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Factors influencing performance on a computerised neuropsychological test battery

By

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Abstract

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To date variables such as acculturation, language and ethnicity within the neuropsychological test literature have been underreported. South Africa presents with a dynamically acculturative society and there is a need to bring into focus these issues within the field of neuropsychological testing. This study investigates the association between acculturation, computerised neuropsychological test performance and personality variables (the temperament and character dimensions). Results from a pilot sample of sixty-three South African university students yielded significant associations between various neuropsychological domains and cultural aspects as measured by an acculturation scale as well as certain personality traits as measured by a temperament and character inventory. The study supports literature evidencing correlations between personality and neuropsychological outcomes in clinical and community samples residing in diverse cultural milieus.

Keywords:

South Africa, neuropsychology, acculturation, personality, emotion, executive functioning

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Chapter 1

Introduction

1.1 Overview

> *Performance in neuropsychological tests is influenced by an array of different variables, including: culture (i.e. beliefs, behaviours, and cultural elements) ecological demands, language and educational level. This group of variables have been only partially studied and scarcely analysed in neuropsychology.*
>
> (Ardila, 1995, p.143)

> *... The South African test arena, due to its many race groups in various stages of westernization, with associated cultural, linguistic and educational diversity ... present an enormous challenge.*
>
> (Shuttleworth-Jordan, 1996, p.97)

These two quotes illustrate that influences on the performance in neuropsychological tests are vast, that the need for research on these variables are pertinent and that these

influences need to be investigated in the South African context. These shortcomings amongst others provide the rationale for this study.

This chapter provides a short introduction into various research studies that will provide a background and contextualise this study. A short literature review focuses on current research of the different variables influencing neuropsychological test performance, specifically concentrating on the lack of research on certain variables. Since this study was conducted on a South African sample it is pertinent to also show an overview of studies conducted in South Africa. Afterwards a synopsis is given on the usage of computerised tests on large groups.

This research overview will allow me to establish the research problem for this study, which will be followed by a discussion of the aims of the dissertation. A brief outline of the structure of the chapters in this dissertation will then follow.

1.2 Context

1.2.1 Current research on influences on the performance in neuropsychological tests

Recent times have shown an emphasis on the importance of socio-cultural and other socio-demographic factors that might possibly influence the performance of

neuropsychological assessment (Ardila, 1995; Byrd, Sanchez & Manly, 2005; Echemendia, 2004; Rosselli & Ardila, 2003). This movement manifests across the neuropsychological research and clinical domain, and this is evident in published works such as books that concentrate on cross-cultural neuropsychology (e.g. Nell, 2000; Uzzell, Ponton, & Ardila, 2007) and articles that investigate these influences (e.g. Ardila, 1995; Dugbartey, Townes, & Mahurin, 2000; Ponton & Ardila, 1999; Rosselli & Ardila, 2003). Of note is the works that apply this movement in the South African context, such as: Nell (2007), Shuttleworth-Edwards, Donnelly, Reid, and Radloff (2004) and Shuttleworth-Edwards, Kemp, Rust, Muirhead, Hartman and Radloff, (2004).

It therefore seems that the old adage, that no variable other than the brain influences test performance, is antiquated. Studies have found that performance on neuropsychological tests are influenced by a diverse collection of variables, such as: (a) socio-demographics, which include age, gender and ethnicity; (b) socio-cultural, which includes education (level and quality), linguistic competence and acculturation; and (c) the verbal and non-verbal nature of tasks (Ardila, 1995; Byrd et al., 2005; Dugbartey et al., 2000; Echemendia, 2004; Ponton & Ardila, 1999; Rosselli & Ardila, 2003; Shuttleworth-Jordan, 1996; Shuttleworth-Edwards & Donnelly et al., 2004; Shuttleworth-Edwards & Kemp et al., 2004).

All of these notions that have been touched on briefly here will be elaborated on and explored in more depth in Chapter 2 – The Literature Review.

1.2.2 Lack of research on certain variables influencing performance in neuropsychological tests

Certain demographic variables such as age, education and gender have been well documented in literature, whereas ethnicity, acculturation and language have not been the focus of much attention, especially in neuropsychology (O'Bryant, O'Jile, & McCaffrey, 2004). The interaction between these variables is complex, largely due to their intricate relationship with each other and with the course of neurodevelopment (O'Bryant et al., 2004). This attests to the necessity of research on socio-demographic and socio-cultural variables and their relationship to neuropsychological performance.

1.2.3 The South African context

South Africa's unique cultural, educational and historical milieu and rich and diverse population provides an arena for cross-cultural neuropsychological research. The limited research done on South African populations have focused on small homogenous groups, clinical samples and individual neuropsychological tasks (Shuttleworth-Jordan, 1996; Shuttleworth-Edwards & Kemp et al., 2004;

Shuttleworth-Edwards & Donnelly et al., 2004). Therefore, little research has been done on those influences that are unique to the South African context, in terms of neuropsychological assessment.

The collection of all these differences in the population poses a challenge for psychological and neuropsychological testing. According to Manly, Byrd, Touradji, and Stern (2004), neuropsychological tests should be normed for their specific target population, since discrepancies exist between different groups' scores. However, according to Shuttleworth-Jordan (1996), this does not take into account the changing milieu of the world due to globalisation, westernisation and urbanisation, which may influence acculturation, and enhances education and linguistic competence. These concerns about the application and interpretation of neuropsychological tests give rise to poignant questions that neuropsychology, no doubt, must address. According to Uzzell et al., (2007) these questions centre on the universality of human characteristics underlying physiological phenomena and the measurement of behavioural output across cultures.

1.2.4 Using computerised assessment

With the advent of globalisation and the fervent rise of technology, the use of computerised tests is also becoming increasingly popular. According to Lezak, Howieson, and Loring (2004) neuropsychological computerised testing is poised to become a common medium in clinical and research assessment environments, largely due to its ease of administration and its potential use in soliciting data from large groups. For these reasons it was decided to use computerised tests in this study.

1.3 Research question

The following research problem was deduced from the literature:

To determine the relationship between acculturation, socio-demographic factors, socio-cultural factors, personality variables and computerised neuropsychological performance in a non-clinical South African sample.

My goal is to show not only that these relationships exist but to what extent these variables influence test performance.

1.4 Aims of the research

Neuropsychology is a relatively young sub-discipline of psychology, which has only recently been included as part of the Board of Psychology's practice framework. Thus, little data exists on the use of neuropsychological tests in South Africa and the need arises to conduct basic research and explore the influence of socio-demographic and socio-cultural variables on a non-clinical South African sample.

The primary aim of this pilot study is to explore the relationships between socio-demographic variables, socio-cultural variables, personality variables and computerised neuropsychological test performance.

The secondary aim is to compare the neuropsychological performance of the South African sample with the performance of the sample from the University of Pennsylvania.

1.5 Structure

The structure of this dissertation is as follows:

Chapter two will introduce the relevant literature on neuropsychological assessment, international cross-cultural neuropsychology and South African research on neuropsychology. This literature includes a brief introduction into the history of neuropsychological assessment and how this has changed to a more holistic view in recent times. This is followed by an investigation into cross-cultural neuropsychology, where Kennepohl's (1999) preliminary connectionist model will be used to show the importance of recognising culture's role in assessment. International cross-cultural neuropsychology will then be discussed with special emphasis on culture as a variable and how culture 'free' tests and verbal and non-verbal items influences assessment. An in-depth look will then be provided into the variables that influence neuropsychological test performance, which include: Acculturation, Education (quality, quantity and parental education), Language as well as the influence of temperament with the help of the Temperament and Character Inventory (TCI). Lastly, South African neuropsychological research will be reviewed and future research in cross-cultural neuropsychology will be explored.

Chapter three presents the methodology used in this study by explaining the research design used, the procedure of data gathering, sampling techniques and measuring

instruments. The analysis techniques used on the data is also explained as well as the ethical considerations that were taken into account.

Chapter four consists of the results obtained from the data. This is divided into results pertaining to the TCI, the computerised neuropsychological tests, correlations between the TCI and the computerised neuropsychological tests, acculturation results and the socio-demographic results.

Chapter five discusses the results given in chapter four. This is done by citing relevant research to verify the results that were obtained in the study. This chapter ends with an answer to the research question and gives recommendations for possible future research.

1.6 Conclusion

This study aims to investigate whether there is a correlation between certain variables (socio-cultural, socio-demographic and personality) and performance on a computerised neuropsychological test. The results shown and discussed in this dissertation are from a pilot study that forms part of a bigger NRF grant investigation.

The results of this study will contribute to the understanding of the lack of research on variables that influence neuropsychological test performance internationally, but more specifically in the South African neuropsychological arena as well.

Chapter 2

Literature review

2.1 Introduction

Traditionally assessment in neuropsychology only focussed on measures of cognition – it primarily tested intelligence achieved by formal schooling (Caetano, 2007). These measures represent abilities that are learned in a cultural environment (Uzzell, 2007), and with every cultural context that differs, different patterns of abilities are produced (Ardila, 1995). It can therefore be infered that if a cultural environment is different from the norm, other patterns of abilities than the norm will develop.

Recent times have seen an emphasis being placed on the importance of socio-cultural and other socio-demographic factors that might possibly have an influence on performance during neuropsychological assessment (Ardila, 1995; Byrd, et al., 2005; Echemendia, 2004; Rosselli & Ardila, 2003). This trend is evident throughout the neuropsychological research and clinical arena in published works such as: books that concentrate on cross-cultural neuropsychology (e.g. Nell, 2000; Uzzell, et al., 2007) and articles that investigate these influences (e.g. Ardila, 1995; Dugbartey, et al., 2000; Ponton & Ardila, 1999; Rosselli & Ardila, 2003). Noteworthy works that

apply this trend to a South African context are those of Nell (2007), Shuttleworth-Edwards, Donnelly, et al., (2004) and Shuttleworth-Edwards, Kemp, et al., (2004).

Clinical Neuropsychology can be uniquely characterised by a form of systematic oversimplification (Nelson & Ponton, 2007). This means that when measures are reliable and valid, these measures can describe individual behaviour and then in turn be compared to relevant normative data. An ideal approach for the application of cross-cultural neuro-psychological assessment requires that functioning should be adressed via the interaction of the universal (not in terms of individuality and specific culture) and that which is unique and ever changing (Caetano, 2007).

These days, a more holistic view is incorporated, where the individual is assessed on a more comprehensive base, which includes a broader range of variables such as emotional responses, coping strategies and so forth (Caetano, 2007). Caetano (2007) has shown that these variables, as well as cognitive processes, are not necessarily universal concepts. Ostrosky-Solis, Ramirez, and Ardila (2004) supports this and according to them; “culture intervenes in the development and use of some cognitive processes” (p. 191).

It is well known in neuropsychology that test norms developed for the dominant culture wil present a skewed picture when applied to individuals from another culture, to such a degree that it will be unusable to evaluate abilities in intact participants (Lezak, 2002). It can therefore be assumed that the influence of different variables such as culture, education and language on neuropsychological tests are more vitally important than what was previously the case. The question now arises as to *how* and to *what extent* the socio-cultural and neurobiological systems influence one another.

This chapter will continue the above discussion further by taking a look into relevant literature. This will be achieved by firstly giving a background on the field of cross-cultural neuropsychology, where the importance of culture and biology will be discussed. After this the connectionist model of Kennepohl (1999), will explain the relationship between these two aspects. Assessment in neuropsychology will then be reviewed with a short overview of the socio-demographic and socio-cultural variables.

This is followed by an overview of international research on neuropsychological test performance, with emphasis on the following aspects: culture, acculturation, education and language. The research findings will also be discussed in conjunction with relevant research from the South African perspective. Following this, research

concerning temperament and performance on neuropsychological assessments will be examined. The use of computerised neuropsychological measures will be investigated, followed by research in the South African context regarding neuropsychological assessment. This chapter will end with a look at the future of cross-cultural neuropsychology and the assessment thereof.

2.2 Cross-cultural neuropsychology

2.2.1 Culture and biology

The discipline of neuropsychology, unlike most other disciplines in psychology, was founded on scientific and medical grounds. This field discounted socio-demographic and socio-cultural variables influencing neuropsychological performance (Wong, Strickland, Fletcher-Janzen, Ardila, & Reynolds, 2000). Due to a variety of studies showing the limitation of biological influences, a different perspective on interpretation of neuropsychological assessment was developed (Ardila, 1995; Byrd et al., 2005; Dugbartey et al., 2000; Echemendia, 2004; Ponton & Ardila, 1999; Rosselli & Ardila, 2003; Shuttleworth-Edwards, Donnelly et al., 2004; Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Jordan, 1996).

Some researchers (Kennepohl, 1999; Morais & Kolinsky, 2000) will argue against the defining of human behaviour (thought and action) only in terms of biology or culture.

According to them these approaches will fail since cognition as we know it is a product of both biology, environment and/or culture. Eviatar (2000) agrees with this statement and emphasises the need for an approach that will show the interaction between culture and the functional differences of the brain.

Today we see the brain as an adaptive organ that reacts to environmental stimuli and generic constraints. The activity of the brain therefore depends on its functional potential. The current challenge facing neuropsychologists is to understand how the processes interact and what the functional outcome would be (Castro-Caldas, 2007).

2.2.2 A Preliminary Connectionist Model

Kennepohl (1999) introduces a preliminary model of cross-cultural neuropsychology that encompasses both biological and cultural elements. This integrated theory addresses the dynamic interaction between the neurobiological and socio-cultural systems. This model proposes that the brain is both an independent and a dependent variable. As an independent variable; the brain prescribes certain thoughts and actions, and as a dependent variable the brain represents and reflects different environmental aspects.

Kennepohl's (1999) preliminary model can also be described as a connectionist model of culture-brain interaction, where possible contributions of cultural agents towards brain development are discussed. This interaction is important since attempting to explain the brain of a human being through only culture or biology will discount the complex interactivity and reflexivity inherent in human nature (Kennepohl, 1999).

Cultural factors modify the brain in several ways, either on an individual basis or combined. Kennepohl (1999) identified the most prominent of these influences: (a) early ecological surroundings may activate appropriate neuronal connections, which may not necessarily occur in another cultural setting; (b) active learning during early childhood alters the brain, which is represented by the relevant neuronal paths; and (c) the continuous ability of the brain to adapt to new environments and acquire new skills to enhance functioning.

Although there has been overwhelming evidence suggesting the brain's dependence on the environment, there have also been profound commonalities across cultures in terms of neuronal organisation and behaviour. Given this, it is clear that a complex system of interacting factors is involved in the brain's development. Kennepohl (1999) states that biological, socio-demographic and socio-cultural variables may

interact with each other, since the brain, which is similar to a primitive network, is genetically programmed to evolve and adapt to environmental influences. This primitive network seems to show remarkable plasticity in terms of adaptation to environmental changes.

The notion of this adaptable entity is summarised in the following (Kennepohl, 1999, p. 375):

> *...the human brain ultimately reflects its ecological, social, and cultural environment. At the same time, this system is subject to some rather stringent developmental and evolutionary constraints. Any model that attempts to represent the culturally sensitive brain must therefore carefully balance these contrasting properties in a manner that is both biologically and psychologically plausible.*

This preliminary model (Kennepohl, 1999) gives researchers the opportunity to formulate a cross-cultural neuropsychological paradigm and investigate the relationships between acculturation and any combining variable's influence on neuropsychological test performance. It should be noted though that this model does not adequately address many facets of culture and it may be criticised for its cognitive

outlook. However, this model is still in its infancy and can therefore, be expanded to incorporate all the facets and variables needed to explain the culturally sensitive brain.

The understanding we now have about the brain's organisation of cognitive abilities can be infered as culturaly biased (Ardila, 1995; Fletcher-Janzen, Strickland, & Reynolds, 2000). This therefore seems to discount and antiquate the adage, that no variable other than the brain influences test performance. Studies have found that performance on neuropsychological tests are influenced by a diverse collection of variables, such as: (a) socio-demographics, which include age, gender and ethnicity; (b) socio-cultural, which includes education (level and quality), linguistic competence and acculturation; and (c) the verbal and non-verbal nature of tasks (Ardila, 1995; Byrd et al., 2005; Dugbartey et al., 2000; Echemendia, 2004; Ponton & Ardila, 1999; Rosselli & Ardila, 2003; Shuttleworth-Edwards, Donnelly et al., 2004; Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Jordan, 1996).

2.3 Cross-cultural neuropsychological assessment

2.3.1 Assessment to date in neuropsychology

Neuropsychology could possibly be defined as the study of brain and behaviour relationships (Kennepohl, 1999). Another definition for Clinical Neuropsychology is that of "an applied science concerned with the behavioural expression of (the) brain" (Lezak, 1995, p.7). On the other hand, Cultural Psychology can be defined as the interaction between individuals and their respective cultures (Shweder, 1995). It can therefore be deducted that Cross-cultural Neuropsychology, is the study of the interaction between the brain-behaviour relationship, and the individuals' respective socio-cultural and socio-demographic variables, that may influence behaviour or performance on neurospychological tests. With several thousands of cultures and over 6800 languages being spoken all over the world (Uzzell, 2007), it seems that the scope of neuropsychology may be more complicated and diverse than what the deducted definition suggests.

The assortment of all these differences in the populations poses a challenge for psychological and neuropsychological testing. According to Manly, et al., (2004), neuropsychological tests should be normed for their specific target population, since discrepancies exist between different groups' scores. Uzzell (2007) underscores this point of view, stating that items in an instrument may be understood by those in the

culture for which it was developed, but not necessarily by those of another culture who may attach a different or no meaning to the same items. She further contends that, since tests on ability apply assumptions from the culture from which the test was developed, aims of reliability and validity becomes highly doubtful. The question now arises whether information processing differences can be attributed to biological differences in cultures or a learned difference due to the cultural point of view of individuals (Kendall, Verster, & Von Mollendorf, 1988).

According to Shuttleworth-Jordan (1996), the above statements do not take into account the changing milieu of the world due to globalisation, westernisation and urbanisation, which may influence acculturation and enhance education and linguistic competence. These concerns about the application and interpretation of neuropsychological tests give rise to poignant questions that neuropsychology, no doubt, must address. Uzzell (2007), states that these questions centre on the universality of human characteristics underlying physiological phenomena and the measurement of behavioural output across cultures.

The aforementioned researchers have opted for separate norms to eliminate the variances in scores of different cultural groups for performance on neuropsychological tests. Manly, et al., (2004) contends that although this will most

likely reduce misdiagnosis, there are still considerable disadvantages to this approach. The primary disadvantage is that the differences found in test performance will then be left without explanation and there will be no further investigation into possible reasons for these differences. Furthermore, seperate norms do not help address the problem of the lack of uniformity in neuropsychological measures, since the prominent cultural abilities are not scrupulously measured (Manly, 2005).

The norming of Neuropsychological tests has seen tremendous effort and devotion, lately. At this point in time the norms are relatively reliable, but in most cases these norms have been obtained from white English-speaking middle class subjects, with high levels of education (Ardila, 2007). This shows a lack of cross-cultural norms for assessment instruments in neuropsychology. Neuropsychology should therefore develop principles that must include cross-cultural methods, so that diversity and universals between cultures will be acknowledge and understood (Uzzell, 2007).

The idea that cultural variances may be eliminated if an accurate translation is given or if certain content in the original is substituted for more local ideas might be plausible, but according to Nell (2000) this idea rests on the assumption that cognitive universals exists, which has not been scientifically proven.

2.3.2 Cross-cultural variables

O'Bryant, et al., (2004) conducted a study in which articles were analysed from five prominent and frequently used journals, from 1995 to 2000, to determine how frequently demographic variables were reported in the studies of neuropsychological test performance. A review of 1440 articles showed that demographical variables, such as age, gender and education, were included in 80% of the articles. Other variables that were identified such as ethnicity, language, socioeconomic status and acculturation, were represented poorly in comparison with age, gender and education. Although great improvements have been seen in the field of cross-cultural neuropsychology, these results show that certain variables are still in need of more research. This highlights the need for change in the current trend of research so that progress in this field can continue.

2.3.2.1 Socio-Demographic Factors

Certain demographic variables such as age, education and gender have been well documented in literature, whereas ethnicity, acculturation and language have not been the focus of much attention, especially in neuropsychology (O'Bryant, et al. 2004). Culture and linguistic competence, especially, are frequently overlooked moderating variables that seem to have an enormous impact on neuropsychological test performance (Ardila, 2007). The interaction between these variables is complex,

largely due to their intricate relationship with each other and with the course of neurodevelopment (O'Bryant et al., 2004). This attests to the necessity for research on socio-demographic and socio-cultural variables and their relationship to neuropsychological performance.

2.3.2.2 Socio-Cultural influences

Previous studies (Ardila, 1998a; Ardila & Rosselli, 2003; Ardila, Ostrosky-Solis, Rosselli & Gomez, 2000; Byrd, et al., 2005), on cross-cultural neuropsychological test performance have focussed on demographic variables such as age, gender and education. Recently, this scope has been extended to include factors such as culture, language, ethnicity, socio-economic status and education in terms of the level and the quality of education (e.g. Dugbartey et al., 2000; Shuttleworth-Edwards, Donnelly et al., 2004; Shuttleworth-Edwards, Kemp et al., 2004). Although more variables have been identified, clinicians and researchers alike should not forget or underestimate the influence of these demographic variables on neuropsychological test performance (Nelson & Ponton, 2007).

2.4 International Cross-Cultural Neuropsychology

2.4.1 Universality of Cognitive functions

A movement toward multiculturalism has become prominent in recent times (Uzzell, 2007). The aim is to have universals across different cultures, which are also common to several other cultures.

According to Greenfield (1997), there are three reasons why cognitive abilities are not cross-culturally universal. The first is that of values and meanings, this already points to an inherent lack in general agreement. For instance, some might consider answering the Raven's Progressive Matrices with a different perspective, they may answer it on an aesthetic principle – for the figure that looks the best in that particular situation, or the decision might be based on a conceptual framework, the one that continues the sequence.

The second refers to different ways of knowing. In some cultures answering questions on an individual bases seems rather absurd. Since most activities in life happen collectively, the culture group does not understand why this particular event should be the exception. The last reason is concerned with conventions of communications. Questions on a test are there on an assumed bases, this assumption is based on the fact that the respondent already has an answer. But in the case of the

Rey-Osterrieth Complex Figure test, some cultures may find it unnecesarry to copy nonsense figures, whereas in societies were testing is typical, copying nonsense figures is not that absurd.

Ardila (2007) on the other hand identified five aspects of culture that potentially might affect an individual's performance on neuropsychological tests. Some of Ardila's (2007) aspects are connected or interrelated to Greenfield's (1997). Ardila's (2007) five aspects are:

1. The pattern of abilities – culture prescribes what is learned, when it is learned and how it is learned, therefore in each cultural environment each individual's cognitive organisation will develop differently.

2. Cultural values – in a testing environment the rationale and procedure rely on a variety of culutral values that can not be regarded as values that are universally known or understood.

3. Familiarity – some testees are familiar with certain testing elements (e.g., bikes, stories, symbols, etc.); and strategies used to solve tasks and attitudes for test taking.

4. Language – differences in semantics, grammar, phonology, etc. which affects the performance of language during testing.

5. Education – school content is included in cognitive tests and schools provide and teaches strategies for studying as well as developing more positive attitudes for intelligence testing.

A recent study from Ardila and Moreno (2001), in which Arauco Indians in Colombia were evaluated, shows the intricate way that variables influence cognition and why it is hard to assess. The sample consisted of 20 participants between the age of 8 and 30, with an education level of no more than six years. The battery consisted of the Rey-Osterrieth figure, identificaton of overlapped figures, spatial memory, a Spanish version of the Wechsler Intelligence Scale for Children-Revised block design, amongst others. The authors reported that the participants did exceptionally well on certain tasks (identification of overlapping figures), but in other tests they did quite poorly (spatial memory).

Ardila and Moreno (2001) concluded that there were three reasons why the performance was affected: (a) educational level – correlation between low scores and low education level; (b) cultural relevance – some tests were more relevant to their culture and others did not make sense; (c) age – a significant association was identified with performance and age. The study shows how different variables

combine to influence the results and why it is important to understant each variable and how it might influence behaviour.

2.4.2 Culture

2.4.2.1 Terminology

> *The integrated pattern of human behaviour that includes thought, speech, action and artefacts; and depends upon man's capacity for learning and transmitting knowledge to succeeding generations.* (Webster's Dictionary)

Uzzell (2007) uses this definition to illustrate the two most important aspects of culture and adds a third aspect not covered in the Webster's Dictionary's definition. The first aspect pertains to the fact that certain features, such as thought, speech, etc., are blended together to form an integrated pattern which is visible in human behaviour. The second aspect is that of continuance and existance of culture. To perpetuate a culture one has to absorb it through learning and transmitting it to the recently born individuals of that particular culture. The last aspect which Uzzell (2007) includes, is the culture's ability to change or it can be decribed as the fluid facet of culture. This can be due to generalisations of cultural aspects (acculturation)

or the individual may have been isolated from the prominent culture for certain reasons.

The term culture has also been used to describe various constructs such as race, ethnicity and sometimes even language, but although culture may demonstrate some of the traits of these constructs, it cannot be seen as synonymous with them (Nell, 2007). Ethnicity for instance is the national origin of an individual; this gives rise to cultural expressions that are passed down from generation to generation (Uswatte & Elliot, 1997).

Various authors have defined culture as a way of living in a specific group with certain behaviours, feelings, attitudes and beliefs that are shared within the group (Ostrosky-Solis, et al., 2004; Rosselli & Ardila, 2003). Flaskerud (2000) sees culture as a non-biological entity which includes features such as ideologies, social structures, languages, etc. Ardila (2007) explains culture in three dimensions: (a) the first includes thinking, feeling, values, etc.; (b) the second concerns behavioural aspects; (c) and the last includes the physical dimensions such as clothes. One culture can be different from another because of the integration of unique components within each individual culture (Uzzell, 2007).

The importance of culture lies in the fact that it dictates what is relevant and what is not in certain situations, and as such it dictates behaviour. Culture is also responsible for the specific ways individuals think, feel and behave (Uzzell, et al., 2007). Culture dictates what is learned and when it is learned; culture therefore determines how each individual's cognitive processes are mapped.

2.4.2.2 Cultural research

The importance of cultural influence can be seen in a study conducted by Nell, (Uzzell, 2007) in South Africa. While using the Raven's Progressive Matrices no correct response were given by the participant. During the post examination interview the reason came to the fore: the participant made selections based on the pretty picture and not on a logical base that requires one to complete the picture. This study emphasises the point that cultural values have to correlate between the participant and the assessor or assessment instrument, otherwise validity and reliability might be threatened. These findings illustrate that one of the most elemental differences between westernised and non-westernised subjects, when it comes to psychological assessment, are 'test wiseness' (Nell, 1999).

There is also evidence suggesting that cultural contexts produce cognitive networks or connections that may become 'hard wired' in the physiology of the brain. In a study by Moriguchi et al., (2005), Japanese and Caucasions were observed while watching fearful facial expressions. Brain activation was monitored by a fMRI, and it showed different regions being activated for the two groups. When using memory tests, significant cultural differences can be noted, this specifically refers to how memory was used and in which situation memory was used (Ardila & Keating, 2007).

Ostrosky-Solis, et al., (2004) concurs with the researchers above, stating that with the use of some cognitive processes culture will play the role of arbitrator. Their research on indigenous and nonindigenous populations' performance on neuropsychological tests (NEUROPSI) shows the influence of cultural aspects. Their participants were divided into four groups: illiterate Maya indigenous group, illiterate Pame indigenous group, nonindigenous group with no education and a Maya indigenous group with 1 to 4 years of education. The results show that the two indigenous groups performed better on the visuo-perceptual and constructive tasks than they did on tests associated with immediate and delayed verbal memory. According to Ostrosky-Solis and collegues (2004), this may be due to the cultural environment where the indigenous participants live. Their culture demands higher skills in visuo-spatial abilities than verbal memory, since they are farmers and basket makers and do not use their verbal memory as much.

2.4.2.3 Culture 'free' tests

Culture has been a major discussion point in psychological assessment. For more than a hundred years the aim was to develop 'culture-free' tests (Rosselli & Ardila, 2003). The ideal was to develop separate norms for each cultural group and in this way enhance the accuracy of diagnosis, since the norms could be applied to individuals who were more demographically similar (Manly, 2005). This approach also had the major drawback of how to classify a cultural group, since certain cultural or ethnic groups are social-political classifications and are not necessarily scientifically defined (Manly et al., 2004).

At this point in time anthropologists have not found a 'culture-free' test (Uzzell, 2007), though reports from Shuttleworth-Edwards, Donnelly, et al., (2004) state that the Digit Symbol-Incidental Learning item from the WAIS-III might possibly be a culturally independent task. Their study consisted of black African first language and white English first language groups, which were grouped according to level of education (graduate and grade 12) and quality of education (advantaged and disadvantaged). Their findings showed no significant difference between the two groups. This indicates that these tasks might be relatively unaffected by the socio-cultural variables.

The conclusion can thus be made that individuals from different cultures react to the testing situations in different ways, and experience the relationship differently (Nelson & Ponton, 2007).

2.4.2.4 Verbal and non-verbal items

For a period of time it was thought that eliminating the verbal items of tests, and therefore only leaving the non-verbal items, would result in a 'culture-free' test (Ardila & Keating, 2007). According to Rosselli and Ardila (2003) culture contributes to certain functions, such as language ability and factual knowledge, which can be termed under 'test wiseness'. When performances of individuals on non-verbal items are compared, significant cross-cultural differences can be identified. The individual's culture can influence simple items on tests such as copying figures, listening to tones or drawing maps (Ardila, 2007). Therefore, the possibility exists that socio-cultural effects are present for both verbal and non-verbal items.

In a study by Ardila and Moreno (2001) they observed the performance of the Aruaco Indian culture, an indigenous South American tribe, on neuropsychological assessment. The authors expected that the non-verbal measures of the western test would be more appropriate, than the verbal measures. With the results their

assumption was shown to be incorrect – the results suggested that non-verbal elements can not be seen as more relative or appropriate than verbal testing, especially with cross-cultural neuropsychology.

Dugbartey, et al's., (2000) study of the Colour Trial Test, a non-verbal test, is a perfect example. The study comprised of 64 non-native English speaking, university students from Turkey. The results of this study demonstrated that the test might not be as culturally fair when used with a group of bilingual students.

Rosselli and Ardila (2003) also investigated performance on non-verbal neuropsychological tests while controlling for different educational levels as well as cultural backgrounds. Two groups were distinguished; the first had different educational levels but similar cultural backgrounds (inter-education & intra-cultural comparison) and the second group had the same educational level but different cultural backgrounds (intra-education & inter-cultural comparison). With the first group a significant relationship between the education level and performance on neuropsychological tests were reported. The second group showed cultural differences independent of educational effects. Hence the conclusion can be made that non-verbal tests, show a bias for cultural elements.

Rosselli, Ardila, Bateman, and Guzman, (2001) conducted a study in which Colombian children were compared to an American normative sample on performance of verbal and non-verbal tasks. Two hundred and ninety children aged between 6 and 11 years were selected from a school in Colombia, and were divided into three age groups: 6 to 7; 8 to 9 and 10 to 11. Their performances were measured on the following neuropsychological tests: Seashore Rythm Test, Finger Tapping Test (FTT), Grooved Pegboard Test, Children's Category Test (CCT), California Verbal Learning Test-Children's Version (CVLT-C), Benton Visual Retention Test (BVRT), and Bateria Woodcock Psicoeducativa en Espanol.

Rosselli, et al's., (2001) results found that most of the tests scores were quite similar, but on the Seashore Rythm test (a non-verbal subtest) the Colombian children performed higher, up to two standard deviations higher than their American counterparts. According to the researchers the reason for this discrepancy may be explained by cultural variations. Musical learning is a significant cultural value among Colombians and this is not evident in the American culture.

These results reinforce the results from a study conducted by Shuttleworth-Edwards, Kemp, et al., (2004). Non-verbal items were used to determine whether socio-cultural elements influence performance on these non-verbal items. Sampling was

modelled after the South African WAIS III standardisation participation. Two language groups were identified (black African first language and white English first language), two educational levels (Grade 12 and Graduate) and two levels for quality of education (advantaged and disadvantaged). The results showed a definite influence of socio-cultural factors on non-verbal measures. For example, the mean for black African first language with an education level of Grade 12, on the picture completion subtest, showed a score of 8.90 and for the same education level the white English first language group obtained a score of 12.21. This once again shows the significant influence of socio-cultural aspects on neuropsychological test performance.

Mulenga, Ahonen, and Aro (2001), also noted a difference in non-verbal test performance when comparing western and non-western children. In their study they administered the NEPSY to Zambian children and compared the scores with the American norms. They used 45 literate school children aged between 9 and 11, from urban Zambia. The results showed that the Zambian children's performance on the language, attention and executive functioning tests were significantly worse than the US norms, but they outperformed the American children on the visuo-spatial tests. The researchers also observed that the Zambian children tended to work slower, although there were clear instructions that the task should be completed as fast as possible. This phenomena has also been reported by Ardila and Keating (2007),

which can be attributed to the possibility that performing faster is an important cultural value of the United States of America but not necessarily so for other non-western cultures.

2.4.3 Acculturation

2.4.3.1 Terminology

Acculturation is a phenomenon in which the degree of one's participation in customs and activities of one's cultural or ethnic group is surpassed by one's participation in activities of the dominant cultural group (O'Bryant et al., 2004). Thus the individual assumes the cultural attributes of the main stream culture, which include language, behaviour and the norms and values of the mainstream culture (Battle, 2002). Acculturation is caused by changes in the cultural patterns and schemas of groups and individuals due to constant contact between different cultural groups (Ponton & Ardila, 1999; Uzzell, 2007). This definition states that contact with another culture is sufficient for the acculturation process to start, therefore acculturation starts at perception and from there influences all other cognitive neuropsychological processes (Rudmin & Ahmadzadeh, 2001).

Uzzell (2007) agrees with the above statement, stating that acculturation begins when the child is born and shapes their behaviour from infancy. According to Kennepohl

(1999) the acculturation process becomes harder during the later stages of life, since all the new information must be filitered through existing and set schemas. Although acculturation is possible in later stages of life it requires a considerable amount of effort.

Due to the fact that acculturation may occur or begin at any time the construct levels of acculturation was developed (Uzzell, 2007). This can be defined as "the degree to which cultural values, beliefs and practices are incorporated by members from another culture" (p.5). Mostly it applies to minority ethnic groups adopting cultural aspects of the dominant culture.

2.4.3.2 Lack of acculturation research

The acculturation process can be seen as a restraining and/or arbitrating variable in neuropsychological test performance. It might, therefore, be necessary to develop measures of acculturation to determine the acculturation effects on an individual's performance on neuropsychological measures (Uzzell, 2007). O'Bryant, et al's., (2004) report, in which neuropsychological journal articles from a period of 5 years were reviewed to determine what percentages of demographic variables were reported, showed that there was a tremendous lack of acculturation data in research articles from 1995 to 2000. O'Bryant and collegues (2004) attributed this to the lack

of a valid and reliable acculturation measure that can determine the actual influence of acculturation. The lack can be seen in in the results represented in Table2.1, where the amount of acculturation data was significantly lower than other socio-cultural variables.

Table 2.1

Percentages of demographic data reported by the journals

Journal	*Education*	*Acculturation*	*Language*
ACN, (n=226)	82.3	0.0	10.2
JCEN, (n=401)	77.1	0.0	12.0
JINS, (n=280)	72.9	0.4	15.7
Neuro, (n=325)	74.5	0.0	13.8
TCN, (n=208)	85.6	0.0	6.3
Total, (n=1440)	97.6	0.1	12.0

ACN – Archives of Clinical Neuropsychology; JCEN – Journal of Clinical and Experimental Neuropsychology; JINS – Journal of the International Neuropsychological Society; Neuro – Neuropsychology; TCN- The Clinical Neuropsychologist.

Adapted from O'Bryant, et al., (2004, p230).

2.4.3.3 Studies with an acculturation measure

Some studies have included a measure for acculturation and certain demographic variables, such as age, gender, education, etc. The investigation by Manly, et al., (2004) yielded interesting results on the independent effects of acculturation and educational experience on neuropsychological tests. The sample included representatives of three broad ethnic groups: Hispanic, African-American and non-Hispanic White; who were 65 years and older. A neuropsychological battery which included measures of learning, memory, abstract reasoning, and visuo-spatial ability, amongst others were used. The acculturation levels were measured by the African American Acculturation Scale (AAAS) by Landrine and Klonoff, which measures acculturation in 10 dimensions. Their results showed higher levels of acculturation were related to higher performances on the test; however, if the other demographic variables were controlled for, this difference disappeared.

In a study by Coffey, Marmol, Schock, and Adams, (2005), a neuropsychological measure, the Wisconsin Card Sorting Test (WCST), together with the Acculturation Rating Scales for Mexican Americans – 2nd Edition (ARSMA-II) was used. They wanted to determine whether higher acculturation scores will show higher performance on the WCST. The participants were divided into two groups according to their scores on the ARSMA-II, one group was less acculturated and the other group more acculturated. The more acculturated subgroup outperformed the less

acculturated subgroup in every instance. To ensure that these results were not confounded by other variables, the researchers investigated the educational backgrounds of the participants. Both groups had similiar education levels but there was a significant difference in where the education was obtained, the more acculturated group recieved more years of education in the United States than the other subgroup. Though it seems that the country of education will play a large role in the acculturation process, results might be confounded due to total years of education and the quality of education obtained.

Byrd, et al., (2005) also yielded similar results in their study of within-group variation, an element that seems to be overlooked in cross-cultural neuropsychology. Participants selected for this study were 65 years of age or older and spoke primarily English, only non-Hispanic Black and Caribbean individuals were eligible for the study. The participants were divided into two groups; US born individuals and Caribbean born individuals (who immigrated to the US). A neuropsychological battery which consisted of a verbal list learning and memory test, a non-verbal memory test and verbal abstract reasoning test, amongst others, was used. The researchers found that the quality of education was the strongest predictor for within-group differences in performance on neuropsychological tests. They also reported a significant positive correlation between acculturation and neuropsychological test scores.

2.4.3.4 Acculturation and language

Llorente, Tuassig, Satz and Perez (2000), state that acculturation is closely associated with language. For instance, if a person has a high language proficiency, in another language other than their primary language, they will probably have high levels of acculturation. Adding to this is the link between bilingualism and performance on neuropsychological tests (Ponton & Ardila, 1999), which will be a significant variable for neuropsychology in the South African context. The role of acculturation, bilingualism and language of choice on performance, has also been reported on the Trail Making Test (TMT) and measures of visuo-motor abilities (Dugbartey, et al., 2000; Ponton & Ardila, 1999).

2.4.3.5 Summary

The influence that acculturation might have on neuropsychological tests brings about questions of whether norms for specific groups are still necessary. And if they are necessary how one determines to which degree the group or individuals have been acculturated into the dominant society, is the question that then needs to be answered.

The biggest problem with acculturation comes about when there are individuals from a minority group that are already partly acculturated into the mainstream culture. The difficulty lies in whether and/or to which degree the individual is acculturated into the

majority culture and how many aspects they still retain from their original culture (Uzzell, 2007).

The consequences of urbanisation and acculturation are greatly overshadowed by the effects of formal education, when both are controlled for in assessment situations (Kendall, et al., 1988). Although an acculturation construct, that traces a hierachy from rural literate to urban literate, still exists in these assessments.

Taking this into account Shuttleworth-Jordan (1996) argues that the nihilistic attitude towards the disuse of common (western) tests and the design and creation of new culturally appropriate tests, should be weighted cautiously. The popular view is that the use of western standardised tests on rural and semi-literate populations requires more care. Shuttleworth-Jordan (1996), further, argues that when some of these western standardised tests are applied on urbanised ethnic groups, little or no variation can be seen due to dynamic acculturative processes.

According to Byrd, et al., (2005) the vast differences that now exists within cultural groups, due to the process of acculturation, requires an in depth understanding of how cognitive test differences are influenced by cultural sources. Therefore, to fully grasp

the influence of acculturation a call for investigations into within-group heterogeneity is needed.

2.4.4 Education

2.4.4.1 Terminology

Studies have shown a strong correlation between the level of education and test performance on neuropsychological measures. These studies includes those of: Ardila, et al., (2000); Ostrosky, Ardila, and Rosselli, (1999); Rosselli and Ardila (2003); Shuttleworth-Edwards, Donnelly, et al., (2004) and Shuttleworth-Edwards, Kemp, et al., (2004).

In an educational environment the primary aim is to learn, as well as to understand how to take tests and how to respond to certain items on these tests (Ardila, et al., 2000). Learning is a process by which the new experience (the item or aspect that is being learned) changes or modifies the existing knowledge, understanding and/or behaviour. This process involves certain culture specific attitudes, motivations and actions that are acquired by the learner (Kennepohl, 1999). In a school environment students also have the opportunity to learn classroom-type skills, which according to Nell (1999), is one of the most powerful moderators of performances on neuropsychological tests. This underlines the importance of education as a whole, but

investigations on the influence of the quality of the education must also be considered (Shuttleworth-Edwards & Donnelly, et al., 2004).

2.4.4.2 Formal Education

> *No other cultural learning experience is as concentrated and as fundamental, than that which is provided, systematically, through the formal education system.*
>
> (Kendall, et al., 1988, p. 310)

Formal education determines what is learned, when and how, and can therefore be seen as part of a transnational culture (Rosselli & Ardila, 2003). This transnational culture is prescribed by a transnational agenda, which can be seen in many democratic parts of the world. Formal education and schools can be seen as a subculture (Ardila, et al., 2000). The school is the provider of certain abilities and a developer of certain attitudes that is based on values of society which is orientated towards science and technology. This of course in itself may be one of the reasons why highly schooled subjects outperform others on cognitive tasks (Ardila, 2007).

Ardila, (1995) and Ostrosky, et al., (1999), warns that although the level of education has been shown to have tremendous influence on the performance of verbal and non-

verbal neuropsychological tests, education is easily confused with cultural differences. Researches are quick to notice the differences in scores during assessment and ascribe it to cultural factors instead of realising that the differences in educational level might be the actual reason.

2.4.4.3 Effect of Education

The effect of education is not linear, but rather a negatively accelerated curve, which ends in a plateau (Ardila, 1998a; Ardila, 2007). Difference in the first three years of education is highly significant, the next three years sees the effects lower and the next three even more so. No difference is expected for 12 to 15 years of education. According to Ardila (1998a), this is due to the ceiling effect of neuropscylogical tests which are usually very low.

This phenomena can be seen in a study by Ostrosky, et al., (1999), where cognitive tests scores between illiterates and subjects with one to two and three to four years of education were compared. Their results showed a negatively accelerated curve, that concurs with Ardila's (1998a) point of view. The differences between the illiterate group and the one to two years education are highly significant; differences between the one to two years and the three to four years are significantly lower than that of the first group.

According to Ardila and Rosselli (1989), education is more influential than any other variables, especially age, on the performance of neuropsychological tests. Thus formal education is probably the variable that truly accounts for discrepancies in scores for performance on Neuropsychological assessment (Greenfield, 1997).

In a study by Ardila and Rosselli (2003), participants were given the Rey-Osterrieth Complex Figure (ROCF) measure, a non-verbal test. The sample consisted of two adult groups aged between 21 and 75, with different levels of education but the same cultural background. The significance of this study is due to the fact that the ROCF is a non-verbal test which should show equivalent scores, if the assumption that non-verbal tests are culture free is adhered to. This study also shows that even when the influences from the cultural backgrounds are controlled for the educational level still has an effect on neuropsychological test performance.

2.4.4.4 Education in South Africa

In South Africa, the apartheid legacy left a breach between the different cultures' educational levels and the quality of education each group received. After apartheid different schooling opportunities have been available, especially for the more advantaged black individual, this may influence the quality of education South African individuals attain, since differences will not only exist across different groups

but also with in these groups (Shuttleworth-Edwards, Kemp, et al., 2004). Corroborating data for the effects of disparate educational quality on neuropsychological test performance is provided by various South African studies (Shuttleworth-Edwards, Donnelly et al., 2004; Shuttleworth-Edwards, Kemp et al.'s, 2004).

The South African study of Nell, Myers, Colvin, and Rees (1993) and Nell, Kruger, Taylor, Myers and London (1995), who administered tests on factory workers and farm laboureres, respectively, shows that the amount of education a subject's undergone, is the largest moderating factor on test performance.

2.4.4.5 Quality of Education

Manly, Jacobs, Touradji, Small, and Stern, (2002) report that when adjustments are made for the quality of education, significant reductions are seen on the effects of ethnicity/culture on neuropsychological test performance. This might also improve the precision of several neuropsychological measures across cultural groups. Byrd, et al's., (2005) study found that the quality of education was the strongest predictor for within-groups differences in performance on neuropsychological tests.

Avenant's (1988), study applied the WAIS-R to Black South Africans aging over 18, with a level of education at least up to Grade 9 (the old standard 7). The sample comprised of two groups; prison wardens and university students from traditionally black universities. The results showed that the university students scored better than the prison wardens, but still performed lower than the American standard.

Contrasting the previous study, Shuttleworth-Jordan's (1996), study of African first language students at a historically white university yielded different results. These students study in the medium of English (a second or third language), and were assessed on different neuropsychological measures which included the South African Wechsler Intelligence Scale (SAWAIS), Digit Span and Digit Symbol tests. The results showed that only a marginally lower score for the black African first language students were obtained, compared to the white English speaking first language students. The black students' scores was also compared to American standardisation data, and it was found equivalent.

The indications from the above studies illustrate that education and specifically the quality of education, should be looked at to understand and describe discrepant findings in neuropsychological measures (Shuttleworth-Edwards, Kemp, et al., 2004). In Shuttleworth-Jordan's (1996) study marginal differences were found between

black and white students, where the black students performed marginally lower then the white students. This might be explained by the quality of education the different groups received. The Black students now have advantageous education at a traditionally white university, but they were likely to have had a history of poor quality of education on primary and high school level. This shows that although the level of education might be controlled for, subtle differences still exists which can possibly be explained by the quality of education the participants received throughout their educational career.

Shuttleworth-Edwards, Kemp et al.'s (2004) study of within-group differences in a black South African sample showed that quality of education is a significant moderator of neuropsychological performance. The sample consisted of two groups; a white English first language group and a black African first language group, with two levels of education (Grade 12 and Graduate) and two levels for quality of education (advantaged and disadvantaged), all of these participants had to be studying or working in the medium of English or speaking English most of the time. The effect for level of education was seen again in this study where scores in both groups (White and Black) were markedly lower for the group with less education than the graduate group. These results were especially evident in the Digit Symbol and Matrix subtest where the mean score had more than one point difference, between the lower and higher education levels.

This study showed an even more significant influence of quality of education in the black African first language group, where the lower quality group shows a significant lower score than the higher quality group. With the Digit Symbol and Block Design subtest a mean score difference of more than one point was observed and with the Matrix reasoning a difference of almost 3 points was observed.

Another remarkable result was that the performance task was extremely low for the black African first language group, almost as low as the verbal tasks; these findings were for the low level of education and low quality of education groups. According to Rosselli and Ardila (2003) and Shuttleworth-Edwards, Kemp, et al., (2004), test-taking skills and educational opportunities (level and quality) has a significant influence on test performance. This study has therefore identified that the Digit Symbol and Matrix reasoning task shows low scores for educationally disadvantaged groups.

Shuttleworth-Edwards, Kemp, et al., (2004), also compared their data with the WAIS III standardised data from the US, their results suggest that when black African first language students receive high quality education they will be able to perform an a broadly equivalent level with the American standardisation norms. However, when the black African first language students are exposed to an inferior quality of

education, one can see a profound lowering of scores when compared to the American standardisation norms.

In research done by Shuttleworth-Edwards, Donnelly, et al., (2004) no significant differences were found for language of origin or level and quality of education when using the incidental learning task of the Digit Symbol measure. This further indicates the complexity of the interaction of socio-demographic and socio-cultural variables on neuropsychological test performance in relation to specific neuro-cognitive tasks.

2.4.4.6 Parental Education

Information about the influences of educational variables, especially parental educational levels, on the performance of neuropsychological tests is limited (Ardila, Rosselli, Matute, & Guajardo, 2005). Parental education is a very important environmental influence on children's cognitive development. According to Hoff (2003), parents with higher educational levels tend to create a more intellectualy stimulating evironment for their children. Research has shown that highly educated and professional parents interact differently with their children, esspecially with respect to their language use (Hoff, Laursen, & Tardif, 2002). Mothers that are college educated talk more, use richer vocabularies, and read more to their children compared to those mothers that are limited to a high school education (Hoff-

Ginsberg, 1991). Therefore children from parents with a higher education are likely to have larger vocabularies, higher school attendance, better language development and enhanced performance on neuropsychological measures (Ardila, et al., 2005).

Ardila, et al's., (2005) study on the influence of parental education illustrates this phenomenon. The researchers predicted a significant correlation between the parents' educational level and the children's performance on neuropsychological measures. They administered verbal and non-verbal executive functioning measures to over 600 children between the ages of 5 and 14. The findings showed that most of the children's test scores correlated significantly with the parent's educational level. This educational difference also corresponds to whether the parents attended university or not. This difference may be a reflection in the environment that these parents, with a higher education, provided for their children (e.g., types of activities, attitudes toward education and values). There is also a strong suggestion that educational level of the parents has a stronger effect on verbal tasks than non-verbal tasks. They also discovered that parental education is a greater predictor of executive functioning test performance than the type of school the children attended.

2.4.4.7 Summary

The role of education (quantity and quality of education) in neuropsychological test performance should not just be negated to cultural influences. All the studies mentioned showed that the influence of this variable is vast and will play a major role in interpreting neuropsychological test scores.

By recognising the role that this variable plays in neuropsychological assessment and by controlling for this variable more accurate results on neuropsychological tests may be possible. This is also true for the effects of parental education, as this influences the child's cognitive development.

In South Africa this might not be as straight forward, due to the political history of South Africa which has had a significant effect on the educational systems in South Africa. This is evident in studies done by Shuttleworth, Donnelly, et al., (2004) and Shuttleworth, Kemp, et al., (2004). In these studies the discrepancies in results from different groups were largely due to the quality of education each group received.

2.4.5 Language

2.4.5.1 Language as a variable

Another important variable in test assessment is that of language. A great example of how intricate and specific the influence of language is, can be perceived in the difference between English and Afrikaans speaking individuals' IQ scores (Nell, 2007). The significance of this comparison is due to the fact that it seems that most other variables have been accounted for, there are no racial differences, the two groups share a culture, and they are brought up in the same state and must also acquire a working knowledge of the other's language. Their socio-economic and educational levels are also equivalent, however their history shows some differences, the Afrikaner is descended from the Dutch and the English from British Colonialisation. The trouble between the two white tribes of South Africa reached a climax with the Great Trek and Anglo Boer War.

In 1959 a report was released stating that the Afrikaners have a lower intelligence than the English, which became an extremely sensitive issue, especially for Apartheid South Africa. From each of these two groups 1 500 participants were tested with the Wechsler-Bellevue Intelligence Scale for White South Africans, the results showed that English speakers scored a six point average scale higher than the Afrikaners. Biesheuvel and Liddicoat (Nell, 2007) found that both groups scored equal on the

Arithmetic tests, but that on Block Design and Digit Symbol Substitution (a supposed culture free test) showed an advantage for English speakers. The researchers at that stage ascribed the difference in scores, to intellectual potentialities - due to lesser stimulus in the Afrikaner environment they are not as stimulated as their English contemporaries.

Nell (2007) states that this examples shows that "even very subtle cultural differences that in this case relate only to social values and norms can have a substantial effect on IQ score, and that such scores cannot therefore reliably reflect an innate, universal intelligence" (p. 83).

2.4.5.2 Language and Education

Language seems to be integrated with education. For instance, proficiency in English (including talking and reading ability) is associated with better quality of education (Ardila, 1995; Shuttleworth-Edwards, Donnelly et al., 2004). Though language is strongly linked with education, it should also be seen as a variable in its own right, since education has many other aspects involved in the process (Morais & Kolinsky, 2000). In the field of neuropsychological assessment, little attention has been given to language, especially concerning the assessment of language proficiency and

competence, as well as its influence on neuropsychological test performance (Echemendia & Harris, 2004).

2.4.5.3 Research in Language

Eviatar (2000), states that language is one of the most crucial dimensions of culture. This dimension works together with systematic differences in the architecture of the brain. This is the faculty which we are most knowledgeable about and we can therefore discuss the similarities and differences in languages in a structured way. For example, research has shown that the degree of brain lateralisation for language can be determined by literacy levels, and studies have demonstrated that performing certain neuropsychological tests (e.g., Colour Trial Test) on bilingual students might not render a culturally fair performance indicator as expected for non-verbal tasks (Ardila, 1995; Dugbartey, et al., 2000).

Learning a second language is a very complex process it involves a multitude of factors that influences the individual's proficiency, their perceived competence as well as their patterns of use (Ardila, 1998b; Harris, Echemendia, Ardila, & Rosselli, 2001), this may be the reason for a discrepancy in the scores of bilingual individuals. A study by Harris, Cullum, and Puente (1995), in which bilingual individuals were tested found no difference if participants were assessed in their dominant language.

Problems occured with non balanced bilingual participants, they learned fewer words and their retention was considerably lower than balanced bilinguals.

There is still a need for more investigations into language as a variable, especially on the effects this variable has on the performance on neuropsychological assessment (Uzzell, 2007).

2.4.5.4 Summary

With globalisation and urbanisation, individuals tend to move in a socio-cultural environment that is ever-changing and dynamic, which may result in socio-cultural variations within groups. Therefore, if one accepts that education and language are a reflection of culture and that these elements can change over time, the issue of homogeneity of these elements within cultural groups is questioned. This in turn can lead to differences in performance on neuropsychological tests, due to the effects of different variables. Urbanisation in South Africa appears to be linked to acculturation processes (Shuttleworth-Jordan, 1996). Hence, the level of how individuals and groups are acculturated differs, and taking note of this will enhance understanding of heterogeneity between and within groups (Ponton & Ardila, 1999).

According to all the authors listed, if one controls the socio-demographic variables it may improve the specificity of neuropsychological measures and if the process of acculturation is taken into account, diagnostic accuracy may improve for certain neuropsychological tests.

2.5 Temperament and Neuropsychological Test Performance

The Temperament and Character Inventory (TCI) (Brandstrom, Richter, & Nylander, 2003), is a personality measure based on the psycho-biological theory of Cloninger. This instrument measures four temperament dimensions and three character dimensions, which together describe Cloninger's unified theory.

According to Richter, Brandstrom, and Przybeck (1999) and Brandstrom, Richter, and Przybeck (2001) the two dimensions on the TCI are related to major neural systems for the adjustment to experiences on various levels and it can also be described as the contrast between "percept versus concept, emotion versus volition, instinct versus will, and habit versus cognition" (Richter, et al., 1999, p. 1316). The items on the temperament dimensions are genetically consistent and independently inherited. These neurophysiological processes influences trends towards activation (Novelty Seeking), inhibition (Harm Avoidance) or maintanance (Reward Dependence) behaviour and influence the environment and society. It is important to

note however that these assumed underlying traits of the biogentic model of personality directly represents the observed structure of Temperament.

Boeker, Klieser, Lehman, Jaenke, Bogerts, and Northoff, (2006) study used neuropsychological measures (working memory and executive functioning tools) and the TCI on a sample of 22 paranoid schizophrenics and 22 healthy participants. One of the focusses in this study was to determine the disparity of the relationship between neuropsychological measures and personaility traits in ego pathology. Their findings shows that the healthy participants had a significant correlation with working memory and the personality dimensions containing to the self (self-directedness and self transcendence), and no correlations with the executive functioning. Whereas the schizoprhenic subjects showed the opposite with correlations between the self-dimensions and executive functions but not with working memory.

2.6 Computerised neuropsychological tests

A multitude of cognitive domains are measured in neuropsychological test batteries, such as: orientation and attention, perception, verbal and visual memory, verbal functions and language skills, executive functioning, etc. (Lezak, et al., 2004). According to Gur, et al., (2001), neuropsychological batteries have been useful for research purposes and have yielded valuable data on the brain's behaviour and

deficits. However, they also have limitations: these tests are time-consuming, require trained professionals for administration, have complex administration and scoring systems and are vulnerable to possible data handling errors.

With the advent of globalisation and the fervent rise of technology, the use of computerised tests is also becoming increasingly popular. According to Lezak, et al., (2004) neuropsychological computerised testing is poised to become a common medium in clinical and research assessment environments, largely due to its ease of administration and its potential use in soliciting data from large groups. The computerised format offers data that assess both speed and accuracy and has the ability to assist in data attainment, transfer and analysis (Gur, et al., 2001). With the availability of the World Wide Web it will be easier to send out updates which will ensure consensus in scoring, as well as easier access to other results of research.

It is important that one is aware that traditional and computerised batteries differ and when analysing results of the computerised battery, this should be taken into account. For example, the former separates speed and accuracy while in the latter they are confounded (Gur, et al., 2001). Furthermore, computerised batteries do not tap into as many cognitive domains as the traditional batteries do.

2.7 South African Neuropsychological research

These socio-cultural and socio-demographic elements are dynamic due to the influences of environmental factors (Rosselli & Ardila, 2003). These influences are very evident in socio-political climate of South Africa; especially the changes in the educational arena that has taken place in the last decade. Therefore, including measures of formal education and language are significant in the South African context, as these factors are known to exert influence on cognitive functioning and neuropsychological test performance (Rosselli & Ardila, 2003).

South Africa's unique cultural, educational and historical milieu and rich and diverse population provides an arena for cross-cultural neuropsychological research. The limited research done on South African populations have focused on small homogenous groups, clinical samples and individual neuropsychological tasks (Shuttleworth-Jordan, 1996; Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Edwards, Donnelly et al., 2004).

In South Africa, researchers have a unique opportunity to study these variables due to the acculturative processes inherent in the genesis of our dynamic society. Research (Nell, 2007), shows that developing countries have a general tendency to show lower scores on psychological tests than their western counterparts. South Africa as a

developing country with different cultures embedded into the larger population also shows this tendency, where the enclave cultures will possibly show scores higher or lower than the population mean.

This data reflects that after years of cross-cultural assessment, the difference in scores cannot be attributed to genetic causes, yet. Not until the different variables such as language, education level and quality (which includes test-wiseness), other cultural factors (cognitive styles and socially mediated factors) have been shown to be equal among all groups and cultures (Nell, 2007).

Since so little research has been done on the influences unique to the South African context, in terms of neuropsychological assessment, it is imperative to recognise these differences in association with the variables that has been discussed.

2.8 Cross-Cultural Neuropsychological and the future

At this point in time it seems that neuropsychology has incorporated cross-cultural awareness, however there is still a long way to go, for all the aspects of behaviour to be recognised in the cultural context (Uzzell, 2007).

A commonality in literature of cross-cultural neuropsychology, is that the growth (and thus the future) of neuropsychology, is the ability to change and alter psychometric properties to correspond to an ever-changing community (Nelson & Ponton, 2007). Van de Vijver (2002), notes that valid assessment in heterogenous groups will become more and more prominent, as western societies are increasingly multicultural in the globalisation era.

The challenge now is to identify the socio-cultural elements most likely to affect performance on neuropsychological tests. It is also equally important to identify measures of neuropsychological functioning that are relatively culture-fair, so that equivalence in performance can be revealed. It is important that before the variables of significance, in terms of neuropsychological test performance, are determined, one must include more than just the obvious variables such as age and gender (Ponton & Ardila, 1999).

If this method is followed we can determine the variable of interest, for example if education is controlled for than language might be the variable of interest. Ponton and Ardila (1999) considers ethnicity, language and acculturation important variables of interest. Manly (2005), stresses that differences in test results are accounted for by these socio-cultural variables, therefore if they are included in the future development

of measures, improvement might be found in the accuracy and validity of the measures in a multicultural environment. However, the effect of all the various variables must be understood before one can even attempt culture free tests.

2.9 Conclusion

This chapter provided a background in the need for a cross-cultural perspective for neuropsychological assessment, especially in post-apartheid South Africa with her assortment of cultures present. An introductory connectionist model was provided to explain the intricate relationship between neuro-biology and cultural aspects. As well as how both these variables are dependent and independent of each other and that is the reason why cross-cultural neuropsychological research is so complicated to comprehend.

Culture is a construct that's not only concerned with biological differences (as ethnicity) but also intrinsic values, norms and perceptions. Culture influences all of the variables investigated in this study, namely acculturation, education and langauge. All of these variables are interconnected with each other, influences each other and has an effect on the other's impact on neuropsychological test performance. For instance langauge is an aspect of culture, that is taught from an early age, this tutorage continues during education (formal and informal) and can be affected when

the individual comes across from a new culture (acculturation). All of this in turn influences how the individual percieves the assessment situation. Personality also plays an important role in neuropsychological performance which can be observed using the TCI, which has shown significant correlations with performance on neuropscyhological measures.

During the late 20th century and the begining of the 21st century the use of technology for psychological testing has increased in leaps and bounds. Computerised testing improves the administation for group testing and analyses of the data, however it can also have a confounding effect on the interpretation of the data.

In conclusion research concerning neurospcyhological test performance is quite limited internationally and even more so in South Africa. There are multiple variables that can influence the test performance and these variables also influences each other. Due to this complexity research is needed, especially in the South African context, and hopefully this study will adress some of these issues.

Chapter 3

Methodology

3.1 Introduction

This chapter presents the methodology used in acquiring the necessary data to answer the research problem. The researcher worked in collaboration with the Brain-Behaviour Laboratory at the University of Pennsylvania, and was able to set up a web-interface between the South African and the USA site. This was necessary since the Neuropsychological battery used in this study was the University of Pennsylvania's Computerised Neuropsychological Test Battery (PennCNP), and it required constant contact with the personnel in the USA.

For this study, the researcher looked at the following variables: parental education; language correlates; acculturation dimensions; personality aspects and two neuropsychological features (Executive and abstract reasoning and emotion recognition). Parental education consist of the years of schooling each subject's parents completed, and was categorised according to the schema proposed by Shuttleworth-Edwards, Donnelly, et al., (2004). In terms of language the researcher looked at biographical information that included home langauge, first language and

language of choice. The medium of school (primary and high) instruction was also recorded. The acculturative processes was measured by the South African Acculturation Scale (SAAS) and the personality aspects by the TCI. Lastly, the Neurospychological features was measured by a computerised neurocognitive scan.

All of the variables data collection procedures will be discussed in more detail during this chapter as well as the assessment measures used in this study. This chapter will conclude with ethical considerations regarding this study.

3.2 Research design

The study focuses on the quantitative analysis of a neuropsychological test battery, consisting of emotions and executive functioning batteries, as well as socio-demographic information, assessments from the TCI and from the SAAS. A correlational design will be used, so that a fuller understanding about the complexities surrounding our variables might be obtained (Cohen, Manion, & Morrison, 2005).

According to Cohen, et al., (2005) this design is intended to answer three questions about the variables. These three questions are: (a) Whether there is a relationship between the variables? If the answer is yes the following questions can be asked; (b)

What is the direction of the relationship?; (c) What is the magnitude of the relationship? The advantage of using this design is that multiple variables can be measured simultaneosly as well as the relationship between each variable, this allows for prediction of future behaviour of the variables. However, it is important to note that a correlational relationship does not imply causality and the researcher will take this into account when she interprets the results (Cohen, et al., 2005).

3.3 Procedure

3.3.1 Process

Pre-administration requirements were implemented and checked by test administrators. Participants were seated at computer consoles in the Computer-Based Testing Laboratory (CBT) at the University of Pretoria. An introductory session was delivered to the participants about the nature of the testing process, information on the nature and complexity of some of the tasks as well as an assurance of anonymity and confidentiality of data. Participants were informed that any queries would be answered by the attending research assistants monitoring the session. In addition to the three attending researchers, eight research assistants were trained in the administration of the battery. Each research assistant was responsible for monitoring eight participants. The research assistants had to electronically submit, upon completion of each task, the status of the task completed. The data captured was

recorded as complete, incomplete or training data. The data collection for the pilot study was completed in one group sitting lasting approximately 120 minutes.

3.3.1 Sampling

Sixty three postgraduate students from the University of Pretoria completed the computerised sessions as part of their course in research methods and neuro-cognitive psychology. Eight of the students had five years of tertiary education and the rest had four years of tertiary education. The ages ranged from 20 to 48 with a mean age of 23.68 (4.94). Of the 63 participants, 58 were right-handed, three were left handed and the remaining two ambidextrous. With regards to parental education, the average years of the mother's education was 13.59 (2.60) and the father's education was 14.33 (2.72) years.

Forty four percent of the sample stated that English was their home language and 39% indicated that Afrikaans was their home language; the remainder of the sample indicated a range of official South African languages. Interestingly, with language of choice almost three quarters (72%) chose English and the remainder indicated that Afrikaans is their language of choice. In terms of language usage during schooling, English was once again dominant, where 61% of the participants indicated that their language medium in primary school was English and 39% stated that they used

Afrikaans during their primary education. Regarding the medium of instruction in high school 64% stated that they were taught in English and 36% in Afrikaans.

3.3.2 Measuring instruments

A multitude of cognitive domains are measured in neuropsychological tests batteries, such as: orientation and attention, perception, verbal and visual memory, verbal functions and language skills, executive functioning, etc. (Lezak, et al., 2004). According to Gur, et al., (2001) neuropsychological batteries have been useful for research purposes and have yielded valuable data on the brain's behaviour and deficits. However, they also have limitations: these tests are time-consuming, require trained professionals for administration and are vulnerable to possible data handling errors. Taking the above into account, the data was collected using a computerised neuropsychological test.

The researcher is aware that traditional and computerised batteries differ and in analysing the results of the battery, this will be noted. For example, the former seperates speed and accuracy while in the latter they are confounded (Gur, et al., 2001). Furthermore, computerised batteries do not tap into as many cognitive domains as the traditional batteries do.

3.3.2.1 Computerised neuro-cognitive scan

The full battery consists of three groups of batteries: (a) Emotions Battery; (b) Memory Battery; and (c) Executive Functioning and Abstract Reasoning Battery (www.penncnp.med.upenn.edu). The PennCNP is not a diagnostic tool and as such no inferences can be made regarding performance on any combination of scales for predictive purposes. For the purpose of expedience and due to time constraints, this study used only the Emotions and Executive Functioning batteries, and excluded the Memory Battery.

A general sensory-motor test (MPRAXIS test or mouse practice test) was administered before the test commenced to allow the participants to become comfortable with the computer-based testing procedure. In addition, it assesses whether the participant can use the computer mouse to complete the computerised test. If the participant is unable to complete this test, further testing will be suspended, since they will not be able to complete the rest of the computerised battery of tests.

3.2.2.1.1 Emotions Battery

The Emotions Battery contains four tests; the Penn Emotion Recognition Task (er40), the Penn Emotion Discrimination Task (edf40), the Penn Facial Memory Test (cpf) and the Penn Emotional Acuity Test (PEAT40). The Penn Emotion Recognition Task (er40) is an emotion recognition test in which participants have to determine the emotion of the faces being shown.

The second test, the Penn Emotion Discrimination Task (edf40), has discrimination tasks in which degrees of expressive intensities are represented and from which participants must decide which face is more intense. The Penn Facial Memory Test (cpf) is a measure of facial memory; this test is included because it contains pictures of neutral faces and measures of immediate memory recall. The Penn Emotional Acuity Test (PEAT 40) is the last test, and it assesses both emotion recognition and discrimination.

3.3.2.1.2 Executive Functioning and Abstract Reasoning Battery

The Executive Functioning and Abstract Reasoning Battery contain five different tests that measures executive functioning and abstract reasoning. The first test is the Penn Abstraction Inhibition and Working Memory Task (AIM), which measures abstraction and concept formation, with and without working memory. The next task,

Letter-N-Back (LNB2), measures attention and working memory based on the n-back paradigm. The Penn Conditional Exclusion Task (PCET) is a measure of abstraction, related to the Wisconsin Card Sorting Test. It is a computerised variant of the 'odd man out' model. The next task is the Penn's Logical Reasoning Test (SPVRT) that measures intellectual ability. The version that was used is a shortened version. The last test is Raven's Progressive Matrices (SRAVEN), which is also a shortened version that measures abstraction and mental flexibility.

3.3.2.2 Temperament and Character Inventory

The Temperament and Character Inventory (TCI) consists of 238 questions with a true/false answer format. The TCI is based on the biosocial model of Cloninger, Przybeck, Svrakic and Wetzel (1994) which divides personality into four temperament and three character dimensions. The four biological based temperament dimensions are novelty seeking (NS), harm avoidance (HA), reward dependence (RD) and persistence (P). These are defined as genetically homogeneous and independently inherited. The three socially based character dimensions comprise of self-directedness (SD), cooperativeness (CO) and self-transcendence (ST), and these reflect individual differences in self concept as related to experience (Brandstrom, et al., 2003; Cloninger & Gilligan, 1987; Cloninger, et al., 1994).

Due to the length of the neuropsychological computerised testing session, self-completion of the TCI outside of the testing session was considered prudent.

3.3.2.3 The South African Acculturation Scale

Research shows a lack of acculturation data in neuropsychological assessment research, due to this there seems to be no true measure for acculturation (O'Bryant, et al., 2004). The acculturation measures that have been developed internationally are not appropriate for use in South Africa; most are usually developed for ethnic minorities such as immigrants. Therefore, Kramers (2000), adapted a measure for South African use, namely the South African Acculturation Scale (SAAS), and based its development on the work of Berry, (1976), Berry, Trimble, and Olmedo (1986) and Helms (1990). The scale is a 20 item self reporting attitude measure, consisitng of three subscales: assimilation, integration and rejection. The measure has a forced choice answer format with each item rated on a 5-point scale ranging from Strongly Agree (1) to Strongly Disagree (5). In a study of 155 participants, Kramers (2000), found that the alpha coefficients of the three subscales ranged between .70 and .66, three factors showed eigenvalues of 1.5 and more (factor analyses) and all three factors accounted for 40% of the total variance.

3.3.2.4 Socio-demographic questionnaire

The socio-demographic questionnaire was designed to capture basic data about the respondent's gender, age, handedness, language of schooling, home language, choice of language use, as well as parental education levels.

3.3.3 Data analysis

Correlational analysis and *t*-tests were used for the analyses of the data obtained from the neuro-cognitive scan, TCI, SAAS and the demographic questionnaire. A brief explanation will be given of each method:

3.3.3.1 Correlational analysis

Essentially correlation describes and quantifies the relationship that may exist between variables (Tilley, 1990). Therefore by using correlational analysis the researcher might be able to determine whether the different variables have a relationship with performance on neuropsychological test performance. Correlational analysis will also be able to describe the strength and direction of the relationship (Tilley, 1990), between the variables and performance on the neuro-cognitive tests.

3.3.3.2 t-Tests

t-Tests are a way of deciding whether one or two sets of scores are random samples from a specific populaiton. *t*-Tests helps with the decision to accept or reject the data set by locating the position of the score in the relevant sampling distribution. The *t*-tests are based on assumptions and can withstand violations of these assumptions (Tilley, 1990).

3.4 Ethical considerations

3.4.1 Informing Participants

At the beginning of the session the researcher addressed all the participants and explained the nature of the testing process. The participants were also informed about the nature and complexity of some of the tasks.

3.4.2 Confidentiality

Confidentiality was assured as no personal identifiers are contained within the data sets. This was achieved by coding all the data sets by using an alpha-numeric coding system and capturing the data as Excel files. The participants were further insured of the confidentiality and anonymity of the data.

3.4.3 Consequences

All the participants were told, during the introductory session, that if they had any more questions regarding the assessment or if they wanted information regarding their scores, that they could contact the head researcher of the project. The researcher's contact details were given.

3.4.4 Nonmaleficence

Due to the nature of the study, specifically the neuro-cognitive scan, it was important to note any previous medical conditions the participant might have had. This specifically attains to seizures (epilepsy) and brain trauma. The participants completed the socio-demographic questionnaire before commencing the neuro-cognitive scan, on this questionnaire a section was reserved for the respondent's medical history. Before the testing commenced the research assistants had to go through the medical section to determine whether any participant had any medical problems that might be negatively influenced by the testing. Although no problems were found there were strategies in place if a participant suffered any medical condition that might influence the testing or worsen their condition.

3.4.4 Ethical Approval

Ethical clearance for the study was obtained from the relevant departmental and faculty committees of the University.

3.5 Conclusion

This chapter looked at the methodology the researcher used in this study. A variety of variables was tested with an assortment of assessment measures, and a correlational design was used so that all the variables can be measured and compared to each other simultaneously.

As stated this study used a variety of measuring instruments including a computerised test (the Neuropsychological cognitive scan) and pen and paper tests (TCI, SAAS and the socio-demographic questionnaire). The data from these instruments were analysed using correlational analysis and *t*-tests.

Ethical considerations were taken into account by ensuring candidates of their confidentiality and receiving ethical approval from the University.

The following chapter will present the results from this pilot study, how the variables correlated with each other and where significant correlations were found.

Chapter 4

Results

4.1 Introduction

This chapter peruses the results obtained from the data after a correlational analysis and *t*-tests were performed. The analysed data will be presented through tables with short interpretations given on the data. All the variables' data will be interpreted in terms of their relationship with the other variables. Extra attention will be paid to the relationships between these variables and the performance on the neurocognitive scan.

4.2 Results of the temperament and character inventory

4.2.1 Descriptive statistics for the TCI dimensions

The descriptive statistics for the TCI dimensions are illustrated in Table 4.1. The TCI cut-off scores for a normal community-based sample indicate that the South African pilot sample scored the following in the four temperament components: a high score was attained in Harm Avoidance (HA); Novelty Seeking (NS) showed a medium

score; Reward Dependence (RD) indicated a medium score and a medium score was also obtained in Persistence (P)

Table 4.1

Descriptive statistics for the seven TCI dimensions

TCI Dimension	Mean	Standard Deviation	Minimum	Maximum
NS Novelty Seeking	19.56	2.83	15	25
HA Harm Avoidance	15.47	2.9	10	24
RD Reward Dependence	15.05	2.0	11	20
P Persistence	4.77	1.13	2	7
SD Self-directedness	25.54	3.95	15	33
CO Cooperativeness	22.96	2.09	18	28
ST Self-transcendence	16.42	3.79	9	23

4.2.2 Comparisons between the South African sample and the TCI

For the purpose of comparison the mean age of the South African sample was used when comparing the data to the TCI manual data (Cloninger, et al., 1994). A t-test on the 18-25 age range as mean for the South African sample showed no significant differences between the two samples. This information is represented in Table 4.2:

Table 4.2

Comparison between the TCI community sample (n=86) and the South African pilot sample

Scale / Age	TCI manual sample 18-25 (N=86)	South African pilot sample 18-25 (N=57)
NS Novelty Seeking	21.6 (5.2)	19.56 (2.83)
HA Harm Avoidance	13.2 (6.7)	15.47 (2.9)
RD Reward Dependence	14.7 (4.3)	15.05 (2.03)
P Persistence	5.6 (1.6)	4.77 (1.13)
SD Self-directedness	26.6 (7.5)	25.54 (3.95)
CO Cooperativeness	27.9 (7.1)	22.96 (2.09)
ST Self-transcendence	20.1 (6.1)	16.42 (3.79)

4.3 Descriptive data on the performance of the computerised neuropsychological battery

Table 4.3 and Table 4.4 indicate the pilot sample's means, standard deviations and the ranges for the PennCNP tests. The total number of correct (accuracy) and median reaction time for correct responses (speed) were selected as performance measures for the neuropsychological tests.

Table 4.3

PennCNP descriptive performance data on the Executive and Abstract reasoning tasks – South African sample

Variable	Mean	Standard Deviation	Minimum	Maximum
AIM sum of correct responses items 1-10, 21-30, 41-50	23.09	3.46	15	29
AIM sum of correct responses items 11-20, 31-40, 51-60	23.87	3.17	17	30
AIM mean response time of median time responses for items 1-10, 21-30, 41-50	2130.99	619.82	1127.83	4375.33
AIM mean response time of median time responses for items 11-20, 31-40, 51-60	1498.57	426.44	745	2968.67
LNBC2 true positive responses	42.95	5.25	5	45
LNBC2 false positive responses	0.8	1.38	0	9
LNBC2 median response time for all correct responses	432.84	99.7	313	899
PCET number of correct responses	38.24	8.68	25	65
PCET median response time for correct responses	2116.78	697.05	1195.5	5078.5
PCET number of perseverative errors	17.4	9.19	4	47
SPVRT total number of correct responses	17.53	4.89	2	26
SPVRT median reaction time for correct responses	8757.62	2826.4	4531	16593
SRAVEN number of correct responses	44	9.31	18	56
SRAVEN median reaction time for correct responses	18657.22	12112.14	5328	71164.5

** response time are indicated in milliseconds*

Table 4.4

PennCNP desciptive performance data on the Emotion tasks – South African sample

Variable	Mean	Standard Deviation	Minimum	Maximum
PEAT40 total number of correct responses	28.31	5.12	10	35
PEAT40 median response time for correct trials	2010	485.58	1266	3500
CPF number of correct responses	37.78	2.57	29	40
CPF median response time for correct responses	1661.1	392.54	1133	2797
ER40 number of correct responses	33.66	2.98	25	39
ER40 median response time for correct responses	1846.65	298.29	1445.5	2812
EDF40 correct responses for happy trials	13.21	2.85	6	18
EDF40 correct responses for sad trials	14.4	2.19	9	19
EDF40 median response time for happy trials	5229.36	1921.04	2547	11907
EDF40 median response time for sad trials	4369.02	1343.24	1641	7719

** response time are indicated in milliseconds*

The University of Pennsylvania's normative data was used to calculate z-scores for the PennCNP performance of the pilot study. The normative data sample has an average age of 29.61 (11.13) and the average age of the South African sample is

23.68 (4.94). An analysis indicated no significant differences between the performances of the two samples on the PennCNP tests.

Significant correlations were found between tests of executive functioning and tests of emotion recognition and discrimination. The accuracy of responses to facial memory (CPF) was negatively associated with the accuracy of responses on the SRAVEN. A negative correlation was also found between the accuracy of recognising and discriminating between happy and sad faces (PEAT 40) and the accuracy of responses on the AIM (with and without the working memory component). Accuracy on the emotional acuity task (PEAT 40) and accuracy of responses on the task of abstraction and mental flexibility (SRAVEN) was positively correlated.

Kohler, Bilker, Hagendoorn, Gur, and Gur (2000), utilised similar emotion recognition and executive functioning tests, however, they found no significant correlations between emotion discrimination and neuropsychological performance for healthy participants. According to them these results are atypical since "most cognitive tasks share common variance related to sensory input, attention to tasks, facial processing and linguistic ability (the 'g factor')" (p.133).

On the other hand, research by Allerdings and Alfano (2006) reported a significant positive correlation between emotion recognition and scores on the picture completion task. They contended that this association is based on the mediating role of the right hemisphere in visual contextual feature detection. The picture completion task also has a judgement and reasoning component that requires conceptual tracking, which is not dissimilar to components of the SRAVEN. The association between the emotion recognition and discrimination and the performance on the SRAVEN in this pilot study, may arise from the same underlying right hemisphere involvement mediating both nonverbal tasks, which calls for elements of pattern matching (Lezak, et al., 2004).

4.4 Correlation between the TCI dimension and the PennCNP battery

Table 4.5 and Table 4.6 indicate the significant correlations between the three temperament and four character dimensions of the TCI and the PennCNP tasks. A brief summary of the correlations are outlined in the following discussions.

4.4.1 Correlations between the temperament dimension on the TCI and the PennCNP tasks

Results between the PennCNP and the TCI's temperament dimension show that Novelty Seeking and performance on the PEAT 40 are negatively correlated, thus the higher the novelty seeking the lower the scores on recognising and discriminating different emotions. A significant correlation can be seen between Harm Avoidance and accuracy and speed of performance for emotional recognition on the ER40 and the speed of performance on the AIM with working memory.

Table 4.5

Significant correlations ($p<0.05$) between the temperament dimension on the TCI and PennCNP tasks

TCI Dimensions	Novelty Seeking	Harm Avoidance	Reward Dependence
AIM Reaction Time (WM)		0.32	0.28
AIM Reaction Time (NWM)		0.28	0.27
SPVRT Reaction Time (Accuracy)			0.32
PEAT40 Accuracy	-0.27		
ER40 Accuracy		0.27	

WM: working memory; NWM: no working memory

Reward Dependence shows significant correlations with participants' speed of abstraction and concept formation with and without working memory on the AIM as well as the response speed on a measure of verbal intelligence on the SPVRT. However, no significant correlations were found between Persistence dimensions and the neuropsychological tests.

4.4.2 Correlations between the character dimension on the TCI and the PennCNP tasks

Table 4.6

Significant correlations ($p<0.05$) between the character dimension on the TCI and PennCNP test performance

TCI Dimensions	Self Directedness	Cooperativeness	Self Transcendence
AIM Accuracy (WM)			0.28
AIM Accuracy (NWM)			0.26
LNBC2 False Positive Responses	-0.28		
PCET Perservative Errors		-0.32	
CPF Reaction Time (Accuracy)		0.4	
EDF40 Reaction Time			0.29
PEAT 40 Accuracy			-0.33
PEAT 40 Reaction Time (Accuracy)			0.33

WM: working memory; NWM: no working memory

On the Character dimension of the TCI, the correlation between the TCI and PennCNP show two significant negative associations between Cooperativeness and performance on the PCET as well as the response speed on a measure of facial memory on the CPF. Self-directedness correlated negatively with LNBC2 false positive responses.

Interestingly, Self-transcendence correlated with the one executive functioning measure and two tests of emotions. There was a significant positive association between this character dimension and accuracy on the AIM (with working memory) response speed for emotional recognition (on the EDF40 'sad trials') and response speed on the PEAT40. A significant negative correlation was found between Self-transcendence and participants' accuracy in discriminating emotional valence on the PEAT40.

4.5 Acculturation results from the SAAS

The SAAS was completed by 57 of the 63 respondents. The Assimilation scale of the SAAS has yielded a mean score of 3.04 (0.56), the integration subscale generated a mean of 2.23 (0.56) and the Rejection scale produced a mean of 3.38 (0.57). A point-biserial correlational analysis (rpd) was conducted on each item of the SAAS. The

item scale correlation coefficient ranged from .21 to .72. One item (Q7) evidenced high variance with the lowest item scale correlation.

A negative correlation can be seen on the SAAS Assimilation subscale and the performance accuracy on the SRAVEN. The SAAS Rejection subscale correlated positively with response speed on a measure of attention and working memory (LNBC2) and the SRAVEN, and negatively with the performance accuracy on the PCET. The PCET (a measure that relates to the Wisconsin Card Sorting Test), the SRAVEN and the LNBC2 are regarded as culture-free/culture-fair neuropsychological measures, however, research has indicated that education and acculturation may influence performance (Lezak, et al., 2004). Of interest was the finding that the mother's educational level correlated positively with the SAAS's integration scale.

There were no significant correlations between the TCI and the SAAS.

4.6 Socio-demographic variable results

With regard to the socio-demographic variables, mother's educational attainment shows a significant negative correlation with both the response speed on the emotional discrimination of 'happy' faces (EDF40) and the response speed on the SRAVEN. A positive correlation was found with the accuracy on the executive functioning measure of the PCET. The father's educational levels correlated negatively with the SRAVEN response speed and the accuracy in recognising emotion (ER40).

A study completed by Ardila, et al., (2005) found a stronger association between parental education levels and verbal executive functioning tasks in comparison to non-verbal executive functioning tasks. They also found age effects on the association between nonverbal executive functioning tasks and parental education levels, with significant associations between the Matrices test (similar to the SRAVEN) and parental education level in an older group of children as well as a significant association between the Card Sorting test (similar to the PCET) and parental educational level in a younger group of children.

Mother's education also showed a negative correlation (-0.26) with the temperement dimension on the TCI for Harm Avoidance.

4.7 Conclusion

This chapter examined the analysed data received from the study, which was correlated with each other so that the relationships between the different variables could be discerned. However, as a pilot study, this sample of 63 can only be considered within a limited context and as such no inferential data can be considered viable in terms of possible conclusions at this stage.

Chapter 5

Discussion

5.1 Introduction

Chapter five aims to discuss the results of this study in light of current available literature. This chapter leads with a discussion on the measures' results, starting with a discussion of the results concerning the TCI and the neuropsychological battery. Then a discussion on the SAAS and the neuropsychological battery will follow and lastly the results of parental education will be discussed in light of the TCI and the neuropsychological battery. Limitations of this research are then discussed, and conclusions are drawn. Lastly recommendations will be made.

5.2 Discussion of results

5.2.1 Results between the TCI and the neuropsychological battery

This study has indicated that there are significant associations between neuropsychological test assessment, with the recognition of emotional valences and performance accuracy and response time for executive functioning tasks, and personality as measured by the TCI. These finding are supported by research that shows correlations between personality and neuropsychological results in various

community and clinical samples across cultural groups (e.g., Henderson & Wachs, 2007; Keilip, Sackheim, & Mann, 2005; Robinson & Tamir, 2005; Robinson & Wilkowsky, 2006).

5.2.1.1 Supporting studies of the TCI and emotion recognition

A study by Winblad, Helström, Lindberg, and Hansen (2007) with a clinical sample of myotonic dystrophy (DM-1) patients showed that reward dependence and cooperativeness correlated significantly with facial emotion recognition. Their study indicated that when the clinical sample was compared to the control group (41 healthy participants), a deficit was found in patients with DM-1 "to recognise negative emotions and a correlation between facial emotion recognition ability and the sociability dimensions of the TCI (cooperativeness and reward dependence)" (p.222). However, in this pilot study with healthy individuals, no significant correlations was found between emotion recognition and the personality dimensions of cooperativeness and reward dependence.

The results showing the significant correlation between novelty seeking and accuracy on the PEAT 40 corroborates the findings of Keilip et al. (2005) on the relationship between impulsivity, a component of novelty seeking, and poor performance on complex tasks. In their study a self-rating scale of compulsiveness and various

neuropsychological tasks that included measures concerned with reaction time, attention and fluency were completed by a sample of 58 healthy volunteers. Their results shows that when demographic factors are controlled for tasks requiring specialised performance, such as decision making and organisation of responses under time constaints, individuals with the impulsivity behavioural trait were slower to respond, not faster.

5.2.1.2 Supporting studies of the TCI and executive functioning

Mardaga and Hansenne (2007), found that the behavioural inhibition system (BIS) was best predicted by the temperament dimensions: harm avoidance and reward dependence. Harm Avoidance is the tendency to inhibit responses and avoid punishment and non-reward. Participants with a high Reward Dependence tendency would be sensitve to both reward and punishment in social settings and would inhibit responses that negate approval and invite criticism. The results of this study indicate that for tasks that require a timed response on the AIM for both working and non-working memory, reaction time correlated positively with Harm Avoidance and Reward Dependence in the presence of feedback on each response.

These results were confirmed in this pilot study where these two dimension on the temperament inventory of the TCI showed significant correlations. The importance

of temperament predicting the BIS was also proposed by Henderson and Wachs (2007). According to them, temperament provides a basis for emotion-cognition interaction across development and this relates to the BIS characteristics of personality.

Regarding the significant association between the character dimension of Self-transcendence and neuropsychological measures, Boeker, et al., (2006) found a significant association between the character dimension of the TCI and working memory on the neuropsychological tests of healthy participants, but not with other tests of executive functioning. They also reported no significant association between temperament dimensions and neuropsychological performance which is in contrast to this study's findings, which found correlations between performance on neuropsychological tests and two constructs on the temperament dimension: Harm Avoidance and Reward Dependence.

The study of Keilip et al., (2005) that correlated the personality trait of impulsiveness (a trait of Novelty Seeking) with the performance on neuropsychological tests, showed some other significant results. The study found significant correlations between impulsiveness and the executive functioning task, which was not the case in the pilot study.

5.2.2 Results between the SAAS and the neuropsychological battery

There were also significant correlations between the SAAS and various aspects of speed and accuracy on the emotions battery and the executive functioning and abstract reasoning battery. These findings are supported by and support the research on the influence of levels of acculturation on neuropsychological performance outcomes (Kennepohl, Shore, Nabors, & Hanks, 2004). A recent study by Coffey, et al., (2005) used the Wisconsin Card Sorting Test (seen as a relatively culture free test) on Mexican-American participants. Their results showed that the higher the level of acculturation, the more improved the performance on the Wisconsin Card Sorting Test, and therfore they concluded that this test may not be a culture-free measure of executive abilities as previously speculated.

5.2.3 Results between parental education, the neuropsychological battery and the TCI

In terms of parental education significant correlations were found for both the mother's and father's education and the Neuropsychological battery. Mother's education correlated with both the Executive functioning and abstract reasoning battery and the Emotions battery. The Father's educational level was only significantly correlated with the Emotions battery. These results are supported by the investigation of Ardila, et al., (2005), where a strong assocation was found between parental education and executive functioning tasks.

The mother's educational level also showed a strong correlation with the temperment dimension of Harm avoidance on the TCI.

5.3 Conclusion

Studies such as this will contribute to the field of cross-cultural psychology, nationally and internationally, by revealing prominent aspects that are related to the influence of individual differences (such as personality, in terms of the TCI), socio-demographic aspects, socio-cultural factors and the comparative commonality of human cognitive functioning across cultural boundaries.

5.4 Limitations

As previously mentioned this study formed part of the pilot study for a larger study on the effects of various variables on neuropsychological test performance, which may limit the result's importance. This study is further limited by the nature of its sample which is moderate in size and relatively bright and highly educated. Furthermore this study was conducted on healthy participants; therefore no inference can be made for clinical groups.

5.5 Recommendations

There is a lack of properly investigated research on the interactive effects of the various variables influencing performance on neuropsychological tests on South African populations, in South Africa. This pilot study can be a useful platform for any future research on this subject. The preliminary results for the larger study that is being conducted in South Africa and Ireland are promising. Results show that there are interactional effects with language and parental education, as well as certain correlations between culture fair test performance. In addition there are associations between the neuropsychological test battery and the TCI.

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