition to analyzing student attitudes using the Survey of Attitudes Toward Statistics (SATS-36) (Schau, 2003). It is envisaged that my current research will enhance the scarce body of literature regarding attitudes towards statistics in a South African context.

You are requested to complete a Survey, the (SATS-36). This survey is designed to help understand student's attitudes toward statistics. The survey will take 10-15 minutes to complete. Your responses to the survey will assist me in learning more about student's attitudes towards statistics so as to assist future teaching of statistics courses. Please click on the link below to go to the survey.

<https://www.surveymonkey.com/r/GXZF8N2>

Since this is a mixed methods research, I kindly request eight students from the Honours class to volunteer to participate in individual interviews that seek to obtain richer information pertaining to student attitudes towards statistics. Interviews will take place at the Psychology Department in the seminar rooms and will take 15 minutes. Interviews will be tape recorded and participants will be required to sign the use of tape recording for research purposes permission form. There are no foreseeable risks involved in participating in this study. Participants have the right to withdraw at any point during the course of the interviews. Identities of the participants will be kept confidential.

Should you be keen to participate in the above mentioned study or interested in being interviewed, please respond to this email or alternatively contact me on 0630054482.

Thank you for taking the time to read this email.

Appendix H

**USE OF TAPE RECORDINGS FOR RESEARCH PURPOSES PERMISSION AND
RELEASE FORM**

Name of participant			
Participant's contacts details		Email address:	
		Phone number:	
Name of researcher : Xolelwa Ngantweni			
Level of research	Honours	Masters X	PhD
Brief title of project :Mixed method investigation into students' attitudes towards statistics			
Name of supervisor : Sizwe Zondo			

DECLARATION

(Please initial/tick blocks next to the relevant statements)

1. The nature of the research and the nature of my participation has been explained to me.	verbally	
	in writing	
2. I agree to be interviewed and to allow recordings to be made of the interview	audiotape	
	videotape	
3. I agree to..... and allow recordings to be made	audiotape	
	videotape	
4. The tape recordings may be transcribed	without conditions	
	only by the researcher	
	by one or more nominated third parties	
5. I have been informed by the researcher that the tape recordings will be erased once the study is complete and the study has been written OR I give permission for the tape recordings to be retained after the study and for them to be utilised for the following purposes and under the following conditions.		

Signature of participants:

Date:

Witnessed by researcher:

Date:

Appendix I
NVIVO NODES

Nodes

Name	Sources	References	Created By	Created On	Modified By	Modified On
Availability of lecturer		1	1	XN	4/10/2017 11:30 P	4/10/2017 11:30 P
Difficulty		3	5	XN	4/10/2017 11:27 P	10/28/2017 8:00 P
Confusion		3	7	XN	4/10/2017 10:31 P	4/10/2017 11:55 P
Fear of failure		3	11	XN	4/10/2017 11:16 P	4/10/2017 11:51 P
Future use of statistics		2	2	XN	4/10/2017 11:21 P	4/10/2017 11:33 P
Increase in anxiety due to exam		2	3	XN	4/10/2017 10:38 P	4/10/2017 11:04 P
Lack of a proper foundation and late introduction to statistics		3	15	XN	4/10/2017 11:02 P	4/10/2017 11:56 P
Minimising statistics anxiety		3	4	XN	4/10/2017 10:40 P	4/10/2017 11:25 P
Person knowledgable in subject area		3	7	XN	4/10/2017 11:09 P	4/10/2017 11:54 P
Preconceived ideas of statistics		4	5	XN	4/10/2017 10:35 P	4/10/2017 11:47 P
Preparation		3	4	XN	4/10/2017 10:37 P	4/10/2017 11:48 P
Relevance of statistics		4	6	XN	4/10/2017 10:58 P	4/10/2017 11:50 P
Role of lecturer		3	6	XN	4/10/2017 11:20 P	10/28/2017 8:02 P
Social sciences and numbers		3	4	XN	4/10/2017 10:53 P	4/10/2017 11:52 P
Spacing out lecturers		3	5	XN	4/10/2017 10:44 P	4/11/2017 11:30 P
Statistics associated with difficult numbers		1	3	XN	4/10/2017 10:28 P	4/10/2017 10:28 P
Statistics not difficult, challenging		3	5	XN	4/10/2017 10:56 P	4/10/2017 11:48 P
Use of practical examples		2	5	XN	4/10/2017 11:12 P	4/10/2017 11:28 P
Use of software		3	4	XN	4/10/2017 10:31 P	4/10/2017 11:49 P
Willingness to help		1	3	XN	4/10/2017 10:45 P	4/10/2017 10:47 P

Appendix J

LETTER TO THE REGISTRAR FOR RECRUITMENT PURPOSES

The Registrar
Rhodes University
P.O Box 94
Grahamstown
6140

RE: PERMISSION TO RECRUIT STUDENTS FOR RESEARCH PURPOSES

My name is Xolelwa Ngantweni and I am currently completing a Master's degree in the Department of Psychology at Rhodes University. I am conducting a study that aims to understand students' attitudes towards statistics, specifically postgraduate Psychology Honours students using the SATS-36 (Schau, 2003) and interviews. This research specifically aims to expand on previous findings on understanding students' attitudes towards statistics; however, my current study seeks to include a qualitative analysis component in addition to analyzing student attitudes using the SATS-36 (Schau, 2003). It is envisaged that my current research will enhance the scarce body of literature regarding attitudes towards statistics in a South African context. My research is supervised by Mr Sizwe Zondo of the Department of Psychology.

In conducting this research, I require participants from the Psychology Honours class of 2016. Participants will be required to fill in a survey that will take ten minutes to complete. I am hereby seeking your consent to approach students and to conduct this study. I kindly request your permission to access students through email access. There are no risks involved in participating in this study. Participants' responses will be sent to a link at SurveyMonkey.com and will remain anonymous. Results of the study will be made available to the participants at their request.

The benefit of this research is that it will attempt to add to the literature by providing research that focuses on postgraduate students. In South Africa, a few studies have employed the SATS-36 (Schau,2003) and this research will add to such studies. This research will also provide an understanding of how the structure of statistics courses can influence attitudes towards statistics, and how statistical teaching can be improved.

Ethical approval has been obtained from the Research Projects and Ethics Review Committee and the protocol number is PSY2016/60

If the above is to your satisfaction, please sign below to indicate that institutional permission has been granted. For any further questions regarding my research, please contact me at g11n3839@campus.ru.ac.za. Alternatively, contact my research supervisor at s.zondo@ru.ac.za.

Thank you for your consideration.

Yours sincerely

Xolelwa Ngantweni

Signed on

The Registrar

Researcher

Appendix K

PSYCHOLOGY DEPARTMENT'S RPERC LETTER

RESEARCH PROJECTS AND ETHICS REVIEW COMMITTEE

31 October 2016

Xolelwa Ngantweni
Department of Psychology
RHODES UNIVERSITY
6140

Dear Xolelwa

ETHICAL CLEARANCE OF PROJECT PSY2016/60

This letter confirms your research proposal with tracking number PSY2016/60 and title, 'A mixed method investigation into students' attitudes towards statistics: A focus on psychology postgraduate students', served at the Research Projects and Ethics Review Committee (RPERC) of the Psychology Department of Rhodes University on 24 August 2016. The project has been given ethics clearance.

Please ensure that the RPERC is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators.

Yours sincerely



Dr Jacqui Marx
CHAIRPERSON OF THE RPERC

Appendix L

Z-TEST SYNTAX

**syntax created by how2stats

**This syntax performs a one sample z-test in SPSS

**Simply enter the four relevant values in the line below underneath the 'begin data' command

**The first number is the sample size (35), the second number is the sample mean (105),

**the third number is the population mean (100)

**and the fourth number is the population standard deviation (15)

**Replace the four values below with your own.

**The p value that is reported is based on a two-tailed test.

**To obtain the one-tailed p value, simply divide the two-tailed p value by 2.

**As an extra, this syntax also calculates Cohen's d as estimate of effect size.

```
data list list / n sample_mean population_mean population_sd.
```

```
begin data
```

```
35 105 100 15
```

```
end data.
```

```
Compute mean_difference = sample_mean - population_mean.
```

```
Compute square_root_n =SQRT(n).
```

```
Compute standard_difference = population_sd/square_root_n.
```

```
Compute z_statistic = mean_difference/standard_difference.
```

```
Compute chi_square = z_statistic*z_statistic.
```

```
Compute p_value = SIG.CHISQ(chi_square, 1).
```

```
Compute cohens_d = mean_difference/population_sd.
```

```
EXECUTE.
```

```
Formats z_statistic p_value cohens_d (f8.5).
```

```
LIST z_statistic p_value cohens_d.
```

Appendix M

POWER ANALYSIS

Statistical power analysis is probability of accepting the null hypothesis, as well the probability of detecting an effect in a given sample size (McDonald, 2014). Power would have been used to determine the necessary number of subjects needed to detect an effect. In my study, power analysis would have been used as a means of finding a difference between the General Psychology and Organisational groups. I would need to know the difference in the means of the two groups, as well as the standard deviation for each group.