

**THE RELATIONSHIP BETWEEN BEHAVIOURAL DIMENSIONS
AND INDIVIDUAL PERFORMANCE ON A LEARNING POTENTIAL
MEASURE IN THE SOUTH AFRICAN CORPORATE ENVIRONMENT**

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DECLARATION

Student Number: 95973404

I, Monique Greenland, the undersigned, hereby confirm that the dissertation submitted by me in fulfilment of the degree Masters in Research Psychology to University of South Africa (UNISA) is my independent work and has not been submitted by me for a degree at another faculty or university.

Monique Greenland

REMARKS

The reader is reminded of the following:

The references as well as the editorial style as prescribed by the Publication Manual (4th edition) of the American Psychological Association (APA) were followed in this dissertation. This practice is in line with the policy of the Programme in Research Psychology of UNISA to use APA style in all scientific documents.

This research product is submitted in the form of a dissertation.

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ABSTRACT

Topic: The relationship between behavioural dimensions and individual performance on a learning potential measure in the South African corporate environment.

Key words: Personal Profile Analysis, Test for Training and Selection, learning potential, behaviour dimensions, speed and accuracy, dominance, influence, steadiness, compliance; and corporate environment.

Psychometric testing is becoming more influential in the recruitment and development of individuals within the corporate environment globally, with over 80% of Fortune 500 companies in the USA and over 75% of the Times Top 100 companies in the UK using psychometric testing, the same trend is emerging in South Africa. The aim of this study was to investigate the possible relationship between an individual's preferred behavioural approach on various behavioural dimensions and the manner in which they complete a psychometric measure, more specifically, a learning potential measure within the corporate environment, as an individual's preferred behavioural approach may act as a biasing factor with regard to the result that they obtain. A causal research design was utilised and two psychometric measures used to respectively determine an individual's preferred behavioural style and learning potential. The sample consisted of 398 economically active adult candidates in either a development or recruitment assessment centre. Both the Personal Profile Analysis (PPA) and Test for Selection and Training (TST) were administered on these 398 individuals. Statistical analysis was carried out on the test results with the use of SPSS and Microsoft Excel. The reliability and validity of the measuring instruments was also ascertained and found acceptable. Descriptive statistics, contingency tables, significant differences, t-test statistics and p-values were used to analyse the data. These statistical methods were used to indicate if a relationship exists. The results indicate that various behavioural

dimensions, (Dominance, Influence and Steadiness) amongst individuals within the South African Corporate environment do have an impact on how they complete a learning potential measure, when consideration is given to the speed and accuracy with which they complete such a measure. Recommendations for the organisation and future research were made.

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CHAPTER 1: CONTEXTUALISING THE STUDY

In this chapter, the background for the research, problem statement, aim and scope for the present study is set out. The general and specific objectives of the study are formulated and the steps that were undertaken to complete the study are specified. An overview of what is to be expected in the following chapters is provided.

1.1 Introduction

This dissertation examines the relationship between behaviour dimensions and the performance on a learning potential measure by the sample drawn from the South African Corporate Environment.

1.2 Problem Statement

Psychometric tests have been used since the early part of the 20th century in the realm of educational psychology; with time its focus has shifted to include psychometric tests within recruitment and selection. These tests were developed to provide employers with a reliable method of selecting the most suitable job applicants or employee for a promotion. Globally, there is a need for companies to obtain cost-effective scientific information from unbiased psychometric testing for better people management decisions. Psychometric testing therefore plays a pivotal role in assisting companies in effective human resource empowerment and planning by accurate profiling of existing and new employees. In South Africa, the same holds true with numerous organisations turning to psychological measures to assist them in the recruitment and development of their incumbents for various positions. (Van De Vijver & Rothmann, 2004; Van der Merwe, 2002). Psychometric tests used by organisational psychologists have attracted controversy due to questions around validity, but their popularity with employers have

increased, with 80% of the Fortune 500 and 75% of the Times Top 100 companies using them in recruitment and selection (Mannion, Konteh, & Davies, 2009).

The increased utilisation of psychometric tests in the corporate environment can be attributed to the following reasons:

- (i) Increased regulation and legislation → a defensive strategy, adopted in response to regulation and legislation, to allow a company's recruitment and selection process to withstand legal challenge. The South African government has implemented legislation with regard to employment that compels companies to improve their empowerment and training programmes for employees. Legislation also demands that previously disadvantaged individuals are afforded the opportunity to gain employment.
- (ii) Test results being more useful now than in the past → political and cultural changes within companies has changed significantly over the past couple of years. In addition, there are concerns that only using qualifications as a criterion for selection may create barriers to access and can be viewed as discriminatory.
- (iii) The increase in costs of training staff → the slow-down after the recession and the increased cost of training and developing staff has resulted in a need to carefully select individuals earmarked for expensive training or fast tracking programs.
- (iv) The cost of psychometric testing has decreased → more providers have entered the market in addition to the increased use of technology in the administering and scoring these tests.
- (v) Increase in formal HR structures → increase in employment related legislation, has encouraged many organisations to recruit highly trained human resource incumbents with experience in psychometrics.
- (vi) Loss of confidence in academic qualifications and limited access to tertiary institutions → academic standards have been

decreasing across all schooling levels. In addition, some individuals may have had limited opportunities, increasing the importance with regard to their potential to develop and learn new skills and competencies.

Due to psychometric tests' importance in making employee decisions, it is vital that the tests themselves are known to produce accurate results based on standardised methods and statistical principles. Therefore a psychometric test must be:

- (i) Objective → the score must not be affected by the testee's beliefs or values.
- (ii) Standardised → the test must be administered under controlled conditions.
- (iii) Reliable → the test must minimise and quantify any intrinsic errors.
- (iv) Predictive → it must make an accurate prediction of performance.
- (v) Non-Discriminatory → the test must not disadvantage any group on the basis of gender, culture, ethnicity, etc.

The results obtained from various psychometric tests used by companies allow them to gain deeper insights into aspects such as team-working ability, leadership qualities, interpersonal effectiveness, analytical and decision making abilities. Psychometric tests are applied at the early stages of recruitment to screen out candidates that are likely to be unsuitable for the job. Psychometric tests aim to measure various qualities such as intelligence, aptitude and personality, however, they make no attempt to analyse an individual's emotional or psychological stability and should not be confused with psychometric tests used in clinical psychology.

Psychometric tests used in the corporate environment for recruitment and selection cover two main areas: personality/interest and aptitude/ability. Psychometric tests that aim to measure aspects of personality do so by

quantifying an individual's personality through asking them about their feelings, thoughts and behaviour in a variety of situations. Aptitude tests aim to measure an individual's intellectual and reasoning abilities by asking them a number of multiple choice questions in an exam-like context. These tests are strictly timed, allowing a limited amount of time to complete a number of questions. The tests themselves aren't actually difficult if performed outside a time frame and the tests are paper based to limit differentiations in speed and accuracy which are outside of a person's actual learning ability. Each test has a norm table against which the test is scored as a method of comparing candidates. Thus, speed and accuracy is key in determining scores for an aptitude measure.

According to Saunders (2002) the interpretation of psychometric results in isolation, without considering the complexity of the human being, often leads to incorrect decisions being made with regard to personnel selection, training and development of individuals. With this in mind, the possible effect of behavioural styles on test performance is of particular importance in the case of aptitude tests and more specifically, for the purpose of this study, learning potential tests. With these tests the way in which a person behaves when completing the test in terms of speed and accuracy will ultimately impact on the score obtained. The specific impact of behaviour dimensions on the manner in which testees may balance accuracy and speed in aptitude test performance is not well-documented or understood; there are a limited number of explorations with regard to this relationship. To date there is no consensus on the actual impact of this relationship (Roberts, 2002; Stough et al., 1996). Within the South African context no studies could be found by the author on the relationship between behaviour dimensions and the performance on a learning potential measure for the corporate adult population.

Assessment Centre Technologies (ACT) is a South African company that conducts psychometric testing for recruitment and development purposes in the corporate environment. In these assessment centres, two of the tests that

are utilised most frequently are the Personal Profile Analysis (PPA) and the Test for Selection and Training (TST). The PPA is classified under the personality/interest arm of psychometric tests, while the TST would be classified as an aptitude/ability test. The PPA measures an individual's preferred behavioural approach, as defined by Dr. William Marston, on various behavioural dimensions namely Dominance, Influence, Steadiness and Compliance (Marston 1928). Behaviour is thought to be influenced by a variety of factors, over and above personality, these include mental ability, current values and motivation, the environment, experience and exposure function in a job or adopting behaviour because of a personal situation. The TST is a psychometric test designed to measure an individual's learning potential or in other terms their fluid intelligence. Learning potential can thus be described as an individual's trainability or their ability to learn, rather than the usual 'intelligence'. Fluid intelligence is a discrete factor of general intelligence, or g although formally recognised by Cattell, the distinction was foreshadowed by Charles Spearman who originally developed the theory of g and made a similar observation regarding the difference between educative and reproductive mental ability (Cattell, 1987).

The persons administering and scoring these tests have casually observed that individuals with certain behavioural dimensions appear to perform better on the TST, in that they manage to complete more items and complete them at a higher accuracy rate. This has raised the question as to whether a relationship exists between an individual's preferred behavioural approach on various behavioural dimensions and the manner in which they complete a learning potential measure. From the assessment centre consultants numerous interactions over the years with test results as well as their observations of the manner in which individuals complete a learning potential measure, such a relationship, appears to exist. Therefore it needs to be considered, based on their observations and accounts that the possibility may exist that the preferred behavioural approach of an individual various behavioural dimensions plays a role in the manner in which they complete

psychometric measures and thus ultimately the results they achieve on such a measure. In this case a learning potential measures that take response accuracy and response speed into consideration in determining the learning potential score.

This study may yield important results for assessment practitioners as they are ultimately responsible for interpreting the results of the tests that they have administered and it is their responsibility towards the testee to ensure that the results that are obtained are unbiased, valid and reliable (Foxcroft & Roodt, 2005).

1.3 Aim of the Study

The research is mainly an explorative study. The aim of the present study is to explore the possible relationship between an individual's preferred behavioural approach on various behavioural dimensions and the manner in which they complete a learning potential measure, with relation to speed and accuracy which is the two dimensions used to calculate the learning potential score. This relationship, if found to exist, can add an element of bias when individuals with alternate behavioural approaches complete a learning potential measure.

The author finds it critical to set the parameters for the study that will allow for the aim as stated above to be achieved. The following section briefly explains the areas to be explored and the reasons for exploring them.

1.3.1 Scope of the Study

An individual's preferred behavioural approach on various behavioural dimensions, if shown to impact on the manner in which they complete a psychometric measure, can act as result in the psychometric test results not being reliable, predictive or non-discriminatory as described in paragraph 1.2 Problem Statement, more specifically page 3. In other words, if the

difference in learning potential test scores can be attributable to an individual's preferred behavioural approach. Such a difference, if found, could be labelled as bias, as there would be systematic differences in the meaning of test scores associated with an individual's preferred behavioural approach. Therefore, if one behavioural approach is found to either over or under perform on the key measures of learning potential, namely speed and accuracy, it could be said that a relationship exists between an individual's preferred behavioural approach and the manner in which they complete a learning potential measure could either be biasing them or other individuals that completed the same learning potential measure who have a different preferred behavioural approach.

The author agrees with Saunders (2002), who stated that the interpretation of psychometric test results therefore cannot be done in isolation without considering the context as a whole. The literature review will therefore reflect on literature that discusses possible biasing factors over and above behaviour, as behaviour can be influenced by personality, mental ability, current values and motivations, the current environment, experience and exposure that may ultimately impact on the results that an individual obtains on a psychometric measure. Possible causes of bias will be categorised into three main categories:

- (i) the test itself,
- (ii) the setting and administration procedure,
- (iii) characteristics of the test taker.

The above points highlight key issues that the author needs to consider when planning the study as well as the data collection and the interpretation of results. The psychometric instruments used, the setting and administrator bias will need to be minimised or accounted for in the study to ensure that any differences that might be observed can be attributed to the

characteristics of the test taker and not as a result of the other biasing factors.

The study will not try to define the relationship between personality and behaviour. For the purpose of this study, it is assumed that personality constructs and other factors (mental ability, current values and motivations, the current environment, experience and exposure) work together and independently of one another to predict behaviour, i.e. personality plays an important role in determining behaviours (Bogg, Voss, Wood & Roberts, 2007). Therefore, it will be implicit for this study that behaviour is a direct result of an individual's personality and other factors working together (Ryckman, 2004). Consequently, this research will not provide evidence that behaviour is resultant from personality. This will be an inherent limitation with regard to the review of literature and theoretical assumptions, as the majority of literature and theoretical assumptions are focused on personality as a biasing factor in test performance. In an attempt to mitigate this inherent limitation, the author will explore the similarities and differences between personality measures that have been used by other researchers to determine if a relationship exists between personality and test performance, and provide a comparison between these and the behaviour measure used in the study.

1.4 Research Objectives

The objectives of the research are as follows:

1.4.2 Specific Objectives

The specific research objectives are:

- a) to understand which factors can act as bias when an individual completes a psychometric measure.

- b) to document and explore the relationship between behaviour that individuals exhibit and their performance on intelligence measures as described in the literature.
- c) to consult literature and determine the types of behaviour patterns that exist and the potential differences in their approach to completing an intelligence measure.

1.5 Primary Hypothesis

1.5.1 Null Hypotheses

Four null hypotheses have been proposed, one in relation to each behavioural dimension on Dr. William Moulton Marston's DISC theory.

H_o = No relationship exists between high **Dominance** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed.

H_o = No relationship exists between high **Influence** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed.

H_o = No relationship exists between high **Steadiness** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed.

H_o = No relationship exists between high **Compliance** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed.

1.5.2 Alternative Hypotheses

It is thought that a relationship exists between an individual's behavioural patterns and the performance on an intelligence measure in a corporate environment. Therefore, test biasing due to an individual's behaviour patterns does occur.

Figure 1 below has been included to provide a visual representation of the alternative hypotheses of this study. It aims to visually portray the expected relationship between an individual's preferred behavioural style and their performance on learning potential measure. This conceptual framework will underpin the literature review.

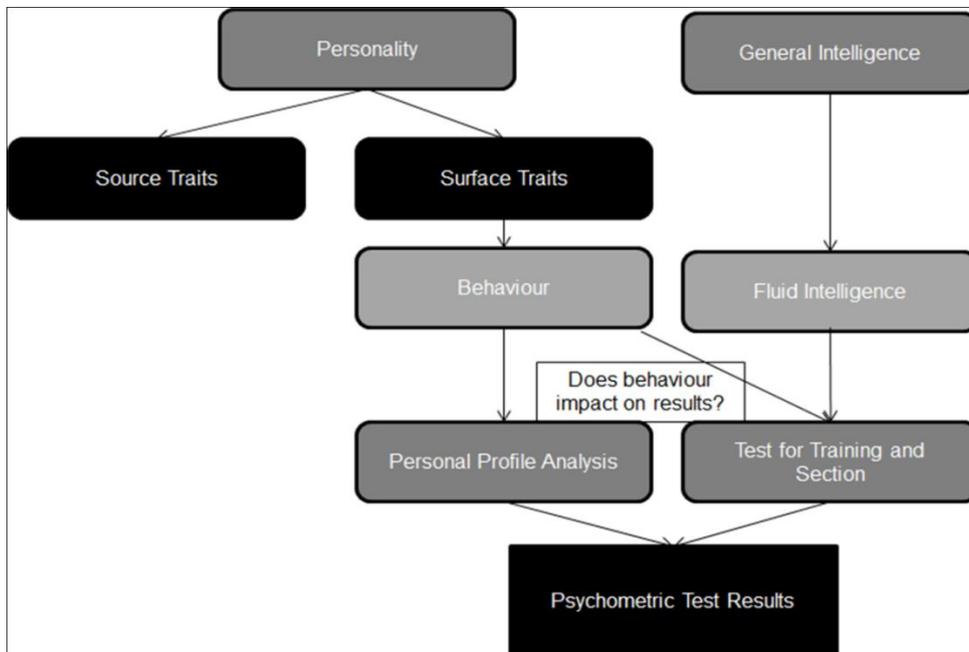


Figure 1: *The relationship that is hypothesised to exist between behavioural profiles and intelligence test completion.*

The alternative hypotheses that are to be tested for in this study are as follows:

H_a = A relationship exists between high **Dominance** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed. An individual with high

Dominance will obtain lower accuracy scores and higher speed scores than an individual with low Dominance.

H_a = A relationship exists between high **Influence** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed. An individual with high Influence will obtain lower accuracy scores and speed scores than an individual with low Influence.

H_a = A relationship exists between high **Steadiness** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed. An individual with high Steadiness will obtain higher accuracy scores and higher speed scores than an individual with low Steadiness.

H_a = A relationship exists between high **Compliance** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed. An individual with high Compliance will obtain higher accuracy scores and lower speed scores than an individual with low Compliance.

1.6 Research Method

1.6.1 Literature Review

A complete literature review will be undertaken in accordance with the following steps:

- (i) To indicate what factors could potentially act as bias when an individual completes a psychometric measure. These will include the test itself, the setting and administration procedure and characteristics of the test taker.
- (ii) To unpack any relationship documented between behaviour that individuals exhibit and their performance on psychometric measures.

- (iii) To document the types of behavioural approaches and their impact on how an individual to completes an psychometric measure.

1.6.2 Empirical Study

The empirical investigation consists of the following steps:

1.6.2.1 The Choice of a Research Design

The study will aim to determine what, if anything is the relationship between the behavioural dimensions of an individual and their performance on a learning potential measure in the South African corporate environment.

The study will therefore be aimed at individuals that are currently active in the South African corporate environment, such as graduates, supervisors and managers. These individuals will be studied specifically with regard to individual behavioural elements and performance on a learning potential measure. The measurement of these individuals will take place during their testing at a recruitment / development assessment centre administered by a trained and accredited assessment professional, of which the author of this dissertation is one. The data will be collected by the use of two separate psychometric measures. The one psychometric measure will be used to determine an individual's behavioural approach, while the other measure will be employed to determine an individual's learning potential.

As the measurement of these two dimensions will be done using psychometric tests that provide numerical output, a quantitative research approach will be followed as opposed to qualitative one.

The quantitative research design that will be employed in this study is a causal design. A casual design investigates the cause and effect relationship between two or more variables, more specifically in this study the effect of preferred behavioural dimensions on the speed and accuracy with which an

individual completes a learning potential measure. This design measures the extent of relationship between the variables. The casual research design will be used in an attempt to specify the nature of functional relationship between the variables. This research design is useful to show the impact of one variable on the other; in addition, the variables which create effect on other variables can be studied in depth through casual research. The designs for casual research can be divided into three categories:

- (i) Historical
- (ii) Survey
- (iii) Experimental

The researcher will be utilising a quasi-experimental design category within causal research design framework. By definition, quasi-experiments lack random assignment. By using a quasi-experimental design the researcher will have considerable control over selecting measures and over how non-random assignment is executed, over the kinds of comparison and with which groups are compared (Shadish, Cook & Campbell, 1969). As the data could only be collected when a recruitment and selection assessment centre was purchased by a client of ACT the researcher introduced an experimental design into their data collection procedure, even though the individual lacks the full control over the scheduling of experiential stimuli, which makes a true experiment possible, collectively such a situation can be regarded as quasi – experimental designs (Campell & Stanely, 1963). The researcher is aware that in quasi-experiments, the cause is manipulable and occurs before the effect is measured. However, quasi-experimental design features usually create less compelling support for counterfactual inferences.

By using a quasi-experimental design it is possible that the control groups may differ in many systematic (non-random) ways other than the presence or absence of a specific behavioural dimension. Many of these factors could be alternative explanations for the observed effect, and so researchers have to eliminate them in order to get a more valid estimate of the relationship (Shadish, Cook & Campbell, 1969). Shadish, Cook & Campbell, (1969)

support the use of a quasi-experimental design to study a descriptive causal question, indicating that they offer excellent cause estimates.

Learning potential, speed and accuracy scores are seen as the dependent variables, while an individual's behavioural dimension is the independent variable. It is also noted that there are confounding variables that may have a significant effect on the dependent variable that cannot easily be controlled or eliminated. The study will try to identify and control for these variables in the statistical analysis of the data.

It is noted at the commencement of this study that the quasi-experimental research design does have shortfalls, as it cannot avoid all the alternative explanations that threaten internal validity. Instead, logical analysis replaces random assignment (Dane, 1990).

Therefore, as the behavioural dimension of an individual as well as their learning potential cannot be controlled, true experimental research is not possible. This research design will, however, allow the study to test the research hypotheses with approximations of experimental research (Cook and Campbell, 1979).

1.6.2.2 The Choice of a Study Sample

The study sample consists of 398 individuals, currently active in the South African corporate environment. The sample is drawn from graduates, supervisors and managers in the corporate environment that were assessed by ACT as part of either a recruitment or selection assessment centre. The sample was obtained by making use of targeted sampling. Therefore, not all individuals in the population had an equal chance to be selected to partake in the study. As the South African corporate environment consists of a high number of individuals, it is practically impossible to provide each of them the equal opportunity to be selected to partake in this study due to the following reasons:

- a) Time constraints of the study.
- b) The monetary investment that would have to be made.
- c) Testing only allowed to be conducted by accredited assessment practitioners, (of which the researcher was one at the time of data collection, due to employment at ACT).
- d) Limited accessibility to the corporate population of South Africa.

Therefore, the study will aim to understand the hypothesised relationship in the context of the South African corporate environment. The population for the purposes of this study will thus be defined as graduates, supervisors and managers working in the corporate environment in South Africa. The data was collected at Assessment Centre Technologies during their standard assessment centres in which graduates, supervisors and managers working in the corporate environment within South Africa completed both a behaviour and fluid intelligence measure.

1.6.2.3 The Choice of Measuring Instruments

For the purpose of this research study, two measures will be utilised. The first measure will be employed in order to determine an individual's behaviour patterns, while the second measure will allow for the assessment of an individual's learning potential.

When making an allowance for which measuring instruments to use for the purpose of this study, the following were considered:

- a) Registration of the measuring instruments with the Health Professionals Council of South Africa (HPCSA).
- b) The instrument must measure the dimension to be explored in this research study.
- c) The instrument must be suitable to administer to graduates, supervisors and managers working in the corporate environment in South Africa.
- d) The instrument should have South African norms.

- e) It must be possible to administer the instrument in a group assessment setting.
- f) The instrument must be valid and reliable.
- g) The researcher must have access the instrument.
- h) The researcher should be trained in the administration, scoring and interpretation of the instrument to be used, to allow for the gathering of the required data.

Using the criteria above, the following two measures were selected; the Personal Profile Analysis (PPA) and the Test for Selection and Training (TST). The PPA is an instrument which assesses behaviour and constructs of an individual, while the TST quantifies an individual's ability to be trained and their potential to learn new information, tasks or a skill, in other words their fluid intelligence. The TST considers five dimensions of learning potential: Feature Detection, Reasoning, Number Speed and Accuracy, Working Memory and Orientation (TST Test Manual, n.d.). The PPA refers to the following four behavioural dimensions: Dominance, Influence, Compliance and Steadiness.

1.6.2.4 Statistical Analysis

The statistical analysis will aim to:

- (i) Provide descriptive statistics
This will be done by describing data to be used in the research study by reporting on the frequencies. This step will be employed to ensure that there are sufficient observations per category to allow for a meaningful distribution, thus ensuring the exclusion of categories that have insufficient observations from the analysis.
- (ii) Determine if differences exists between an individual's behavioural dimension (high or low) and their speed and accuracy score obtained on a learning potential

This will be done by utilising two statistical approaches, contingency tables and significant difference test. This will allow the researcher to determine if any patterns can be identified that could be indicative of significant differences on speed and accuracy scores between the variables measured.

(iii) Hypothesis testing:

Hypothesis testing will follow the process as prescribed by Albright, Winston & Zappe (2002). A significance level of rejection will be selected to indicate how strong the evidence in favour of the alternative hypothesis must be to reject the null hypothesis. The p -value will be used to determine how significant the sample evidence is, with a small p -value providing support for the alternative hypothesis. In addition, a t-test statistic will also be used to either refute or accept the alternative hypothesis.

SPSS, Stat Tools 5.7 and Microsoft Excel will be used to run the above mentioned analyses.

1.7 Overview of Chapters

In Chapter 2 a theoretic investigation is undertaken to explore the various factors that may have an impact on and bias psychometric testing and the results obtained. The possible relationship(s) between behaviour and performance on a fluid intelligence or learning potential measure will be explored and commented on.

Chapter 3 documents the design and methodology followed in this research project, considering the key concepts, relating issues of measurement, sampling design and methods as well as data collection and data capturing and analysis.

Chapter 4 documents the statistical results of the research project delineating sample profiles, the presentation of results, a discussion of the hypothesis and interpretations.

Chapter 5 is the concluding chapter that summarises and discusses the salient points as well discussing gaps in the data. The chapter also recommends future research in light of the current findings.

CHAPTER 2: LITERATURE REVIEW

As stated previously in Chapter 1, paragraphs 1.3.1, 1.4.2, 1.6 and 1.7, the literature review will focus on a variety of aspects. The literature reviewed will be used to provide the reader with an overview of the possible biasing factors on three basic levels:

- (i) The test itself, to indicate what factors could potentially act as bias when an individual completes a psychometric measure.
- (ii) The setting and administration procedure, to allow the reader to understand how the setting and administration procedure could possibly act as bias.
- (iii) Characteristics of the test taker. This aspect will be unpacked in greater detail; to unpack any relationship documented between behaviour that individuals exhibit and their performance on psychometric measures. In addition, the literature will aim to document the types of behavioural approaches and their impact on how an individual completes a psychometric measure.

Therefore, at the close of the literature review the reader should have a clear understanding of bias, behavioural dimensions, individual test performance, learning potential and how the researcher operationalises in greater detail.

The question of bias in psychological tests arose mainly as a result of the nature of psychological processes and the measurement of such processes. Psychological processes are not directly observable or measurable and consequently have to be deduced on the basis of behaviour. In the field of psychology there is consensus on very few of these deductions or hypothetical constructs (Winn, 2002). It is against this broad background that the criticism, including that of bias is levelled against psychometric tests, should be seen, especially with regard to those aimed at measuring intelligence and aptitude. Therefore, the researcher is of the opinion that an individual's behavioural dimensions can act as a biasing factor with

reference to an individual's test performance on a learning potential measure. The reliability of test scores can therefore be compromised by a random measurement error (unsystematic error), and the validity of test score interpretations can be compromised by response biases that systematically obscure the psychological differences among respondents.

Standardised achievement testing regularly shows large gaps between the scores of different groups – Caucasian vs. students of colour, middle class vs. low income, etc. Those who would study this gap are confronted with a paradox. Are the gaps the result of true differences in achievement or are they the result of bias in the measurement instruments themselves? Each of these explanations appear to preclude the other (Schellenberg, 2004). From literature, it is evident that there are various factors that could potentially have an impact on psychometric test results that an individual obtains; these include elements such as age, cultural background, physical impairment, language and behavioural dimensions. Most of these elements are easy to define and measure, such as age and language spoken by a test taker. However behavioural dimensions, a direct result of an individual's personality (Ryckman, 2004), is a more complex and diverse element to define and measure. The definition of personality that is most widely supported to date is attributed to the neurologist Paul Roe. He found personality to be an individual's predisposition to think certain patterns of thought and therefore engage in certain patterns of behaviour. It is these resulting behavioural dimensions that will be the focus of this study.

The Society of Psychology of Ireland have highlighted the importance of considering test bias and the impact that it can have on test results in a document relating to psychological testing, in association with the International Test Commission, in 2006. The document indicated that the use of psychometrics is increasingly coming under scrutiny and the issue of bias and test fairness is becoming more important as a result of local and international developments. It is thus essential to understand the issue of bias to ensure that individuals being subjected to psychometric testing are treated fairly. A rights issue is also emerging along with the possibility of

litigation issues for those exposed to tests and for test users (International Test Commission, 2001).

2.1 Factors That May Cause Bias in Psychological Measurements:

The study focuses on the relationships between behavioural dimensions and an individual's performance on a learning potential measure. The envisioned impact that an individual's behavioural dimensions have on how they complete a learning potential measure could act as a biasing factor and ultimately how they perform on such a measure.

For the purpose of this study, individual performance will be defined as the score that an individual obtains on a learning potential measure. This, in terms of the number of questions that the test taker answered correctly, i.e. their accuracy, as well as the number of questions they answered correctly in the designated time, i.e. their speed. Both the speed and accuracy scores of the individual is used to calculate their learning potential score.

Bias is an extensive construct and is found in an array of areas from media to electronics. However, for the purpose of this study, bias will be focused on in the context of psychometrics. Research on test bias has developed along two broad lines – psychometric and socio-cultural- receiving its highest exposure during the 1970's and early 1980's (cf. Berk, 1982; Jensen, 1980; Reynolds and Brown, 1984). Test publishers in turn incorporated controls for bias into their test development procedures as a matter of course, so that the most obvious biases are no longer evident. To a large degree, the subject of test bias has died down and is not at the forefront of discussions and research.

From the beginning of modern psychological testing, researchers have found differential results. In the work of Binet and the early development of the Army Alpha, group differences were noted and even assumed (Matarazzo,

1972). Eels et al. (1951) summarise the three general explanations that were common at the time:

- (i) Subjects scoring well on tests are genuinely superior in inherited genetic equipment.
- (ii) Large-scale group differences are probably the result of a faulty test, in other words the test itself.
- (iii) High scores are generally the product of a superior environment and low scores the product of a poor one. In other words, the setting and administration.

This literature review will not discuss the first of these explanations, though this does not imply that it is not worthy of investigation. Rather, it can be attributed to evading a discussion that will lead down a very emotionally loaded and non-productive side-track (witness the reactions evoked by Jensen, 1980 and Herrnstein and Murray, 1994). The last two of the above explanations, however, are capsule summaries of the arguments that have led to most of the research in this field. The research itself falls into two general categories – psychometric and socio-cultural. Psychometric approaches concentrate on examining the testing instrument and students' responses to it. Socio-cultural approaches look at performance on the test as part of the overall context in which a student lives and learns. Rather than being discordant viewpoints, as they are sometimes portrayed, these two approaches are complementary. Neither offers a complete picture, but both offer pieces to the question surrounding bias.

Companies that develop and distribute tests will be able to defend their respective tests by sharing in considerable detail the steps, both subjective and statistical, that have been taken to seek out and destroy biased items. Subjective techniques usually involve panels of experts from diverse backgrounds examining items to detect potential bias. Most, if not all, of the statistical approaches share a common conceptual base. Higher or lower scores by a group on a given item are not sufficient evidence to identify a

biased item. It may be that the underlying ability is actually different among the groups. Therefore, the group's performance on the item must be either better or worse than the group's performance on the test as a whole for the item to be eliminated. This extensive focus on item characteristics has led to fundamental changes in the appearance of standardised achievement tests.

The context of the test bias discussion has changed considerably since the 60's and early 70's. At that time, the issue was almost completely entwined with desegregation concerns. This discussion became relevant in South Africa after the fall of Apartheid. Several other issues have broadened the discussion in recent years. Court decisions regarding psychological testing for special education are having an influence on the uses of achievement tests as well, dictating a great deal more caution in applying test results beyond their intended uses. Test developers have responded to these concerns with untimed tests and sometimes with translated tests, each of which present new psychometric issues in their standardisation. Bias in the field of psychometrics is currently grouped in three main categories, namely construct bias, item bias and method bias.

Construct bias occurs when the construct (e.g. personality) that is measured by the test displays significant differences between the original culture for which it was developed and the new culture where it is going to be utilised. These differences can occur in the way that the construct was formulated and developed as well as in the relevant behaviours that are associated with the construct. It is critical to examine whether the underlying theory of the test is subject to construct bias and this can be examined through the studies examining the construct and its associated behaviours in the context that it will be utilised in. If there are significant differences found in these studies, it may be indicative that there is a construct bias. Major revisions may be required to overcome this bias. If not, the validity of the test will be affected.

Item bias is another source of bias that can occur in the translation of tests and these refer to biases that occur with the items in the test. This is usually

the result of either poor translation choices for items or due to culturally inappropriate translations. In this manner, a literal translation of a phrase would be a poor translation as it does not convey the correct meaning of the item. The items in the test need to be culturally equivalent, where the meaning of the items needs to be correctly translated so as to maintain the validity of the test in the new cultural context.

Method bias refers to factors or issues related to the administration of the test that may affect the validity of the test. Examples of areas where method bias can occur include social desirability, acquiescence response styles, the conditions in which the test was conducted and the motivation of the respondents. Across cultures, there are potential differences that can occur in these areas and these can affect the way that the respondents answer the items in the test. This can potentially lead to differences that are erroneously attributed to cultural differences when, in fact, this is the result of differences in the administration procedure. Test developers not only need to focus on the adaptation of the test itself but also need to be aware of issues regarding the implementation of the test in a new context (Van der Vijer & Hambleton, 1996). It is thought that an individual's behavioural dimensions may act as a form of method bias when individuals with varying behavioural dimensions complete a learning potential measure. Therefore, for the purpose of this study, we emphasise that the operational nature of the test score bias in both of its forms is a theoretical concept; in part, because both types of bias depend on the theoretical notion of a true score. There is no one way to detect test score bias any more than there is one way to calculate directly such psychometric test score properties as reliability or validity. An overarching issue in the definition and detection of test bias is that the existence of a group difference in test scores does not necessarily mean that test scores are biased. Suppose you find that females have higher scores on self-esteem than males. This difference is not *prima facie* evidence that the test is biased (Jensen, 1980; 1998; Thorndike, 1971). The participants' test scores might in fact be good estimates of their true self-esteem. In such a case, the test is not biased, and the group difference in test scores reflects a real difference in average self-esteem.

It is propagated that any psychometric test that is administered, irrespective of the test type or the test administrator, must in all situations take into consideration issues of bias that may impact on the results in any manner. Fairness in testing is especially critical if the test is being used with individuals from different groups, such as groups differing in terms of gender, cultural background, education, ethnic origin or age.

2.1.1 The Test Itself

The psychometric test or measure itself can very often impact on the results obtained by individuals on whom the test is administered. Johnson et al. (1997), found that test format affects the type of processing subjects engage in. This can be due to the structure, medium and timescales of the test as all of these were found to have an impact on the results that are obtained on a psychometric test.

The test itself may also age, more so if it is 'semantically laden'. In addition, the history of tests and use of psychometric measuring devices, instruments, methods and techniques in South Africa has been tainted by the legacy of segregation which influenced certain stereotypical attitudes and culturally insensitive and inappropriate interventions. As a result, few tests are available that have been developed and applied with the necessary appreciation of cultural and other diversity concerns with a view of standardising it for all South Africans. (Health Professionals Council of South Africa, 2006).

Another aspect that may act as a biasing factor with regard to the test itself is the variations in the degree to which the situation provides opportunity for the accuracy of interpretations to be checked in the light of subsequent information and amended if needed (International Test Commission, 2001).

2.1.2 The Setting and Administration Procedure

The setting, administration and administrator of the psychometric test also play a pivotal role in the results that are obtained on such a measure. This can be due to the type of pre-test information shared with the test taker, as this may have an impact on the results obtained on the specific measure. It can also hold true with regard to the type of test instructions that are given.

2.1.2.1 The Setting:

The setting can allow for results that are not a true reflection of the individual's actual ability. This could be due to the environment not being conducive to testing. Unfair testing conditions may act as a bias due to light, heat, humidity, noise, distractions or even the test administrator themselves. The time at which the test is administered could also impact on the results obtained, as it can affect stress levels, ability to complete the test and alertness, depending on the time of day (Groth-Mamat, 2009).

Other aspects such as the social, political, institutional, linguistic and cultural differences in and between assessment settings may also have an impact on results, thus acting as a potential bias. In addition, the purpose of the test and the test setting, such as it being administered in an educational or work related setting, may also have an impact on the results obtained as these add to the stress experienced by the test taker.

It has also been found that there are differences relating to individual versus group assessment and that these different settings also impact on the results obtained on a psychometric measure. Sarason (1975) found that anxiety may affect performance on ability tests only when they are administered in competitive settings, whereas under neutral conditions the differences between apprehensive and non-apprehensive individuals would be trivial. Evidence of this was also found by Markham and Darke (1991). They found that a high level of anxiety repressed verbal reasoning; however, this was only apparent under very demanding test settings.

In addition to the setting in which the test is administered, the form in which the test is administered may also impact negatively on the test results obtained, for example paper based versus computer based tests. The use of different administration mediums highlights the concern of the comparability of computer administrated and pen-and-pencil tests, especially when scores obtained on the two testing modes may be used interchangeably.

Another concern is with regard to the rapidly proliferating computerised interpretations of test results, which range from fairly objective statistical analyses to extensive narrative interpretations involving clinical judgement. Of special interest amongst psychologists is the growing role of computers in the construction, administration, scoring, as well as interpretation of tests. There are numerous guidelines currently in development to assist in dealing with such issues in an attempt to prevent this bias from impacting on results (Anastasi, 1976). However, all aspects of these phenomena must first be fully understood before successful guidelines can be implemented to prevent any bias from impacting on test results.

Another form of bias that can be attributed to the setting in which the test is administered, in addition to how the test is administered, is that of professional psychological societies that govern that country. There are numerous guidelines set out by a country's professional psychological society and other relevant professional bodies over and above the various legalities. This impacts on how the test is administered and can thus impact on the results received by the test taker on a specific measure, especially if the measure is a test that is used internationally (International Test Commission, 2006).

In the United States of America, psychologists are bound by the Ethical Principles for Psychologists that is published by the American Psychological Association (APA) (Anastasi, 1976), while in South Africa there are policies that classify psychometric measuring devices, instruments, methods and techniques. These are predominately enforced by the Health Professionals Council of South Africa (HPCSA). There are also legal obligations as

outlined in various acts that infer how psychometric testing should be approached such as the Employment Equity Act 55 of 1998.

According to the Employment Equity Act, psychometric testing and other similar assessments of an employee are prohibited unless the test or assessment that is being used:

- a) has been scientifically shown to be valid and reliable;
- b) can be applied fairly to all employees; and
- c) is not biased against any employee or group.

2.1.2.2 The Administrator:

The role of the test administrator is also crucial with regard to the results obtained by a test taker. They are responsible for ensuring that the test taker is subjected to fair testing. Therefore it is critical for the test administrator to ensure that the tests are unbiased and appropriate for the group that they are testing and that the constructs that are being assessed are meaningful in each group represented. The test administrator must also ensure that if evidence is available on possible group differences in performance on the test, that the effects of group differences not relevant to the main purpose (e.g. differences in motivation to answer or reading ability) are minimised (International Test Commission, 2006).

If the test administrator does not have the expected level of knowledge, understanding and skill to administer the test correctly and in a fair manner, the competence of the administrator could impact on the results that an individual obtains on a psychometric test (International Test Commission, 2006). It is thus conceivable that the test setting, administration, as well as the actions that follow due to an individual's test results will have an impact on the respondent (Strelau, Zawadzki, and Piotrowske, 2001).

The onus is thus on administrator to not only be familiar with the broad domain of psychometric theory and research regarding the use of these tests

and test results, but to also be familiar with and contribute to specific empirical studies related to the psychometric properties of the tests they use.

2.1.3 The Characteristics of the Test Taker

Just as the actual test, the test setting, administration process and test administrator can have an impact on the results obtained, so the characteristics of the actual test taker can bias the results either positively or negatively.

Characteristics of the test taker that have been documented as impacting on test results obtained by such an individual are numerous and range from experience, confidence, emotions, motivation, memory and culture to attitude. Piper (1979) indicated that results of a test may also be affected by the test takers attitude towards testing; they can either find it enjoyable or threatening. The test takers that find the experience threatening may become more agitated and more incorrect answers may occur as a result. As such, they may even refuse to complete the test at all.

Other aspects of the test taker that may have an impact on the results that they obtain on a psychometric test include their ability to maintain concentration, also known as the Hawthorne effect. In addition, other elements such as panic and carelessness when completing a test, as well as failure to focus on questions, excessive anxiety, cramming, faulty diet, lack of proper exercise, lack of motivation toward success on tests, lack of sleep and poor attitude toward taking the test may also have an impact on the test results.

As the test taker is a complex and multi-faceted individual, when considering the bias based on personal characteristics they will be grouped into the following broad categories: biological, intrapsychic, social, cognitive styles and behaviour dimensions.

These categories are defined as follows:

- (i) Biological factors such as age, gender and physical impairment.
- (ii) Intrapsychic factors including transient conditions and psychopathology.
- (iii) Social context such as culture, socio-economic status and language.
- (iv) Cognitive styles.
- (v) Behavioural styles including elements such as shyness, type A versus type B personality, extroversion and introversion and so forth.

In the subsequent section of this chapter these categories will be unpacked and explored in more detail.

2.1.3.1 Bias as a Result of Biological Factors:

Psychologists and researchers alike have extensively explored aspects that could have an influence on performance of psychological measurements. Such studies included extensive research work conducted with the aim of determining the influence variables, such as gender and age, in the individuals' response styles.

2.1.3.1.1 Age:

One of the most obvious factors affecting individual test performance is that of chronological age. Age can affect intelligence and thus performance on psychometric testing. This is why measures are developed for certain age groups based on the skills, interests and characteristics of that particular age group. As an individual ages the content and difficulty of measurements increases and changes. One such example is that of an intelligence measure, which is a standardised measurement of intellectual ability with norms for different age groups (Foxcroft & Roodt, 2001).

The age of a test taker can therefore bias the results that they obtain on a psychometric measure, especially if the correct norms are not applied. This bias is evident with regard to Intelligence Quotient (IQ) and its associated tests. IQ tests have also been widely studied in the context of adult development and aging. Both cross-sectional and longitudinal studies have found age-related declines in cognitive functions presumed to be associated with fluid intelligence, thus if a test taker is elderly they may receive lower scores on a IQ measure due to the decline in their cognitive function. (Bors & Forrin, 1995; Horn & Cattell, 1967; Kail & Salthouse, 1994).

Studies have found that the ratio between mental age and chronological age is fairly constant up to a certain age and consequently IQ scores also remain fairly constant. Mental age starts levelling off after the age of sixteen and it is generally found that performance on intelligence tests shows no further noticeable improvement. Adults' scores may vary a little as a result of life experience and subsequent accumulated knowledge, but ability remains almost the same. Scores on intelligence measurements therefore stabilise during early adulthood and then start abating after the age of approximately fifty five, as older individuals react more slowly and are less able to cope with new situations. It is important to note that an IQ score in no way fully expresses a person's intelligence. The score is an indication of performance on a sample of tasks used to assess aspects of intellectual ability in a particular assessment situation. There are many non-intellectual (non-cognitive) factors that influence performance on a psychological measurement (Foxcroft & Roodt, 2001).

In addition to the decline on IQ tests with age, a decline in the speed of information processing in higher cognitive abilities, such as memory functions and fluid intelligence has also commonly been linked to age differences. Rabbitt (1990) contended that psychometric intelligence accounts for all of the slowing of information-processing rates associated with normal aging. To the contrary Salthouse (1985) postulated that a reduction in speed of information processing is primarily responsible for age related differences and declines in cognitive activities. He suggested that

once information-processing speed has been accounted for, the correlation between age and IQ should vanish.

This correlation that has been observed between information processing ability and age can therefore be considered as a bias as some psychometric tests use the time it takes a test taker to respond as a part of the score. The speed-accuracy decomposition (SAD) is a technique used for studying the time course of information processing speed; it uses information from both the temporal distributions and the accuracies of the participants' responses to derive an estimate of the amount of partial information available to participants at specific points in processing. Thus the two most commonly used measures of mental functioning are response time (RT) and accuracy of response (Smith, Kounios & Osterhout, 1997).

Over the past 2 decades, researchers have reported small to moderate negative correlations between reaction time (RT) on elementary information-processing tasks and measures of psychometric intelligence (IQ) as age increases (Vernon, 1987). Reaction time (RT) has also been found to strongly associate with age with a similar pattern of age-related changes across the lifespan for RT (Deary and Der, 2005). Similar findings were reported by Rammsayer and Troche (2009), as well as by Versavel, Laack, Everetz, Meier and Kuhlmann (1996) who confirmed that older subjects performed worse in the reasoning tests they had administered and had a longer working time in the memory tests than their younger counterparts. Therefore, consistently across studies characteristically, older adults are slower than their younger counterparts on simple RT tasks (Borkan and Norris, 1980; Salthouse, 1985), and the same is true of performance on choice RT tasks (Strayer et al., 1987). Consequently it is evident that the chronological age of a test taker can act as a biasing factor when they are taking a test.

In addition to the effect that age has on information processing speed, it has also been found to have an effect on the broad abilities of Crystallised Intelligence (Gc) and Fluid Intelligence (Gf). Cross-sectional studies have found an age-related decline in general fluid intelligence from early

adulthood to senescence. Longitudinal studies estimate that there is about a 10% decrease for measures of crystallised abilities to 20% for fluid abilities and 30% for working memory, indicating that age has a direct impact on the score obtained on psychometric measures (Baltes, Staudinger, and Lindenberger, 1999). Although Borris and Forrin's (1995) findings validated that the performance on a Gf measure showed a decline, they were of the opinion that this decline occurred from the age of 30 years. The degree of decline varied from study to study, ranging from three to seven IQ points per decade of age with the median estimate between four and five IQ points for cross-sectional studies and somewhat less for longitudinal studies (Brody, 1992). Borris and Forrin (1995) were also of the opinion that performance on measurements of Gc will remain relatively stable or even increase during adulthood. Salthouse, (1996) and Ghisletta and Lindenberger (2003) validated Borris and Forrin's findings by using the processing speed theory which points to a stronger relationship between processing speed and measures of fluid ability and working memory than with measures of crystallised ability.

Thus, information-processing tasks and recall scores have been found to be reliable and consistently correlated with age. While a large portion of the age-related differences in fluid intelligence was found to be accounted for by age-related declines in a general latency factor (cognitive speed).

It can thus be concluded that older subjects respond more slowly and this creates problems with psychometric testing (Piper, 1997). Three general conclusions about the genetic and environmental influences on the relationship between processing speed and cognitive aging can be drawn. First, a significant proportion of the genetic influences on cognitive ability in the second half of the lifespan arise from genetic factors affecting processing speed. Second, this effect is amplified in late adulthood, such that an increasing proportion of genetic variance for cognitive ability can be attributed to genetic influences on processing speed. Third, it is not the linear age changes but the accelerating age changes in cognitive performance that share genetic variance with processing speed, at least for

fluid abilities. Therefore it can be stipulated with certainty that psychometric test scores are affected by age (Heaton et al, 1991).

2.1.3.1.2 Gender:

Bachman and O'Malley (1984), Watkins and Cheung (1995) and Clarke (2000, 2001) found that gender generally is not associated with response styles or, ultimately, psychometric results. On the contrary, they found that there are significant cultural differences at play. In contrast to these findings, Rosenman (1977) found men and women have statistically significant differences in average scores on tests of particular abilities. Furthermore, Rosenman (1997) illustrated consistently that there is a greater variance in the performance of men compared to that of women (i.e. men are more represented at the extremes of performance). Thus Rosenman (1997) concluded that there was a marked difference between the results obtained by the two gender groups.

Ozer (1987) also alluded to the fact that gender differences are evident with regard to scores obtained on psychometric tests. He conducted a longitudinal study of cognitive and personality development and examined the various correlations of spatial visualisation ability as per the Vandenberg's Mental Rotations Test and measured personality as per the California Q tests. He found that there were gender differences, more specifically with regard to spatial visualization ability, in females. This factor was correlated with verbal IQ and various aspects of personality (vivaciousness, responsiveness to the social world, willingness to face rather than avoid problems and sociability) while these correlations were absent in males.

2.1.3.1.3 Physical Impairment:

According to Foxcroft and Roodt (2001) there is a wide variety of physical conditions that can affect individual test performance. This may include factors such as hearing impairment, serious illnesses, previous head trauma and neurological impairment. Aspects such as speech impairment also have an impact on individual test performance, when the assessment practitioner cannot understand the verbal responses of a speech impaired test taker; lower scores may be awarded than would have been the case if the responses were understood. Patients with motor impairments may be penalised by timed tests and a proper indication of their ability can only be obtained by using an alternative measure or by adapting standard measures. Any condition that affects motor performance can affect performance, especially when speed is an important factor in a test such as a power test (Piper, 1997).

In addition to permanent disabilities, there are also transient physical conditions that can depress scores, this includes aspects such as chronic pain and disturbed sleep (Lindsley, 1994). Medication can also have an effect on individual test performance of an individual, such as excessive intake of painkillers which can affect the performance on psychological measures negatively (Garrido, Celenzene and Levy, 1994). Piper (1997) agrees with this sentiment and states that any incurrent illness, especially depression, can also have an effect on the performance of an individual.

2.1.3.2 Bias as a Result of Intrapsychic Factors:

Intrapsychic factors that have been found to affect individuals' test performance refer to aspects such as an individual's experiences and feelings about him- or herself. However, it is difficult to separate the biological and intrapsychic factors because the individual's experiences, interpretations, feelings and personality depend on biologically based

processes such as perception, cognition, emotion and motivation (Foxcroft and Roodt, 2001).

2.1.3.2.1 Transient Conditions:

Transient conditions are described as everyday events that unexpectedly crop up and upset an individual to the extent that they do not function in the manner in which they normally would and therefore cannot perform as well as they normally would, if they undertook a psychological measurement. The resulting stress and anxiety from an unexpected transient event in any form can interfere with normal functioning, such as an individual's ability to think clearly, to concentrate, and to act on plans and intentions, especially when the assessment is psychological in nature. An example of such a condition may include bereavement or excessive concern about a sick family member as these may significantly impair functioning and thus have a negative impact on the individual's test results (Beckham, Crawford and Feldman, 1998).

2.1.3.2.2 Psychopathology:

Psychopathological conditions have also been found to impair an individual's test performance (Boone, 1993). These would include disorders like anxiety and depression which have a negative effect on an individual's test performance and ultimately on the score obtained.

2.1.3.3 Bias as a Result of Social Context

2.1.3.3.1 Culture:

There is also a growing recognition of the impact factors such as ethnic and socioeconomic diversity that can also in play with regard to cognitive and psychological function (Lowenstein et al, 1993; Geisinger, 1994). Since the earliest measurement of human abilities, it has been evident that the psychological tests used and the results testees obtained could be linked to culture. A testee's culture has an influence on the way they think, learn and behave.

There is a school of thought that postulated the belief that behaviour is shaped by prescriptions of the relevant culture, its values and guiding ideals. It is accepted that cultural experience influences the meaning of events for an individual and, therefore, responses will differ among cultures (Foxcroft, 2002).

The impact of culture on psychometric measures becomes even more controversial with projective measures such as the Thematic Apperception Test that rests on the assumption that the stories an individual tells, based on the pictorial stimulus material, will reveal something of the person's personality disposition (Foxcroft and Roodt, 2001).

Although the influence of culture is in many respects subtle and difficult to observe directly, it can nevertheless be a significant source of bias in tests, affecting the results obtained, especially in communities with divergent cultural backgrounds (Ghuman, 1980). In order to limit the effect that culture may exert on the results obtained in a psychometric measure, Catell (1940) proposed "culture-free" tests. The Binet and Simons intelligence test was identified as an intelligence test that is culturally bias, in that it was observed that children from the prevailing cultural groups on average obtained higher scores than children from marginalised and minority cultural groups (Owen and Taljaard, 1996). The movement of culture free tests came into full force in the United States of America from the 1960's onwards.

Another consideration with regard to how culture can act as test bias is that the content of any measure will reflect the culture of entities who designed the measure. Clearly, people who do not share the culture of the test

developers will be at a disadvantage when taking that particular measure. This is especially relevant to the South African context as a large portion of the tests used currently are of European or American origin.

Cultural bias has become critically important as, until recently, in most cases separate tests had been constructed for the different ethnic groups and there had been no particular need for cross cultural comparison. However, in the light of the changing political and employment conditions in South Africa, situations such as competition between the different cultural groups has arisen that can no longer be handled using separate tests. In addition to the different cultures in South Africa, there is also the problem on variations of acculturation, as it occurs at different speeds and may not be the same for all facets of an individual's behaviour (Owen and Taljaard, 1996).

Such multicultural considerations are particularly important among minority cultures who may be tested using psychometric tests that have not been standardised for their specific culture, as unrecognised language and cultural biases can lead to unreliable and invalid results (Gurland et al, 1992).

Cultural bias may become even more critical and key as it is expected that by the year 2030, one quarter of the older adults in the US will be part of an ethnic minority (American Psychological Association, 1997). Thus it will become increasingly important to have additional information on the use and interpretation of psychological tests with culturally diverse groups, as much concern centres on the lowering of test scores by cultural conditions that may have affected the development of aptitudes, interests, motivation, attitudes and other psychological characteristics of minority group members. Thus, differences in the cultural backgrounds of individuals are inevitably manifested in test performance. Every psychological test measures a behaviour sample. In so far as culture affects behaviour, its influence will and should be detected by tests (Anastasi, 1976).

2.1.3.3.2 Socio-Economic Status (SES)

As with other factors that may act as a bias, the role that socio-economic factors play in the results that people obtain on a psychometric measures has become increasingly important in psychometrics. Socio-economic status (SES) refers to the broader indices of a person or family's social standing. The major indicators of SES are education, occupation and income (Foxcroft and Roodt, 2001).

Differences and lower scores are often seen for individuals in a lower socio-economic class. This is often related to factors such as poverty, poor health, malnutrition, inadequate school facilities, lack of books, resources and all other apparatus of modern civilisation that contribute to moulding the thinking of a higher socio-economic society.

Individuals from less affluent areas and upbringing often perform poorly on psychological tests because the tasks are strange to them and they regard them as unimportant. Widgor and Garner (1982) found that the extent of differences in achievement between low and high SES groups in the USA is noteworthy. The test achievement of individuals that fall in the highest 20% of the socio-economic distribution, lies approximately in the 65th percentile in respect to the general population, while the average score of those individuals of the bottom 20% of the socio-economic distribution, lies approximately in the 35th percentile, thus pointing to the impact of SES on test performance.

The impact of SES on test performance is further explained by Owen and Taljaard (1996). They found that the SES of an individual has an effect on test performance as a result of their perception of the type of item, their typical response pattern to the item, familiarity with the type of material from which the item originates and the motivation to do well.

2.1.3.3.3 Language:

According to Nell (1994), language is generally regarded as the most important single moderator of performance on an assessment measure as

performance could be a product of language difficulties and not ability factors if a measure is administered in another language than the test taker's home language.

Furthermore, Oakland (1977) points out that the language used in a psychometric test should be of such a nature that every testee can understand what is expected of them in the test situation and respond freely and comfortably. If this is not the case it can have an impact on the results obtained by the testee on that specific measure.

The translation of a psychometric measure also gives rise to numerous problems in respect of concepts that are to be measured, cultural interpretations and connotations. Merely translating a test into non-standard dialects apparently also does not provide a solution, as it leads to only a slight improvement in the achievement on such a translated measure (Oakland 1977). In the case of a bilingual testee, where the language of the test is not the dominant language of the testee, a test, e.g. for intelligence, can sometimes also measure abilities it is not meant to, such as language skills.

Thus it is evident that when administering a psychometric measure to a testee, the language of the test can have a material effect on the achievement and results in the test. In South Africa this is an area for concern as fair testing practices entail administering tests in the language in which the test-taker is sufficiently competent, with eleven official languages and tests predominately only available in English. In addition, at present there are not sufficient psychologists, psychometrists, and psychotechnicians in South Africa who are fluent in the various African languages (Health Professionals Council of South Africa, 2006).

2.1.3.4 Bias as a Result of Cognitive Styles:

Allinson, et al. (1977) postulated that the typical cognitive style of individuals can contribute to differences in test achievement and therefore

result in test bias. An individual's cognitive style is also referred to as an individual's "thinking style". This term is used in cognitive psychology to describe the way individuals think, perceive and remember information. Cognitive style differs from cognitive ability (or level), the latter being measured by aptitude tests or so-called intelligence tests.

While, Witkin et al (1977) considered the possible bias of cognitive styles on test results by classifying individuals into two categories, either field dependence or field independence. Field dependence refers to the tendency of an individual to organise their experiences in an analytical or global way, while a field independent person can focus on a particular stimulus in the midst of a number of alluring but irrelevant stimuli. This way of thinking is more than an approach, and it represents a general analytical orientation and thus cognitive style. They found that a field independent person can overcome or reconstruct the organisation or structure of a given field while a field dependent person accepts the structure as it is and finds it difficult to distinguish parts of the field within the global context, thus they may experience a limitation in respect to differentiation.

Witkin et al (1977) thus concluded that an implication of varying cognitive styles on test performance is that each different cognitive style can influence the test results in a variety of different ways, depending on the type of test used and the type of thinking task that must be carried out.

Friedman and Cook (1995) also explored the possible relationship that exists between cognitive styles and test performance by assessing the importance of a test takers cognitive style in relation to their answer process. Friedman and Cook conducted two independent studies using undergraduates ($n = 125$ and $n = 84$). For the first study they considered field dependence/field independence, as well as a measure of impulsivity/reflectivity, and in addition used a test that consisted of multiple-choice items, these elements were all considered as variables in the study.

For the second study they created variables by gathering two answer-changing scores for each subject using the scan-able forms from a test. The two scores were calculated as follows: the first score reflected the effect of

answer changes and the other representing the number of changes. Canonical correlation analysis was used to describe the relationship between the two sets of variables. In the end they found that the structure coefficients indicated that the cognitive-style variables had little impact on the canonical solution and that a combination of the effect of answer changes, the number of changes, and unit examination scores were the most influential components of the first canonical variants (Friedman and Cook, 1995).

2.1.3.5 Bias as a Result of the Behavioural Dimensions:

Before exploring bias as a result of various behavioural dimensions, it is key to operationalise behavioural dimensions as understood in the context of this study. As discussed in paragraph 1.3.1, the study will not try to define the relationship between personality and behaviour. For the purpose of this study, it is assumed that personality constructs and other factors (mental ability, current values and motivations, the current environment, experience and exposure) work together and independently of one another to predict behaviour, i.e. personality plays an important role in determining behaviours (Bogg, Voss, Wood & Roberts, 2007). Behavioural dimensions are measurable descriptive characteristics (parameters) that qualify particular aspects of an individual's performance. The author uses the term behavioural dimensions in the same sense Charles Morris did when he said: "This term is presupposed by semiotic and not defined within it. Roughly speaking, behavioural dimensions consist of sequences of responses by which an organism seeks goal – objects that satisfy its needs. Behaviour is therefore 'purposive' and is distinguished from responses as such and from even wider class of reactions. Behaviour is individual or social, and when social it may be cooperative, competitive or symbiotic". The focus of this study is however on individual behavioural dimensions, these are behaviours that can be observed and measured. Individual behavioural dimensions can thus be operationally defined by looking at the following elements:

- (i) Frequency or rate of behaviour, i.e. how often and how many.
- (ii) Topography, i.e. what does it look like.
- (iii) Locus, i.e. where and when does it happen.
- (iv) Duration.
- (v) Latency.
- (vi) Force of intensity.

Behavioural dimensions are approached in a variety of ways by different models of behaviour. One such model is the Biophysical Model, which postulates that behaviour is the result of chemical and genetic conditions. The model puts forward the following assumptions:

- (i) Physiology determines how the individual responds to the environment.
- (ii) Control of maladaptive behaviour is achieved by physiological means.

Another model is the Psychodynamic Model. This model operates on the premise that human behaviour is the result of mental states. The Psychodynamic Model therefore is of the opinion that:

- (i) Disorders are caused by pathological imbalances.
- (ii) Illness is the result of some unconscious motivation or underlying conflict.

Yet another model that aims to describe humans with regard to behavioural dimensions is the Cognitive Model. This model is built on the premise that behaviour is the result of thought processes that arise from past observations or interactions with the environment. The final behaviour model is the Learning Model. This model states that behaviour is learned by watching or interacting with the environment. The Learning Model is built on the following assumption; behaviour is a function of environment. The environment can be described by its effect on behavioural dimensions. The

effect can either be said to be one of the following: neutral stimuli (no predictable effects whether presented or withdrawn reinforcing stimuli) or aversive stimuli (associated with decrease in behaviour) or discriminative stimuli (special type of antecedent stimuli). The author is therefore of the opinion that learning model of behaviour is most appropriate and descriptive of the specific research being conducted, as the study's focus is the influence that the testing environment will have on an individual's behaviour and how they complete a psychometric measure. The test can either act as a neutral, aversive or discriminative stimuli, depending on how the individual in question interprets the test situation.

As evident from the preceding literature reviewed, a test taker's test results can be dependent on so many aspects, from biological to SES to cognitive styles. In addition to the numerous aspects identified such as cognitive factors, which are traditionally associated with achievements, it is essential to explore non-cognitive personality traits and their place in the context of ability and the testing of these abilities (Inscape, 1996).

To date there have been numerous debates with regard to an individual's performance on tests and how it may be distorted by non-ability factors confounded in the test scores (Furnham, 1992). It has been stated that psychometric test results, which are based on performance, can in no way be thought to be a "pure" measurement, as performance may also be influenced by personality (Strelau, Zawadzki and Piotrowske, 2001).

When consideration was given to the available literature, various relationships between patterns of behaviour and results obtained on a psychometric test measure became evident. This view is echoed by Meijer (1993) who is of the opinion that characteristics, such as anxiety, that are unrelated to true ability can influence test performance, and in the long term even success in the working environment.

There is longstanding empirical evidence indicating that both personality and intelligence are important predictors of performance as both have been

known to be related to learning and thus performance (Busato, Prins, Elshout, and Hamaker, 1999; Eysenck, 1981; Furnham, 1992). However, researchers are more interested in how inner motivation affects achievements and behaviour, and to a greater degree how inner motivation is related to a personality's dispositions (Saparniene, Merkys, Saparnis, 2006). Inner motivation thus affects an individual's personality disposition which in turn affects their test performance.

2.1.3.5.1. Achievement Motivation and Fear of Failure

The literature on behaviour furthermore makes numerous references to Atkinson's views in which he postulates that individuals with the same ability can manage to obtain different scores on the same measure, due to behaviour bias experienced. Atkinson goes further by suggesting that behaviour associated with achievement motivation and fear of failure also has an influence on test performance (Maehr and Sjoren, 1971). In subsequent articles, Atkinson and Feather (1974) proposed that the motive of an individual to avoid or approach a task is a function of the motive to seek success or to avoid failure, in other words behaviour and personality traits as well as the perceived difficulty of the task can have an impact on the end result obtained by such an individual. They also hypothesised that when tests are implemented that rely on speed and accuracy to obtain a composite score, individuals who display high levels of achievement motivation as well as a high level of fear of failure obtain a lower score as they try to work more accurately, compromising speed. When such individuals are subjected to a retest they work faster but make more mistakes as they demonstrated the inability to trade-off between speed and accuracy (Meijer, 1993).

2.1.3.5.2 Extroversion and Introversion

Although the dimension of behaviour studied by Robinson (1983) in relation test performance differed from Meijer, he too highlighted the relationship that exists between an individual's behaviour patterns and the end results

obtained on a psychometric measure. He focused primarily on personality factors such as those of Extraversion and Introversion, these personality factors and their associated behaviours and test performance that have been explored in great detail by numerous researchers, providing a wealth of information on the relationship between personality and test performance.

Robinson claimed that the concepts of introversion and extroversion and the logical behavioural differences of these two categories have an impact on performance on intelligence test results that an individual achieves (Robinson, 1983). The researcher acknowledges that a psychological measure is only biased when the test is developed for use in a specific group, i.e. introverts and administered to a another group, i.e. extroverts. Therefore, in certain cases it could be classified as a confounding variable and not as a factor causing bias. However, in the context of this study these behavioural dimensions may act as a form of method bias

Extraversion is characterised by positive emotions, urgency and the tendency to seek out stimulation as well as the company of others, with pronounced engagement with the external world. Characteristics associated with introverts such as the lack the exuberance, energy and activity levels, in addition to their tendency to be quiet, low-key, deliberate and less involved in the social world. However, their lack of social involvement should not be interpreted as shyness or depression. Introverts simply need less stimulation than extraverts and more time alone (Goldberg, 1990).

Robinson (1985) anticipated that introverts may perform better on tasks requiring verbal intelligence, whereas extroverts may fair better on tasks requiring performance intelligence. He thus concluded that gregarious individuals will be superior to more recluse individuals on intelligence tests measuring ability and inferior to more hesitant individuals on intelligence tests measuring verbal ability (Strough, Brebner, Nettlebeck, Cooper, Bates and Mangan, 1996). However, Robinson's (1985) initial research did not show to the dominance of extrovert performance in psychometric testing. He was one of the few researchers who did not follow an atheoretical approach

to exploring personality variables associated with different cognitive styles and intelligence; he employed a theoretical basis derived from a neo-Pavlovian neurophysiological model. Through his research Robinson observed the superiority of introverts over extroverts on the verbal subtests of the WAIS. However, he also observed that extroverts outperform introverts on verbal tasks related to operational intelligence

Various research studies that have been done with regard to the relationship between personality and psychometric test scores all point to the correlation between psychometric intelligence and extraversion to vary from positive to negative. That is, the results are equivocal. Revelle, Amaral, and Turriff (1976) were among the first to observe these contradictory results caused by the use of different types of ability tests.

Robinson's research results from 1985 were duplicated by Kirkcalby and Siwfen (1991) contrary to researchers such as Furnham, Forde and Cotter, Kirkcalby and Siwfen used the Wechsler Adult Intelligence Scale together with the Eyesneck Personality Questionnaire, and found that introverts tended to do better than extroverts on all the WAIS scales, the difference being statistically significant.

As indicated, although the vast number of researchers have found a strong correlation between personality, its associated behaviours and psychometric test results, Ackerman and Heggestad (1997) were of the opinion that personality traits are only weakly but positively and significantly related to g ($r = .08$). However, they did maintain that the correlation may be larger in younger samples, reaching $r = .21$ for males and $r = .19$ for females. Austin et al. (2002) were of the opinion that the correlations were weak; they found relatively few (and negative) correlations between psychometric intelligence and Extraversion. These inconsistencies Austin felt like Matthews can be partly explained in terms of different types of ability tests and their specific relation to Extraversion/Introversion. However, other studies (Rawlings and Skok, 1993; Furnham, Forde, and Cotter, 1998a) failed to replicate these results obtained by Austin and Matthews.

Eysenck and Eysenck (1985) suggested that the link between psychometric intelligence and extraversion was, to an important extent, dependent on the test conditions. This interaction was later explained by Eysenck and Eysenck's arousal theory, which states that the resting level of cortical arousal for introverts is higher (i.e. have lower reactive inhibition) than that of extraverts. Hence, introverts tend to avoid arousing stimuli, whereas extraverts tend to seek them (Eysenck, 1991). Therefore, one may predict that the relationship between psychometric intelligence and extraversion will differ in arousing and non-arousing situations, favouring extraverts or introverts respectively. Extraverts also show greater vigilance decrement than introverts and, consequently, trade off speed for accuracy when taking an ability test.

Thus, extraverts may have slightly different results than introverts depending on the style of the test (in particular, whether it is timed and how long it takes). Extraverts would seem to have an advantage when tests are short (2-5 minutes) and timed, whereas introverts would benefit from long (e.g. 40 minutes) and untimed tests.

One such hypothesis is that the more introverted individuals tend to work more slowly, but also more carefully and thoroughly, double-checking all answers. This specific style of test taking behaviour will therefore affect their score negatively, if it is a psychometric measure that takes both time and accuracy into account when calculating a score (Saklofske and Zeidner, 1995).

Accordingly, introverts can be expected to outperform extraverts on verbal tests and problem-solving tasks that require insight and reflection (Matthews, 1992), whereas extraverts would outperform introverts on speed (i.e. timed) tests.

This hypothesis was tested by Rawling and Carnie (1989), who showed that the relationship between extraversion and IQ is partly a function of time pressure. The authors found that the timed version of the WAIS favoured extraverts, whereas the untimed version favoured introverts. Eysenck (1994a) agreed with Rawling and Carnie that extraverts have a general

tendency to spend less time doing a test (and even tend to give up toward the end of a test), concluding that extraversion is related to speed of working.

This bias becomes even more critical when the measure in question is a power test, where speed scores may represent different things depending on the perceived difficulty of the task. At an easy level, these tests may be measuring aspects of Gf (Fluid Intelligence), but other non-ability intrapersonal factors, possibly stylistic or perhaps related to self-esteem, confidence or introversion may come into play when the task becomes difficult (Saklofske, and Zeidner, 1995).

The power test and introversion/extroversion relationship was also of interest to Rawling and Carnie (1989). They used two untimed WAIS sub tests and two timed performance tests and found that time limited and unlimited procedures differently influenced the WAIS profiles of introverts and extroverts. Extroverts were superior on information and on both the timed tasks of block design and picture arrangement.

These findings were collaborated by Furnham, Forde, and Cotter (1998a, 1998b) who found that extraverts significantly outperformed introverts on a measure of logical reasoning on a timed test. Furnham et al. (1998a, 1998b), furthermore confirmed Matthews' findings that the relationship between extraversion and intellectual ability is influenced by the type of intelligence test used, thus timed tests tend to favour extraverts, while longer and non-timed test tend to favour introverts. Thus the argument becomes more valid that an individual's characteristics can influence the results of the test that is being undertaken by such an individual. Therefore these results do not allow for an accurate reflection of such an individual's true ability.

Further, Furnham et al. (1998a) also hypothesised that, although it could be that the relationship between extraversion and psychometric intelligence is influenced by the type of test used or the type of intelligence being measured, introverts can also outperform extraverts on speed tasks. It is arguable that the type of test used by Furnham et al. (1998a), i.e. the Baddeley Reasoning Test (Baddeley, 1968) may also have tapped aspects of verbal ability because this measure is based on grammatical transformations,

not just speed. This may have helped introverts' performance (Matthews, 1992).

Zeidner (1995) argued that introverts have an advantage in tasks related to superior associative learning ability (verbal tasks); whereas extraverts have an advantage in tasks related to ready acquisition of automatic motor sequences (performance tasks). This argument was also tabled by Eysenck (1971) and Robinson (1985), who attributed these differences to interpersonal variation in cerebral arousability (excitation/inhibition of the autonomic system). Thus extraverts, who are naturally less aroused, find it harder to concentrate for a long time and end up trading speed for accuracy. The opposite should apply to introverts. In this sense, the positive correlation between extraversion and psychometric intelligence would be consistent with the representation of intelligent individuals as characterised by higher speed of information processing (Neubauer, 1997; Roth, 1964; Vernon, 1987).

Kirkcalby and Siwfens (1991) results indicated a coherent relationship between the personality variables, extraversion, Psychoticism-Social Conformity and intellectual functioning based on the results obtained from the verbal subtests of the Information Similarities. The distinction between verbal and non-verbal intelligence seems supported. Therefore personality traits appear to be related to verbal intelligence to a greater degree than to performance intelligence.

Even with the vast amount of research conducted, the relationship between extraversion and psychometric intelligence is far from well-established and, therefore, remains an interesting topic of research for differential psychologists. Most researchers would agree, however, that there is definitely more to intellectual ability than processing speed (Ackerman, 1999; Stankov, 1999). In fact, even those who adopt RT-based approaches to intelligence have found only modest correlations between short RT measures and psychometric intelligence, as shown by Jensen (1987) through his meta-analysis. Thus, further research is needed to clarify the inconsistencies in the relationship between psychometric intelligence and

personality styles and its associated behaviours (Roberts, 2002; Stough et al., 1996).

2.1.3.5.3 Extroversion Psychoticism

Kirkaldy and Siefen (1991) focused their investigations on behaviours linked to extroversion psychoticism. They found that a relationship does exist between extroversion psychoticism described as unconventional, radical and dominant behaviour and social conformity with regards to intellectual functioning. These authors are also of the opinion that individuals that exhibit high scores on psychoticism tend toward inferior test performance. On the other hand, individuals that show high social conformity scores and low scores on psychoticism usually perform better on tests.

2.1.3.5.4 Submissive vs. Dominant scale as per the Clinical Analysis Questionnaire

Authors Birenbaum (2006) and Levi-Kern (1994) also examined the relationship between speed at which a test is completed (measured by the number of unreached items on a mental rotations test) and accuracy levels in relation to an individual's traits. Their investigations focused on the speed and accuracy of completion in relation to the submissive vs. dominance that is part of the PAD Temperament Model (Mehrabian, 1995a). Birenbaum and Levi-Kern (1994) found that when they correlated individual characteristics with the speed results obtained on that measure, individuals that exhibited the trait of "obsessive correctness" worked slower on mental rotation tasks. Thus the correlation was a negative one between speed and the Submissive vs. Dominant scale (E Scale) of the Clinical Analysis Questionnaire

2.1.3.5.5 Dimensions of Behaviour as per the Big 5 Personality Theory

The behavioural dimensions that are identified by the Big 5 Personality Theory have also been explored with regard to its effect on test

performance. One such study was with regard to conscientiousness and intellectual openness. Dollinger (1987) found and reported that conscientiousness correlated with responsibility and achievement via conformance while openness correlated achievement via independence

From Barrett's (2007) review of recent empirical literature that discussed the relationship between the Big Five personality dimensions and post-secondary academic achievement, it is evident that there were consistent results. He used a meta-analysis which showed conscientiousness, in particular, to be most strongly and consistently associated with academic success. In addition, openness to experience was sometimes positively associated with scholastic achievement, whereas extraversion was at times negatively related to the same criterion, although the empirical evidence regarding these latter two dimensions was somewhat mixed.

The relationship between personality and varied test results has also been considered with regard to the dimensions measured with regard to neuroticism and conscientiousness. Chamorro-Premuzic and Furnham (2003) in their exploration of the Big Five personality factors namely neuroticism and conscientiousness found these factors predict overall final marks over and above several academic predictors, accounting for more than 10% of unique variance in overall test scores. With conscientiousness being defined as a tendency of an individual to show self-discipline, act dutifully, and aim for achievement. The trait shows a preference for planned rather than spontaneous behaviour. It influences the way in which we control, regulate, and direct our impulses. Conscientiousness includes the factor known as need for achievement (NACH) and is consistently associated with positive performance (Blickle, 1996). Conscientiousness is closely related to motivation, a variable of considerable importance with regard to all types of performance (Heaven, 1990)

The benefits of high conscientiousness are obvious. Conscientious individuals avoid trouble and achieve high levels of success through purposeful planning and persistence. They are also positively regarded by

others as intelligent and reliable. On the negative side, they can be compulsive perfectionists and workaholics (Paunonen and Ashton, 2001).

Across various personality measures, these two factors- extraversion and agreeableness - account for most of the measured differences between people. Although it is believed to mean that extraversion and agreeableness are among the most universally recognised features that differentiate one person from another, the other factors cannot be ignored. In most of the literature reviewed it is apparent that most of the studies documented utilised mostly measures, WAIS, Big 5 and 16 PF. The WAIS measure was used specifically to focus on extroversion and introversion. However, most of the authors focused on analysing and quantifying the effects of neuroticism and extraversion on IQ test performance, but due to the correlational nature of most studies, this high correlation can be seen as a considerable limitation to this theory (Furnham, 1992).

Neuroticism can be described as the tendency of an individual to experience negative emotions, such as anger, anxiety, or depression. It is sometimes called emotional instability. Those who score high in neuroticism are emotionally reactive and vulnerable to stress. They are more likely to interpret ordinary situations as threatening, and minor frustrations as hopelessly difficult. Their negative emotional reactions tend to persist for unusually long periods of time, which means they are often in a bad mood. These problems in emotional regulation can diminish a neurotic's ability to think clearly, make decisions, and cope effectively with stress (Paunonen and Ashton, 2001).

Zeidner (1995) was of the opinion that although neuroticism may impair test performance, we should not question the validity of ability tests, but rather provide additional information about the individual who completes the tests (Furnham, Forde and Cotter, 1998a). This argument is based on the assumption that anxiety affects real-world performance in the same way that it affects (impairs) test performance. Although, in the case of neuroticism it may be more related to IQ test performance than to actual intelligence (Child, 1964; Eysenck, 1971)

Ackerman and Heggestad (1997) conducted a large meta-analysis of 135 studies, they supported Zeidner, Child and Eysenck's findings. They reported a significant, albeit modest, correlation between psychometric intelligence and neuroticism ($r = -.15$), while, Ackerman and Heggestad (1997) found that g was negatively and moderately correlated with self-report measures of test anxiety ($r = -.33$). This is consistent with the findings of what is considered the most important paper on the relationship between test anxiety and intelligence namely, Hembree's (1988) review of 273 studies. Here correlations between test anxiety and ability test performance ranged from $r = -.06$ up to $r = -.29$ (with a mean correlation of $r = -.18$). These correlations were replicated by the results of another large study ($N = 36,000$) by Siepp (1991) and Austin et al., (2002).

There are several more studies presenting evidence for the significant correlation between neuroticism and ability tests. They show essentially that trait anxiety is likely to impair performance under arousing conditions. Callard and Goodfellow (1962) were among the first to find a low but statistically significant association between IQ and neuroticism.

In a study that examined the relationship between IQ and the Junior Maudsley Personality Inventory, a sample of 3559 school children aged from 11 to 14 years of age were studied. The results also confirmed group differences in neuroticism, such that higher IQ scorers tended to be low in neuroticism and vice versa. Interestingly, within the high IQ group, neuroticism was positively related with intelligence, whereas in the low IQ group, the relationship between neuroticism and IQ was negative. Kalmanchey and Kozeki (1983) reported ($n=642$) low but significant correlations between neuroticism (as assessed by the EPQ) and psychometric intelligence in their examination of similarly aged children. More recently, Furnham, Forde and Cotter (1998a) obtained modest but significant correlations between neuroticism (as assessed by the EPQ), Wonderlic Personnel and Baddeley Reasoning tests, two well-established measures of IQ and Gf , respectively.

Matarazzo, (1972) postulated that without salient exceptions, and even when the correlation does not reach significant levels, the relationship between neuroticism and psychometric intelligence is negative, implying that intelligence would decrease with negative affectivity (e.g. anxiety, worry, tension, depression, anger, etc. (Zeidner and Matthews, 2000)). As mentioned earlier, this does not necessarily mean that neurotic individuals are inherently less intelligent than stable ones. Rather, it is likely that negative effects such as anxiety and worry, which are typical of neurotic individuals, would interfere with the cognitive processes (e.g. memory and attention) required to solve ability tests.

Importantly, the literature reviewed by Barrett indicated that the narrow personality traits or facets presumed to underlie the broad Big Five personality factors are generally stronger predictors of academic performance than are the Big Five personality factors themselves. Furthermore, he found that personality predictors can account for variance in academic performance beyond that accounted for by measures of cognitive ability. He suggested future research on this topic be undertaken, which should aim to improve the prediction of scholastic achievement by overcoming identifiable and easily correctable limitations of past studies.

Another dimension of the Big 5 theory that was explored is openness to experience. Openness to experience is the factor most frequently associated with intelligence (Ackerman & Heggestad, 1997; Austin, Hofer, Deary and Eber, 2000; Brand, 1994; Goff and Ackerman, 1992; Zeidner & Matthews, 2000). McCrae (1993), Holland,C., Dollinger, Holland,D. and MacDonald (1995) reported significant correlations ($r = .33$ and $r = .42$) between the openness to experience factor and the Wechsler Adult Intelligence Scale. Blickle (1996) also found openness to experience to be associated with performance. Johnson (1994) and Saucier (1994) noted that openness to experience is related to lexical intellect and thus performance. Openness, as referred to by Blickle (1996), can be defined as a general appreciation for art, emotion, adventure, unusual ideas, imagination, curiosity and variety of experience. The trait distinguishes imaginative people from down-to-earth,

conventional people. People who are open to experience are intellectually curious, appreciative of art and sensitive to beauty. They tend to be, compared to closed people, more creative and more aware of their feelings. They are more likely to hold unconventional beliefs.

People with low scores on openness tend to have more conventional, traditional interests. They prefer the plain, straightforward and simple over the complex, ambiguous and subtle. They may regard the arts and sciences with suspicion, regarding these endeavours as abstruse or of no practical use. Closed people prefer familiarity over novelty. They are conservative and resistant to change (Paunonen and Ashton, 2001).

2.1.3.5.5 Shyness

Another behaviour type that has been explored in relation to test performance is shyness. Cozier & Alden (2001) found that there has been little examination of factors contributing to these individual differences in the past. Thus the aim of their research was, amongst other things, to investigate cognitive-competence and behaviour differences in performance on tests of vocabulary. They focused on the effect of shyness on test performance and found that shy individuals differ from their peers not only in their use of language as well as their routine social encounters but also in formal assessments of their language development, including psychometric tests of vocabulary.

Cozier & Alden (2001) conducted their research by examining the performance of shy and less shy individuals under different conditions of test administration, individually with an examiner or among their peers within the familiar classroom setting. The results found that the conditions of test administration influenced the vocabulary test performance of shy testees. They performed significantly poorer than their peers in the two face-to-face conditions as opposed to group test conditions.

However, Cozier & Alden (2001) found that a comparable trend for an arithmetic test was not statistically significant. Therefore, across the sample as a whole, shyness correlated significantly with test scores. Thus shyness and its associated behaviours do influence testees cognitive test performance and its impact is largest when individuals are tested in a face-to-face situation as opposed to a more anonymous group setting.

2.1.3.5.6 Type A and B Personality:

It is not just shyness and its associated behaviours that have an impact on the manner in which an individual completes a test. Earlier studies by Rosenman and Friedman (1977) studied the influence of Type A behaviour pattern on test-taking performance and time. They described the Type A individual as a person that has a high level of competitiveness and who strives for achievement. Rosenman and Friedman (1977) predicted that Type A individuals would be better prepared and might strive to complete the test sooner than their Type B counterparts.

They used 65 students in their study, utilising the modified Jenkins Activity Survey to evaluate A and B behaviour patterns. They then recorded the time that it took the respondents to complete a test. Through their data analysis, they yielded significant personality type factors. Further analysis using the Newman-Keuls test for significant interaction indicated that the scores obtained by Type B females was significantly higher than any of the other groups, while the scores for Type B males was significantly lower than any of the other groups.

2.1.3.5.7 The Stability of Behavioural Profiles:

From the exploration of available literature provided above, it is implicit that a relationship does exist between various dimensions of personality, behaviour and performance on various psychometric and scholastic

measures that rate ability and intelligence. This inherent relationship has various implications for psychometric testing practices, especially within a South African context, where psychometric assessments form part of many companies' recruitment process. Therefore, the results obtained by an individual on psychometric tests are often used to make and guide numerous important decisions, such as decision-making in selection and screening, or for providing information to support guidance or counselling. As much weight is given to the results obtained on these tests it is essential to understand what elements other than behaviour can also impact on these results. Saklofske and Kostura (1990) felt that exploration is essential. They were of the opinion more research needs to be done with regard to these complex interactions to determine the relationship between individual traits and intelligence, as any relationship that exists between these two may not be as linear as so easily implied.

Thus, it is important to consider the effect of an individual's propensity towards a certain behaviour style and the impact it will have on how such an individual will behave during the completion of a task. It is apparent from literature reviewed that people have an inbuilt dominance to act and behave in a certain way, i.e. their normal behaviour. Human beings develop their own behavioural style from a very early age. Thus people vary in their behaviour, that is to say, there are demonstrated individual differences between people.

Furthermore, there is evidence that individuals vary in how they adapt to changing environments such as a testing environment), and the way they adapt may be the most consistent feature of their personalities. Thus one can infer that behaviour during transition points is not necessarily predictive of behaviour during a period of relative stability. Most studies considering behaviour have examined changes over time in groups of individuals and concluded that at different stages in a person's life certain patterns appear affecting their behaviour in different ways (Inscape, 1996).

These differences in human behaviour are consistent to a great extent, for that reason it is conceivable that behaviour has certain stability which

depends upon many interacting variables including the situation and the biological state of the individual. Despite variations there will be certain behaviour dimensions that some individuals will find more difficult to adopt (Chapman, 2005). It is therefore critical that there is a clear understanding of how and if these behaviour patterns could affect personal performance.

Therefore, it is conceivable that the variations in behaviour dimensions, as well as the individual's ability or lack of ability to adapt behaviour style, may also impact an individual's psychometric test results, as an individual may have a preferred behaviour style which could impact on how they complete a test and ultimately affect the results they obtain.

The interactive model of Chamorro-Premuzic and Furnham (2003) suggests that both intelligence and personality comprise salient individual differences which influence performance. Intelligence (what a person can do) influences performance through specific abilities which facilitate understanding and learning, while personality (how a person will do it) influences performance through certain traits which enhance or handicap the use of these abilities. Stanger (1933) was of the opinion that the manner in which an individual does something, i.e. their personality, has an impact on their performance. He felt that using personality traits as predictors may account for additional variance in performance.

The importance of the relationship between personality and psychometric tests results has become so defined that it has recently been claimed that personality measures on their own are powerful enough to explain a moderate percentage of the variance in performance. Boyle (1983), in one instance, demonstrated that under non-emotive conditions, intelligence accounted for most variance whereas under stressful conditions, personality factors accounted for most of the predictive variance in results.

Rindermann and Neubauer (2001) looked at psychometric results obtained by an individual and postulated that non-ability factors may impact the results that an individual obtains on such a test. Numerous researchers (Eysenck, 1967a; Furnham, Forde and Cotter, 1998b), agreed that an individual's inclination to be stimulated by a task could determine their

particular test-taking styles or the way in which they approach the questions. This will in turn affect performance on cognitive tests and impact on the results.

It is evident that personality and its associated behaviour traits can have an impact on how an individual approaches and completes a psychometric measure, ultimately affecting the results he/she obtains. It is in this light that it becomes more critical to understand the impact of various non-cognitive components and how they may influence test results. These include personality traits in the assessment of intellectual competence. This understanding may provide additional information on the individual, as well as improve the prediction of his or her performance in real-life settings (Wechsler, 1950).

2.2 Personality and Behaviour Measures:

The literature reviewed described the relationship between behaviour style and measures of intelligence as complex and pivotal. Developing an understanding of behaviour patterns is a useful way to improve knowledge of possible bias that may exist when an individual completes a psychometric measure.

Literally hundreds of these instruments that measure behaviour exist. They share several key attributes, virtually all measure four behaviour patterns (styles) based on two general behavioural dimensions – assertiveness and responsiveness (Merrill and Reid, 1981). In order to explore this relationship from a consolidated view it is necessary to find a theory that shares commonalities with various theories with regard to personality and/or behaviour. One theory that does to some degree cover the elements covered in these tests is Marston's Theory. The reasoning for this assertion will be explored below.

The Marston's Theory referred to dates from the early twentieth century and details a theoretical framework for understanding behaviour (Bonnsetter

et al., 1993). Numerous psychometric measures have been based on the Dominance, Influence, Steadiness and Compliance (DISC) principle described in the theory. Psychometric instruments that are based on Marston's theory measure an individuals' natural and adapted behaviour dimensions based upon self-reported levels of Dominance, Influence, Steadiness and Compliance. The score reflects the way people conduct themselves in order to succeed in a specific environment. The natural score measures how people behave under pressure. Adapted styles are situationally mediated and these may vary over time. Natural styles are unlikely to change significantly over time unless triggered by emotional life changing events (Mckenna, Shelton and Darling, 2002).

One such test that is underpinned by Marston's theory is the Personal Profile Analysis (PPA). As alluded to earlier, Marston's theory encapsulates various elements of many mainstream personality theories. These similarities will be explored in the subsequent paragraphs.

The PPA uses words common to various other personality measures (Table 1). Twenty seven of the one hundred and twelve words that are included in a core list of words used to study the Big Five personality prototypes are also included in the PPA (John, 1992). These 27 words are grouped to form four major behavioural dimensions, namely Dominance (D), Influence (I), Steadiness (S) and Compliance (C).

Table 1: *The PPA Words Common to Various Other Personality Measures*

<u>Individual Words</u>					
Adventurous	Friendly	Sociable	Forceful	Refined	Logical
Cautious	Good-natured	Assertive	Generous	Sympathetic	Thorough

Contented	Kind	Conscientious	Helpful	Calm	Dominant
Enthusiastic	Talkative	Cooperative	Gentle	Outspoken	Insightful
Original	Reserved	Outgoing	Original		

2.2.1 PPA Comparison to the Big 5 Personality Measures:

When an investigation was done with regard to Factor I of the Big Five describes "surgency" or extraversion, it becomes evident that other measures like the PPA also refer to a similar trait as extraversion, activity, assertiveness, gregariousness, excitement-seeking, positive emotions and power. Items from DISC theory and subsequently the PPA that appear to measure a factor similar to that of surgency are talkative (I), assertive (D), outgoing (I), outspoken (D), dominant (D), forceful (D), enthusiastic (I), sociable (I) and adventurous (D).

From this overlap it is evident that nine of the PPA items are included on the Factor I list. However, it is clear that dominance and influence are not clearly separated in the broad personality categories generated. While they may be distinguishable at the individual scale level, they overlap in meaningful ways because of the initiation or drive implicit in both of them. In fact, there is a meaningful correlation between dominance and influence on PPA. For the purpose of the PPA they can be considered as two separate expressions of personal power, based on Marston's theory.

Factor II of the Big Five is generally labelled agreeableness while on different personality instruments similar constructs are called social adaptability, likeability, friendly compliance and love. The PPA items that appear on the Factor II list are sympathetic (S), kind (S), generous (S), helpful (S), good-natured (S), friendly (I), cooperative (S), and gentle (S). With one exception, this factor appears closely associated with the

steadiness dimension on the PPA measure, therefore, there once again appears to be a noteworthy overlap in the two measures.

With regard to Factor III of the Big Five personality measure, namely conscientiousness, only four words appearing in the PPA are found on this scale: thorough (C), conscientious(C), cautious(C), and precise (C). However, on examination, it is evident the two scales are not measuring exactly the same thing. Factor III of the Big Five is often described as an orientation toward work that is responsible, conscientious and, in that sense, reliable. It relates to measures of honesty and trustworthiness, while on the PPA measure it emphasis is on working conscientiously within existing circumstances to ensure quality and accuracy.

Factor IV of the Big Five, neuroticism vs. emotional stability includes two items from the PPA measure; both from the steadiness scale; these words are calm (S) and contented (S). It is important to note that at the negative end of Factor IV are items that generally describe neurosis, which the PPA measure does not intend to measure (Inscape, 1996).

Factor V of the Big Five is labelled intellect, culture, flexibility and openness to experience. Three items from the PPA measure can be found in this factor. These are original (D), insightful (C) and logical (C). This is a broad measure of a person's readiness to learn, creative imagination, and resourcefulness. It does not appear to be represented on Marston's theory and therefore is not comparable to the PPA.

From the evidence above it is apparent that Marston's theory and the PPA measure have a lot in common with the broad foundation of personality measurement as defined by the Big Five prototypes, particularly with the first three factors in the model which account for most of the observed differences among people. This finding lends credibility to the assumption that the PPA measure is measuring important aspects of human behaviour of different people. Therefore, the PPA is a suitable measure to be used in this particular study.

2.2.2 PPA in Comparison to the 16 PF Modelled After Cattell's Research

Studies done on the comparability of Marston's theory to that of Cattell focused on the comparability of the four constructs/traits, Dominance, Influence, Steadiness and Compliance and how and whether they were theoretically related to Cattell's theory. The study used 103 research subjects and they were expected to complete both a DISC measure and a 16 PF measure which are based on Marston's and Cattell's theories respectively. The scales of the two instruments were correlated and the following correlations were found between the two measures as showed in Table 2.

Table 2: The correlation of the DISC and 16 PF scales

Cattell –16PF	Marston –PPA	Relationship
Dominance	Dominance	Dominance scale on the 16PF showed a measure strong and positive correlation ($r=.62$) to the Dominance scale of the DISC measure. While for the S scale on the PPA had a strong negative correlation ($r=.52$) to the Dominance scale
Liveliness scale	Influence Scale	Liveliness scale is positively correlated ($r=.61$) with the Influence scale on the DISC measure. With slight negative correlations reported with Compliance
Sensitivity Scale	Dominance and Steadiness	The Dominance scale demonstrated a negative and moderate but statistically significant relationship with the Sensitivity scale, while Steadiness indicated a positive correlation with the Sensitivity scale although not statically significant.
Rule Consciousness scale	Consciousness	The research indicated a small but statistically significant relationship between these two scales.
Social Boldness Scale	D I S and C	The S and C show moderate negative correlations while the D and I scales show moderate positive relationships with the social boldness scale.

Cattell –16PF	Marston –PPA	Relationship
Privateness Scale	I and C	The I scale showed a moderately negative correlation with this 16 PF scale while the C scale showed a moderately positive and statistically significant correlation.

Other research studies (Childs, 1993; Leary, 1987; McCrae and Costa, 1989) on the comparability of these two measures have confirmed the findings reported above with regard to correlations that exist between the 16PF and DISC measures. In addition, it has been found that D and I are compatible to the “Exvia” or extraversion scale on the 16 PF, while S is somewhat comparable to the “Pathemia” or feeling scale. In addition, C may be compared to the “Superego Strength” scale, though only that subject of items which measures reliability and conscientiousness (Inscape, 1996).

2.2.3 PPA in Comparison to the Myers-Briggs Type Indicator®

The Myers-Briggs Type Indicator (MBTI) measure is a personality inventory based on the theoretical work of Carl Jung. It is important to note that there are aspects of MBTI that differ from a DISC measure in important ways. The MBTI measures both thinking and behaving patterns while DISC measure focuses primarily on behaviour. In addition, the MBTI explains human behaviour from a different perspective, for example, by describing how people orient toward the world and how they get information. Therefore, the investigation into the similarities will take on a slightly different approach, excluding the areas that could show differences from the onset. Therefore, the comparison will only focus on the following MBTI factors, Introversion / Extroversion and Thinking / Feeling (Table 3)

Table 3: *The Comparison between MBTI factors Introversion / Extroversion and Thinking / Feeling and DISC measures*

Carl Jung - MBTI	Marston - DISC	Relationship Between the Two Measures
Introversion/ Extroversion (I/E)	Influence (I) Steadiness (S)	I scale showed a strong positive correlation (r=.65) with the I/E scale. While the C scale demonstrated a negative correlation (r=.65) with the I/E scale.
Feeling / Thinking (F/T)	Dominance (D) Influence (I) Steadiness (S) Conscientiousness (C)	The F/T scale had a negative correlation with the D scale, with a slightly more positive correlation with C. The I and S demonstrated the positive correlations with the F/T scale.

Although Marston’s DISC theory does not correlate with all the personality traits and characteristics on the various mainstream personality measures, it overlaps and incorporates important aspects of three of the big personality measures, namely The Big 5, 16 PF and MBTI to one degree or another (Figure 2).

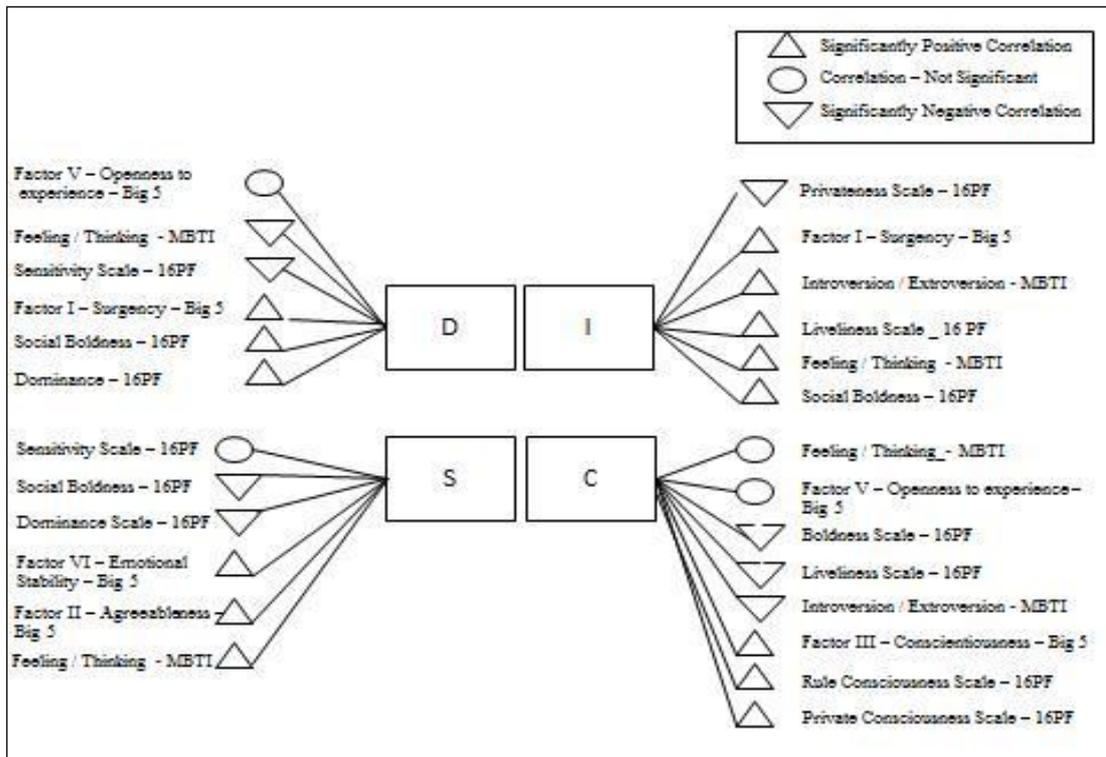


Figure 2 : Graphical representation of relationships that exist between The Big 5, 16 PF MBTI and PPA

The PPA is therefore considered to be an appropriate tool to be used to provide an indication of an individual’s behaviour style.

2.3 Measuring Accuracy and Speed:

It is evident from the literature examined that the type of test used to measure an individual’s psychometric ability has a definite impact on the results obtained, however this bias transpires in conjunction with the other elements highlighted in the beginning of the chapter. Even though differences among various instruments have been compared and contrasted, there is no data indicating under which circumstances usage of a particular instrument would be more appropriate or produce better results than the use of another. It appears that many supporters of behavioural style assessments

base their enthusiasm for the process more on subjective perceptions than documented results (Mckenna, Shelton and Darling, 2002). However, there is consensus that timed versus untimed tests have an impact on the results that various personality types could obtain when completing a psychometric measure. Therefore, if a psychometric measure is timed it is evident that this would favour a particular personality type.

The consensus that time versus untimed tests may impact on results obtained by different personality types is based on speed scores from batteries of diverse personality and intelligence tests tend to exhibit somewhat higher average inter-correlations than accuracy scores. In addition, the size of the correlation was found to depend on the nature of the tests, when correlated the accuracy scores from a test of Fluid Intelligence (Gf) with the speed of the test taking scores from a variety of cognitive tests. In general, speed when doing easy tasks shows a higher correlation (in the .30s) with intelligence, whereas speed when doing difficult or power tests shows zero correlation (Spilsbury, Stankov and Roberts, 1990).

Rosenman and Friedman (1977) as well as Rawling and Carrie (1989) made use of timed tests to better understand this relationship between personality and variance in test results. Their findings not only indicated that a relationship exists between an individual's preferred behaviour style and performance on a psychometric test, but more specifically that a relationship exists between an individual's preferred behaviour style and performance on a power test. This could be due the stress that power tests place on the individual as a result of the time constraints attributed to the completion of such a measure. Therefore, an individual's inclination to act in a certain way may either benefit or disadvantage them when they complete a power test.

The most noticeable and replicated cases refer to this relationship of speed and accuracy with reference to the extraversion trait and associations between neuroticism and test anxiety (Chamorro-Premuzic and Furham, 2005). Dobson (2000) showed that only under stressful situations such as those associated with time pressure or a power test when the results have important consequences for the individual, can neuroticism be associated

with lower performance on numerical reasoning tests. As these situations underestimate neurotics' true intellectual ability, thus their propensity to behave in a certain matter may unduly disadvantage them by resulting in a score that is not an accurate reflection. Therefore, it has become important to understand such potential bias and ensure that the measure that is used in the assessment of an individual does not unduly disadvantage the test taker or that bias is eliminated by using appropriate norms.

2.4 Summary of Factors that may Cause Test Bias:

There are numerous factors that can act as bias when an individual undertakes a test. These range from the test itself, the setting and administration procedure and even the characteristics of the test taker.

The characteristics can include a test takers age, race, language and even their personality traits and associated behaviour. In addition, it has been found that differences in socio-demographics, age, behaviour and so forth account for up to 6 per cent of the variance in the results obtained in a measure, thus representing a significant potential source for misinterpretation (Dolnicar, 2007). Although consensus cannot be reached on the magnitude of the bias caused by an individual's personality profile, it is evident that such a relationship does exist, however big or small in nature.

Understanding the bias that personality and its associated behaviour patterns have on test performance will have far reaching effects. From an applied point of view, the successful prediction of academic performance throughout an academic career would provide important empirical evidence to support the inclusion of well-established personality inventories as predictors of performance in university settings. This could result in the prediction academic achievement from the results of personality inventories having a consequence for educational admissions systems.

Personality and behaviour are central to the being of each individual. Individuals tend to exhibit behavioural patterns in which they say and do

how they relate to people and how they perform tasks or process information (Mckenna, Shelton, Darling, 2002). Decision making, work pace, problem solving, influence tactics, assertiveness, responsiveness, extroversion and learning styles are but a few style attributes that may vary among individuals. As behavioural style focus on how one acts – what you say and what you do (Darling and Walker, 2001). It can be stated that behavioural patterns are synonymous with personality. Thus personality can be seen as pattern of relatively enduring ways in which a person feels thinks and behaves George and Jones (2002).

Further implications of this relationship are also evident as individuals lend themselves to some degree of modification by:

- i. Selecting an environment which does not inhibit change by causing fear or defensiveness; and/or
- ii. By selecting behaviours within one's repertoire which are more appropriate to the situation (Inscape, 1996).

This implies that individuals with certain personality types may willingly remove themselves from situations that may require them to complete a measure.

However, when considering this relationship and its implications, it is imperative to bear in mind that nobody is exclusively one temperament or behavioural profile. Each individual is likely to have a single preference or dominant type or style, which is augmented and supported by a mixture of the other types. Different people possess differing mixtures and dominances - some people are strongly orientated towards a single type, which usually emerges under pressure situations, such as those experienced in a power test situation.

Due to the diversity of variables from test conditions and distractibility to physical illness that may have a significant influence on test results, it is evident that problems arise when it comes to interpreting the results of IQ tests one cannot assume that the score is a true reflection of the tested person's ability (Chamorro-Premuzic and Furham, 2005).

This problem was already highlighted by Wechsler (1950), who proposed that IQ tests should be redesigned to include (rather than exclude) non-ability factors. In doing so they would not only facilitate interpretation, but also increase validity with regard to other types of performance and address the possible effect of this bias. Nevertheless, Wechsler's advice appears to have had little or no effect on most test constructors, administrators, and testers, due to the already complex nature and the difficulties of measuring personality traits objectively. As the assessment of non-cognitive traits is associated with self-report inventories, for example Cattell's 16PF, this measure included an element of intelligence. However, a modification of an IQ test to include personality traits would require an abrupt methodological change, which most intelligence researchers would not happily accept (Chamorro-Premuzic and Furham, 2005). Thus it is important to understand the relationship between personality and psychometric intelligence and take it into account when selecting, administering and interpreting test results.

Even though we know that test performance may be affected by variables other than intelligence; it is felt that psychometric test remains a sound indicator of an individual's ability, resulting in important implications for ability scores obtained on measures that measure cognitive or IQ test elements. Currently theoretical approaches to personality intelligence interface differently according to their representation of actual ability or ability as output/performance although the two are related (Chamorro-Premuzic and Furham, 2005).

According to the comprehensive taxonomies of personality (e.g. Big Five, Gigantic Three and 16PF), psychometric scores can be accounted for and consequently predicted by personality traits. In conclusion, an individual may either be advantaged or disadvantaged by the results obtained due to their preferred behaviour style and thus the manner in which they complete such a measure, rather than the result being a true reflection of the individual's state of being, for example learning potential. In other words, it is imperative to ascertain if a certain behavioural style (behavioural approach) either provides the individual with a benefit or disadvantage in their performance on a psychometric test.

CHAPTER 3: DESIGN AND METHODOLOGY

This chapter focuses on the study's sampling methodology, sample size and characteristics of the sample that have been used, as well as describing the research design used and the instruments that will be used to gather data.

3.1 Research Design

The following elements were taken into consideration when choosing the research design that was to be employed in this particular study:

- (i) The research question.
- (ii) The variables that were to be measured to answer the research question.
- (iii) Sample selection.
- (iv) Data collection.
- (v) Analysis process to be followed.

The research question reads: Does a relationship exist between behavioural dimensions and individual performance in relation to speed and accuracy scores obtained on a learning potential measure in the South African corporate environment? When consideration is given to the research question at hand, it is implicit that the variables that will be measured and reported on are behavioural dimensions and speed and accuracy scores obtained on a learning potential measure. The sample would consist of South Africans that are currently employed in the corporate South Africa, who are older than 18 years of age and are currently applying or employed as a graduate, manager or supervisor. Data with regard to these individuals' behavioural dimensions and their speed and accuracy on a learning potential measure will be collected by administering two psychometric tests to individuals in the corporate South Africa that attend an assessment centre for recruitment or training and development purposes, in an active daily functioning assessment centre company. The first test the Personal Profile Analysis (PPA) measures behaviour patterns, while The Test for Training

and Selection (TST) is a power test that measures and calculates learning potential by considering the speed and accuracy of an individual. As the data collected will be numerical in nature, the analysis approach will be quantitative, using statistics to report on the data and determine if a relationship does exist.

The approach to deciding on a research design mimics that described by Moss (1988), who indicated that the research design should include information about who will be studied, what will be observed or measured, when the observations and/or measurement will occur and how this data will be collected.

A causal research design will be employed as this type of design lends itself to the investigation of the cause and effect relationship between two or more variables, more specifically in this study, the effect of preferred behavioural dimensions on the speed and accuracy with which an individual completes a learning potential measure. This design allows the researcher to measure the extent of relationship between the variables. The researcher will be utilising a quasi-experimental design category within causal research design framework. Quasi-experimental designs resemble true experimental designs in that they have the equivalent of treatment conditions, outcome measures and sampling units. They are considered to be “quasi-experimental” designs, however, because they do not use randomisation to allocate sampling units to treatment conditions, inferring Causation. The researcher understands that the primary inferential risk in quasi-experimental research results from the non-random assignment of sampling units to treatment conditions. The researcher will attempt to emulate the causal reasoning of the randomised experimental approach in order to reach causal inferences that are as sound as possible. This approach allows the researcher to identify the type of moderator variables based on the identification of moderator variables, which are factors associated with variations in the magnitude of a given relationship. The goal is to show that some variables are associated with changes in the magnitude of the given relationship.

The data could only be collected when a recruitment and selection assessment centre was purchased by a client of ACT. With this restraint in place, the researcher introduced an experimental design into their data collection procedure. Even though the individual lacks the full control over the scheduling of experiential stimuli, which makes a true experiment possible, collectively such a situation can be regarded as quasi-experimental designs (Campbell & Stanely, 1963).

By using a quasi-experimental design it is possible that the control groups may differ in many systematic (non-random) ways other than the presence or absence of a specific behavioural dimension. Many of these factors could be alternative explanations for the observed effect, and so researchers have to eliminate them in order to get a more valid estimate of the relationship (Shadish, Cook & Campbell, 1969). Shadish, Cook & Campbell, (1969) support the use of a quasi-experimental design to study a descriptive causal question, indicating that they offer excellent cause estimates. Because there is a loss of control in the quasi-experimental design, it is necessary for the researcher to decide what and when to measure (Dawson, 1997). The researcher will be utilising a multiple substantive posttest. The one-group design without pretests can be more interpretable under theory linked conditions variously called pattern matching (Campbell, 1966a) or coherence (Rosenbaum, 1995a). This approach allows the researcher to look at the effect, by considering the availability a of pattern of clues that specify specific results. Therefore, this approach lends itself to an investigative approach. The variables serve as multiple, unique and substantive posttest design. This design assumes that the potential cause is known but the effect is unknown. The researcher is aware that for this approach, the pattern matching logic is less compelling because the cause is often a variable with an unknown pattern of effects. Thus adding multiple posttests under a prospective design can increase Type I errors, especially as humans are adept at finding and interpreting patterns even in random data (Fischhoff, 1975; Paulos, 1988). Careful prior specifications of patterns that support a

causal relationship is crucial. In addition, these predicted patterns should be unique. Therefore, if the learning potential, speed and accuracy scores are similar for all the different behavioural dimensions, the results do not allow the researcher to discriminate among the results based on behavioural dimensions

For the purpose of this study, learning potential, speed and accuracy scores are seen as the dependent variables, while an individual's behavioural dimension is the independent variable. It is also noted that there are confounding variables that may have a significant effect on the dependent variable and that cannot easily be controlled or eliminated. The study will try to identify and control for these variables in the statistical analysis of the data.

The researcher is aware of the advantages and disadvantages of using this specific research design. One distinct advantage is that almost any variable can be studied by a researcher and, in addition, the results can be used for prediction - also called regression. A disadvantage of this research design is the fact that the results may be subject to extraneous variables and even more noteworthy that the results do not give causal inferences. (<http://www.psy.pdx.edu/PsyTutor/Tutorials/Research/Elements/P4.htm>)

Therefore, the researcher agrees with Grinell (1993) who is of the opinion that research designs that fall into this approach are at the highest end of the knowledge continuum. As they have the most rigid requirements and produce results that can easily be generalised to the general population. A causal research design can thus be seen as being able to provide valid and reliable research results that can add to the professional theoretical knowledge base.

3.2 Hypothesis and Definition of Constructs:

3.2.1 Hypothesis

The hypotheses that are being explored are that a relationship exists between an individual's behavioural dimensions and the performance on an intelligence measure in a corporate environment. As certain behavioural dimensions are characterised by specific behaviour it can be expected that individuals will be inclined to stay true to their preferred behaviour dimension when placed in a situation where they need to complete a learning potential measure, ultimately impacting on the manner in which they complete the measure with reference to speed and accuracy levels, which in turn will have an impact on their score on such a measure, either advantaging or disadvantaging them. Represented below (Figure 3) is the envisaged relationship that exists between individuals' preferred behaviour dimensions and their performance on learning potential measure considering the speed and accuracy components. The detailed hypotheses have been provided in chapter 1 paragraph 1.5.

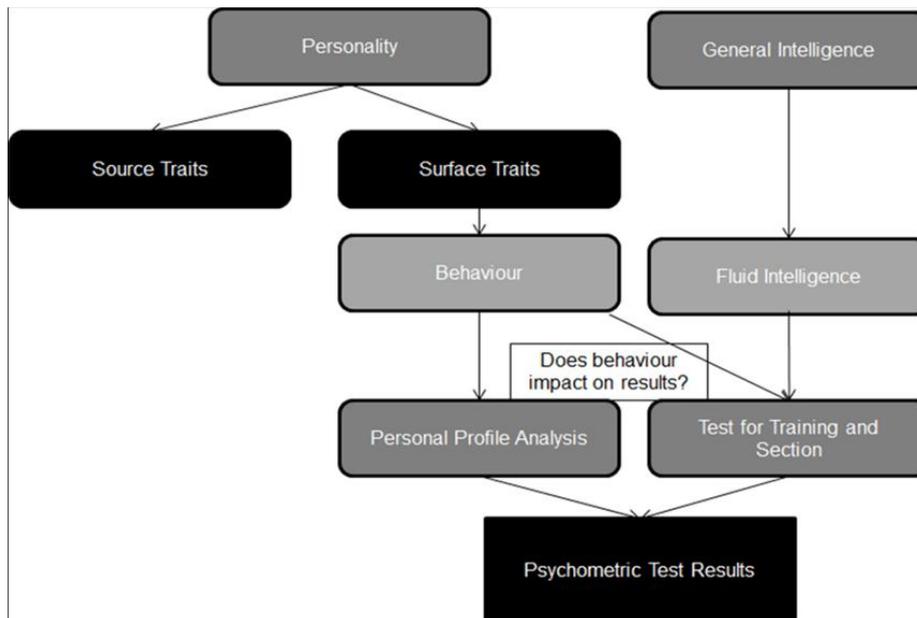


Figure 3: *The relationship that is hypothesised to exist between behavioural dimensions and intelligence test completion.*

3.2.2 Definition of Constructs

It is essential to define the key concepts and variables that will be used in this study. The first to be defined are the constructs by which behaviour will be measured and reported on. These four variables are from Dr Marston's DISC theory as previously referred to in this document. These four main factors are named Dominance, Influence, Steadiness and Compliance. Each of these will be discussed providing the definition of them as well as the behaviour typically associated with that particular construct.

3.2.2.1 Dominance

Dominance is defined as an active, positive posture in an unfriendly environment or in other words an individual who shows positive behaviour in an antagonistic situation where they drive to accomplish in the face of opposition or antagonism. Such individuals are competitive and quick decision makers. They are concise when making a decision and take an idea and proceed with it. They are aimed at the achievement of results, especially if the assignment is a difficult one. They are often viewed as impatient and impulsive and often inattentive to the little things (Thomas International, 2000, p 61).

An individual demonstrating dominant behaviour can be described as being quick to react. Such individuals love a challenge. They may be considered restless by some. An individual with high dominance is always ready for competition. When something is at stake, it brings out the best in them. They have respect for authority and responsibility and aim high and want their authority to be accepted at face value. If a challenge is not present, this person may stir up trouble. An individual with high Dominance will continually work long hours, especially to overcome tough situations.

In dealing with people, this person is usually direct, positive and straightforward, saying what they think; they are blunt and even sarcastic although not a grudge-holder. Such a person can explode and take issue with acquaintances. They take for granted that others think highly of them. An individual with a high dominance factor likes to be out front and have the spotlight. If they are not the centre of the stage, they will sulk. Such individuals may hurt the feelings of others without realising it. They tend to be responsive to flattery since they are essentially egotistical. They can be described as usually rugged and self-sufficient while being excessively critical and fault-finding when things or people do not meet their standards. After saying what they have to say, they forget it and move on. They will usually join organisations for the furtherance of some goal rather than social activity.

Such individuals are interested in the unusual and are adventurous and usually curious; they often have a large range of interests and are willing to

attempt anything. An individual that is classified as a having a high Dominance factor is a self-starter. Due to their multiple interests, they prefer an ever-changing environment. Such individuals may however lose interest in a project; once the challenge is gone and prefer that others complete the job to an obvious conclusion. Dominant individuals may spread themselves too thin in order to be an active part of as many facets as possible. Due to their innate restlessness, they continually seek new horizons. They tend to be dissatisfied and impatient. Dominant individuals are capable of doing detailed work necessary to obtain a goal, provided the detail is not repetitive or constant. They are generally resourceful and able to adapt easily to most situations. They must see a goal ahead and be recognised for effort (Thomas International, 2000, p 59).

3.2.2.2. Influence

A person with a high Influence factor can be defined as an active, positive posture in a favourable environment, outgoing, persuasive and gregarious. Such an individual is usually optimistic and can generally see some good in any situation Thus they are associated with positive behaviour in favourable or friendly situations, influencing others to act positively or favourably.

Such individuals may be described as acting impulsively and at times are inconsistent in the conclusions they reach. They are often inattentive to detail and have been known to have difficulty planning and executing time expenditure. Individuals with a high influence factor may lack depth in problem solving or even overestimate problem complexities (Thomas International, 2000, p 69).

A high influence individual is principally interested in people, their problems and their activity. They are willing to help others promote their projects as well as their own. Individuals with high influence may lose sight of business goals. People tend to respond to this person naturally. Such an individual will normally join an organisation for social activity. They meet

people easily and are poised; in addition, they become intimate on a first-name basis at the first meeting, with all the warmth of a life-long friendship. An individual that is labelled as being a high influence individual will claim to know a tremendously wide range of people and can be a name dropper. They tend to be superficial and shallow and can switch sides of an argument without any apparent awareness of inconsistency.

Such individuals tend to jump to conclusions and may act on an emotional impulse. They may make decisions based on a surface analysis of the facts. As they trust easily and are willing to accept people, they may misjudge the abilities of others. High influence individual's feel they can persuade and motivate people to the kind of behaviour they desire in them and usually perform well where poise and charm are essential factors. Public relations and promotion are natural areas of endeavour. Being reluctant to disturb a favourable social situation, they may experience difficulty in the area of disciplining subordinates (Thomas International, 2000, p 66).

3.2.2.3. Steadiness

Steadiness is the next factor that will be defined in accordance with Marston's theory. An individual with a high Steadiness factor can be defined as being passive and agreeable in a favourable environment; this individual thus displays passive behaviour in a favourable situation (Thomas International, 2000, p 74). They maintain steadiness to accomplish results and usually have a systematic approach, concentrating and finishing assignments. They are deliberate in approaching problem solving and fact gathering. They follow established procedures. High steadiness individuals work steadily for completion of a project. They are apt at time management and often set challenging objectives. They wait for orders before acting and are thorough with details. Individuals with high steadiness ask questions for clarification.

An individual that is classified having high Steadiness is usually amiable, easy going and relaxed. They are undemonstrative and controlled and not explosive and easily triggered. They may conceal grievances and be a grudge-holder. A high Steadiness individual likes to build close relationships with a relatively small group of intimate associates. They appear contented and relaxed. Such individuals are patient and deliberate in character and behaviour.

They are a good neighbour and always willing to help those considered to be friends. They strive to maintain the 'status quo', being wary of change, particularly when it is unexpected or sudden. Once in the 'groove' of an established work pattern, this person can follow it with seemingly unending patience. They are usually very possessive and develop strong attachments to work groups, a club, but particularly family. A high Steadiness individual has deep family ties and will be uncomfortable when separated from family or base for extended periods of time. They operate well as a member of a team and can co-ordinate their own efforts with those of others with rhythm and ease. Such individuals develop good work habits and can do routine work (this however, does not mean at a low level) (Thomas International, 2000, p 76).

3.2.2.4 Compliance

Compliance is the last behavioural dimension in Marston's theory on behaviour. An individual with a high level of Compliance is defined as an individual characterised by being peaceful, adapting to situations so as to avoid antagonism. Such an individual displays passive behaviour in an antagonistic situation and aims for compliance with high work standards to avoid trouble or error (Thomas International, 2000, p 82).

They usually employ a critical approach in solving problems and employ logical analysis to problems. They require a full explanation and thoroughness before doing the task. Behaviour usually associated with

Compliance is that, such individuals gather detailed information and examples and are set on getting things done right. They adhere to standard operating procedures to ensure quality (Thomas International, 2000, p 38)

A high compliance individual is sensitive and seeking of appreciation, thus this person can be hurt by others. They are basically humble, loyal and non-aggressive, doing to the best of their ability whatever is expected of them by others. Being basically cautious and conservative, this person is slow to make decisions until all available information has been checked. This may frustrate colleagues who are faster acting. As such individuals are reluctant to make decisions, there is a tendency to wait and see which way the "wind is blowing" before acting. A high compliance individual can often display a good sense of timing and shrewdness in selecting the right decision at the right time. They are capable of moulding themselves to the image expected of them. Such individuals will go to extreme lengths to avoid conflict and very seldom step on anyone's toes intentionally.

A high compliance individual strives for a stable, ordered life and tends to follow procedure in their personal as well as business life. They can be described as a systematic thinker and worker, who proceed in an orderly, predetermined manner. Such individuals are precise and attentive to detail. A high compliance individual usually sticks to methods that have brought success in the past. They try to escape the unfavourable but are unlikely to show this tendency if not placed in an antagonistic situation. They have a cautious, undecided response to an antagonistic environment designed to calm the degree of antagonism.

In Table 4 below a summary is provided of the four behavioural dimensions and descriptive words that are associated with each of them respectively.

Table 4: *Summary of descriptive words for Dominance, Influence, Steadiness and Compliance*

High

Dominance	Influence	Steadiness	Compliance
Assertive	Communicative	Amiable	Accurate
Competitive	Friendly	Dependable	Careful
Direct	Influential	Deliberate	Compliant
Driving	Persuasive	Good Listener	Logical
Forceful	Positive	Kind	Perfectionist
Inquisitive	Verbal	Persistent	Precise
Self-Starter	Confident	Steady	Systematic
Decisive			Cautious

Low

Dominance	Influence	Steadiness	Compliance
Indecisive	Probing	Active	Firm
Mild	Reflective	Alert	Independent
Non-demanding	Reserved	Demonstrative	Persistent
Cautious	Self-Conscious	Eager	Strong-willed
Hesitant	Suspicious	Mobile	Stubborn
	Logical	Restless	Unconventional

3.2.2.5 Speed and Accuracy

Speed and accuracy have also been identified as constructs that will be used in this research and thus it is essential to delineate and define these concepts and the way in which they have been used in this research. The speed and accuracy constructs used in this research make reference to the speed and accuracy as measured on a learning potential test.

3.2.2.5.1 Speed

Speed in this context can be defined as a result that is purely an indicator of how quickly the individual worked in certain tasks. Speed is reported as a number.

Speed, in the context of the learning potential measure, takes the following into consideration:

- (i) How many items has the individual completed?
- (ii) How many items does each subtest have?
 - a. Subtest one on the learning potential measure - Feature Detection contains sixty items.
 - b. Subtest two on the learning potential measure - Reasoning has fifty items.
 - c. Subtest three on the learning potential measure - Number speed and accuracy has sixty items.
 - d. Subtest four on the learning potential measure - Working Memory has a total of seventy two items.
 - e. Subtest five on the learning potential measure - Orientation comprises of sixty items.
- (iii) How many options has the individual had to choose from for the correct answer?
 - a. Feature Detection provides the individual with five alternatives.
 - b. Reasoning provides the individual with three options to choose from.

- c. Number Speed and Accuracy has three options that the individual needs to decide between.
 - d. Working Memory has only two options from which the individual needs to make a selection.
 - e. Orientation provides the individual with four alternatives.
- (iv) How many most others managed to complete. What is the standard?
 - (v) This is then calculated and plotted on a scale roughly equivalent to that of the General Training Quotient (GTQ) which runs from 68 to 131+.

In addition, a test takers individual speed scores are used to calculate an overall accuracy score for the learning potential measure.

3.2.2.5.2 Accuracy

Accuracy is also numerical in nature. It is a numerical indicator that is given as a percentage and calculated by dividing the number of test responses done correctly by the number of test responses done within a given time frame. To get a percentage this result is multiplied by a hundred.

The formula is thus:

$$(\text{Items done correctly} / \text{Items completed}) \times 100$$

An accuracy score is provided for each subtest on the learning potential measure and then used in the calculation of overall accuracy of the individual (Thomas International, 1986, p 70).

3.3 Measuring Instruments

Two measuring instruments will be utilised in this study, the first will be used to gather data on behavioural dimensions, while the second will be used to gather data on speed and accuracy scores on a learning potential measure. The two measuring instruments that will be used for data collection purposes in this study are:

- (i) Personal Profile Analysis (PPA) that measure behavioural dimensions.
- (ii) The Test for Training and Selection that measures speed and accuracy as part of the calculation of learning potential.

The Personal Profile Analysis measure (PPA) consists of 96 items measuring the four behavioural dimensions namely Dominance, Influence, Steadiness and Compliance (DISC) and allows for the identification of an individuals preferred behavioural style. The PPA questionnaire, as derived by Hendrickson, was introduced in 1981 and remained unchanged until 1997 when a revision was compiled to allow for current attitudes regarding equal opportunities and gender neutrality. The PPA is available in 50 languages and is used worldwide (Thomas International, 2000, p 3). The Test for Training and Selection (TST) is a result of the research commissioned by the British Civil Service in the mid-80. The TST looks at potential from cognitive perspective, known as learning potential or trainability.

The next section is dedicated to a discussion of the instruments used in the data collection of key variables in this study. It provides a brief overview of the psychometric measures development, standardisation, item format, reliability, validity and norms.

When deciding on which measure to use, the following was considered:

- (i) Access: The ease with which data could be obtained using the particular measure employed in research. Access also refers to being accredited to access and administer the tests.

- (ii) Amount: The amount of data that needed to be collected to allow for statistical analyses.
- (iii) Time: Consideration was also given to the amount of time that would be needed to collect the data.
- (iv) Distortion: How different the behaviour measured is to the actual behaviour. It needs to be acknowledged that specific measures may inhibit or enhance real behavioural responses.
- (v) Reliability: How reliable and consistent the measures are.
- (vi) Validity: Whether the measure actually measures the phenomena it was intended to measure.

(<http://www.psy.pdx.edu/PsyTutor/Tutorials/Research/Elements/P3.htm>)

All these elements listed above were considered with regard to the selection of the two measures used, namely the TST and PPA measure.

3.3.1 Personal Profile Analysis

The Personal Profile Analysis will hereafter be called by its abbreviation, PPA.

The Thomas PPA is a self-administered behavioural assessment. Forced-choice methods of evaluation are designed to eliminate the bias inherent in individual responses. In free-response methods of evaluation, social desirability may cause individuals to differ significantly in their responses (consistently rating their choices in either higher or lower ranges). Therefore, the PPA requires respondents to answer only most or least, and ultimately eliminates this variance (<http://www.thomasknowspeople.com/science.asp>).

The PPA is currently registered with the British Psychological Society (BPS) (Hendrickson, 2007) and the Health Professions Council South Africa (HPCSA) (HPCSA, 2006b; SATP, 2003).

The PPA is designed to measure surface traits, those behaviours readily seen and reported. Each dimension of behaviour, namely Dominance, Influence, Steadiness and Compliance (DISC) is reliably measured as it is shown that items on each scale contribute to the total score for that scale. The PPA thus describes behaviour and does not explain what causes behaviour, while still yielding valid information.

Because the PPA forces a person to choose between Most and Least, Very Highs and Very Lows, the extremities of the profile tend to be the certainties and the most stable factors. As a result, these are the most critical factors to analyse (Thomas International, 2000, p 8).

Each person has a particular way of working and behaves in a particular way. Some people become bossy at work and want to take charge, telling others what to do. Some act very cautiously, thinking about things before they act so as not to get into trouble. Some are willing to be told what to do and then to do it in a steady and organised manner. Still others enjoy talking to people in the workplace and doing exciting things (Thomas International, 2000, p 11). A person's work style is the way they show these characteristics when working. No work style is good or bad but some work styles are better suited to a particular job than others.

The designers of the PPA are of the opinion that by an individual knowing their own style, they can make sure that they take on jobs which best suit them and their behavioural preferences. Furthermore, by knowing the style of other individuals they can learn how to modify their style so as to work more effectively as a team.

The PPA is deemed as a quick, easy and accurate method of enabling individuals to describe their preferred work style. It is not considered to be a test as there are no right or wrong answers. It can be called a liberation instrument as it is an opportunity for each person to say, "This is me. These are my strengths. This is how I want to be treated."

3.3.1.1 Original Construction of the DISC measure

The first empirical trials were conducted by Hendrickson on a small group of 115 people (67 males/48 females) in 1958 and the occupational distribution was: 46 college students, 17 teachers, 27 supervisors, 16 other professionals, 13 office workers, 6 miscellaneous. Frequency distributions of responses were made and words were re-combined in tetrads such that each tetrad contained a word relating to each dimension. Moreover, attempts were made to combine words of relatively equal response strength in order to reduce the effects of social desirability in response patterns. High response words were grouped together with other high response words, low response words with other low response words. 76 of the original 96 words were absorbed in this manner and 5 extra tetrads were constructed to bring the total once more to 24. Of the words retained, 39% are the same as in the original word list provided by Marston.

The revised form was administered to a larger and more representative sample group of 500 (388 male/122 female) divided between the following occupation groups: 212 managers, 128 professionals, 62 clerical, 38 salespeople, 34 machine operators, 36 miscellaneous. A random sample of 100 was drawn from this group to determine split half reliability and inter-correlation among the four factors. The results indicated that the Personal Profile had a satisfactory internal consistency when assessed in this way. To eliminate non-discriminating items from the scoring key, an item analysis was initiated. A random sample of 185 (130 male/55 female) was drawn from a population of 1200 with an occupation distribution of 89 managers, 35 technicians, 26 office workers, 12 engineers, 12 salespeople, 6 staff and 5 miscellaneous.

The internal consistency was confirmed and the scoring key adjusted. At this stage, the Marston dimension of Submission was changed to Steadiness and the Marston dimension of Inducement changed to Influence. A random sample of 100 (75 male/25 female) was selected to test the new scoring key and the results correlated against the original trials. To develop and add to

the reliability, test/retest trials were conducted on a sample of 72 (47 male/25 female) with the new scoring keys. This research in the early 1960's and the final version formed part of an extensive paper on the question of behaviour in the work place. This paper was submitted to the American Psychological Society both in terms of the results the PPA achieved and the methodology of the research (Thomas International, 2000, p 4).

3.3.1.2 Further Exploration of DISC Measures

DISC Measures represent a measure in the analysis of a person's propensity towards a specific behaviour style. The four styles identified by Marston were reclassified as Dominance, Influence, Steadiness and Compliance, resulting in the acronym DISC. The "D" (Dominance) factor measures how people respond to problems and challenges. The "I" (Influence) measures how people make contact with others and influence them to their point of view. The "S" (Steadiness) measures how people like consistency and responds to the pace of their environment. The "C" (Compliance) measures how people prefer to respond to rules and procedures set by others (Bonnstetter et al., 1993).

To help clarify what the Marston's DISC Model measures, it may help to identify what the DISC Model does not measure. The DISC Model does not measure intelligence levels, values, skills, experience, education levels or training needs. What DISC assessments do measure is behavioural style (a person's preferred manner of doing things), all of which is observable. It is also important to delineate and explore the possible limitations as well as the strengths of the DISC model (Table 5) measures as they are understood by the researcher.

Table 5: Possible Strengths and Limitations of DISC Measures

Possible Limitations of DISC Measures	Possible strengths of DISC Measures
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<p>Although a psychometric instrument cannot be used in clinical settings to determine emotional health and therefore it cannot be utilised to provide clinical insights into people's psyches.</p>	<p>It has been found that in the present day, Marston's theory and postulations with regard to the interpersonal behaviour still hold true.</p>
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<p>DISC Measures are a self-score and self-interpretative instrument and thus are a subjective description of one-self.</p>	<p>DISC Measures provides a strength and limitation report as well. Thus indicating for each work strength there is a limitation</p>
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<p>The DISC Measures only utilise four dimensions to explain a very complex phenomenon.</p>	<p>DISC Measures are relatively simplistic and thus require little training to interpret profiles.</p>
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<p>The DISC Measures do not take the context of the individuals' into account (in that traits rarely express themselves consistently across various situations, most personality psychologists now accept as fact that traits and situations are interactive).</p>	<p>The labels that are used in the DISC Measures are user friendly in a business setting</p>
--	--

Possible Limitations of DISC Measures	Possible strengths of DISC Measures
--	--

To validate the DISC Measures results, the individual must be tested-retested and thus there is a need to ensure that the DISC Measures is taking a measure of the same situation, or risk; confusing the measure with true differences in a person's behaviour from one situation to the next.

The DISC Measures is a work measure, so if the applicant has never had work experience, is it a true reflection?

The DISC Measures Profiles are never completely stable, but usually it is the secondary factors which change the most. The extreme factors tend to remain stable.

The DISC Measures cannot identify intelligence, experience or qualifications which may have an impact on behaviour.

Elements such as needs, values and personality characteristics which are not measured by the DISC Measures are likely to come into play during times of change in behaviour.

3.3.1.3 Test/Item Format

There are 24 lines to be answered. The candidate is instructed to be as spontaneous as possible. They are instructed to go with their first thought as that is probably the right one. The completion of the PPA form should take only 10 minutes. Each line has 4 words/phrases on it. It is given to the testee who is requested to complete one line at a time. They are advised to think of themselves in the working environment. The PPA requires the individual completing it to choose one word/phrase which most describes them (M) and one word/phrase which is least like them (L) per line. However this approach to only choosing two words per line does not mean that the unmarked words are not part of his/her behaviour.

3.3.1.4 Test Output

As with each psychometric measure there are certain terms and jargon that are unique to that specific measure. The same is true for the PPA. Various terms and jargon are used when commenting on the results obtained after completing the measure; these are explained in the Table 6 below.

Table 6: *Jargon Used in the PPA Report to Describe the Results Obtained*

Abbreviation / Term	Description
PPA	Personal Profile Analysis
Profile	A graphic shape of behavioural characteristics
Tight profile	Any profile falling on or between 8 to 5 dotted lines
Midline	It indicates a clear divide separating opposites. It is not a continuum

High factor	Any factor that is above or on the midline
Low factor	Any factor that is below the line

The PPA provides the test taker with three distinct graphs (Figure 4) on the completion of the measure, these are:

- (i) Graph I – This graph is a reflection of the “Mosts”. It is known as the M graph and the Work Mask. Hence the picture provided by the “Mosts” tends to be how individuals like to mask themselves in order to be successful.
- (ii) Graph II – This graph provides a picture by providing by the “Leasts” and is known as the L graph or the behaviour under pressure graph. It also represents an individual’s historical or instinctive behaviour because when they talk in terms of “Leasts” it is usually based on past experience it takes into account all the things that the individuals have learnt in the past, in other words their instinctive learning. These are the characteristics which are likely to be exhibited in a pressure situation over and above everyday work pressure (a crisis). This graph describes the raw/real self.
- (iii) Graph III - This is the arithmetical total of the addition of the “Mosts” and the subtraction of the “Leasts”. It is the most important graph of all and approximately 70% of the individual’s total information comes from this profile. It is called the Self-Image. It is most important because it takes cognisance of both the “Mosts” and the “Leasts” (Thomas International, 2000, p 13).

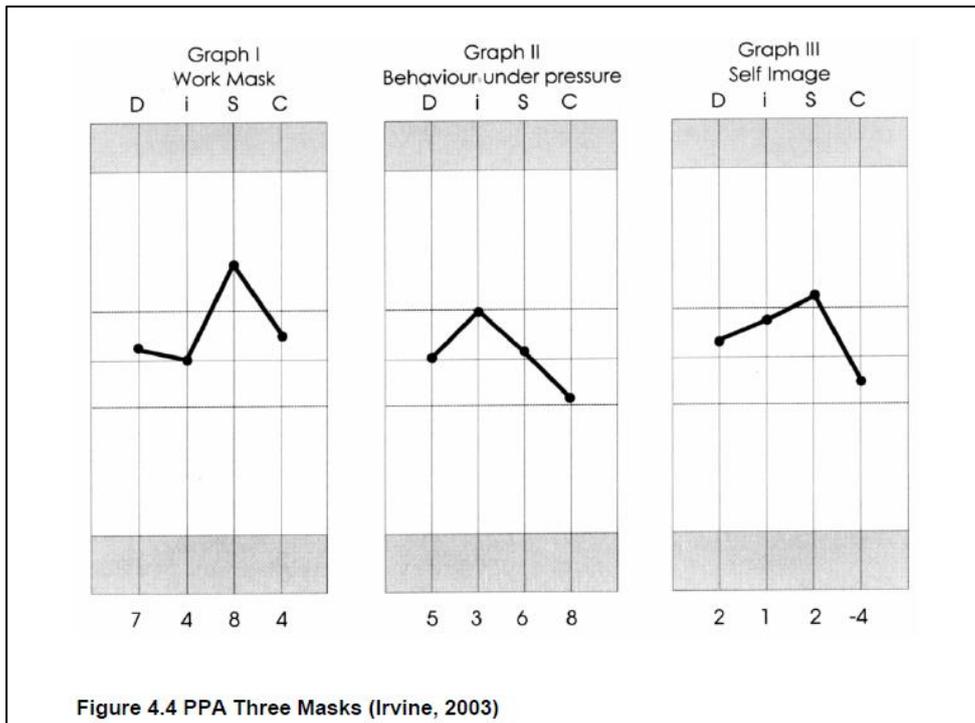


Figure 4: Three distinct graphs provided by the PPA as output

It is also important to remember that the midline is a clear divide between opposites. In Professor Marston's original theory, it would represent the watershed between active and passive and between antagonistic and favourable Dots that are above the centre line are considered as 'high'; when they are below the centre line, they are considered as 'low'. For example, see above in Graph II; this individual's pressure mask indicated high I, high D and high S, but low C. This represents that this individual is more likely to remain a high I person, with acceptable D and S, but low C during pressure condition. This profile is termed ISD (followed by the strength of the profile) in Thomas system.

It should also be noted that when reading a PPA graph that its shape is always more significant than its size. Another point for consideration is that a change of shape between graphs, i.e. the movement of a particular factor, is an indication of a modification of behaviour. Where there is substantial modification there also tends to be significant stress.

Therefore, the mechanism that is embedded within the PPA allows for the identification of Hi- Lo marker. This means that items are only scored when

marked with 'M' or 'L'. Hi items are the 'non-socially preferable' items. This means that, it is very likely that they would be marked as 'L' (least). Such items normally contain extreme descriptions of certain traits of the target culture, and they are therefore very likely to be marked as 'L' (least). It is unlikely that ordinary individuals would describe themselves in these terms, especially when referring to the sample that is being used in this study.

However, it is very common for subjects to deny that they possess these traits. Since scoring 'L' would decrease the spread due to the reason that most of the respondents would use such an option, that option is excluded. The item is scored only when it is marked with 'M' (most). This is the rationale behind **Hi item**. Alternatively, **Lo items** are the 'socially preferable' items, which mean that they are very likely to be marked as 'M' (most). Scoring all the 'M' responses would also decrease the spread of the data. Therefore they are only scored when they are marked as 'L'. This is the rationale behind **Lo item**. The other items are neither popular or unpopular in terms of 'M' or 'L' and no Hi/Lo scoring structure is therefore assigned (Huang, 2011).

The PPA system uses the percentile rank as the aim of interpretation. Individuals who generate a more than a 50 percentile rank would be considered as 'High' on this specific construct.

It can be concluded that the PPA instrument has compared favourably against other Marston-based instruments. One of the instruments based on Marston's theory was compared against five popular psychological instruments and found to compare favourably to each of them in terms of accuracy and reliability. Researchers have concluded that the PPA instrument displayed a high degree of similarity to the compared instruments and is an assessment tool that shows much evidence of constructive validity. (<http://www.thomasknowspeople.com/science.asp>)

3.3.1.5 Reliability, Validity and Utility of the PPA Instrument

It is generally accepted that the efficacy of tests, or assessments, is best measured by Reliability, Validity and Utility. The PPA is widely used by individuals, business and government including several Employment Equal Opportunity Commissions agencies in the United States. Since its development in the 1960's, the PPA has never been challenged in court. Marston-based instruments similar to the PPA have been administered to over 30 million people worldwide and have earned the respect of individuals and professionals alike based on their accuracy and validity (Hendrickson, 2004).

3.3.1.5.1 Reliability

A test is said to be reliable if it provides the same result for each subject on different occasions. **In considering Validation & Reliability Estimates it needs to be ascertained** what constitutes validation of behavioural assessments instruments.

Reliability estimates for the PPA were obtained using the Spearman-Brown split-halves reliability coefficient. This coefficient indicates the degree of internal consistency of response to the instrument as a whole. The coefficients for each dimension are represented in Table 7 below and are compared to a similar study completed previously.

Table 7: *Spearman-Brown split-halves Reliability Coefficient for the PPA*

	<u>Study 1</u>	<u>Study 2</u>
Dominance	r=.92.	r=.91
Influence	r=.89.	r=.90

Steadiness	r=.91.	r=.92
Compliance	r=.90.	r=.89

It is evident from these reliability coefficients tabled above that there is an unusually high degree of internal consistency in response to the PPA as a whole, and to each of the related behavioural dimensions.

The study with regard to internal consistency was replicated, in part, by Watson (1989) of Wheaton College; he tested the internal consistency of two DISC measures, The Thomas Personal Profile Analysis and the Personal Profile System and found internal consistency figures similar to the results in the table above. The study concluded that there is no statistically significant difference between the scores of the PPA and the Personal Profile System. Another study was conducted in 1983, by Kaplan to investigate the validity of the PPA. In this study the PPA was compared to the following psychological instruments:

- (i) Wechsler Adult Intelligence Scale
- (ii) Myers-Briggs Type Indicator (MBTI)
- (iii) Cattell 16 Personality Factor Questionnaire
- (iv) Minnesota Multiphasic Personality Inventory
- (v) Strong Interest Inventory
(<http://www.thomasknowspeople.com/science.asp>)

Kaplan found that the validity of the PPA measure was comparable to that of the five tests it was compared to (Wittman, 2008). Numerous other studies have also been done with regard to the PPA Instrument and the four key behavioural dimensions which it assesses. In one such a study, a substantial sample size (n=2771) was utilised. It found the PPA to be a valid and reliable measure as Dr. Marston's system is in complete mathematical harmony with the works of Jung.

The test supplier recommends that the PPA be administered at intervals of no less than 3 months. The minimum acceptable index for test reliability is 0.7. High test/retest reliability has been demonstrated by the PPA. UK and international data is regularly reviewed, one such a review of the test/retest reliability analysis involved 72 people (47 male/25 female), all employed in executive or professional positions. The re-test intervals ranged from 3 to 12 months, with a mean of 5 months. The test/retest reliability coefficients of the PPA dimensions (DISC) were as per Table 8:

Table 8: *The Test/Retest Reliability Coefficients of the PPA Dimensions*

Dimension	Test/retest reliability
D	0.84
I	0.70
S	0.77
C	0.87

These results suggest that the PPA is a reliable assessment measure which is stable over time.

3.1.3.1.5.2 Predictive Validity

Early data suggested that the PPA and its interpretation of the DISC factors achieved a predictive validity of 85%+. More recent research conducted by Professor Sidney Irvine, whose results were published in the journal "Current Psychology" (Irvine, Mettam & Syrad, 1994), showed that PPA

provides good predictive validity when objective and verifiable criteria are applied. It showed clearly distinguishable profiles for different job types and also clearly identifies differences within the profiles for successful and sub-standard performance within these roles. Evidence for the validity of profile types as persistent and recognisable personal work-styles is due to be published in the near future by Professor Irvine (Thomas International, 2000, p 5).

3.1.3.5.3 Concurrent Validity

Any test or assessment can be claimed to be valid if it measures what it claims to measure. Concurrent Validity indicates where test and retest results, using one instrument, confirms that another instrument, or instruments, are saying similar things about the same people. International studies that compare PPA results with 16PF and OPQ Factor 3 indicate that there is a close correlation between the PPA and other reliable and valid assessments (Thomas Technical Manual, 1986). Between 1981 and 1987 major trials, conducted by suitably qualified practitioners, clearly showed that PPA is saying the same things about the same people as do 16PF, MBTI and 16PF, as identified in chapter 2 Figure 2.

3.3.2 Test for Training and Selection – TST

The Test for Training and Selection will be called by its abbreviation TST from this point on.

Mamphela Ramphela (1999) is of the opinion that "We need to discover how to build a system that focuses on excellence that is accessible to all and promotes the development of the young into citizens who can build the country. We may share different backgrounds, but we are all human beings. By focusing on potential, we can nurture talent."

The TST is thus an aptitude test with an independently validated battery of normative ability tests. While academic achievement plays a large part in selection decisions, it is not an effective measure of a person's mental ability and potential. The TST aptitude test measures a person's mental processing speed, current ability level and ability to learn new information. The results provide insights into how quickly a person can learn and retain new skills and information. The TST is an ability test, not an intelligence test.

The TST is utilised to obtain an indication of the individual's learning potential and cognitive responsiveness to new training and developmental tasks in the work environment. Each occupational role requires different fields of trainability, e.g. Human Resources requires the individual to be strong in literacy, reasoning and mental concentration, whereas technical positions require the individual to be strong in the fields of orientation (practical and hands on work), problem solving and a level of concentration.

The TST measure can be utilised to assess an individual's ability to learn as well as their mental agility. It can also be employed to measure an individual's concentration levels, speed and accuracy. A further use will be to determine an individual's number skills and their ability for deductive logic. The TST is also employed in the identification of an individual's mechanical and technical orientation. Another facet that it can assess is the individual's verbal reasoning as well as their ability to retain information. It also gives an indication of the test takers literacy level and their ability when considering mental visualisation (<http://www.thomas.co.za>)

The TST was developed by Dr. Janet Collis and Professor S.H. Irvine in 1994 on behalf of central government agencies by The Human Assessment Laboratory of the University of Plymouth.

3.3.2.1 Original Construct Methodology

The TST is a workplace oriented test battery and is a normative aptitude test. The British Civil Service commissioned the original research for the TST in the mid 1980's which was carried out at Plymouth University, under the auspices of Professor Sidney Irvine, Head of the Human Assessment Laboratory. In 1992, numerous (documented) reliability and validity studies had been completed for the Directorate of various Government Departments. The TST is the result of this comprehensive research program and is available now as an important managerial tool.

3.3.2.2 Test/item format

The TST consist of five different sub-tests, each contributing to the overall measure of Fluid Intelligence. It is a timed pen and paper based test that consists of five subtests, each dedicated to another aspect of Fluid Intelligence.

The sub-tests are as follows:

- (i) Feature Detection is a perceptual speed measure. Feature Detection is said to measure the Psychometric factor of General Speed (Gs). This sub-test assesses how quickly and accurately an individual can check for error and precision when dealing with alphabetical, text-based information, and then evaluate the data and/or make inferences against this. In addition, it is a measure of perceptual speed and general literacy. An example of an item in feature detection is provided in Figure 4:

D F H R a g t r <hr/> 0 1 2 3 4	q a c b Q A C B <hr/> 0 1 2 3 4	M N D E w f t h <hr/> 0 1 2 3 4
---------------------------------------	---------------------------------------	---------------------------------------

Figure 5: Example of an item in the feature detection sub-test of the TST

- (ii) The Reasoning Test is a deductive reasoning measure. Reasoning explores the Psychometric Factor of Fluid General Intelligence (Gf). This sub-test assesses the ability of an individual to hold information in memory and solve problems after receiving either verbal or written instructions. It is a useful measure of overall learning potential, negotiation skills and deductive reasoning. Each question is about who is heavier or lighter or taller or shorter – or something else – than the next person. Test takers are asked to put a circle around the letter beside the correct answer. An example (Figure 5) of a reasoning question is provided below:

Rachel is taller than Wendy.
Wendy is taller than Karen.
Who is tallest ?
[A] Rachel [B] Wendy [C] Karen

Figure 6: An example of an item in the Reasoning subtest of the TST

(iii) Number, Speed and Accuracy is relevant to mental agility and general memory assessment. Number Speed and Accuracy can be described as measuring the Psychometric Factor General Memory Capacity (with Numerical Specific) Gm. This is an assessment of numerical potential. It is relevant to most roles that emphasise the need for high concentration levels and numerical aptitude. It also assesses mental agility and general memory. The test taker is asked to see how quickly and accurately they can carry out simple number tasks in their head. They are asked to find the highest and the lowest of a set of three numbers, then decide whether the highest or lowest is further away from the number that remains. An example of the test item is provided below (*Figure 7*).

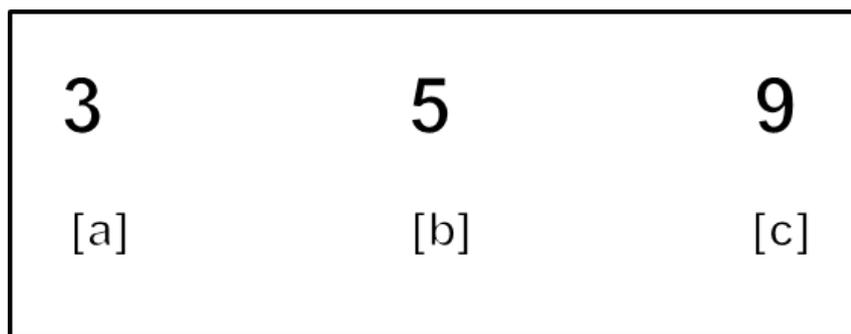


Figure 7: An example of an item in the Number Speed and Accuracy subtest of the TST

(iv) Working Memory is seen as the sub-test relevant to information retention and deductive logic. Working Memory is dedicated to the Psychometric Factor of General Memory Capacity (Gm). This is a deductive problem solving assessment. It is especially relevant in roles with a high mental workload and reliance on memory, where there is a need for sustained mental attention and where concentration over long periods is a prime requirement. This sub-test will have questions such as those shown in Figure 8. The testee is told that it is an exercise in how quickly and accurately people carry

out simple memory tasks in their heads. They need to remember the order of the letters in the alphabet to do this task. They are asked to look at a set of three letters in the alphabet, then decide which one of the two letters with circles beneath them is further away from the letter in the middle of the order

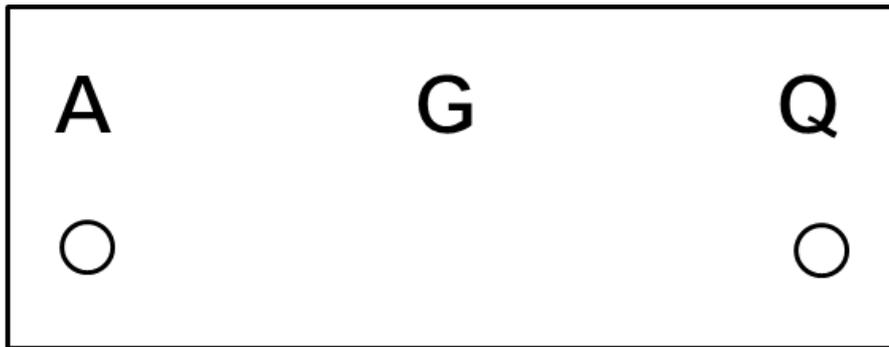


Figure 8: An example of an item in the Working Memory subtest of the TST

- (v) The Orientation subtest is a spatial orientation measure. Orientation is said to measure the psychometric factor of General Visualisation (Gv). This test examines an individual's ability to deal with mechanical and technical detail, logic, strategic problem solving and spatial aptitude. Orientation is introduced to the candidates by the following sentence; telling them that it is an exercise on how quickly people can turn shapes around in their heads. The puzzle is to find given blocks of shapes, one above the other, and decide how many pairs are exactly the same shapes. They need to rotate the shape without flipping it over to make the pairs. An example (Figure 9) of an Orientation test item is as follows:

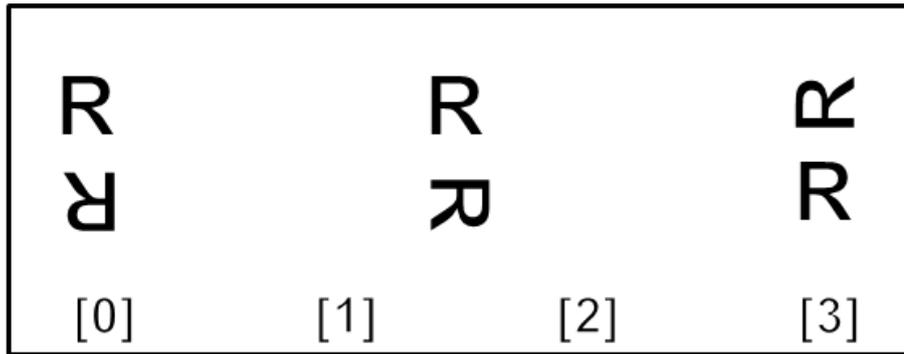


Figure 9: An example of an item in the Orientation subtest of the TST

An individual accredited as a test administrator generates raw scores utilising the scoring masks. These raw scores are captured by the accredited administrator in a standardised format provided on the front cover of each candidate's test pack, providing the accredited individual with the following information as indicated in Table 9 below.

Table 9: Example score output on the TST measure

Test Name	Done	Right	Percentile	Benchmark Graduate	Benchmark SchoolLeaver	Accuracy	Speed	GTQ
Feature Detection	37	31	50	70	60	83	97	100
Reasoning	19	18	55	30	20	94	118	102
Number Skills	18	16	5	20	10	88	81	74
Working Memory	21	17	5	40	30	80	70	74
Orientation	37	33	85	40	35	89	154	116
OVERALL			30	40	30	86	104	92

The score has been described in technical publications as a measure of Fluid Intelligence. The higher the score, the better the individual is likely to be at performing mental tasks accurately and quickly. Results from a TST are given in two forms: a TQ (Training Quotient) score and a percentile rating showing the position of the candidate compared to the norm which has been

delineated as Executives in Management, Senior Supervisory Roles and Graduates.

The TST aptitude test is applicable at all levels of the organisation. Accurately identifying an individual's ability level will enable you to match candidates and employees more effectively with job requirements. The TST aptitude test is also used to benchmark your current work force so that continuous improvement can be achieved.

3.3.2.3 Reliability, Validity and Utility of the TST instrument

The TST Assessment is a measure of Fluid Intelligence which provides a reliable indication of development potential and trainability. It is not a measure of performance nor is it a measure of accumulated knowledge. The TST was developed in the United Kingdom where it was extensively validated using 20 000 test subjects. TST has a reliability coefficient of 0.94.

In the TST, reliability was determined by employing both split half reliability as well as test/retest reliability. The split half reliability aimed at checking the internal consistency of the TST. In the case of the TST there are 5 different sub-tests, each measuring something different to the other. Together, the aim is to measure fluid intelligence. Therefore internal consistency is important. Each sub-test must measure the construct for which it was designed each time. If this is the case it can be said that reliability is high. Internal consistency is increased by a standardised administrative process (Wright 1992).

With the other measures, reliability comes from a procedure by which the same subjects are tested twice with time interval between tests. This is known as test-retest reliability. In the case of TST, three interval periods (immediate retest, six week intervals, and longer than six weeks) were used and the correlations were then analysed.

A third form of reliability test is used and refers to reliability of a parallel form of the TST. If the parallel form of the original test gives the same results, it is referred to as parallelism.

In the Table 10 below, a summary of the results of the various reliability tests are provided.

Table 10: Reliability results of the TST measure

Reliability measure for sub-tests	Feature Detection	Reasoning	Number Speed and Accuracy	Working Memory	Orientation
1. Internal Consistency	.81	.90	.93	.88	.94
2. Test/Retest Reliability	.74	.78	.86	.84	.73
3. Parallelism	Analysis of variance showed no significant differences				

The results for the reliability trials show that the series has very good internal consistency on a single trail, satisfactory test/retest reliability and parallelism. The test can therefore be totalled to provide a general training index of how well an individual is likely to perform in training contexts. When this is done, the reliability of the composite has been shown by Wright (1992) to not be less than .95.

Validity for the TST employs the following types of validity, namely face validity, content validity, construct validity, concurrent validity and predictive validity. The results of all these various validity measures were found to be fully acceptable to excellence depending on the type of validity that was tested for (Thomas International, 1989, p27).

3.3.2.4 Factors associated with TST test performance

In any appraisal of validity and reliability, it is important to report what factors are associated with test performance. Irvine and Berry (1998) offered taxonomy of such influences for testing in general, of which only two have been consistently observed in many studies carried out over the past four years.

One of them is a treatment effect and the other is a dispositional quality:

- (i) Treatment effects, such as practice, prior test experience and/or coaching are described as low inference variables by Irvine & Berry (1998). Previous exposure to the TST tests will increase test performance but will affect the reliability except where the first test is artificially depressed because of literacy and numeracy skills below those of an average 11 year old.
- (ii) Dispositional variables, such as sex, age and severe mental and physical impairment are attributes that seldom, if ever, undergo a significant change. Whereas age and impairment may be described as low-inference because they cause performance change, the same cannot be said for sex differences, which are associated with test performance but which cannot easily be said to cause it. (TST Manual 142)

3.3.2.5 Norm groups

An extensive norm group was assembled during the South African test phase. Research participants from a range of companies from all the major centres in the country were included in the study. Subjects were not selected randomly because the norm sample had to reflect the real work environment in South Africa rather than a theoretically defined population. The research findings showed that the best manner in which candidates can be compared fairly would be in relation to different language categories (Dann, 2004). South African norms have therefore been developed for three main language

groupings, namely African, Afrikaans and English. Considering age, education, race and gender information, the total sample size n=1632 (TST Standardisation Documentation).

3.3.2.6 The context in which the test is used

The TST was intended for application in the workplace. It was created for measuring fluid intelligence from a normal cognitive functioning perspective in a business related context. The assessment is utilised as part of human resources or organisational decision making processes and can be applied to:

- i. Recruitment
- ii. Development and training
- iii. Identifying potential for advanced roles
- iv. Succession planning
- v. Career management based on natural cognitive strengths

The Human Resources department can use the information obtained from the TST measure to determine if the person under consideration can think on their feet, cope with the mental demands of the job, is a high performer and/or if the person is a problem solver.

TST is administered as a pen and paper based test and can be administered in both group and/or 1-on-1 formats. The test items all have clearly defined right and wrong answers. All subtests are scored for speed (the number of items completed in the allocated time) and accuracy (the number of items completed correctly) using standardised scoring masks this scoring method is objective, and raw scores are captured on a standardised software system.

In order to administer, score and interpret the results of the TST an individual would need to be accredited on the TST user course. The course will accredit individuals from organisations to administer the TST. It is also noteworthy that the accreditation course can only be run by psychologists/accredited in-house professionals under the direct supervision of the psychologists. The researcher thus had to receive training in the TST measure to ensure that the results generated from the tests could be understood and used in the current research study. The course attendees will be legally obliged to adhere to the terms and conditions specified for administration and use of this psychological test.

3.4 Sample design and sampling method

3.4.1 Sampling Methods

The data was collected by the researcher and her colleagues during assessment centres run at ACT for recruitment and development for clients of ACT. The sample consisted of the literate working adult population of South Africa. Not all candidates that came to ACT for recruitment and development assessment centres were exposed to the TST and PPA due to the requirements of the ACT client. Therefore, the researcher could only collect data in assessment centres that required the candidate to complete both assessment tools.

The quasi-experimental design does not allow for random allocation of respondents. This approach involves selecting groups, upon which a variable is tested, without any random pre-selection processes. As the researcher utilised a one group posttest, quasi-experimental research design, no allocation into groups was necessitated.

This has been described as a flexible approach to sampling, as it does not lend itself to the implementation of rigid rules. (Watters & Biernacki, 1989)

This implies that the cases included in the sample are gathered in such a way that it does not give all the individuals in the population an equal chance of being selected. This sampling method was chosen due to the following considerations:

- (i) The time available to collect the data.
- (ii) The cost implications of collecting data.
- (iii) The testing environment in which the measures have to be administered.
- (iv) The accessibility of the respondents that have completed both measures.

The researcher agrees with Kerlinger (1986), who stated that taking any portion of a population or universe as representatives of that population or universe does not imply that it is in fact representative but the portion that has been selected is considered to be representative. It is imperative to familiarise oneself with the various sampling procedures firstly to ensure that the best sampling method was employed and secondly to show awareness of the possible limitations of this method in relation to the other methods that could have been utilised. The researcher is aware of the limitations that this sampling approach holds in that an unknown proportion of the entire population was not included in the samples. This implies that the sample may not represent the entire South African corporate population accurately. Therefore, the results cannot be generalised pertaining to the entire corporate South Africa.

The primary goal of this sampling procedure was to obtain a representative sample with an acceptable margin of error. Whatever the undefined characteristics of the population from which the sample came, the researcher will know that the population includes the independent variable as a characteristic because the researcher manipulated the sample. Even though nothing else is known about the imaginary population from which the sample was selected, it can be assumed that the sample represents a population that has experienced the independent variable.

3.4.2 Sampling Bias and Sample Size

Sampling bias can be a result of systematic errors in the sampling process, e.g. if the researcher wanted to take one fourth of the students in a grade four class as a sample to use in a research study, notes are sent to the parents requesting permission for their child to participate in the study and the researcher will then select those students whose parents give permission as the sample for the study. In this study, the same aspect of sampling bias may be present as the researcher could only use those cases where the respondents indicated that they do provide permission for their results to be used for research purposes. The sampling bias as described above can also be implicit in the current study as only individuals that attended an assessment centre in which they completed both measures could be selected as part of the sample for this study.

When referring to sample size the general rule is the larger the sample size, the more representative it is of the population, the ideal sample size is shown in Table 11 below (Krejcie & Morgan, 1970).

Table 11 Random Sample Sizes (n) Required for Population (N) Representation

Population Size (N)	Sample Size(n)
50	44
100	80
500	217
1000	278
1500	306
3000	341
5000	357
10000	375
50000	381
100 000	384

For this research project the population size was unknown to the researcher. However, when referencing All Media and Products Survey (AMPS®)

conducted by the South African Research Foundation and released twice a year, it is evident that of the 34,019,670 people that reside in South Africa, 32% of these are employed full-time. Only 6,533,738 are employed full-time in the private sector (i.e. corporate South Africa). According to AMPS® full-time employees in the private sector fall into the following occupation groups (Figure 12).

Table 12: AMPS results for full time employees in the Private Sector fall into the following Occupations group

Occupation Groups	Private Sector
Total (Autobase)	6,533,738.00
Row %	100%
Clerical/Sales	23%
Service	18%
Production/Mining	13%
Professional/Technical	11%
Artisans	10%
Agriculture	10%
Transport/Communication	7%
Admin/Managerial	6%
Other	1%

From the data above it is evident that only 6% of the individuals employed full time in the private sector are in managerial/supervisory positions and 11 % can be defined as holding a professional/technical role. In addition, it is estimated by this survey that only 19% of the South African population have a post grade 12 qualification. Therefore, for the purpose of this study, it will

be assumed that graduate, supervisor and managerial corporate population within South Africa is a population of 1,689,425 in total.(All Media And Product Survey 2011A (Jul '10 - Jun '11)).

The sample for this study has 398 cases of individuals who completed both the TST and PPA. When calculating the best sample size for 1,689,425 a sample size of 385 is seen as optimal, providing a 5% margin of error, 95% confidence level and response rate of 50% (which is within the industry specifications). When considering the current sample size obtained, the margin of error for the sample is 4.91%

3.5 Data Collection, Methods and Field Work Practice

All the data collection was done by an accredited individual, who has received accreditation on both measures from the test distributors and was employed by Assessment Centre Technologies. The administrators comprised of psychometrists, industrial psychologists and intern research psychologists. The measures were completed as part of an assessment centre for recruitment, development or selection of individuals. The individuals signed a consent form on which it was indicated that the results will be kept confidential and may be used for research purposes. On the TST cover page, it indicated which information will be used for research purposes.

All tests were administered in a controlled testing setting; this implies the following conditions were maintained for the duration of the testing:

- (i) A quiet room with a desk and a chair,
- (ii) Adequate lighting, and
- (iii) Minimal noise.

Once the respondents had received writing utensils, were briefed as to what the aim of the assessment was and what would be expected from them during the administration, they completed the measures as per the test instructions and timing.

When completing the PPA the respondents were given time to complete their biographical information. They were then provided with the instructions on how to complete the measure. One example was provided to them to ensure that they understood how to complete the measure. Although no time limit was given for the test, the respondents usually completed the measure in a time of between ten to twenty minutes. It was suggested that individuals try to complete the measure quickly and swiftly, choosing the answer that first comes to mind in order to prevent a socially desired response.

When administering the TST, the respondents were asked to complete the biographical information and not to page over until they were instructed to do so. The purpose of the assessment was explained to the individuals. The administrator then proceeded to take the testee through the instructions. The testee was given time to go through the instructions and do examples per sub test. Before the actual assessment began the administrator would check the examples and explain if the instructions were not clear. As previously mentioned, items were set at one particular level and there was no progressive increase in difficulty. The actual assessment was timed and the respondents were told when to start and stop every test. Time was limited and the individual was instructed to work as fast and as accurately as they could.

All these tests were done under invigilation as this would ensure that queries, discipline, emergencies and general maintenance of the test environment.

Data collection was spread over a long time period (May 2004 – December 2011) as a maximum of five individuals were sent to be assessed in a given week and some weeks no assessments were conducted at all. As previously indicated, the researcher made use of data that was collected in assessment centres for recruitment and development by an independent assessment house.

3.6 Data Capturing and Editing

It is a well-known fact that when gathering and coding data (preparing data for analysis) data collection must be accurate, where tests are used, they must be scored correctly and observations must be made systematically. In this particular study, data had to be coded and an electronic spread sheet created in Microsoft Excel was created, to allow both raw data and coded data to be recorded. The spread sheet was used to calculate descriptive and inferential statistics on the data as well as to export data to SPSS (<http://www.mnstate.edu/wasson/ed602lesson2.htm>).

The researcher is aware that errors need to be considered as part of the data capturing, especially as the scores were manually captured in a Microsoft Excel spread sheet. Therefore, numerous checks of the data were conducted in order to correct any capturing errors that may have occurred. Any incorrect inputs were rectified to ensure that the data set that was used in the analysis could be deemed as correct. Also, random checking is applied to assure the accuracy of data.

The data was grouped and coded in the following manner:

3.6.1 Demographics

Gender was coded as Female = 1 and Male =2. Race was coded as Coloured = 1, Indian = 2, Black =3 and White =4.

3.6.2 The PPA

For the PPA, each behavioural profile that was found to be present in the sample was named and allocated a code (Table 12), Forty two unique behavioural profiles were identified. The same code frame was used for the Work, Pressure and Self Image Mask. In addition, each behavioural dimension was coded into high (dot falls above midline) and low (dot falls below the middle line) providing the researcher with a dichotomous variable.

Table 13: PPA behavioural profiles found to be present in the sample

Behavioural Profile	Code	Behavioural Profile	Code
DCI	1	DS	23
CS	2	ID	24
CSI	3	IC	25
DIC	4	IS	26
ICS	5	CD	27
IDC	6	CI	28
IDS	7	CS	29
DSI	8	SD	30
ISC	9	SI	31
CSD	10	SC	32
SCI	11	D	33
ISD	12	I	34
CID	13	S	35
CIS	14	C	36
CDI	15	DSC	37
CDS	17	DCS	38
ICD	18	SCD	39
SIC	19	SDI	40
SDC	20	DIS	41
DI	21	SID	42
DC	22		

In addition, the highest factor on the Self Image Mask was also recorded and coded to be used as part of the analysis. The codes were kept the same as above for Dominance, Influence, Steadiness and Compliance.

The individual scores obtained per behavioural dimension per graph were also captured into the data set; however, these were not coded due to the small range of these numbers

3.6.3 The TST

When consideration was given to the data that was obtained from the TST measure, the following parameters (*Figure 10*) provided by the test distributors was considered when grouping and coding the speed, accuracy, percentile and general training quotient.

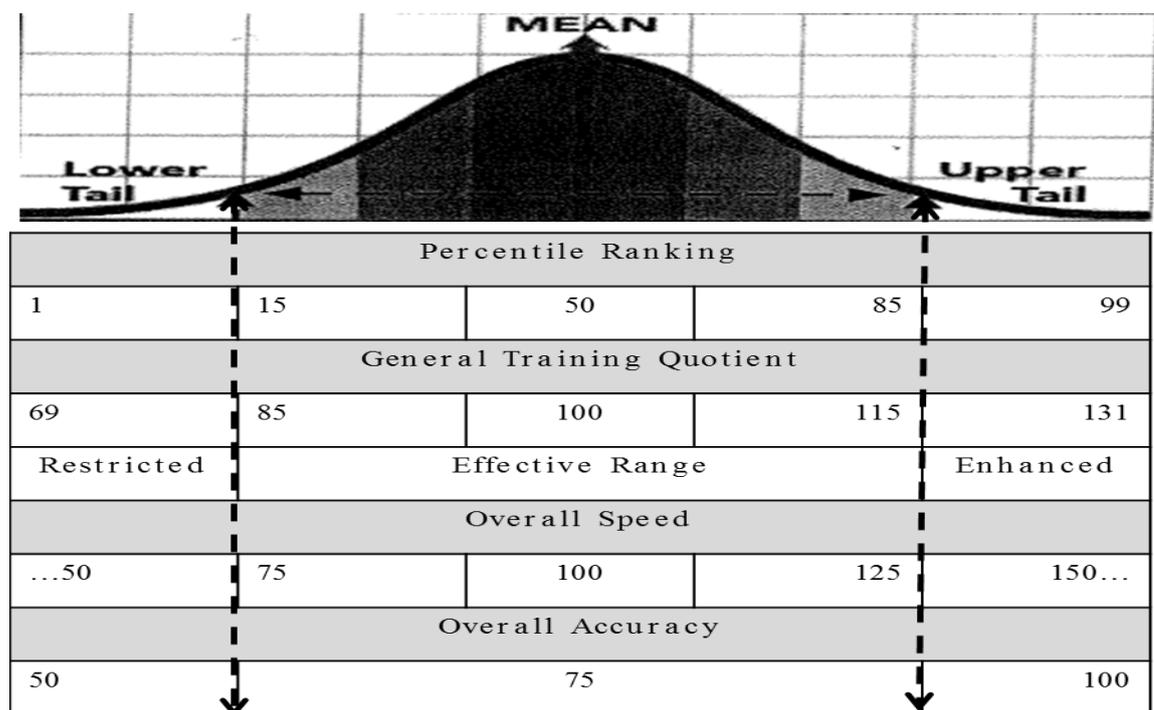


Figure 10: TST speed, accuracy, percentile and general training quotient groupings

Therefore, the grouping for percentile was done as follows (Table 14).

Table 14: Coding for Percentile on the TST

Naming Convention	Range	Code
Very Low	1-5	1
Low	6-19	2
Below Average	20-44	3
Average	45-59	4
Above Average	60-89	5
High	90-95	6
Highest	96-99	7

While the scores for Accuracy were grouped and coded according to the parameters below (Table 15).

Table 15: Coding for Accuracy on the TST

Naming Convention	Range	Code
Very Low	1-15	1
Low	16-30	2
Below Average	31-45	3
Average	46-60	4
Above Average	61-75	5
High	76-90	6
Highest	91-100	7

Speed scores on the TST were grouped and coded in the following manner (Table 16).

Table 16: Coding for Speed Scores on the TST

Naming Convention	Range	Code
Very Low	>50	1
Low	51-74	2
Below Average	75-89	3
Average	90-109	4
Above Average	110-125	5
High	126-146	6
Highest	150<	7

While the General Training Quotient was grouped and coded based on the following parameters (Table 17).

Table 17: Coding for General Training Quotient on the TST

Naming Convention	Range	Code
Very Low	69-74	1
Low	76-84	2
Below Average	86-96	3
Average	98-102	4
Above Average	103-114	5
High	115-126	6
Highest	127 -131	7

3.7 Data Analysis

As the data that was collected in this study was numerical in nature, statistical analysis was utilised to analyse the data and provide findings with regard to the research question the researcher was trying to answer.

The data analysis was to be undertaken in a three step approach.

- (i) Describing the data that is in the data set.
- (ii) Determine if differences exists between an individual's behavioural dimension (high or low) and their speed and accuracy score obtained on a learning potential.
- (iii) Hypothesis testing.

Valentin (1997) made a claim that with an understanding of eight statistical procedures, it is reasonable to have an understanding of 90% of quantitative research. Experimental designs lend themselves to straightforward, often simpler, statistical analysis than quasi-experimental designs. Advanced statistical procedures are typically necessary in quasi-experimental research, largely due to the lack of randomisation (Dimsdale & Kutner, 2004).

Two specific techniques include multiple regression analysis and factor analysis. Multiple regression analysis is a statistical application that is utilised in studies in which impact is being measured. Using statistical methods, a control group is simulated, and multiple adjustments can be made for outside factors. Thus, the control that is in the design of an experiment is inserted through analytical techniques (SERVE Centre, 2007).

Factor analysis is a useful technique when a study has a large number of variables. This statistical application allows for a reduction in the number of variables while detecting possible relationships between those variables of interest (Dimsdale & Kutner, 2004). It is commonly applied when data is collected through a survey, especially when the survey contains a large number of items. Analysis of covariance (ANCOVA) is yet another analytical technique employed to increase the strength of the quasi-experimental design. By making compensating adjustments, ANCOVA reduces the effects of the initial differences between groups. This again is an attempt to respond to the lack of randomisation

The section below will explore each of these steps in detail put forward above.

The statistical analysis will aim to:

(i) Provide descriptive statistics

This will be done by describing data to be used in the research study by reporting on the frequencies. This step will be employed to ensure that there are sufficient observations per category to allow for a

meaningful distribution, thus ensuring the exclusion of categories that have insufficient observations from the analysis.

- (ii) Determine if differences exists between an individual's behavioural dimension (high or low) and their speed and accuracy score obtained on a learning potential

This will be done by utilising two statistical approaches, contingency tables and significant difference test. This will allow the researcher to determine if any patterns can be identified that could be indicative of significant differences on speed and accuracy scores between the variables measured.

- (iii) Hypothesis testing

Hypothesis testing will follow the process as prescribed by Albright, Winston & Zappe (2002). A significant level of rejection will be selected to indicate how strong the evidence in favour of the alternative hypothesis must be to reject the null hypothesis. The p -Value will be used to determine how significant the sample evidence is, with a small p -Value providing support for the alternative hypothesis. In addition, a t-Test statistic will also be used to either refute or accept the alternative hypothesis. The researcher is aware of the inherent limitations of these statistical analyses. The t-Tests require that certain assumptions be made regarding the format of the data, with regard to distribution. In addition, experimental and observational data on human behaviour are bound to be so variable that the evidence produced by these data is uncertain. While it is essential to keep in mind that these procedures are based on assumptions of random variability of the data, therefore the significance of results could be due to an error of the first kind and just as none significant results could be an error of the second kind.

SPSS and Microsoft Excel will be used to run the above mentioned analysis.

It should however be noted that the following gaps/shortcomings may have an impact on the results obtained:

- (i) The spread of PPA profiles are not even.
- (ii) The researcher attempted to define the population with the information sources available, and does not have a definite answer, therefore generalisation of results are not possible.
- (iii) Not all biographical data captured are on the test and thus it could not be used in the analysis.
- (iv) PPA is only valid for six months and then it needs to be re-tested.

CHAPTER 4: RESEARCH RESULTS

The current study was descriptive in nature and therefore the author has included all relevant results to enhance the understanding of the potential relationship between behaviour patterns and the manner in which respondents complete a psychometric measure. In this chapter the data is presented, firstly from simple frequency and descriptive statistical analysis methods, in order to get an overview of the data collected.

The sample consisted of 398 cases of individuals who completed both the TST and PPA. These individuals were graduates, supervisors and managers in corporate South Africa.

4.1 Demographics of Respondents

In terms of gender, 51% of the respondents were male and 49% female. This distribution of gender can be considered as representative of the South African Population as it corresponds to the 47% and 53% gender split as per AMPS[®] 2011A.

Table 18: Frequency Distribution of Gender

Gender	Frequency	Percentage
Male	202	51 %
Female	192	49 %
Total	394	100 %

The distribution of the sample according to racial groups is presented in Table 19. The black group represents 59% of the total sample. The author acknowledges that according to AMPS[®] 2011A the black population represents 75% of the total South African population. However, if race groups are viewed in accordance to occupation and education levels, the black population is considered to constitute 49% of all managers,

supervisors and graduates within the South African Corporate environment (AMPS® 2011A). Therefore, the author will consider the race distribution as acceptable for the purpose of this study.

Table 19 : Distribution of the Sample According to Race

Race	Frequency	Percentage
Coloured	15	4 %
Indian	41	10 %
Black	230	59 %
White	108	27 %
Total	394	100%

4.2 Behavioural Dimensions of Respondents as per the PPA

The data for the four behavioural dimensions, namely Dominance, Influence, Steadiness and Compliance, is presented in the following section. Data for Graph I (Work Mask) will first be presented.

4.2.2 Distribution of Respondents on the Behaviour Dimensions on Graph I (Work Mask)

The four behavioural dimensions were considered in isolation on each graph. As previously discussed, when interpreting results on the PPA each behavioural dimension is viewed as being either Low or High. If each individual point on the PPA scale is taken into account, the distribution of the sample for the Dominance behavioural dimension on the Graph I (Work Mask) is as shown in

Figure 11 below. The figure below indicates 65% of the sample on the Dominance dimension on Graph I can be classified as having low Dominance and 35% as high Dominance.

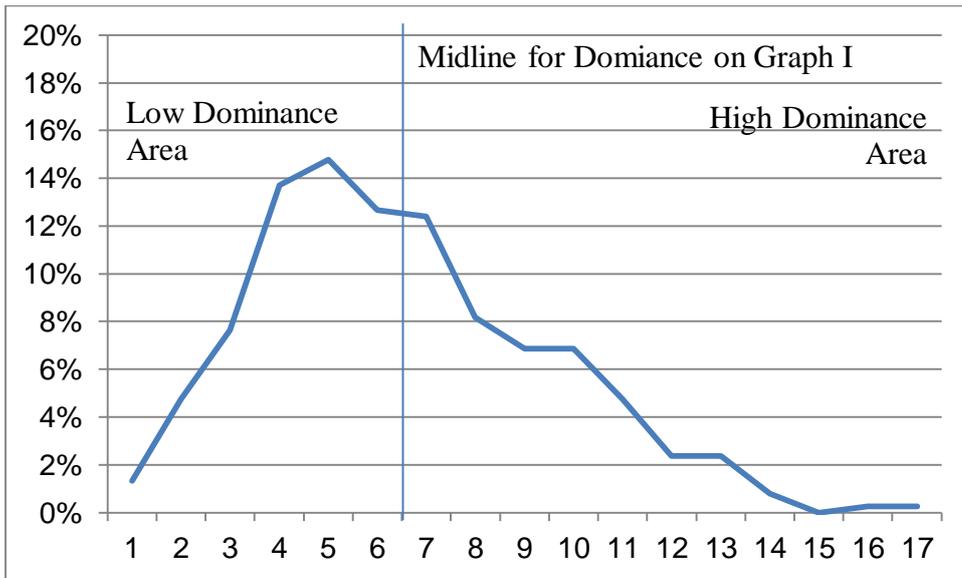


Figure 11: Distribution of the Sample on the Dominance Behaviour Dimension on Graph I

As shown in Figure 12, 58% of the sample can be classified a high Influence individual on Graph I.

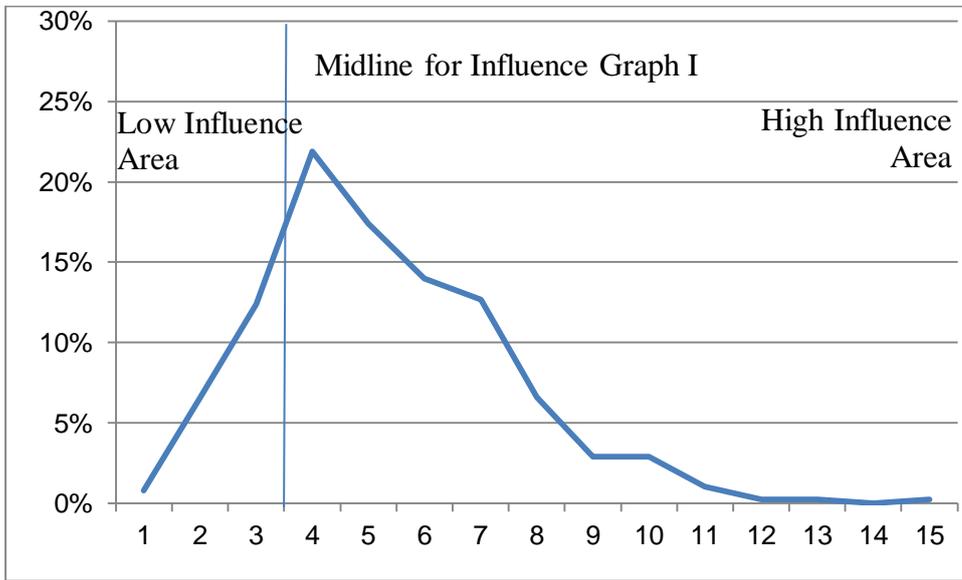


Figure 12: Distribution of the Sample on the Influence Behaviour Dimension on Graph I

Of the sample, 55% can be categorised as having a high Steadiness factor with 45% having a low Steadiness factor as shown in Figure 13 below.

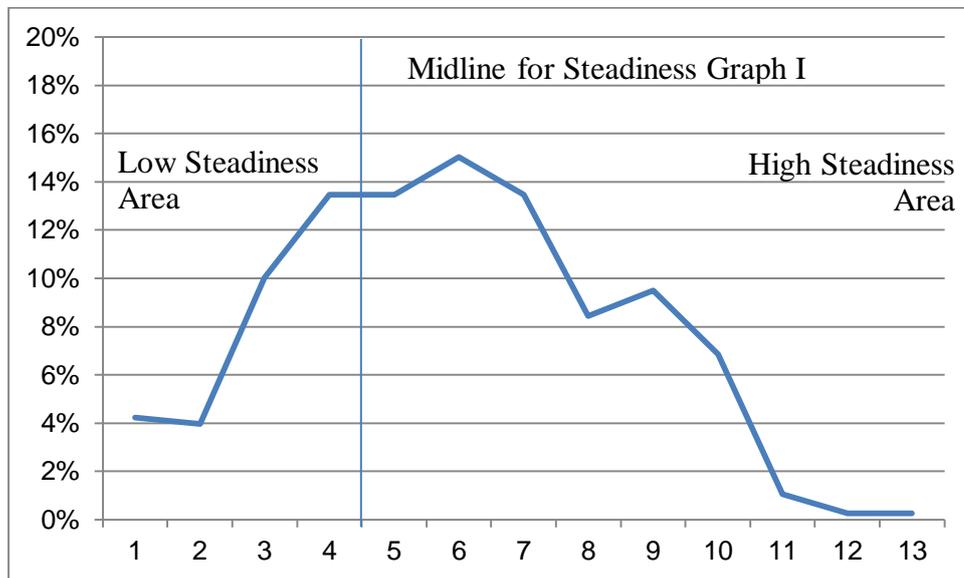


Figure 13: Distribution of the Sample on the Steadiness Behaviour Dimension on Graph I

Dominance, Influence and Steadiness have had relatively equal distributions with regard to high and low behavioural dimensions. However, the same is not true for the Compliance factor, where 90% of the sample can be categorised as having high Compliance as shown in Figure 14.

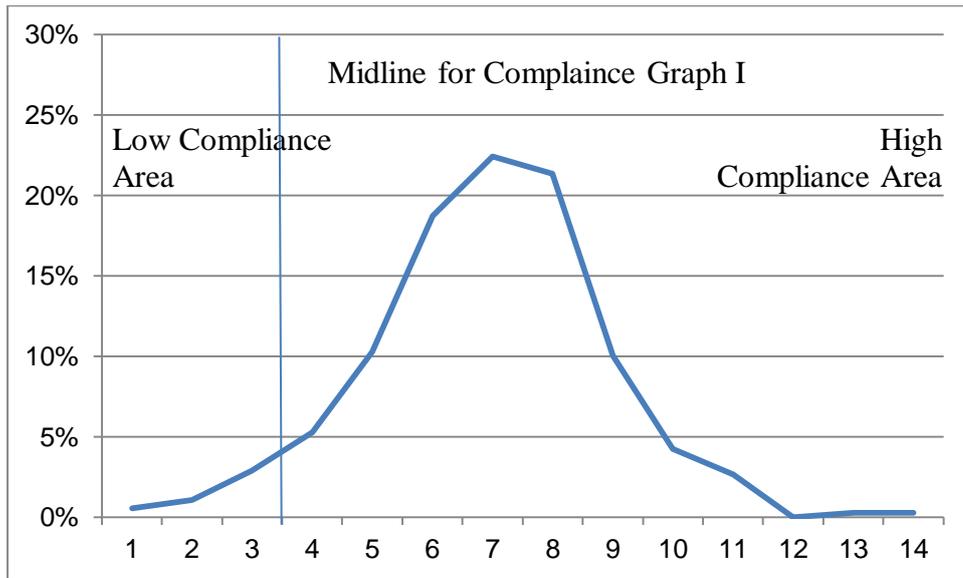


Figure 14: Distribution of the Sample on the Compliance Behaviour Dimension on Graph I

Table 20 presents the minimum, maximum and mean scores for the behavioural dimensions on graph I. The mean is a measure of central tendency or the arithmetic average of a distribution (Jackson, 2006). Compliance has the highest mean, ($\mu = 5.929$), with the midline between high and low Compliance between 3 and 4, it is once again evident that the majority of the samples' Compliance factor is above the midline and therefore high. The kurtosis for Dominance can be said to be Mesokurtic distribution, which is a normal distribution, while Influence and Compliance are show a Leptokurtic distribution, this means there is a high probability for extreme values. Lastly, Influence can be defined as having a Platykurtic distribution, which means the probability for extreme values is less than in a normal distribution. It is also evident when looking at the skewness scores that Dominance, Influence and Steadiness have a right skewed distribution, indicating that most values are concentrated on left of the mean, with extreme values to the right. However, compliance has a left skewed distribution, which implies most values are concentrated on the right of the mean, with extreme values to the left.

Table 20: Descriptive Statistics of the Sample on all Four Behaviour Dimensions on Graph I

	Dominance	Influence	Steadiness	Compliance
Mean	5.525	4.285	4.876	5.929
Variance	8.684	4.739	6.178	3.638
Std. Dev.	2.947	2.177	2.485	1.907
Median	5.000	4.000	5.000	6.000
Mode	4.000	3.000	5.000	6.000
Minimum	0.000	0.000	0.000	0.000
Maximum	16.000	14.000	12.000	13.000
Range	16.000	14.000	12.000	13.000
Kurtosis	2.9917	3.9861	2.3786	3.7036
Skewness	0.5770	0.7848	0.0739	-0.0954

4.2.3 Distribution of Respondents on the Behaviour Dimensions on Graph II (Pressure Mask)

As shown in the data in Table 21 it is evident that the sample distribution on Graph II follows a similar pattern of distribution to that of Graph I. The midline that divides the behavioural dimension into the two categories, high and low has also been indicated on Table 21 below. 32% of the sample can be categorised as having a high Dominance factor and 51% a high Influence factor. 63% of the sample can be considered as having a high Steadiness factor, while more than half (74%) have a high Compliance factor.

Table 21: Distribution of the Sample on the Behavioural Dimensions on Graph II

Point on Graph	Dominance		Influence		Steadiness		Compliance	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0	4	1.06%	5	1.32%	3	0.79%	1	0.26%
1	17	4.49%	16	4.21%	8	2.11%	16	4.22%
2	22	5.80%	33	8.68%	13	3.43%	24	6.33%
3	40	10.55%	60	15.79%	44	11.61%	55	14.51%
4	39	10.29%	80	21.05%	60	15.83%	54	14.25%
Midline for Dominance and Influence on Graph								
5	55	14.51%	55	14.47%	63	16.62%	64	16.89%
6	49	12.93%	60	15.79%	46	12.14%	66	17.41%
Midline for Steadiness and Compliance on Graph								
7	44	11.61%	26	6.84%	47	12.40%	36	9.50%
8	42	11.08%	26	6.84%	47	12.40%	36	9.50%
9	31	8.18%	10	2.63%	22	5.80%	17	4.49%
10	14	3.69%	3	0.79%	15	3.96%	6	1.58%

	Do mi nan ce	Influe nce	Steady ness	Comp liance		Domi nance	Influe nce	Stea dines s
Point on Graph	Frequency	Percentage	Frequency	Percentage	Point on Graph	Frequency	Percentage	Frequency
11	9	2.37%	5	1.32%	5	1.32%	3	0.79 %
12	10	2.64%	0	0.00%	4	1.06%	1	0.26 %
13	1	0.26%	1	0.26%	1	0.26%	-	-
14	1	0.26%	-	-	1	0.26%	-	-
15	1	0.26%	-	-	-	-	-	-

The mean, mode and medium for Graph II are displayed in the table below (Table 22).

Table 22: Descriptive Statistics of the Sample on all Four Behaviour Dimensions on Graph II

	Dominance	Influence	Steadiness	Compliance
Mean	5.884	4.617	5.752	5.169
Variance	7.886	4.866	5.944	4.956
Std. Dev.	2.808	2.206	2.438	2.226
Median	6.000	4.000	5.000	5.000
Mode	5.000	4.000	5.000	6.000
Minimum	0.000	0.000	0.000	0.000
Maximum	15.000	13.000	14.000	12.000
Range	15.000	13.000	14.000	12.000
Kurtosis	2.7674	3.4688	2.9413	2.6697
Skewness	0.2614	0.4894	0.3281	0.2202

4.2.4 Distribution of Respondents on the Behaviour Dimensions on Graph III (Self Image Mask)

As indicated previously, Graph III (Self Image Mask) represents how individuals see themselves. It is scored by a combination of the work and pressure masks, as the data for both of these masks have been presented in detail above, the author will provide a summary of Graph III based only on the high and low categorisation of the behavioural dimensions. It is evident, as per Table 23, that the vast majority of the sample had a high Compliance factor (84.17%), while only 38.36% had a high Dominance factor. The Kurtosis score for Dominance (3.4688) indicates that it is Leptokurtic distribution, while Influence (2.9413), Steadiness (2.9413) and Compliance (2.9413) all have a Platykurtic distribution. All four behavioural dimensions have right skewed distribution.

Some individuals that were tested obtained an invalid on Graph I, II or III due to inconsistencies in the completion of the measure. These individuals have been excluded for all other analysis that compares the PPA and TST, leaving the researcher with a sample size of 379.

Table 23: Summary of the Behavioural Dimensions on Graph III

Behavioural Dimension on Graph III	Frequency	Percentage
High Dominance	145	38.36%
Low Dominance	233	61.64%
High Influence	185	48.81%
Low Influence	194	51.19%
High Steadiness	228	60.16%
Low Steadiness	151	39.84%
High Compliance	319	84.17%
Low Compliance	60	15.83%

The central tendency data once again highlights that the sample has a lower concentration of Dominance and Influence individuals, while having a higher supply of Steadiness and Compliance individuals.

4.3 Speed and Accuracy of Respondents as per the TST

The speed and accuracy of the respondents have both been categorised into seven groupings that place the respondents' performance in a group that ranges from very low to very high.

4.3.1 Distribution of Respondents' Accuracy Scores on the Five TST Subtests

As per Table 24, it is evident that the majority of the sample has a high accuracy rate. On average 40.6% of respondents achieved a 91-100% accuracy rate. While on average only 7% had an accuracy rate below 45%.

Table 24: Distribution of Accuracy Scores for the Five Subtests on the TST

	Feature Detection		Reasoning		Number Speed and Accuracy		Working Memory		Orientation	
	Correct Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1-15 %	0	0%	0	0%	2	0.51%	1	0.25%	8	2.05%
16-30%	3	0.76%	3	0.76%	4	1.03%	1	0.25%	25	6.39%
31-45%	1	0.25%	15	3.82%	29	7.44%	3	0.76%	42	10.74 %
46-60%	6	1.53%	30	7.63%	22	5.64%	7	1.78%	63	16.11 %
61-75%	20	5.09%	71	18.07 %	56	14.36 %	35	8.88%	75	19.18 %
76-90%	145	36.9%	123	31.3%	116	29.74 %	131	33.25 %	127	32.48 %
91-100%	218	55.7%	151	38.42 %	161	41.28 %	216	54.82 %	51	13.04 %
Total	393		393		390		394		391	

The mode is a measure of central tendency, the score in the distribution that occurs with the greatest frequency (Jackson, 2006). From the mode it is evident that accuracy rate amongst this sample is very high as per the table below (Table 25).

Table 25: Descriptive Statistics of the Sample on Accuracy for the five TST Subtests

	Feature Detection	Reasoning	Number Speed and Accuracy	Working Memory	Orientation
Mean	89.05	81.75	80.83	88.83	67.18
Variance	130.11	339.86	424.32	163.80	556.07
Std. Dev.	11.41	18.44	20.60	12.80	23.58
Skewness	-3.4130	-1.1159	-1.4724	-1.9741	-0.6581
Kurtosis	21.2385	4.3610	4.9792	9.0215	2.7403
Median	91.43	86.67	87.10	93.10	72.73
Mean Abs. Dev.	7.26	14.50	15.76	9.50	19.48
Mode	100.00	100.00	100.00	100.00	100.00
Minimum	0.00	0.00	0.00	9.68	0.00
Maximum	100.00	138.46	100.00	115.15	131.71
Range	100.00	138.46	100.00	105.47	131.71
Count	393	393	390	394	391

4.3.2 Distribution of Respondents' Speed Scores on the Five TST Subtests

Speed unlike accuracy on the TST varies greatly across the five subtests (Figure 15), with reasoning having the largest portion (61.7%) of its speed scores below 50 (as per the coding on Table 16). On the Orientation subtest, 8.7% of the respondents obtained a speed score of above 150. Overall, the sample tended to work slower, with 76.4% obtaining a score of 109 or below for speed.

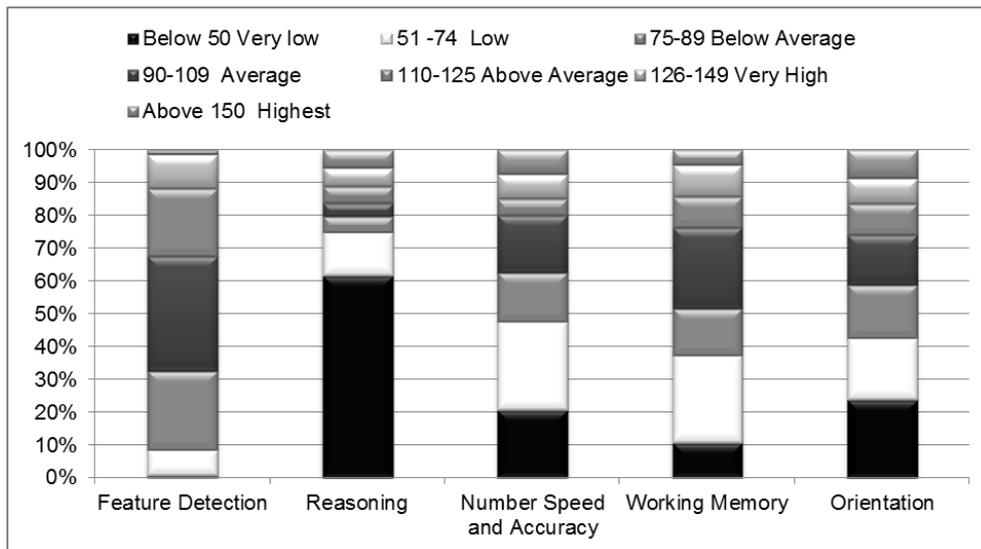


Figure 15: *Distribution of Speed Scores for the Five Subtests on the TST*

The highest speed (287) obtained in the sample was on the Reasoning subtest, while the lowest (157) was obtained on the Feature Detection subtest.

Table 26: Descriptive Statistics of the Sample on Speed for the five TST Subtests

	Feature Detection	Reasoning	Number Speed and Accuracy	Working Memory	Orientation
Mean	101.53	101.38	98.16	99.39	98.70
Variance	340.53	795.52	995.51	586.80	842.20
Std. Dev.	18.45	28.20	31.55	24.22	29.02
Skewness	-0.4396	0.9524	1.9851	1.0685	1.0591
Kurtosis	7.0806	8.6660	11.7324	8.7002	7.1235
Median	100.00	100.27	95.32	97.95	96.19
Mean Abs. Dev.	13.50	18.18	18.77	16.24	18.89
Mode	97.79	98.43	92.63	87.79	87.41
Minimum	0.00	18.00	14.00	6.00	25.00
Maximum	157.00	287.00	272.00	240.00	225.00
Range	157.00	269.00	258.00	234.00	200.00
Count	394	394	393	394	393

4.4 Relationship Existing between Behaviour Patterns and the Speed and Accuracy with which a Psychometric Measure is completed.

Various steps were undertaken in the attempt to determine if a relationship exists between behaviour patterns and the speed and accuracy with which an individual completes a psychometric measure. From the frequencies reported above for the individual points on the behavioural dimensions, it is evident that some sample sizes per data point would be insufficient to be included in analysis as is. Therefore, the researcher has combined the scores on the PPA measure into its two main categories, namely high and low. For the remainder of the analysis, the high and low variables will be used when

working with PPA data. In addition, the TST data will be included in the analysis as per the 7 categories, from very low to very high.

4.4.1 Contingency Tables and Significant Differences

The first step is basic cross tabulations between the individual behavioural dimensions and speed and accuracy scores as obtained on the TST.

Due to the volume of data, the research will only highlight data that is essential to building knowledge on the research question at hand.

Contingency tables allow a researcher to break data down into subpopulations to allow the researcher to look at each of these separately (Albright, Winston & Zappe, 2002). For purposes of this study, each individual behavioural dimension on the three graphs was broken into its two dimensions, high and low. These two dimensions were then compared to speed and accuracy scores of each subtest, the results which are represented in Table 27 to 35.

The contingency tables highlighted differences in scores on both accuracy and speed scores for the high and low dimensions respectively. The researcher then proceeded to determine if these differences in scores were statistically significant. The researcher understands statistical significance to mean an observed difference between two descriptive statistics that is unlikely to have occurred by chance (Jackson, 2006). The author adheres to the standard of statistical significance at the .05 (or the 5%) level, also known as the 0.5 alpha level. The p-value will be reported on. If the p-value obtained is less than 0.05α , then the result obtained will allow for the rejection of the null hypothesis. However, if the p-value obtained exceeds 0.05α then the alternative hypothesis has to be accepted. The researcher will use the p-value categorisation (Figure 16) as published by Albright, Winston & Zappe (2002).

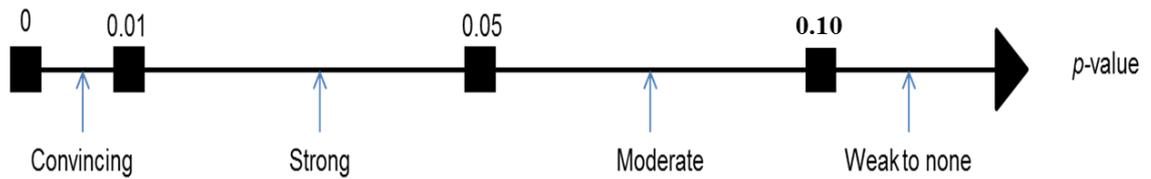


Figure 16: p-value Classification in Favour of the Alternative Hypothesis

The researcher is aware of the various limitations and possibility of misinterpreting the p-Value that can result in the null hypothesis being rejected and the alternative hypothesis accepted, which may also not be correct (Sterne & Smith, 2001). Given the aforementioned limitations, the researcher is of the opinion that the method is still statistically relevant as part of the hypothesis testing process as described by various authors (Albright, Winston & Zappe, 2002; Sapp, 1958). The advantage of the p -value is that they can all be interpreted in basically the same way; a small p -value provides support for the alternative hypothesis.

The differences, highlighted below in table 27 to 35, between the high and low behavioural dimensions on speed and accuracy scores are therefore not due to chance and are most likely due to a true or real difference between the groups. If the result is statistically significant, it supports the case to reject the null hypothesis and allows the researcher to conclude that the alternative hypothesis is to be accepted.

4.4.2 Contingency Tables and Significant Differences for Behavioural Dimensions on Graph I

From Graph I, the results of the contingency tables and significant differences provide the first indication of differences in speed and accuracy scores on the various subtests on the TST in relation to high and low behavioural dimensions. As the results are similar across all three graphs'

results, some results for Graph II and III have been included in the subsequent section.

4.4.3 Contingency Tables and Significant Differences for Behavioural Dimensions on Graph II

The contingency tables and *p*-values highlighted differences on all four behavioural dimensions with regard to speed and accuracy scores obtained on the TST. These two groups were compared to each other and the results are presented below (Table 27). The results indicate that individuals with a low and high Dominance factor obtain significantly different speed scores on various subtests. Low Dominance individuals (27.34%) are significantly more likely than high Dominance (17.21%) individuals to obtain a very low speed score on the Orientation Subtest. The sample sizes for high and low Dominance were 122 and 256 respectively.

Table 27: Significant Differences on Speed Scores for High and Low Dominance on Graph II

Subtest - Speed Component	Score	High D Percentage	Low D Percentage	p-value	Classification
Feature Detection Speed	Below Average	15.57%	27.62%	0.0026	Convincing
Reasoning Speed	Very low	55.73%	67.70%	0.0128	Strong
Working Memory Speed	Low	19.67%	29.57%	0.0155	Strong
Orientation Speed	Very low	17.21%	27.34%	0.0108	Strong

A difference in Accuracy is evident on two subtests when the high and low Dominance is considered. A low Dominance (59.59%) individual is significantly more likely than a high Dominance individual (45.90%) to obtain an accuracy score of between 91 to 100% on the Feature Detection subtest (Table 28).

Table 28: Significant Differences on Accuracy Scores for High and Low Dominance on Graph II

Subtest – Accuracy Component	Score	High D Percentage	Low D Percentage	p-value	Classification
Feature Detection Accuracy	91-100%	45.90%	59.59%	0.0101	Strong
Orientation Accuracy	16-30%	3.30%	7.84%	0.0251	Strong

The high and low Influence individuals also obtained significantly different results on three of the subtests (Feature Detection, Reasoning and Working Memory) when their speed scores are compared to each other. Individuals with a low Influence factor are significantly more likely to obtain very low scores on both Feature Detection (1.15%) and Reasoning (68.08%). The *p*-values are also indicative of differences on accuracy scores obtained by individuals with a high and low Influence factor on Graph II. These differences are evident on Feature Detection and Reasoning tests. On Feature Detection, low influence individuals are perceived to be significantly more accurate (57.69%) on the 91-100% accuracy level when compared to high dominance individuals (47.06%).

The Steadiness factor also shows significant differences on speed and accuracy scores. Results for speed on the Reasoning and Number, Speed and Accuracy Subtests, are indicative of an individual with a high Steadiness factor being slower on these tests

The Compliance factor on Graph II shows the biggest number of differences between a high and low factor in comparison to the other three behavioural dimensions on this graph. As per Table 29 below, it is evident that an individual with a high Compliance factor on Graph II appears to complete the subtests on the TST at a slower pace than an individual with a low Compliance factor.

Table 29: Significant Differences on Speed Scores for High and Low Compliance on Graph II

Subtest - Speed Component	Score	High C Percentage	Low C Percentage	p-value	Classification
Feature Detection Speed	Above Average	17.56	27.27	0.0258	Strong
Reasoning Speed	Highest	3.93	10.10	0.0285	Strong
NSA- Speed	Average	14.13	24.24	0.0159	Strong
NSA- Speed	Very High	5.80	12.12	0.0365	Strong
Working Memory Speed	Very High	7.50	15.15	0.0258	Strong
Orientation Speed	Above Average	7.14	14.14	0.0325	Strong

The relationship between Accuracy and Compliance is evident on a few accuracy categories on the various subtests on the TST. As per (Table 30: Significant Differences on Accuracy Scores for High and Low *Compliance on Graph II*), individuals with high Compliance appear significantly less in the 91-100% accuracy ratings on Working Memory (51.79%) and Number, Speed and Accuracy (38.04%) when compared to high Compliance individuals.

Table 30: *Significant Differences on Accuracy Scores for High and Low Compliance on Graph II*

Subtest - Accuracy Component	Score	High C Percentage	Low C Percentage	p-value	Classification
Feature Detection Accuracy	76-90%	34.41	46.46	0.01823	Strong
Reasoning Accuracy	91-100%	33.21	48.48	0.00400	Convincing
NSA – Accuracy	91-100%	38.04	49.49	0.02442	Strong
Working Memory Accuracy	91-100%	51.79	61.62	0.04305	Strong
Orientation Accuracy	76-90%	27.50	45.45	0.00038	Convincing

4.4.4 Contingency Tables and Significant Differences for Behavioural Dimensions on Graph III

As with Graph I and II, a relationship between the four behavioural dimensions and certain speed and accuracy scores obtained is evident on Graph III. As per Table 31 below, a high Dominance individual, when compared to low Dominance individuals, appears to be significantly less likely to have below average and very low speed scores on four of the five subtests.

Table 31: Significant Differences on Speed Scores for High and Low Dominance on Graph III

Subtest - Speed Component	Score	High D Percentage	Low D Percentage	p-value	Classification
Feature Detection Speed	Below Average	15.75	28.76	0.0011	Convincin g
Reasoning Speed	Very low	56.85	68.24	0.0129	Strong
Number Speed and Accuracy Speed	Very low	15.07	25.00	0.0078	Strong
Orientatio n Speed	Very low	18.49	27.59	0.0183	Strong

The only differences in the accuracy scores obtained by individuals with high and low Dominance respectively, is evident for the 16-30% accuracy level on the Feature Detection and Reasoning Subtest (Table 32). Low Dominance individuals are significantly more likely to obtain this level of accuracy when compared to high Dominance individuals.

Table 32 Significant Differences on Accuracy Scores for High and Low Dominance on Graph III

Subtest - Accuracy Component	Score	High D Percentage	Low D Percentage	p-value	Classification
Feature Detection Accuracy	16-30%	0	20.00	0.0406	Strong
Reasoning Accuracy	16-30%	0	1.29	0.0406	Strong

When consideration is given to the analysis of the Influence behavioural dimension on Graph III, significant differences in the scores obtained are once again evident. An individual with a low Influence factor is significantly more likely (1.55%) to work at a very low speed on the Feature Detection subtest when compared to a high Influence individual (0%). A similar difference is also noted on the speed at which these two respective groups complete the Number Speed and Accuracy subtest. The low Influence individual is significantly more likely (20.62%) to maintain an average speed when compared to a high Influence individual (12.5%). Only one noteworthy difference between these groups is noted on their accuracy scores, which is that low Influence individuals are implicitly more likely (11.86%) to obtain an accuracy rating of 61-75% on the Working Memory subtest than high Influence individuals (6.49%).

Cross tabulations were performed between the behavioural dimension Steadiness and the Speed and Accuracy items. Once again, there was a statistically significant difference between high and low Steadiness individuals. As per Table 33 a significant difference is evident with regard

to very low speed on the Reasoning subtest ($p=0.008$). Other differences observed in the data are presented below (Table 33).

Table 33: *Significant Differences on Speed Scores for High and Low Steadiness on Graph III*

Subtest - Speed Component	Score	High S Percentage	Low S Percentage	p-value	Classification
Reasoning Speed	Very low	71.93	51.66	0.008	Convincing
Number Speed and Accuracy	Average	14.04	20.67	0.050	Strong
Number Speed and Accuracy	Very High	5.26	10.67	0.032	Strong
Working Memory Speed	Average	21.49	31.13	0.019	Strong
Orientation Speed	Highest	6.58	12.67	0.028	Strong

A similar picture was found comparing the high and low Steadiness individuals' accuracy on the Number Speed and Accuracy subtest ($p=0.047$) as well as Working Memory ($p=0.04$).

A significant difference was found between high and low Compliance individuals when comparing speed scores on Reasoning average ($p=0.042$) and highest (0.024) speed, as per results provided in Table 34.

Table 34: *Significant Differences on Speed Scores for High and Low Compliance on Graph III*

Subtest - Speed Component	Score	High C Percentage	Low C Percentage	p-value	Classification
Reasoning Speed	Average	3.13	10	0.0428	Strong
Reasoning Speed	Highest	4.08	13.33	0.0204	Strong

The only significant difference between a high and low Compliance individual on the accuracy dimension (Table 35) is with regard to an accuracy score of 76-90% on Feature Detection ($p=0.035$).

Table 35: *Significant Differences on Accuracy Scores for High and Low Compliance on Graph III*

Subtest - Accuracy Component	Score	High C Percentage	Low C Percentage	P value	Classification
Feature Detection Accuracy	76-90%	35.53	48.33	0.0335	Strong

The significant differences between high and low behavioural dimensions of the PPA in relation to speed and accuracy dimensions of the TST are only evident for a few points (i.e. high speed or 91-100% accuracy) on respective scales. However, it is clear from the data presented above that there may be sufficient evidence to refute some of the null hypotheses posed in chapter one. The remainder of this chapter will be aimed at providing data to either accept or refute the null hypotheses posed.

4.4.5 Correlation coefficients

In order to measure of the strength of the straight-line or linear relationship between two variables, in this case, the TST and PPA variables the researcher utilised the correlation coefficients. The statistical results (Table 7 Correlation coefficients) highlighted only indicate a weak positive (negative) linear relationship via a shaky linear rule. Although the individual variables of the PPA were highly correlated with the other variables present in the PPA, the same trend is evident for the TST variables.

Figure 17 Correlation Coefficients

	FD Accurac	FD Speed	R Accuracy	R Speed	NSA Acc	Nsa Spe	WM Acc	WM Spe	O Accura	O Speed
Work_Mask Profile	-0.014034	-0.019387	-0.036773	-0.113695	0.042909	-0.062712	-0.008966	-0.062829	-0.037800	-0.026744
Pressure_Mask Profile	0.010678	0.004609	0.038941	-0.075086	0.044241	0.032621	0.038204	0.027799	0.078995	0.062822
Self_Image Profile	0.010400	0.029222	-0.072149	-0.089383	0.015779	0.029332	-0.050396	-0.008274	0.001066	-0.012412
Higest Factor Profile	0.031198	-0.120195	-0.202652	-0.217670	-0.024822	-0.122979	-0.167115	-0.204775	-0.135627	-0.155836
ppa I D	-0.099331	0.096801	0.017708	0.230435	-0.038725	0.119984	0.011659	0.183242	0.044854	0.163185
ppa I I	0.007858	-0.028960	0.068143	0.073542	0.031077	0.023576	0.076994	-0.049608	0.034231	-0.034906
ppa I S	0.025297	-0.075453	-0.072434	-0.237699	0.015312	-0.159206	-0.048458	-0.155013	-0.061963	-0.131748
ppa I C	0.073714	-0.024802	0.096739	-0.061515	0.075177	0.043726	-0.009592	0.008710	0.013947	-0.017945
ppa II D	0.063939	-0.050028	0.059098	-0.136772	0.050167	-0.117503	-0.036313	-0.156126	-0.050659	-0.124391
ppa II I	0.060838	0.047330	0.009182	-0.099093	0.092509	0.070117	0.049523	0.042160	0.128362	0.066647
ppa II S	-0.043941	-0.002335	-0.009155	0.190213	-0.091454	0.039714	-0.057493	0.067291	-0.043551	0.042952
ppa II C	-0.068320	0.154435	0.163998	0.197866	0.112004	0.140644	0.131283	0.165772	0.148616	0.132792
ppa III D	-0.077020	0.064160	-0.022075	0.187684	-0.043762	0.121270	0.026229	0.165439	0.044473	0.146129
ppa III I	-0.025379	-0.045325	0.028130	0.110738	-0.034704	-0.023890	0.008906	-0.044955	-0.059331	-0.048860
ppa III S	0.042699	-0.015147	-0.030535	-0.225169	0.050574	-0.091525	0.012587	-0.117936	-0.041457	-0.075387
ppa III C	0.080566	-0.114841	-0.049962	-0.173935	-0.022931	-0.069664	-0.081824	-0.102547	-0.080283	-0.096608

4.5 Data Analysis in The Process of Accepting or Refuting the Null Hypotheses put Forward in this Study

In this section, hypotheses will be discussed in terms of the findings in the data. It will be seen whether hypotheses are supported or refuted and whether research questions have in fact been answered.

As previously discussed by the researcher, Graph III (Self Mask) is derived from Graph I (also known as the “most mask raw score” minus Graph II), known as the “least mask raw score”. Based on the assumption that Graph III represents a combination of Graph I and Graph II, hypothesis testing will be done using Graph III and its behavioural dimensions as the independent factors, while the speed and accuracy scores from the TST will be used as the dependent variables.

In the process of hypothesis, the researcher used parametric statistics, as it assumes that the data that is being used has come from a type of probability distribution that will allow inferences about the parameters of the distribution to be made (Jackson 2006). The use of parametric methods implies that more assumptions had to be made than if the researcher was using non-parametric methods. The researcher is aware that if these assumptions are incorrect, any parametric method used can be deceptive and are often described as not being robust. The researcher has taken care to examine the diagnostic statistics (mean and standard deviation) which require a probability distribution to be normal.

Another requirement with regard to parametric statistics is the use of data that has a ratio and interval scale. The author is aware that many measures (e.g. personality, intelligence, etc.) within the psychology represent ordinal data. As an example, Intelligence Quotient (IQ) scores for a group of individuals will represent differences between individuals and the direction of those differences but lack the ability of indicating the amount of the differences. Psychologists have no way of truly measuring and quantifying intelligence. An individual with an IQ of 70 does not have exactly half of the intelligence of an individual with an IQ of 140. Therefore, IQ scales

should theoretically be treated as ordinal data. As discussed earlier, the PPA in contrast to the traditional Likert-scale format, measures an individual's affective traits via 96 items. Therefore this data can be treated as parametric (interval or ratio) data. This view allows the researcher to use the data collected in parametric statistical techniques such as the calculation of a mean and standard deviation.

Data obtained from the speed and accuracy scores of the TST are classified as ratio data for the purposes of this study, while the PPA data when considered per individual behavioural dimension can be considered to be interval. However, as stated previously the PPA data was redefined into two variables per behavioural dimension, namely high and low, and as such the data can be considered as a ratio scale.

The researcher followed used various statistical methods in the analysis process to determine if the null hypothesis can be refuted or not. Hypothesis testing thus took place by running and looking at the following statistics on the data:

- (i) Mean
- (ii) Standard deviation
- (iii) Standard error of mean
- (iv) Degrees of freedom
- (v) t-Test statistic
- (vi) p-Value

The researcher used statistical software to insert the hypothesised mean for accuracy and speed as per the alternative hypothesis proposed and ran the analysis to determine if the hypothesised relationship does exist. The parameters for speed and accuracy were set at the following levels, using the code frame as per the code frames in Table 14 and Table 15.

For high Dominance, the means were hypothesised to be as follows:

- (i) Accuracy $H_{o=}$ $\mu > 4$
- (ii) Accuracy $H_{a=}$ $\mu \leq 4\mu$

- (iii) Speed $H_{o=} \mu < 5$
- (iv) Speed $H_{a=} \mu \geq 5$

With regard to high Influence, the following parameters were set:

- (i) Accuracy $H_{o=} \mu > 4$
- (ii) Accuracy $H_{a=} \mu \leq 4$
- (iii) Speed $H_{o=} \mu > 4$
- (iv) Speed $H_{a=} \mu \leq 4$

When looking at high Steadiness, the parameters were set at:

- (v) Accuracy $H_{o=} \mu < 5$
- (vi) Accuracy $H_{a=} \mu \geq 5$
- (vii) Speed $H_{o=} \mu < 5$
- (viii) Speed $H_{a=} \mu \geq 5$

Lastly, for Compliance the following strictures were set:

- (ix) Accuracy $H_{o=} \mu < 5$
- (x) Accuracy $H_{a=} \mu \geq 5$
- (xi) Speed $H_{o=} \mu > 4$
- (xii) Speed $H_{a=} \mu \leq 4$

The results are presented below in table 36 to 43.

5.4.1 Testing Alternative Hypothesis 1

The alternative hypotheses that are to be tested for in this study are as follows:

$H_a =$ A relationship exists between high **Dominance** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure

in a corporate environment is completed. A high Dominance individual will obtain lower accuracy scores and higher speed scores than an individual with low Dominance.

As per the data in Table 36, the null hypothesis can be refuted and the alternative hypothesis accepted to be true. Therefore, it can be said that a relationship exists between high Dominance on Graph III and the accuracy with which an individual completes the TST.

Table 36: Hypothesis Testing Statistics for High Dominance and Accuracy

<i>High D</i>					
	Feature Detection	Reasoning	Visual Speed Accuracy	Working Memory	Orientation
Sample Size	145	145	145	146	145
Sample Mean	6.372	5.890	5.745	6.411	5.007
Sample Std Dev	0.781	1.068	1.418	0.819	1.455
Hypothesised Mean	4	4	4	4	4
Alternative Hypothesis	> 4	> 4	> 4	> 4	> 4
Standard Error of Mean	0.065	0.089	0.118	0.068	0.121
Degrees of Freedom	144	144	144	145	144
t-Test Statistic	36.5668	21.3067	14.8166	35.5549	8.3312
p-Value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Null Hypoth. at 10% Significance	Reject	Reject	Reject	Reject	Reject
Null Hypoth. at 5% Significance	Reject	Reject	Reject	Reject	Reject
Null Hypoth. at 1% Significance	Reject	Reject	Reject	Reject	Reject

The same analysis was done to test if the alternative hypothesis, relating to the relationship between high Dominance and Speed, can be accepted or rejected.

The results of the statistics (Table 37) show that once again the alternative hypothesis can be accepted and the null hypothesis can be rejected at all three levels of significance. Therefore, a relationship exists between a high Dominance factor on Graph III and the speed with which an individual completes the TST.

Table 37: Hypothesis Testing Statistics for High Dominance and Speed

<i>High D</i>						
	Feature Detection	Reasoning	Number Speed Accuracy	Working Memory	Orientation	
Sample Size	146	146	146	146	146	
Sample Mean	4.144	2.390	3.336	3.719	3.589	
Sample Std Dev	1.186	2.042	1.805	1.635	2.016	
Hypothesised Mean	5	5	5	5	5	
Alternative Hypothesis	< 5	< 5	< 5	< 5	< 5	
Standard Error of Mean	0.098	0.169	0.149	0.135	0.167	
Degrees of Freedom	145	145	145	145	145	
t-Test Statistic	-8.7222	-15.4399	-11.1401	-9.4672	-8.4565	
p-Value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
Null Hypoth. at 10% Significance	Reject	Reject	Reject	Reject	Reject	
Null Hypoth. at 5% Significance	Reject	Reject	Reject	Reject	Reject	
Null Hypoth. at 1% Significance	Reject	Reject	Reject	Reject	Reject	

5.4.2 Testing Alternative Hypothesis II

H_a = A relationship exists between high **Influence** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed. A high Influence individual will obtain lower accuracy scores and speed scores than an individual with low Influence.

This hypothesis was tested by running various statistics including the t-test statistic and p-value. When considering the results as per Table 38 below, it is evident that the alternative hypothesis can be accepted and the null hypothesis rejected. High Influence on Graph III does have a relationship with the accuracy score obtained by an individual on all five subtests.

Table 38: Hypothesis Testing Statistics for High Influence and Accuracy

<i>High I</i>	Feature Detection	Reasoning	Number Speed Accuracy	Working Memory	Orientation
Sample Size	185	185	183	185	183
Sample Mean	6.4000	5.995	5.754	6.3676	4.869
Sample Std Dev	0.8156	1.091	1.501	0.8877	1.546
Hypothesised Mean	4	4	4	4	4
Alternative Hypothesis	> 4	> 4	> 4	> 4	> 4
Standard Error of Mean	0.0600	0.080	0.111	0.0653	0.114
Degrees of Freedom	184	184	182	184	182
t-Test Statistic	40.0235	24.8675	15.8110	36.2748	7.6039
p-Value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Null Hypoth. at 10% Significance	Reject	Reject	Reject	Reject	Reject
Null Hypoth. at 5% Significance	Reject	Reject	Reject	Reject	Reject
Null Hypoth. at 1% Significance	Reject	Reject	Reject	Reject	Reject

The same relationship, however, is not evident between high Influence on Graph III and the speed at which an individual completes a psychometric measure, namely the TST. From the results below (Table 39) it is palpable that the null hypothesis cannot be refuted and that the alternative hypothesis must be rejected.

Table 39: Hypothesis Testing Statistics for High Influence and Speed

<i>High I</i>						
	Feature Detection	Reasoning	Speed Accuracy	Working Memory	Orientation	
Sample Size	185	185	185	185	185	
Sample Mean	4.005	2.168	2.973	3.324	3.211	
Sample Std Dev	1.149	1.885	1.860	1.669	1.976	
Hypothesised Mean	4	4	4	4	4	
Alternative Hypothesis	> 4	> 4	> 4	> 4	> 4	
Standard Error of Mean	0.084	0.139	0.137	0.123	0.145	
Degrees of Freedom	184	184	184	184	184	
t-Test Statistic	0.0640	-13.2220	-7.5085	-5.5064	-5.4310	
p-Value	0.4745	1.0000	1.0000	1.0000	1.0000	
Null Hypoth. at 10% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Don't Reject	
Null Hypoth. at 5% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Don't Reject	
Null Hypoth. at 1% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Don't Reject	

5.4.3 Testing Alternative Hypothesis III

An alternative hypothesis was put forward that:

H_a = A relationship exists between high **Steadiness** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure in a corporate environment is completed. A high Steadiness individual will obtain higher accuracy scores and higher speed scores than an individual with low Steadiness.

This hypothesis was tested in the same manner as previously discussed. The results obtained (Table 40) from analysis allow the researcher to accept only that a relationship does exist between the high Steadiness factor on Graph III and the accuracy score on the Orientation subtest (0.0337), if the data is considered at 10% and 5% significance levels.

Table 40: Hypothesis Testing Statistics for High Steadiness and Accuracy

<i>High S</i>	Feature Detection	Reasoning	Speed Accuracy	Working Memory	Orientation
Sample Size	228	228	227	228	226
Sample Mean	6.4474	5.842	5.903	6.3904	4.810
Sample Std Dev	0.8139	1.180	1.310	0.8244	1.556
Hypothesised Mean	5	5	5	5	5
Alternative Hypothesis	< 5	< 5	< 5	< 5	< 5
Standard Error of Mean	0.0539	0.078	0.087	0.0546	0.104
Degrees of Freedom	227	227	226	227	225
t-Test Statistic	26.8523	10.7718	10.3861	25.4671	-1.8381
p-Value	1.0000	1.0000	1.0000	1.0000	0.0337
Null Hypoth. at 10% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Reject
Null Hypoth. at 5% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Reject
Null Hypoth. at 1% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Don't Reject

The alternative hypothesis also postulates that a relationship exists between a high Steadiness factor and the speed at which an individual completes a psychometric measure. The p-value and t-test statistic are shown (Table 41) to be acceptable to reject the null hypothesis and accept the alternative hypothesis.

Table 41: Hypothesis Testing Statistics for High Steadiness and Speed

<i>High S</i>					
	Feature Detection	Reasoning	Speed Accuracy	Working Memory	Orientation
Sample Size	228	228	228	228	228
Sample Mean	3.961	1.776	2.925	3.250	3.083
Sample Std Dev	1.177	1.584	1.815	1.643	1.870
Hypothesised Mean	5	5	5	5	5
Alternative Hypothesis	< 5	< 5	< 5	< 5	< 5
Standard Error of Mean	0.078	0.105	0.120	0.109	0.124
Degrees of Freedom	227	227	227	227	227
t-Test Statistic	-13.3316	-30.7292	-17.2597	-16.0834	-15.4802
p-Value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Null Hypoth. at 10% Significance	Reject	Reject	Reject	Reject	Reject
Null Hypoth. at 5% Significance	Reject	Reject	Reject	Reject	Reject
Null Hypoth. at 1% Significance	Reject	Reject	Reject	Reject	Reject

5.4.3 Testing Alternative Hypothesis IV

The last alternative hypothesis put forward in this study is:

H_a = A relationship exists between high **Compliance** on Graph III (Self Mask) and the speed and accuracy with which a learning potential measure

in a corporate environment is completed. A high Compliance individual will obtain higher accuracy scores and lower speed scores than an individual with low Compliance.

A relationship is evident between high Compliance Graph III and accuracy on the Orientation Subtest ($p=0.0242$), allowing the researcher to only reject a part of the null hypothesis when considering a 5% significance level. No relationship is found to exist between high Compliance and accuracy on Feature Detection ($p=1.0000$), Accuracy ($p=1.0000$), Number Speed and Accuracy ($p=1.0000$) and Working Memory ($p=1.0000$) as per Table 42.

Table 42: Hypothesis Testing Statistics for High Compliance and Accuracy

<i>High C</i>	Feature Detection	Reasoning	Number Speed Accuracy	Working Memory	Orientation
Sample Size	318	319	316	319	318
Sample Mean	6.4403	5.865	5.820	6.3699	4.827
Sample Std Dev	0.8068	1.148	1.344	0.8511	1.556
Hypothesised Mean	5	5	5	5	5
Alternative Hypothesis	< 5	< 5	< 5	< 5	< 5
Standard Error of Mean	0.0452	0.064	0.076	0.0477	0.087
Degrees of Freedom	317	318	315	318	317
t-Test Statistic	31.8320	13.4591	10.8433	28.7478	-1.9822
p-Value	1.0000	1.0000	1.0000	1.0000	0.0242
Null Hypoth. at 10% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Reject
Null Hypoth. at 5% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Reject
Null Hypoth. at 1% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Don't Reject

The null hypothesis cannot be rejected when considering high Compliance and the speed at which an individual completes a psychometric measure. No relationship could be found between high Compliance and overall speed scores obtained per subtest as per Table 43 below:

Table 43: Hypothesis Testing Statistics for High Compliance and Speed

<i>High C</i>	Feature Detection	Reasoning	Number Speed Accuracy	Working Memory	Orientation
Sample Size	319	319	319	319	319
Sample Mean	4.000	1.966	3.038	3.367	3.197
Sample Std Dev	1.163	1.722	1.829	1.623	1.930
Hypothesised Mean	4	4	4	4	4
Alternative Hypothesis	> 4	> 4	> 4	> 4	> 4
Standard Error of Mean	0.065	0.096	0.102	0.091	0.108
Degrees of Freedom	318	318	318	318	318
t-Test Statistic	0.0000	-21.1054	-9.3989	-6.9667	-7.4264
p-Value	0.5000	1.0000	1.0000	1.0000	1.0000
Null Hypoth. at 10% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Don't Reject
Null Hypoth. at 5% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Don't Reject
Null Hypoth. at 1% Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Don't Reject

It is interesting to note once again that only some of the high behavioural dimensions have a relationship with the overall speed and accuracy scores achieved on a psychometric test. The meaning of these results, as well as their relationship to the literature, will be discussed in Chapter 5.

CHAPTER 5: DISCUSSION OF RESULTS AND CONCLUSIONS

5.1 Aim of the Study

The purpose of this study was to investigate whether there is a relationship between the preferred behaviour style of an individual and their speed and accuracy performance on a learning potential measure. This has been done by comparing four behaviour variables (Dominance, Influence, Steadiness and Compliance) to the speed and accuracy variables. The results and conclusions with regard to this aim will now be discussed below.

The research question was asked: does a relationship exist between behavioural dimensions and individual performance in relation to speed and accuracy scores obtained on a learning potential measure in the South African corporate environment?

Although research results differ on the magnitude of biasing that can be as a result of an individual's personality or behaviour patterns, it is evident from literature reviewed that certain personality types and their associated behaviour can have a direct effect on their performance on a psychometric measure. For example, individuals who are extroverted tend to perform better on psychometric measures. As it was established earlier in the text, both the Influence and Dominance behavioural dimensions on the PPA correlate with the extroversion dimensions, providing support for the result obtained from the data analysis in this research. Authors such as Heide, Grønhaug, Boyle and Kline also provided evidence for both the existence of a relationship between behaviour patterns and performance on learning potential measure.

The t-test statistic and p-value analysis on the behaviour and the speed and accuracy scores obtained on the TST, found that a significant relationship exists between the speed and accuracy levels of some subtests and the higher end of the four behavioural patterns. While the correlation

coefficients and regression did not support the hypothesis that there was a linear relationship between the results obtained on the TST and that obtained on the PPA.

5.2 Summary and Conclusions

As described previously, the behavioural dimensions that were used in the research are high Dominance, Influence, Steadiness and Compliance. These individuals can be described as:

- (i) High Dominance individuals are competitive and quick decision makers. They are concise when making a decision. They aim towards the achievement of results, especially if the assignment is a difficult one. They are described as quick to react and, if something is at stake, it brings out the best in them.
- (ii) High Influence individuals are usually optimistic and can generally see some good in any situation. Such individuals may be described as acting impulsively and at times are inconsistent in the conclusions they reach. They are often inattentive to detail and may lack depth in problem solving or even overestimate problem complexities. Such individuals tend to jump to conclusions and may act on an emotional impulse. They may make decisions based on a surface analysis of the facts.
- (iii) High Steadiness individuals can be described as maintaining steadiness to accomplish results and usually have a systematic approach, concentrating and finishing assignments. They are deliberate in approaching problem solving and fact gathering. They follow established procedures. High steadiness individuals work steadily for completion of a project. They wait for orders before acting and are thorough with details. Individuals with high steadiness ask questions for clarification. They are apt at time management and often set challenging objectives.

- (iv) High Compliance individuals usually employ a critical approach in solving problems, employing logical analysis to problems. They require a full explanation and thoroughness before doing the task. Behaviour usually associated with Compliance is that such individuals gather detailed information and examples and are set on getting things done right. They adhere to standard operating procedures to ensure quality.

Based on the descriptions of the four behavioural dimensions, the alternative hypotheses proposed, that predicted the relationship between the high end of the behaviour patterns and speed and accuracy to be as shown in Figure 18.

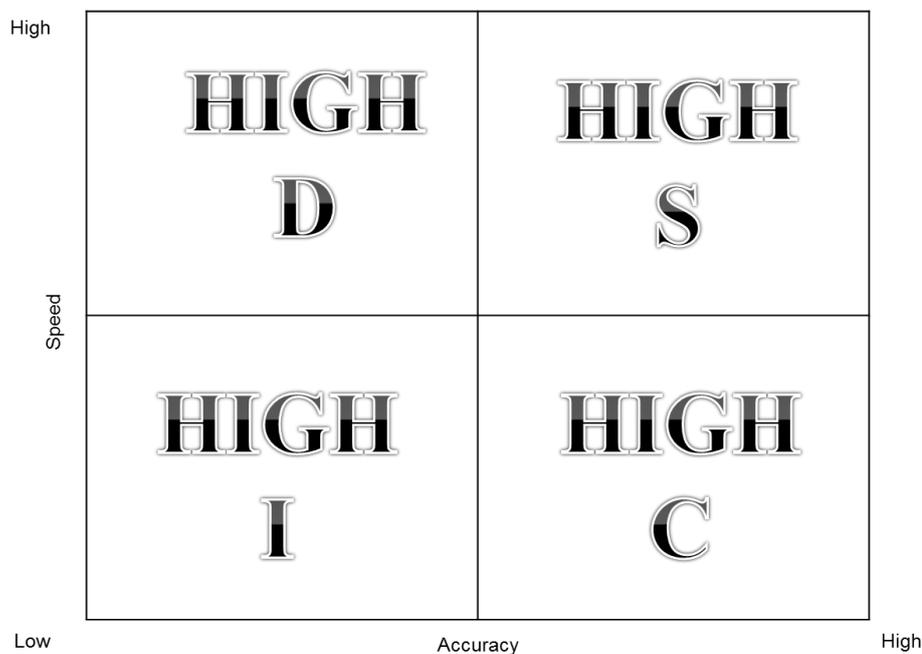


Figure 18: Alternative Hypotheses Proposed for the Behaviour, Speed and Accuracy Relationship

Descriptive results revealed that individuals that completed the TST worked at a slower speed but with higher accuracy. This could be attributed to two elements. Firstly, the purpose of the testing for recruitment and development purposes ensuring more diligence on the part of the test taker. Secondly, the

calibre of the test taker. All these individuals were graduates, supervisors and management, thus it could be expected that they would once again modify their behaviour to try and secure the best result possible on a psychometric measure.

The contingency tables and significant testing revealed the different impact that high and low behaviour dimensions have on all three graphs with regard to specific accuracy and speed scores attained. The results for Graph III indicated that individuals with a high Dominance were significantly less likely to have scores rated at below average and very low on the Feature Detection, Reasoning, Number Speed and Accuracy and Orientation subtests. While the results for Influence on Graph III also exposed that individuals with a high Influence factor are less likely than those with low Influence to have a higher degree of accuracy on the Working Memory subtest.

The current research showed the extent to which behaviour, as measured by the PPA, impacts on the speed and accuracy with which an individual completes a learning potential measure. The study specifically showed that there was a relationship between:

- (i) high Dominance and Speed and Accuracy scores
- (ii) high Influence and Accuracy scores
- (iii) high Steadiness and Speed scores

Therefore, if consideration is given to all the data presented, the following relationship between high behavioural dimensions on Graph III and Speed and Accuracy are evident (Figure 19).

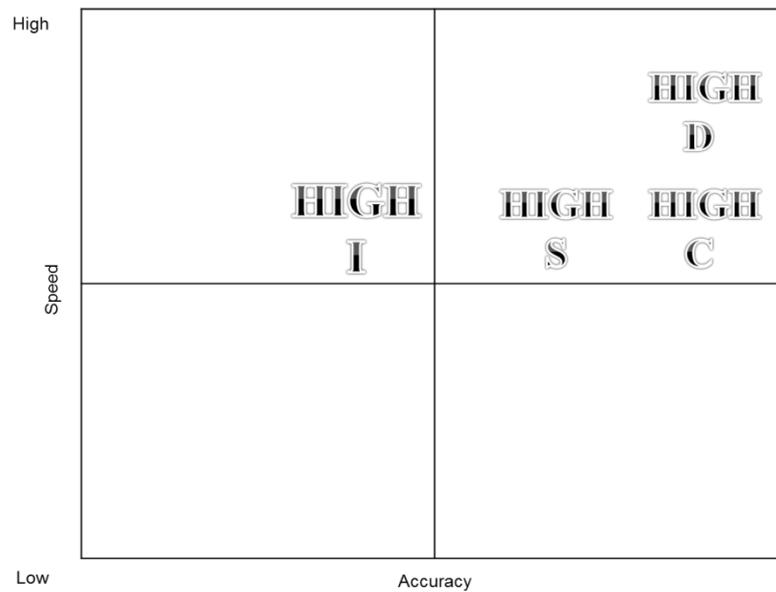


Figure 19: Relationship between Behaviour, Speed and Accuracy based on the Study Results

5.3 Contributions to Knowledge

From these results is evident that it will be imperative to consider an individual's preferred behavioural style when they complete a learning potential measure, as various elements of behaviour have an impact on how an individual completes a learning potential measure. This will be pertinent especially if an individual's preferred behavioural style puts them at a disadvantage when completing a measure. The onus therefore lies with the assessment practitioner to ensure that the bias, that is as a result of a characteristic of the test taker themselves, is acknowledged and either accounted for or factored into the reporting mechanism when results are shared with a potential or current employer. The research highlights that behaviour as well as intelligence needs to be taken into consideration when recruiting or selecting an individual for a position, as a person with a particular behavioural profile may be unduly discriminated against as a result of it.

The research results also highlight that the impact of behavioural profiles should be mitigated for on learning potential measures that are developed. This is to ensure that these measures are a true reflection of an individual's abilities and not influenced either positively or negatively by their behavioural profile and how it impacts on the manner in which they complete the measure.

5.4 Limitations in the Research

Although the sample was robust in size, it did not allow for each dimension of the independent and dependent variables to be measured (i.e. point on the Dominance scale and each Accuracy score). The sample size was restricted due to the costly and time consuming nature of the data required. Individuals had to complete both the PPA and TST measure, which at the time of data collection cost thousands of Rands per test.

The limitation resulted in the sample not being randomly drawn but selected on the premise that each respondent had completed both measures allowing for comparison. In addition, it resulted in an unequal distribution of all the various behavioural profiles. It would have been beneficial to have an equal or proportionate number of high and low D, I, S and C individuals in the sample. Another limitation of the study was that the data did not contain sufficient demographics to allow the researcher to factor in these impacts into the completion of an intelligence measure.

The purpose of the testing, i.e. recruitment and development, may have had an impact on the manner in which the individuals approached the completion of the two measures. The respondents may have been highly motivated to achieve 'excellence' in their psychometric performance. Past research indicated that such eagerness to 'do well' in a psychometric test could lead to various types of response biases (Brown & Harvey, 2003;

Crowne, 1960; Dicken, 1963; Griffith, Chemielowski, & Yoshita, 2007). This is known as socially desirable responding (SDR).

It is important to note that other factors that have been shown to bias test results, such as socioeconomic status, education and age, were not assessed (Adler et al., 1994; Roberts & Bogg, 2004). The cross-sectional nature of the design and relatively homogeneous sample represent additional limitations of the present study.

5.5 Recommendations for Future Research

It would be beneficial for an operational definition of behaviour to be put forward within the field of Behaviourism to allow for the focused research of this topic. It is suggested that future research aims to delineate and test a model to define how behaviour and intelligence are interrelated in a South African context.

In addition, it would be worthwhile to include aspects such as race, gender and other socio-demographics in future studies so that the impact of each aspect can be determined on the performance on an intelligence measure. Especially in a country that has such a unique and diverse population.

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Original research

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