Normative Indicators for an isiXhosa-speaking population with disadvantaged education for tests of hand motor function and verbal fluency.

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ABSTRACT

The aim of the study was to obtain preliminary normative data for two tests of hand motor function (Successive Finger Tapping and Purdue Pegboard tests) and two tests of verbal fluency ("S"-Words-In-One-Minute and Words-In-One-Minute), administered in English, on a non-clinical sample of black, isiXhosa-speaking unskilled workers with a background of relatively disadvantaged former DET education ($N = 33$). The sample was equally distributed for gender; educational level was restricted to 11 – 12 years; age range was 18 – 40 years divided further into two age categories (18 – 29 and 30 – 40 years). Results of t-test comparative analyses revealed significant age effects on both trials of the Successive Finger Tapping test in the direction of the younger age group outperforming the older age group, and a marginal but consistent tendency towards poorer performance at an earlier age stage than proposed by the available literature, for the Purdue Pegboard, "S"-Words-In-One-Minute and Words-In-One-Minute. Gender effects were only in evidence on the Purdue Pegboard in the direction of females outperforming males. A descriptive comparison of the norms acquired for the present study with available normative data for English first language speaking populations with higher levels and/ or relatively advantaged quality of education revealed consistently poorer performance for the present study. The findings highlight the effect of relatively low levels and/ or poor quality of education on both verbal *and* non-verbal neuropsychological test performance and confirm the need for demographically specific normative data.

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1. Introduction

Comprehensive neuropsychological assessments remain a standard in neurodevelopmental disorders, traumatic brain injury, and general cognitive ability evaluations. In recent years, the growth of clinical neuropsychology as a professional practice has involved increased recognition of the influence of demographic factors on neuropsychological test performance. It is within this context that cross-cultural research studies focusing on the application of demographically sensitive norms have become paramount. This study forms part of a broader South African cross-cultural research project aimed at establishing preliminary normative indications, in respect of a non-clinical sample of isiXhosa speaking, black South Africans with a relatively disadvantaged quality of education, for 16 commonly employed neuropsychological measures, administered in English. These neuropsychological measures pertain to a cross section of six functional modalities (attention and concentration; language; verbal memory; visual memory; visual perception; and motor function). In addition, neurological measures commonly employed in the assessment of malingering were included. Three investigations into common neuropsychological measures associated with functions of memory, attention and concentration, and malingering respectively, have already been completed and the present study constitutes a fourth focus of analysis. The objective of the present study was to obtain preliminary normative data (means and standard deviations) for two tests of verbal fluency and two tests of motor function, administered in English on a population of black, South African, isiXhosa speaking people who attended a former DET type school in the Eastern Cape, with a grade 11 or 12 education level and age range of 18-40, further divided into a younger and older age group (18-29 and 30-40).

The literature review that follows serves to contextualize contemporary neuropsychological assessment and norm selection within recent cross-cultural research endeavours. Specific reference will be made to those clinical and ethical challenges associated with neuropsychological assessment in diverse cultural and linguistic settings such as South Africa. Additionally, those specific demographic characteristics, such as culture, education and language, which have been found to be powerful correlates of neuropsychological test performance, will be discussed. Specifically, recent cross- cultural research into the effects of cultural and educational variables on non-verbal neuropsychological tests, previously considered to be uncontaminated by these variables will be discussed. Further, two tests of hand motor function, being the Successive Finger Tapping test and Purdue Pegboard test, and two tests of verbal fluency, being the "S"- Words-In-One-Minute test and Words-In-One-Minute test, will be reviewed. Lastly, the rationale and hypotheses guiding this research endeavour will be introduced.

2. Literature Review

2.1 Neuropsychological Assessment and Norm Selection in the South African Context

Neuropsychology focuses on the relationship between brain functioning and behaviour and neuropsychological assessment involves investigations into the psychological and behavioural effects of neurological dysfunction associated with brain injury or neuropathological processes (Lezak, Howieson, & Loring, 2004). Furthermore, neuropsychological assessment is integral in the determination of neurocognitive ability (Lezak et al., 2004). Integral to a comprehensive neuropsychological assessment is the administration of neuropsychological tests for the formal assessment of cognitive functioning. A review of the existing literature on cross-cultural neuropsychology reveals the evolution of the profession from understanding test performance as directly related to brain functioning to acknowledging the influence of a number of other factors, not related to brain functioning, on test performance (Brickman, Cabo & Manly, 2006; Byrd et al., 2006). Factors that have been found to be powerful correlates of neuropsychological test performance are socio-cultural experience often encompassing: level and quality of education and socio-economic status, geographic location, ethnicity, race, IQ, age, effort, fatigue and pain (Ardila, Rodriguez-Menendez, & Rosselli, 2001; Brickman et al., 2006; Byrd et al., 2006; Nell, 1999; Shuttleworth-Edwards et al., 2004).

Psychologists conducting neuropsychological investigations in diverse cultural and linguistic settings face considerable clinical and ethical challenges. These challenges are particularly pertinent to the practice of neuropsychology in the diverse South African context, in that, some neuropsychological tests have precarious diagnostic accuracy when used on populations other than middle to upper class Caucasians, who are first language, English speakers, with advantaged educational experience (Ardila et al., 2001; Brickman, et al., 2006). To understand these challenges more clearly it is important to evaluate the significance of norms in clinical neuropsychological practice. A fundamental tenet in neuropsychological assessment, in order to determine a patient's cognitive status, is the comparison of individual test scores to scores obtained from a normative population, and when comparison reveals significantly worse performance than the norm group it is seen to be indicative of possible brain pathology and cognitive impairment. As such, test results in comparison to a normative cohort are taken as indicators of true performance, potential and ability and are used to make critical decisions pertaining to diagnoses, treatment recommendations, funding recommendations, recruitment and medico-legal contexts (Strauss, Sherman, & Spreen, 2006). The ramifications of such decisions serve to impact people's lives and futures. Therefore the utility of any set of normative data is largely dependent upon the degree of similarity between the individual test taker and the characteristic features of the normative sample (Lezak et al., 2004). However, many of the measures included in standard neuropsychological batteries have been developed in middle-class, westernized contexts and have never been standardized or demonstrated to be reliable and valid with culturally and linguistically diverse populations. It is then argued that potential for misdiagnoses and faulty inferences within these populations escalates, and that the application of tests of cognitive ability from one cultural group to another without appropriate standardization could have deleterious consequences for appropriate management (Shuttleworth-Edwards et al., 2004).

Accordingly, it is argued by proponents of cross-cultural neuropsychology that one of the most pressing needs for neuropsychologists assessing diverse populations, like that of South Africa, is the development of appropriate norms (O'Bryant, O'Jolie & McCaffrey, 2004). Selecting appropriate norms for the purposes of evaluating test scores forms an integral part of the interpretative process in neuropsychological assessment and it is argued that interpretive validity can be maximized through the use of demographically specific normative data. In recent years, efforts to obtain age, gender and education corrected normative data have increased in North America but unfortunately the dearth of equivalent efforts in South Africa threatens to compromise service delivery to a significant portion of the population and hinder the further development of neuropsychological services in the government and private health care sectors (Anderson, 2001). Therefore, as stated by Mitrushina, Boone, Rozani, and D'Elia (2005), neuropsychology as a profession has an obligation to continue to refine normative data sets to approximate, as closely as possible, the demographic characteristics of the individual being assessed so that inferences made from norm comparisons most accurately reflect those factors that impact cognition and related test performance.

It is important to note that demographic characteristics such as ethnicity and race are often conflated with other more fundamental variables that influence test scores such as degree of acculturation, socio-economic status and education (Helms, 1992; Shuttleworth-Edwards et al., 2004; Strauss et al., 2006). Studies investigating culture and quality and level of education differences have found reliable discrepancies in test scores and have highlighted cross-cultural differences in attitudes towards test taking, as well as in acquired cognitive skills (Brickman et al., 2006; Rosselli & Ardila, 2003; Shuttleworth- Edwards et al., 2004). These discrepancies have been most evident when considering the factor of quality of education. What follows is an explication of cultural and educational variables considered to have a potent effect on cognitive test performance. The effects of language and gender will also be considered.

2.2. The Effect of Culture, Quality of Education, Language and Gender on Neuropsychological Test Performance.

2.2.1. Culture

Culture can be broadly defined as the "specific way of living of a human group" (Ardila, 2005, p. 185) and it includes a set of learned skills necessary to survive physically or socially in a specific context (Ostrosky-Solis, Ramirez & Ardila, 2004). Within this broad definition, two dimensions of culture can be distinguished: (1) the internal, subjective or psychological representation of culture which pertains to thinking, feeling, knowledge, values, attitudes, and beliefs, and (2) the behavioural dimension which includes ways of relating to others and ways of behaving in different circumstances and contexts (Ardila, 2005). In effect culture coupled with ecological demands prescribe what abilities and skills are important to learn, at what age, and by which gender and in turn serves to moderate the development and use of some cognitive processes (Ostrosky-Solis et al., 2004). Therefore, although basic cognitive processes are understood to be universal, cross-cultural differences in cognition reside in how different cultural environments and the differing ecological demands of these environments lead to the development of different patterns of abilities.

As mentioned above, common neuropsychological tests have been developed and standardized in middle-class, westernized contexts and their development has been based on westernized conceptualizations of intelligence and patterns of abilities. Furthermore, testing situations, like any other social situation, are governed by implicit western cultural rules, values, knowledge's, skills, ways of thinking, behaving and interacting (Helms, 1992). In effect, those cognitive abilities, commonly measured in neuropsychological tests, represent those learned abilities salient to western cultures and successful test performance correlates with a subject's exposure to those learning opportunities and contextual experiences characteristic of western cultures. Therefore, poor test performance in individuals from different cultures may be a reflection of limited acculturation to middle-class, westernised cultures rather than an indication of cognitive impairment (Helms, 1992; Manly, Byrd, Touradji, Sanchez & Stern, 2004; Shuttleworth-Edwards et al., 2004). Acculturation has been defined as the extent to which an individual has learnt and shares the language, values, and cognitive styles of their own cultural group versus those of the dominant culture (Manly et al., 2004). Acculturation has therefore been identified as a more fundamental variable influencing test performance than ethnicity or race and has been used to operationalise cultural variability in test performance and specifically within cultural group variability (Helms, 1992; Shuttleworth-Edwards et al., 2004). Variability in the following specific aspects: cultural values, salience of cognitive skills, familiarity with certain problem solving strategies, exposure to cognitive test items, participant/examiner interactions and test-taking attitudes, has been identified as moderating cognitive test performance.

2.2.2 Education

2.2.2.1 Education as subculture.

Education can be thought of as a type of sub-culture that contributes to the acquisition of crystallised functions of language ability and factual knowledge as well as procedural functions; those skills necessary in the execution of neuropsychological tests encapsulated under the term 'test wiseness' (Nell, 1999; Ostrosky-Solis et al., 2004; Shuttleworth, et al. 2004). Exposure to class room type skills contributes to a participant's level of 'test wiseness'. 'Test wiseness' includes pencil use, familiarity with copying tasks, better attitudes, an appreciation of the importance of paying attention, obeying instructions, self confidence and concentration in test taking situations (Anastasi, 1982; Nell, 1999). Nell (1999, p. 133) acknowledges 'test wiseness' to be the "most powerful moderator of test performance". Variability in the acquisition of these crystallized and procedural functions is determined by the level of educational achievement and the quality of education received.

2.2.2.2 Level and quality of education.

In addition to being culturally diverse, the South African educational landscape is characterised by enduring disparities with regard to educational opportunity and quality of educational experience (Cooper, 2004). The legacy of apartheid and resultant segregated education has been implicated in the discrepancy of quality of education amongst black and white South Africans. The majority of black people in South Africa attended schools run by the former Department of Education and Training (DET schools) with these schools receiving markedly less educational funds than schools delivering education to white scholars (Claasen, Krynauw, Paterson, & Mathe, 2001). In addition, variable teacher education and political unrest had a profound impact on the quality of education received by black South Africans (Manly et al., 2004; Nell, 1999; Shuttleworth-Edwards et al., 2004). Despite the fact that segregated education has been officially dismantled, former DET type schools still receive education that is of a relatively lower standard to that received at State and Private schools (Grieve & Viljoen, 2000), with former DET type schools in the Eastern Cape being particularly affected by lack of educational resources and infrastructure up to the time when the present study was conducted and beyond (Matomela, 2008).

It is argued that years of education is thus an inadequate measure of educational experience and fails to accommodate the disparate educational experiences of different groups in South Africa (Shuttleworth-Edwards et al., 2004). A study demonstrating the effect of quality of education on the Wechsler Adult Intelligence Scale III (WAIS III), conducted by Shuttleworth-Edwards et al. (2004), revealed that scores for white and black African first language adults with advantaged education were comparable to US standardisation, whereas scores for black African first language participants with disadvantaged education were significantly lower than this. This decrement was more pronounced for those black African first language participants with a low educational level (Grade 12) compared with those with tertiary education (Graduate group). This suggests that the effects of ethnicity are reduced on neurocognitive test performance when quality of education is controlled for, and that collated normative data in seminal North American texts are unlikely to be applicable to black South Africans who have disadvantaged educational experiences, and are even less applicable to those individuals with low levels of education. It is therefore proposed that adjusting for quality of education may improve the specificity of certain neuropsychological measures across ethnic groups in South Africa. As mentioned, there is a particularly poor quality of education delivered in the Eastern Cape Province (Matomela, 2008), and it is especially important that appropriate normative data be obtained for the people of this area who have received this relatively disadvantaged education.

2.2.2.3 Education and age-related cognitive decline during normal ageing.

In recent years, interest in the association between education and cognitive change related to normal ageing has grown. Investigations into the role of education in age related cognitive decline and, how this role is expressed in cognitive test performance, have largely been couched in the theoretical contributions of Satz (1993) and more recently Stern (2002).

Satz (1993) introduces the concepts of brain reserve capacity (BRC) and threshold factor to explicate individual differences in functional impairment following head injury. Although, Satz's theory focuses on variability in symptom onset following head injury, it also has applicability to variability in symptom onset associated with neural attrition due to ageing. The concept of threshold factor refers to that threshold level that exists prior to the presentation of symptoms due to neurological disease or head injury. The central tenet of BRC theory is that individual differences exist in terms of BRC that account for varying instances of protection from or vulnerability to symptom onset and therefore symptom threshold levels vary between individuals. Following cerebral insult, greater BRC acts as a protective factor and reduces the risk of functional impairment. Conversely, less BRC acts as a vulnerability factor and predisposes the individual to functional impairment.

Satz (1993) highlights a number of vulnerability factors that serve to reduce BRC, lower symptom threshold levels and in effect increase an individual's vulnerability to functional impairment. These include ageing, low education and IQ, psychiatric/neurological disorder, prior head injury, gender effects, and high task challenge. For the purposes of this review, the factor of ageing, education and high task challenge will be discussed further. Ageing is regarded as a vulnerability factor that reduces BRC therefore, individual differences in, pre-existing BRC, pre-existing vulnerability and protective factors, will result in differential vulnerability to functional impairment associated with age related cognitive decline. For example, the aggregate effect of neural attrition due to normal aging and pre-existing vulnerability factors, such as low level of education, and/or additional exposure to neurological damage or disorder and/or enhanced task challenge will result in reduced BRC and an increased vulnerability to functional impairment. In the context of this theory a low level of education is regarded as a vulnerability factor that acts to lower symptom threshold and enhance an individuals risk to functional impairment and conversely, a high level of education is regarded as a protective factor that contributes to greater BRC and higher symptom threshold. With regard to the vulnerability factor of high task challenge, Satz (1993) proposes that increased challenge serves to lower symptom threshold and in effect a pathological process may become symptomatic or show functional impairment under conditions of appropriate challenge. Therefore, with respect to neuropsychological assessment, the pathological process may remain undetected, due to the protective factor of BRC, until an appropriate assessment challenge is introduced.

Stern (2002), proposes the related concept of cognitive reserve from a somewhat less biologically oriented perspective than BRC theory, and understands the function of education and a stimulated mental life as enhancing the efficient utilization of brain networks and, the ability to recruit alternate brain networks as needed. Therefore, rather than a physical and protective process that slows biological ageing in normal ageing or delays the start of decline, education and verbal advantage could serve as a means of compensatory strategies (Stern, 2002; Stern, Hilton, Flynn, DeLaPaz & Rakitin, 2003). These strategies are developed through formal education and the use of these strategies could mask comparable rates of biological ageing between different educational groups. It is this advantage, coupled with several other variables that are associated with advantaged formal education such as good health, appropriate occupation and active engagement with ones environment, that serves to explain why cognitive stimulation acts as a moderating influence on changes in cognitive performance associated with ageing (Stern et al., 2003; Scarmeas & Stern, 2003). In effect, the effect of brain pathology is mediated through reserve and an individual with more cognitive reserve is able to withstand more pathology before functional impairment becomes evident (Stern et al., 2003).

2.2.3 Language in the South African Context

South Africa is a multi lingual country, with 11 official languages, which are further differentiated by a myriad of dialects. It is not uncommon for South Africans to know at least two of these official languages, with a large proportion of the population being second language English speakers. Standard neuropsychological tests have been developed and standardised for English first language individuals, and available normative data are based on them being administered in English. The translation of these already validated and internationally well established tests into the relevant language of the test taker is considered to be a costly and impractical enterprise. It is therefore considered more feasible to administer these neuropsychological tests in their English form and gather appropriate normative data for second language English speakers.

When considering neurocognitive test performance of second language speakers one needs to consider the factor of bilingualism. Bilingualism and by extension multilingualism is argued to present a further set of problems in neuropsychological assessment. A review of the literature shows that research efforts have focused on comparing linguistic ability to cognitive test performance and have indicated that bilingual people perform comparatively worse on tests than monolingual people (Ardila et al., 2001). Rosselli et al. (as cited in Ardila et al., 2001) compared the language test performance in Spanish/English bilinguals and found a decrease in semantic but not phonological fluency as a result of the interfering effect between both languages.

There is a continuum of language mastery in bilingualism and possible interaction effects are highly diverse. The concept of balanced bilingualism will be utilised to explicate this distinction with specific reference to the English and Xhosa languages (Albert & Obler as cited in Ardila et al., 2001). The concept proposes a spectrum of proficiency, where at one extreme is the individual who is Xhosa dominant and has limited proficiency in English and at the other extreme is the English dominant bilingual who has a limited mastery of Xhosa. The individuals at both extremes, while bilingual, are regarded as unbalanced, in that their education is lacking in a given areas of oral or written competency. An individual who has mastered all language modalities in both languages is considered a balanced bilingual. Differences in language usage and variations in mastery can depend upon the cultural (subcultural) context, the age at which either language was learnt and the individual's educational level and quality of education received (Ackerman & Banks, 2001).

A study by Shuttleworth-Edwards et al. (2004) on the Wechsler Adult Intelligence Scale III (WAIS III), serves to demonstrate the interplay between language proficiency and quality of education on cognitive test performance. The study revealed that scores for black, English as second language participants with advantaged education were comparable to US standardisation, whereas scores for black, English as second language participants with disadvantaged education were significantly lower than this. A possible explanation for the variation in test performance could be that an advantaged education contributed to higher level of English language proficiency, even though English was not their first language. Manly & Jacobs (2001) highlight the importance of acknowledging quality of education as a corollary variable to test performance. More specifically they argue that interpretation of neurocognitive test performance is more dependent on knowledge of literacy or reading skills than on years of education (Manly & Jacobs, 2001). Manly et al. (1999) have attempted to assess the effect of quality of education by focusing on reading level and propose that reading level could reflect educational experience. In her study of African American and White American elders, it was found that significant discrepancies in test performance between years of education matched African American and White American elders became non significant when reading score, as measured by WRAT-III reading subtest, was used as a covariate (Manly et al., 1999). Results of her study indicated that reading level is more sensitive to aspects of educational experience and is important for successful performance on measures across several cognitive functional domains (Manly et al., 1999). It is noted that further research may be necessary to elucidate whether reading level is an accurate measure of quality of education and whether norms stratified by reading level provide more accurate detection of cognitive deficit than those stratified by level of education (Manly et al., 1999)

2.2.4 Gender

A number of specific gender differences have been reported for various tests of cognition across the adult age groups. Reported domain-specific findings reflect a pattern of male superiority in spatial skills and female superiority in verbal skills (Brauer Boone & Po Lu, 2000). In addition, a pattern of male superiority for fluid type abilities and speeded tasks has also been noted (Brauer Boone & Po Lu, 2000). Shaie (as cited in Jordan, 1997) highlights an earlier decline for men on crystallized abilities, and for females on fluid abilities. Shaie (as cited in Jordan, 1997) reveals strong support for overall female advantage with respect to aging effects and highlights male gender as the most potent of variables that predict earlier than average cognitive decline.

2.3 The Effect of Cultural and Educational Variables on Non-Verbal Neuropsychological Test Performance

The effect of these cultural and educational variables, explicated above, have been well documented in respect of intelligence tests and verbal neuropsychological tests, however, their effect on non-verbal tests has been less researched (Rosselli & Ardila, 2003). This paucity of research speaks to the profession's long upheld view that non-verbal tests are uncontaminated by culture and education (Rosselli & Ardilla, 2003).

However, subsequent research has highlighted that performance on non-verbal tests often requires specific cognitive styles, test taking skills and strategies that are not universal, and are specifically characteristic of middle-class, Western culture and westernised formal education (Rosselli & Ardila, 2003). Differing exposure to copying of figure tasks and the valuing of time restricted performance can be used as examples to explain culture specific cognitive styles and strategies. For example, copying figures as measured by numerous neuropsychological tests are not universal skills. Furthermore, timed non- verbal tests that rely on speed of performance are said to be influenced by the individual's culture and become problematic when speed of performance and time restrictions are not important values in the culture of the individual being assessed (Rosselli & Ardila, 2003). Rosselli and Ardila (2003) introduce research done by Anastasi; Irvine and Berry; and Vernon that observed even larger group differences in performance in non-verbal tests than in verbal tests. In research conducted with Aruaco Amerindians of Colombia (South America), Ardilla and Morena (2001) found that their performance on the Rey Ostterich Complex Figure (ROCF) was particularly low whereas their verbal fluency performance was in the normal range when compared to Canadian and western-Colombian counterparts. Mulenga et al. (as cited in Rosselli & Ardila, 2003) found that Zambian children performed better in visuospacial tests than US children. Even motor skills, often considered independent of educational attainment are influenced by education. Ostrosky et al. (1985) reported that individuals with low levels of education had difficulties with tasks requiring fine motor movements and co-ordinated movements. Similarly, Rosselli, Ardila, and Rosas (1990) found education to be a significant variable predicting the performance, of a sample of illiterates, on praxic ability tests consisting of finger alternating movements, meaningless movements, coordination of both hands, and cancellation tests.

The above stated implies that not only verbal but also non-verbal tests may be culturally biased and, since education is seen as an element of culture, educationally biased. These challenges to the "culture free" assertion, raises the question of whether the use of non-verbal tests are necessarily more appropriate than verbal tests for use with populations from diverse cultures and different educational experiences and highlights the need for demographically specific South African normative date sets for both verbal *and* non-verbal neurocognitive assessment instruments. Spanning these two domains are two frequently used non-verbal tests of *hand motor function* (the Successive Finger Tapping Test and the Purdue Pegboard) (Denckla, 1973; Tiffin & Asher, 1948, respectively) and, two frequently used tests of *verbal fluency* ("S"-Words-In-One-Minute and Words-In-One-Minute) (Benton, Hamsher, & Sivan, 1994; Baker & Leland, 1967, respectively), that have been specifically isolated for the purposes of the present study. These tests have widespread use in neurocognitive assessment internationally (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006), and accordingly also within neuropsychological evaluation in South Africa (Prof. A. Edwards & Dr. F. Hemp, Personal Communication, May, 2010).

2.4 Hand Motor Function

Non-verbal neurocognitive instruments, such as tests of hand motor performance are frequently utilized in neuropsychological examinations because deficits in motor function are seen in numerous neurological disturbances, and motor tasks are widely used as indicators of lesion lateralization (Lezak et al., 2004; Strauss et al., 2006). Moreover, motor functions are integral to the successful performance of almost all tasks of daily living therefore those motor problems, such as those associated with head injury or dementia, represent a pervasive and debilitating source of difficulty that affects functional ability and quality of life (Strauss et al., 2006). The importance of assessing motor function can therefore not be understated (Strauss et al., 2006). A recent study addressing the utility of motor based assessments of neurocognitive functioning for resource limited settings further acknowledges the utility of tests of motor function particularly with regard to the neuropsychological assessments of people living with HIV/AIDS (Parsons, Rogers, Hall & Robertson, 2007). The authors acknowledge that tests of motor function are sensitive to the subcortical and prefrontal striatal processes underlying AIDS dementia complex (Parsons et al., 2007). The progression of the disease is associated with decline in motor function, executive skills, verbal free recall and information processing speed. Of these, motor function and psychomotor slowing is recognized as the most sensitive indicator of AIDS dementia complex (Parsons et al., 2007).

Specific hand motor function measures, including tests of, speed such as the Successive Finger Tapping Test (Denckla, 1973) and, dexterity such as the Purdue Pegboard (Tiffin & Asher, 1948), are particularly sensitive to ascertaining the functional condition of the two cerebral hemispheres (Strauss et al., 2006). What follows is a brief overview of each test which includes a review of neurological findings and available international and local normative data. Further, an explication of the demographic effects on each test is included.

2.4.1 The Successive Finger Tapping Test: An Overview

Finger tapping tests are particularly sensitive indicators of brain impairment, in that finger tapping performance may be impaired with most types of cerebral damage (Mitrushina et. al., 2005). Diffuse brain damage has been shown to impede finger tapping rate bilaterally (Lezak et al., 2004). Additionally, finger tapping tests provide an indication of lateralized dysfunction. Lateralized lesions usually tend to have a slowing effect on the finger tapping rate of the contralaterol hand. Epilepsy and diseases of the brain and spinal cord such as multiple sclerosis have a significant slowing effect on finger tapping rate (Lezak et al., 2004).

Various finger tapping tests with differing administration techniques and scoring procedures are utilised in empirical research and clinical practice. Of focus in the present study is the Successive Finger Tapping Test (Denckla, 1973), however the Finger Tapping Test (Reitan, 1969) will be briefly introduced for contextual purposes. The Finger Tapping Test (Rietan, 1969) originally the Finger Oscillation Test was included in Halstead's (1947) test battery and since then a number of administrative procedures have been developed. The administrative procedure most commonly employed is that proposed by Reitan & Wolfson (1985). The Finger Tapping Test uses a specifically adapted tapper upon which the examinee is required to tap as fast as possible using the index finger of the preferred hand and then the non-preferred hand (Lezak et al., 2004). Five consecutive, 10-s trails are allowed for each hand and the score represents the mean of five consecutive 10-s trails within a range of 5 taps (Lezak et al., 2004). By design it is a measure of speeded repetitive movements and requires the use of equipment. The Successive Finger Tapping test is one of the six timed motor tasks included in the Physical and Neurological Examination for Subtle Signs (PANESS). Specifically, it is a measure of hand motor speed and hand motor control. The PANESS was developed to be sensitive to developmental changes in children and was originally normed on 237, predominantly white, middle class, children with an average IQ and ranging in age from 5-7.

The Successive Finger Tapping test does not rely on equipment and instructs the examinee to touch every finger to thumb beginning with the index finger. By design, it offers a measurement of speeded sequential movements, and in effect is particularly sensitive to left hemisphere functioning. It is suggested that the left hemisphere is predominantly involved in the timing of complex sequences, and several researchers have suggested that there is a greater reliance on the left hemisphere in the execution of sequenced tasks regardless of which hand executed the movement (Grafton et al.; Haaland, Elsinger, Mayer, Durgerian, & Rao; Harrington & Halland, as cited in Larson et al. 2007). The Successive Finger Tapping test is therefore a particularly useful measure in that it is brief, minimizes the need for equipment and has significant clinical utility due to its sensitivity to left hemisphere functioning. Despite this reported clinical utility a review of seminal texts in neuropsychological assessment (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006) and a search of computerized databases ("Academic Search Premier", "PsychArticles", "PsychInfo", and "Medline") reveals that Denckla's (1973) Successive Finger Tapping test is not commonly employed internationally in neuropsychological batteries for adult populations. It seems Rietan's (1969) Finger Tapping Test and its variants enjoy more widespread use in international settings. However, several prominent neuropsychologists in South Africa employ the Successive Finger Tapping test, for adult populations, for both clinical and research purposes (Prof. A. Edwards & Dr. F. Hemp, Personal Communication, May 2010, Hemp, 1989). The use of this test originates from work conduced in Groote Schuur hospital and was incorporated in neuropsychological test batteries because of its clinical utility and its appropriateness for use in the South African context. In a resource limited context such as South Africa, a hand motor dexterity test that requires no equipment is most valuable.

As mentioned above, there are minimal published research studies specific to the use of the Successive Finger Tapping test for adult populations and consequently there is, limited information available regarding demographic effects specific to the Successive Finger Tapping test and, a scarcity of normative data for adult populations. An extensive review of the seminal texts in neuropsychological assessment (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006), computerised databases ("Academic Search Premier", "PsychArticles", "PsychInfo", and "Medline), and existing local literature revealed no international normative data sets and no local *published* normative data sets pertaining to the age group 18-40 years. International normative data sets are however available for children between the ages 5-14 and include normative data from the original standardisation of the Successive Finger Tapping test and a set of miscellaneous normative data presented in a published research study (Larson et al., 2007). Similarly, *unpublished* local normative data for adult populations are available and include those presented by Shuttleworth-Jordan (1992a), Shuttleworth-Jordan & Bode (1992) and Ancer (1999). The dearth of Successive Finger Tapping test normative data for adult populations confirms the need for local normative studies that are able to account for the influence of culture and quality of education, particularly in light of research illustrating that culture and varying educational experience may influence timed non-verbal tests that rely on speed of performance (Rosselli & Ardila, 2003).

Each of these normative data studies for the Successive Finger Tapping test, identified above, will be discussed in turn below.

2.4.1.1 Review of available international and local normative data.

The original standardisation of the Successive Finger Tapping test was conducted on a sample of 237, predominantly white, English speaking, middle class, American children with an average IQ and offers normative data for the age group 5-7 (Denckla, 1973). Larson et al. (2007) provide a set of normative data for the age group 7-14. The sample utilised in this study comprised of 144, predominantly white, English speaking, middle class American children with a high average IQ.

Shuttleworth-Jordan (1992a) provides normative data stratified for two age groups (18-25) and (40-49) for 1st and 2nd language English speakers. Normative data are presented for the preferred and non-preferred hand. These norms were garnered from sample of undergraduate and graduate students. The process of obtaining the norms formed part of a psychology practical whereby psychology students were trained in the use of the test by a clinical psychologist and required to obtain normative data from an English speaking sample stratified by two age groups (18-25) and (40-49) and an African first language speaking group ranging in age 18-25. The data were collated by a research co-ordinator and forwarded for statistical analysis. A study, aimed at developing age related normative data for a number of neuropsychological tests including the Successive Finger Tapping test, by Shuttleworth- Jordan & Bode, (1992), outlines normative data for a non-clinical sample of English speaking South Africans with a relatively high level of education. The sample comprised of 131 participants between the ages of 20 and 89 years with at least 10 years of education. The mean education level is reported as 14.9 years. Preliminary normative indications for five age groups (20-39, 40-59, 60-69, 70- 79, and 80-89 years) are presented for both preferred and non-preferred hand. Normative data were collected for a sample of professional sportsmen with an average education level of 13.7 years and relatively advantaged education (Ancer, 1999). The study formed part of a larger study into the effects of mild closed brain injury in rugby and utilised a sample of professional cricket and rugby sportsmen.

2.4.1.2 Demographic effects on the Successive Finger Tapping test

Those findings on demographic effects specific to the Successive Finger Tapping test indicated in the available international and local normative data will be discussed below. Moreover, those demographic indications available for finger tapping tests in general will also be discussed.

Typically, normal adult performance on finger tapping tests tends to decline with advancing age (Bornstein, 1985; Mitrushina et al., 2005). With respect to the Finger Tapping test (Rietan, 1969) age related slowing becomes most prominent from the fifth decade, and slowing continues, with increasing decrement, through subsequent decades (Lezak et al., 2004). With respect to the Successive Finger Tapping test, no statistical comparisons are available, however the Shuttleworth-Jordan (1992a) and Shuttleworth-Jordan and Bode (1992) normative data reveal a consistent tendency of an age effect in the direction of slower tapping rate with advancing age. Unfortunately due to the way in which the age groups are stratified in these studies, discrete age-related changes cannot be identified and therefore it can not be confirmed from what point slowing becomes most prominent in Successive Finger Tapping test performance. Essentially, an age effect across all finger tapping measures including the Successive Finger tapping test, is evident.

With respect to gender effects on Finger Tapping Test (Reitan, 1969) performance, all but one study (McCurry et al. as cited in Strauss et al., 2006) indicated that gender has a somewhat greater effect on finger tapping test performance, amongst adults, than age, with males outperforming females (Bornstein, 1985; Mitrushina et al., 2005; Ruff & Parker, 1993; Yeudall et al., 1987). Heaton et al. (as cited in Strauss et al., 2006) reported that, in adults about 16-20 % of variance in Finger Tapping Test performance was attributable to gender. Information regarding gender effects on Successive Finger Tapping test performance, amoungst adults, is not readily available because those local studies (Ancer, 1999; Shuttleworth-Jordan, 1992a; Shuttleworth-Jordan & Bode, 1992) identified for review are not stratified by gender. However, information regarding gender effects on Successive Finger Tapping performance, amoungst children, is available from the data presented by Denckla (1973) and Larson et al. (2007). Denckla (1973) found that girls performed faster than boys at each age level represented in the study (ages 5-7) and this tendency of slight female superiority was replicated in the Larson et al. (2007) study, in that girls performed better than boys at each age level represented in the study (ages 7-14). Whether, these differences may diminish after age 14 (the highest age band represented in the two studies reviewed) or whether males then go on to perform better than females, similar to the gender effect pattern identified in Finger Tapping Test performance, is unknown.

Performance on the Finger Tapping Test tends to be better with increasing IQ and with more years of education (Bornstein, 1985; Heaton et al. as cited in Strauss, 2006; Ruff & Parker, 1993), with age and gender considered to have stronger effects on performance than education in adult populations (Bornstien, 1985). According to Heaton et al. (as cited in Strauss, 2006), education accounts for only 2% to 4% of variance in Finger Tapping Test scores. Information specific to education effects on the Successive Finger Tapping test is not readily available in that all the international and local normative data studies reviewed for both, children (Denckla, 1973; Larson et al., 2007) and adult (Ancer, 1999; Shuttleworth-Jordan 1992a; Shuttleworth-Jordan & Bode, 1992) populations, are not stratified by education or IQ and all samples represent advantaged education in terms of both level and quality of education.

Scores for the Finger Tapping Test (Reitan, 1969) tend to be higher with the preferred hand than with the non-preferred hand in both children and adults (Heaton et al. as cited in Strauss et al. 2006). With respect to the effect of hand preference on Successive Finger Tapping test performance in children, Denckla (1973) and Larson et al. (2007) highlight a similar pattern of preferred hand superiority. Regarding the effect of hand preference on Successive Finger Tapping test performance in adults, Ancer (1999), Shuttleworth-Jordan (1992a) and Shuttleworth-Jordan and Bode (1992) do not provide information regarding the direction of effects and no *consistent* tendencies are discernable.

2.4.2 <u>The Purdue Pegboard Test: An Overview</u>

The Purdue Pegboard was developed in the 1940's and was originally used to assess motor dexterity for employment selection in the industrial sector (Tiffin & Asher, 1948). It has since enjoyed widespread international use as a test sensitive to lesion lateralization and motor dexterity among brain damaged patients (Lezak et al., 2004). A study of its sensitivity to impairment revealed accuracy cutting scores of 70% in predicting a lateralized lesion in the validation sample, 60 % in the cross validation sample, and 89 % in predicting brain damage in general for both samples (Lezak et al., 2004). The base rate of brain damaged patients in this population was 73% and therefore the Purdue Pegboard accuracy score represented a significant ($p<.05$) predication gain over the base rate (Lezak et al., 2004). In patients of all ages, a brain lesion is most likely indicated when the non preferred hand score exceeds that of the preferred hand, or preferred hand exceeds that of the non preferred hand by 3 points or more (Lezak et al., 2004). A lesion on the contralatoral hemisphere is indicated when there is one sided slowing whereas bilateral slowing indicates diffuse or bilateral brain damage (Lezak et al., 2004). Ratio scores comparing the two hands are unreliable therefore large lateralized differences should only be considered of diagnostic value when similar differences are confirmed by other tests (Lezak et al., 2004).

2.4.2.1 <u>Review of available international and local normative data.</u>

Available international normative data reviewed for the Purdue Pegboard (Tiffin, 1968; Yeudall, Fromm, Reddon & Stefanyk, 1986) were noted to be based in Canada and the United States of America; all participants were English first language speakers with relatively advantaged education and norms are not stratified by quality of education. A more in-depth review of these normative data studies is provided below. An extensive search of available literature revealed no *published* South African normative data, confirming the need for local normative studies that are able to account for the influence of culture and quality of education, particularly in light of research illustrating that culture and varying educational experience may influence timed non-verbal tests that rely on speed of performance (Rosselli & Ardila, 2003).

Relatively out-dated normative data for occupational groups is available (Tiffin, 1968). This data is however not stratified by age or gender and information regarding hand preference is not available (Tiffin, 1968). The average scores of those normative groups presented, consisting of production workers and applicants for production work jobs, ranged from 15 to 19 for the right hand, from 14.5 to 18 for the left hand, from 12 to 15.5 for both hands (Tiffin, 1968). More recently, Yeudall, et al. (1986), collected normative data, stratified on the basis of age (15-40) years and gender, from a large sample of neurologically intact, non-psychiatric adults on 12 tests used in neuropsychological assessment. One such test was the Purdue Pegboard and the normative data was compiled from 225 healthy adults, with an above average IQ, residing in Western Canada. Subtest scores are based on one trial per sub test.

2.4.2.2 Demographic effects on the Purdue Pegboard.

The most important demographic effects on Purdue Pegboard results include age, gender and hand preference, with education seen as unrelated to Purdue Pegboard performance (Strauss et al., 2006). Findings associated with age related change in performance indicate an improvement in performance during childhood with performance slowing with advancing age (Strauss et al., 2006). Furthermore, scores drop with advancing age at a slightly greater rate for men than for women (Lezak et al., 2004). A positive association between female gender and better performance on the test has been elucidated (Strauss et al., 2006; Yeudall et al., 1986). In the Yeudall et al. (1986) study females, across all the age groups, performed better than males on the preferred hand, non-preferred hand and both hands trail. Averages for groups of women tend to be one half to two or more points above the averages for groups of men (Lezak et al., 2004). It is argued by Peters, Servos, Day (1990) that gender differences in tasks of fine manual dexterity may be confounded by gender differences in finger size and these researchers reported that when measures of index finger and thumb size were used as co-variates, gender differences were not evident. Generally, performance is better with the preferred hand than the non-preferred hand (Lezak et al. 2004; Strauss et al., 2006; Yeudall et al., 1986). A study of 30 left handed participants and 30 right handed participants found that both groups placed approximately four more pegs with the preferred hand than the non-preferred hand during three trials (Lezak et al., 2004). Moreover, the Yeudall et al. (1986) normative data reveal a consistent decrement in performance through the three trials, with highest scores associated with preferred hand performance and lowest scores associated with both hands performance.

2.5 Structured and Unstructured Verbal Fluency

Assessment of verbal fluency, in the form of structured or unstructured verbal fluency, is an important component in clinical neuropsychological evaluation. Those tests used to assess structured ("S"-Words-In-One-Minute) and unstructured (Words-In-One-Minute) verbal fluency are measures of verbal productivity and successfully tap into a number of cognitive mechanisms. Verbal fluency has commonly been viewed as a component of executive function alone however, a number of studies have highlighted the multidimensional nature of the cognitive mechanisms underlying verbal retrieval and recall (Mitrushina et al., 2005). Those cognitive mechanisms involve, auditory attention, speed and capacity of verbal production, mental organization, search strategies, ability to initiate behaviour in response to a novel task, short term memory illustrated by an ability to keep track of words already said, speeded mental processing, response inhibition capacity, long term vocabulary storage, cognitive flexibility, and ability to initiate and maintain a word production set (Mitrushina et al., 2005; Oberg & Ramirez, 2006).

Verbal fluency has proven to be a sensitive indicator of brain dysfunction or injury, and research has shown significant correlates between verbal fluency and site of cerebral compromise (Lezak et al., 2004). Studies have elucidated that verbal fluency is related to anterior cerebral function, particularly left hemisphere functioning (Lezak et al., 2004). Although both right and left frontal lesions tend to depress verbal fluency, patients with left frontal lesions produce on average one third fewer FAS words than those with right frontal lesions (Lezak et al., 2004). Similarly, every dementing process and most aphasic disabilities are characterised by reduced verbal productivity (Lezak et al., 2004). Furthermore, verbal fluency deficits have been reported in patients with left temporal lobe epilepsy, multiple sclerosis, mild traumatic brain injury, Parkinson's disease, Huntington's disease and Schizophrenia (Oberg & Ramirez, 2006).

A brief overview of "S"-Words-In-One-Minute and Words-In-One-Minute follows and includes a review of neurological findings and available international and local normative data. Further, an explication of the demographic effects on each test is included.

2.5.1 "S"-Words-In-One-Minute: Standard Neuropsychological Test Used to Assess Structured Verbal Fluency

Structured verbal fluency is routinely tested in phonological and category domains. Several variants of the phonological verbal fluency task are evident in the literature. A review of the historical origins of these variants, explicates how they stem from the Thurston Word Fluency Test (Mitrushina et al., 2005).

Thurston's version of the task required participants to write as many words beginning with the letter "S" in 5 minutes and then as many four letter words beginning with the letter "C" in 4 minutes (Mitrushina et al., 2005). Due to difficulties inherent in writing based tasks, an oral version was developed, and named the Controlled Verbal Fluency Task (CVFT). This version instructs participants to orally generate as many words in one minute beginning with the phoneme F, A and S. All three phonemes are used and one minute is allowed for each. This test was later included in the Multilingual Aphasia Examination battery and assumed the new name, Controlled Oral Word Association Test (COWA; Benton, et al., 1994). In this version the two letter sets of CFL and PRW are used instead of the FAS letter set.

To date, the FAS letter set has enjoyed continued use as a measure of phonological verbal fluency and is included in the Neurosensory Center Comprehensive Examination for Aphasia (NCCEA; Tombaugh, Kozak, Rees, 1999). Differing variants of administration, for the FAS form, are evident in the literature, for example Tucha, Smely & Lange (1999) report using a short version, where just the letter "S" was used in their investigation of verbal and figural fluency in patients with mass lesions of the left and right frontal lobes. It is this variant of administration that is considered in this review. Borkowski et al., as cited in Mitroshina et al. (2005) undertook an analysis of letter difficulty as determined by the frequency of associations for 24 different letters and the letter "S" was classified as easy due to its very high frequency. Test-retest reliability coefficients for the FAS letter set are quite high. A reliability study, that retested elderly persons after a one year interval, reported reliability co-effients of r=.70 or r=.71 for the letters F and S, with the letter A fairing slightly lower (Lezak et al., 2004).

Cross-cultural studies have found validity for verbal fluency tests in speakers of languages other than English; for example Spanish [Ardila & Rosselli, 1994; (Lopez- Carlos et al.; Ponton et al.; Rosselli et al. as cited in Mitrushina et al. 2005)], Finnish (Klenberg, Korkman, & Lahti-Nuuttila, 2001), Hebrew (Axelrod, Tomer, Fisher, & Aharon-Peretz, as cited in Mitrushina et al., 2005), and Greek (Kosmidis, Vlahou, Panagiotaki & Kiosseoglou, as cited in Mitrushina et al., 2005). In these studies different combinations of letter sets have been used based on letter difficulty analysis within each language.

2.5.1.1 Review of international and local normative data for "S"-Words-In-One- Minute.

Although short forms including only one letter are often used in the South African context, there is a dearth of both local and international normative data regarding normal performance (Oberg & Ramirez, 2006; Tucha et al., 1999). Therefore, those local and international normative studies providing normative data, including means and standard deviations for each of the three letters in the FAS letter set will also be considered for review and the data specific to the "S" word will be extracted for comparative purposes. Of particular focus are those studies that provide norms for the age group 18-40, stratified according to similar age groups of 18-29 and 30-40. An extensive search of seminal texts in neuropsychological assessment (Lezak et al., 2004; Mitrushina et al., 2005; Strauss, et al., 2006) computerized data bases ("Academic Search Premier", "PsycArticles", "PsycInfo", and "Medline") and existing local literature yielded only one set of international normative data (Yeudall et al., 1986) and two sets of *unpublished* local normative data (Ancer, 1999; Ferrett et al., 2010), that met the above search criteria and therefore deemed appropriate for review. Each of these sets of normative data will be discussed in turn below. The review confirmed the increasing need for studies that examine the normative equivalence of this short form verbal fluency test, administered in English, particularly for English second language speakers aged 18-40 years

In general, normal subjects are able to generate an average of 12 words per minute for different letters including "B", "F", "L", "M", "R", "S" and "T" (Spreen & Strauss, 1998).

Yeudall et al. (1986), obtained normative data based on 225 Canadian volunteers, aged 15-40 years. All participants were English first language speakers with a mean education level of 14.12 years. The sample was adequately screened for medical and psychiatric exclusion criteria. The sample is stratified into four age groups and the normative data are presented for males and females separately. In summary this reviewed international normative data set for "S"-Words-In-One-Minute, is based on a normative study conducted within Canada and the sample utilised comprised of English first language speakers with high education levels.

Norms were collected for a sample of English first language, professional sportsmen with an average education level of 13.7 years and relatively advantaged education (Ancer, 1999). The study formed part of a larger study into the effects of mild closed brain injury in rugby and utilised a sample of professional cricket and rugby sportsmen. It was decided to use the normative data collated for the cricket players for comparison. This was deemed more appropriate for comparison because cricket is a non-contact sport and thus players were less likely to have suffered cumulative head injuries during their professional sport playing careers.

More recently, Ferrett et al. (2010) have endeavoured to address the complexities involved in testing phonemic fluency in multilingual contexts and provide normative data for Afrikaans, English and isiXhosa speaking South Africans. The normative data is stratified by language, level and quality of education and is based on a non-clinical sample of government school learners and community members from in and around the Western Cape Province. Quality of education was based on the classification type each school belonged to in the pre-democratization era. The Western Cape Education Department lists all the government schools in the province and states each schools pre-democratization classification type. There are five types of classification: DET (Department of Education and Training, i.e. "black"), HOD (House of Delegates, i.e. "Asian"), HOR (House of Representatives, i.e. "coloured"), CED (Cape Education Department, i.e. "white") or WCE (Western Cape education or "amalgamated"). Previously "disadvantaged" thus includes DET, HOD and HOR schools (as per previous classification) and previously "advantaged" include CED and WCE schools. To date, the findings of this study remain unpublished and have been presented at the South African Clinical Neuropsychological Association (SACNA) 12th biennial conference, however publication is pending. Ferrett et al. (2010) utilized an adapted form of the Controlled Oral Word Association Test and elected to use a SBL letter set for English and Afrikaans participants and an IBL letter set for isiXhosa speaking participants.

2.5.1.2 Demographic effects on "S"- Words-In-One- Minute.

Research on life span performance, elucidates a substantial increase in performance between the ages 5 and 7, with this increase peaking at age 30- 39 and a mild decline in old age (Loonstra, Tarlow & Sellers, 2001; Mitrushina et al., 2005; Strauss et al., 2006). Findings concerning age related decline in performance are variable. A recent meta-analysis of the FAS task in normal, healthy adults across the lifespan demonstrated a fairly robust age related decline in the task (Loonstra et al., 2001). However, Ruff and Parker (1993), and Yeudall et al. (1986) related minimal age effects on the task. Other authors report age related decline in semantic but not in phonological fluency (Parkin & Java as cited in Mitrushina et al., 2005; Troyer, 2000). A point of contention noted is whether verbal fluency performance varies across the lifespan as a function of education as suggested by cognitive reserve theory. Normative data studies conducted by Tombaugh et al. (1999) have shown that a significant amount of lifespan variance in fluency performance can be attributable to education. Gladsgo et al. as cited in Mitrushina et al. (2005) elucidated a significant correlation between age and number of years of education in FAS performance. Similarly, Parkin and Lawrence as cited in Mitrushina et al. (2005) reported significant age related decline in verbal fluency only in older cohorts with low educational levels.

The impact of gender on fluency performance and, possible changes in performance across the lifespan of male and female gender, has not been clearly elucidated. Some studies indicate slightly better performance by females on phonological fluency tasks (Loonstra et al., 2001) while others indicate no differences between male and female performance (Tombaugh et al., 1999; Yeudall et al., 1986). Tombaugh et al. (1999) reported that gender accounted for less than 1% of variance in their sample of 1,300 cognitively intact individuals aged 16-95 years.

There is emphatic agreement across studies that this verbal fluency task is impacted by education experience, level and quality, in that higher levels of education are associated with better performance (Ardila, Ostrosky-Solis, Rosselli & Gomez, 2000; Gladsjo et al. as cited in Mitrushina et al., 2006; Loonstra et al., 2001; Tombaugh et al., 1999; Troyer, 2000). Although statistical comparisons are not presently available, a similar and consistent tendency of better performance associated with higher levels of education and advantaged education is evident in the local unpublished normative data of Ferrett et al., 2010. Those aggregate statistics of FAS totals by education provided by Loonstra et al. (2001) indicate better performance by those with an education level beyond 12 years. Performance in language ability tests strongly correlates with an individual's educational level and can even be more significant than the aging effect (Ardila et al., 2000). Ardila et al. (2000) found that educational level accounted for 38.5% of the variance in the phonological fluency task. Regression analysis performed by Tombaugh et al. (1999) on FAS scores demonstrated that education accounted for more variance than age, in that, education accounted for 18.6 % of the variance, while age accounted for only 11.0%.

With respect to the effect of language on verbal fluency performance, Rosselli et al. (as cited in Ardila et al. 2002) studied the influence of bilingualism, specifically that of Spanish-English, on both phonological and semantic conditions of verbal fluency. The findings illustrate greater language interference on the semantic condition as the bilingual participants generated fewer words than the monolingual English participants in the animal naming condition but not in the FAS condition.

2.5.2 Words-In-One-Minute- Standard Neuropsychological Test used to Assess Unstructured Verbal Fluency

The Words-In-One-Minute test is derived from the free association subtest included in the original Detroit Tests of Learning Aptitude (Baker & Leland, 1967) and has since gained utility in the assessment of unstructured verbal fluency. Various revised versions of the Detroit Tests of Learning Aptitude have been developed throughout the years, however it is not clear from what is available whether the Words-In-One-Minute subtest is included in recent versions. It is the original version that is considered in this study. It would appear, from a review of seminal texts in neuropsychological assessment (Lezak et al., 2004; Mitrushina et al., 2005; Strauss, et al., 2006) and, an extensive search of computerised data bases

("Academic Search Premier", "PsycArticles", "PsycInfo", and "Medline"), that unstructured verbal fluency in the form of Words-In-One-Minute is not commonly employed internationally in neuropsychological batteries for adult populations. However, several prominent neuropsychologists in South Africa employ this test for both clinical and research purposes (Prof. A. Edwards & Dr. F. Hemp, Personal Communication, May, 2010; Hemp, 1989). The use of this test originates from work conducted in Groote Schuur hospital and was incorporated in neuropsychological test batteries because of its clinical utility and its appropriateness for use in the South African context.

The clinical utility of the Words-In-One-Minute test lies in its unstructured nature and, as a consequence, its increased sensitivity to deficits in ability to generate strategies to guide the search for words. To elaborate, a comparison of the structured verbal fluency tasks, as represented by phonological verbal fluency and category fluency, highlights differences in the amount of scope each condition provides subjects seeking a strategy for guiding the search for words. Phonological fluency tests that require the generation of words according to an initial letter provide the greatest scope to subjects seeking a strategy for guiding the search for words and are most difficult for those who cannot develop strategies of their own (Lezak et al., 2004). Whereas, fluency tests that require word generation according to a specific category, such as animal naming, serve to provide the structure lacking in phonological fluency tests (Lezak et al., 2004). In effect the more unstructured the verbal fluency task, the greater the scope for seeking strategies and the more the subject has to rely on their own ability to develop strategies. With this understanding it is useful to go one step further and employ a verbal fluency task with no structure. A measure of unstructured verbal fluency provides the most scope for subjects seeking a strategy and would be particularly sensitive to deficits in ability to generate strategies in the search for words. This increased sensitivity to deficits in organization of thought renders the test particularly sensitive to possible brain pathology, specifically frontal lobe impairment. With respect to its appropriateness for use in the South African context, it is argued that the unstructured nature renders it a fairer test for second language English speaking subjects because it places less restriction on which words can be generated.

2.5.2.1 Reviewed international and local international normative data for Words-In-One-Minute.

Due to the fact that Words-In-One-Minute is seldom used, in international settings, for adult populations, as evidenced by its exclusion from those seminal texts in neuropsychological assessment, well stratified miscellaneous norms for this version do not seem to be available internationally. Additionally, only minimal collections of local normative data are available. Local norms available include norms for children between the ages of 5 and 15. These norms were obtained through a local standardization of this test at the UCT child guidance clinic which, at the time of the standardisation, serviced an English speaking white community (UCT Child Guidance Clinic, 1956). It is assumed that the sample characterised the demographics of this community. The specific demographic information of this sample is not available.

Unpublished preliminary local normative data available for adult populations include those provided by Shuttleworth-Jordan (1992b). These norms were garnered from sample of undergraduate and graduate students. The process of obtaining the norms formed part of a psychology practical whereby psychology students were trained in the use of the test by a clinical psychologist and required to obtain normative data from an English speaking sample, with relatively advantaged education, stratified by two age groups (18-25) and (40-49) and an African first language speaking group, with relatively advantaged education, ranging in age 18-25. The data was collated by a research co-ordinator and forwarded for statistical analysis. More recently norms were collected for a sample of professional sportsmen with an average education level of 13.7 years and relatively advantaged education (Ancer, 1999). The study formed part of a larger study into the effects of mild closed brain injury in rugby and utilized a sample of professional cricket and rugby sportsmen.

2.5.2.2 Demographic effects on Words-In-One-Minute.

As explicated above, unstructured verbal fluency in the form of Words-In-One-Minute is not commonly employed internationally in neuropsychological batteries for adult populations, therefore an extensive search of seminal texts in neuropsychological assessment (Lezak et al., 2004; Mitrushina et al., 2005; Strauss, et al., 2006) and computerised data bases ("Academic Search Premier", "PsycArticles", "PsycInfo", and "Medline") yielded no published information regarding the demographic effects specific to this test of unstructured verbal fluency. Therefore, the limited demographic indications available from the local unpublished normative data studies are considered below with a view of highlighting possible broad based parallels with those demographic effects documented for the phonological condition of verbal fluency.

Age related change in the phonological condition of verbal fluency (e.g. "S"-Words-In-One-Minute) is reported to follow a curvilinear pattern, characterized by increased performance until the 3rd decade, with a peak performance in the age range 30-40 years. A mild decline in verbal fluency performance is then anticipated from 40 years onwards (Loonstra et al., 2001; Mitrushina et al., 2005; Strauss et al. 2006). With regards to Words-In-One-Minute a similar age effect in the direction of greater word production with increasing age can be noted. Although the UCT child guidance clinic (1956) study provides no statistical comparisons regarding age effects, a consistent tendency of an increase in word production through to age 15 (the highest age band of their study), is evident. Similarly, a descriptive comparison of the number of words produced by the 18-25 age group in the Shuttleworth-Jordan (1992b) study, to the number of words produced by the highest age band (15) in the UCT child guidance clinic (1956) study, reveals higher word production for the 18-25 age group suggesting continued increase in word production to at least age 25. Unfortunately due to the way in which the age groups are stratified, in these local studies, discrete age-related changes cannot be identified. Therefore, at what point, peak performance can be expected or, age related decline becomes most prominent, is unknown. Essentially, broad based parallels with the phonological condition of verbal fluency are evident specifically with respect to age effects, however exact parallel effects cannot be assumed until there is more specific research. With respect to language, the Shuttleworth-Jordan (1992b), normative data indicates greater word production by the English first language sample group.

The local unpublished normative data sets are only stratified by age (UCT child guidance clinic, 1956) and, age and first language (Shuttleworth-Jordan, 1992b) and are based on samples with relatively advantaged education therefore no comment on gender or education effects can be made from these data sets. However, typically, higher rates of word generation are associated with higher education levels (Ardila et al., 2000; Gladsjo et al. as cited in Mitrushina et al, 2005; Loonstra et al., 2001; Tombaugh et al., 1999; Troyer, 2000;) and it is assumed that this education effect would extend to rates of word generation in Words-In-One-Minute. Specific research however is needed to confirm exact parallel effect in Words-In-One-Minute.

2.6 Rationale, Objectives and Hypotheses of the Present Study

2.6.1 Rationale and Objectives

In conclusion, the literature and cross-cultural research indications presented above highlight the need for demographically specific South African normative data sets for both verbal *and* non-verbal neuropsychological assessment instruments due to the potential for highly variable socio-cultural influences on test performance. Shuttleworth- Edwards et al. (2004), WAIS-III research highlights specifically how variability of educational experience in the South African context can have deleterious effects on test performance, with this effect, most pronounced for black South African individuals with lower levels and relatively disadvantaged quality of education. There is a need to extend the valuable research base in terms of the WAIS-III cross-cultural research to include normative datasets for key neuropsychological tests that tap into the broad functional modalities as outlined in the above discussion (see section 1). In recent years, efforts to refine normative data sets and obtain demographically specific normative data have increased in

North America but unfortunately the dearth of equivalent efforts in South Africa threatens to compromise service delivery to a significant portion of the population and hinder the further development of neuropsychological services in the government and private health care sectors (Anderson, 2001). Specifically there is a need for demographically relevant normative data for the age range (18-40) considering that the age range of persons in South Africa most likely to incur a traumatic brain injury is 20-40 (Nell & Ormond Brown, 1991).

This study forms part of a broader South African cross-cultural research project aimed at establishing preliminary normative indications, in respect of a non-clinical sample of isiXhosa speaking, black South Africans with a relatively disadvantaged quality of education, for 16 commonly employed neuropsychological measures, administered in English. These neuropsychological measures pertain to a cross-section of six functional modalities: 1) Attention and Concentration: Visual and Auditory; 2) Language (Verbal Fluency); 3) Visual Perception 4) Verbal Memory; 5) Visual Memory and 6) Motor Function. In addition, to the six functional modalities covered, neurological measures commonly employed in the assessment of malingering were included. Three investigations into common neuropsychological measures associated with functions of memory, attention and concentration, and malingering respectively, have already been completed and this study constitutes a fourth focus of analysis. The objective of the current study is to attain preliminary normative data (means and standard deviations) for two tests of verbal fluency and two tests of hand motor function, administered in English on a population of black, South African, isiXhosa speaking people who attended a former DET type school in the Eastern Cape, with a grade 11 or 12 education level and age range of 18-40. In addition, the study aims to investigate any differences in younger and older age (18-29 versus 30-40) and gender performance. This investigation into age and gender effects is guided by a set of research hypotheses as derived from and informed by the literature review. These hypotheses will be discussed for each test in turn. Descriptively, the normative indications for this South African isiXhosa speaking population will be compared with available norms for each of the tests. This descriptive comparison will be discussed in the context of level and quality of education.

2.6.2 Research Hypotheses

The research hypotheses, derived from the literature review, will be discussed, for each test in turn, below.

2.6.2.1 Successive Finger Tapping test.

Research hypothesis 1. No significant age effects on Successive Finger Tapping test performance will occur.

This hypothesis is based on the following rationale taken from the literature review. There is a lack of information regarding age effects on adult Successive Finger Tapping test performance, therefore, at what point, peak performance can be expected or, age related decline becomes most prominent, is unclear. In the context of this dearth of demographic indications for the Successive Finger Tapping test, broad based parallels to the Finger Tapping Test (Reitan, 1969) are assumed with caution. Typically, age related decline in Finger Tapping Test performance is anticipated to only be prominent from the 5^{th} decade onwards (Lezak et al., 2004) and therefore, assuming parallel effects, age effects on present study Successive Finger Tapping test performance are not expected to occur since the age range of focus is that of 18-40 years.

Research hypothesis 2. A significant gender effect on Successive Finger Tapping test performance will occur. However, based on the lack of information regarding gender effects on adult Successive Finger Tapping test performance, the direction of gender effects cannot be hypothesized.

This hypothesis is based on the following rationale taken from the literature review. With regard to gender effects, the direction of gender effects on Successive Finger Tapping test performance, in adult populations, is unclear. Information regarding gender effects in child populations is however available and highlights gender effects in the direction of females outperforming males. However, available international data trends, based on adult populations, elucidate gender effects in the direction of males outperforming females for other finger tapping measures such as the Finger Tapping Test (Bornstein, 1985; Mitrushina et al., 2005; Reitan, 1969; Ruff & Parker, 1993; Yeudall et al., 1987). Essentially, gender effects across finger tapping measures in general, including the Successive Finger Tapping test, are evident. However, the direction of effects on adult Successive Finger Tapping test performance is unclear. Therefore, gender effects on adult Successive Finger Tapping test performance are expected to occur however, the direction of effects cannot be hypothesized.

2.6.2.2 <u>Purdue Pegboard.</u>

Research hypothesis 3. No significant age effects on Purdue Pegboard performance will occur. Specifically, there will be no significant age related decline in performance.

This hypothesis is based on the following rationale taken from the literature review. With regards to the effect of age, investigations into age related change in performance on the Purdue Pegboard reveals slowing with advancing age (Strauss et al., 2006) with decline only expected beyond the age range (18-40) represented in the present study. Therefore, age effects on present study Purdue Pegboard test performance are not expected to occur since the age range of focus is that of 18-40 years.

Research hypothesis 4. A significant gender effect on Purdue Pegboard performance, in the direction of females outperforming males, will occur.

This hypothesis is based on the following rationale taken from the literature review. With regards to the effect of gender, all the literature reviewed indicates a positive association between female gender and better performance. Averages for groups of women tend to be one and a half to two or more points above the averages for groups of men (Lezak et al., 2004). It is therefore expected that a significant gender effect on Purdue Pegboard performance, in the direction of females outperforming males, will occur.

2.6.2.3 <u>"S"-Words-In-One-Minute.</u>

Research hypothesis 5. No significant age effects on "S"-Words-In-One-Minute performance will occur.

This hypothesis is based on the following rationale taken from the literature review. With regard to the effect of age, research investigating age related changes in the phonological condition of verbal fluency measures reveals a curvilinear pattern, with increased performance until the 3rd decade and peak performance anticipated in the age range 30-40 (Loonstra et al., 2001; Mitrushina et al., 2005; Strauss et al., 2006). A mild decline from 40 years onwards is then anticipated. Therefore, with respect to the present study, it is expected that no significant age effects on "S"-Words-In-One-Minute performance will occur, since the focus of the study is the age range 18-40.

Research hypothesis 6. No significant gender effects on "S"-Words-In-One-Minute test performance will occur.

This hypothesis is based on the following rationale taken from the literature review. With regard to the effect of gender, some studies indicate only slightly better performance by females (Loonstra et al., 2001), whereas others indicate no differences between male and female gender (Tombaugh et al., 1999; Yeudall et al., 1986). Essentially, reviewed literature suggests that gender is not a significant feature of influence on "S" –Words-In-One-Minute and therefore, no significant gender effects on "S"-Words-In-One-Minute performance are expected to occur.

2.6.2.4 Words-In-One-Minute.

Research hypothesis 7. No significant age effects on Words-In-One-Minute performance will occur.

This hypothesis is based on the following rationale taken from the literature review. Due to the lack of literature regarding age effects on unstructured verbal fluency, at what point, peak performance can be expected or, age related decline becomes most prominent, is unclear. In the context of this dearth of demographic indications for unstructured verbal fluency, broad based parallels to structured phonological verbal fluency are assumed with caution. Typically, a mild decline in structured phonological verbal fluency measures is anticipated from 40 years onwards (Loonstra et al., 2001; Mitrushina et al, 2005; Strauss et al., 2006). Therefore, assuming parallel age effects, it is expected that no significant age effects on Words-In-One-Minute performance will occur, since the focus of this study is the age range 18-40.

Research hypothesis 8. No significant gender effects on Words-In-One-Minute will occur.

This hypothesis is based on the following rationale taken from the literature review. No local or international literature regarding gender effects on unstructured verbal fluency could be identified. In the context of this dearth of demographic indications for unstructured phonological verbal fluency, broad based parallels to structured phonological verbal fluency are assumed with caution. Varying results, regarding the effect of gender on structured phonological verbal fluency measures, are presented in the literature. Some studies indicate no differences between male and female performance (Tombaugh, et al. 1999; Yeudall et al., 1986) and others indicate a marginal difference in performance in the direction of females outperforming males (Loonstra et al., 2001). Therefore, assuming parallel gender effects, it is expected that no significant gender effects on Words-In-One-Minute will occur.

3. Method

The present study formed part of a larger study on the collection of South African normative data for a comprehensive neuropsychological battery that was planned in late 2007, and for which the data collection took place in June and July of 2008. The data were collected by a number of researchers including the present researcher, and divided up into a number of separate entities for subsequent analysis and discussion purposes. Three investigations into common neuropsychological measures associated with functions of memory, attention and concentration, and malingering respectively, have already been completed and this study constituted a fourth focus of analysis. The present study utilised an experimental design procedure, for the purposes of collecting normative data for two tests of hand motor function and two tests of verbal fluency, administered in English on a population of black, South African, isiXhosa speaking people who attended a former DET type school in the Eastern Cape, with a grade 11 or 12 education level and age range of 18-40. The results of the study were analysed using descriptive statistics and independent *t*-test analyses were conducted to investigate possible age and gender effects.

3.1 <u>Sample</u>

A non-clinical sample of 33 black, first language isiXhosa speaking participants, was utilised in this study. These participants ranged in age from 18-40 years (mean age=28.39 years; SD=5.99). Participants were drawn from and resided in the Eastern Cape, and only participants who had attained their Grade 11-12 education level in this province, from a former DET type educational institution were included in the study. Specifically, the majority of the sample (n=19) was drawn from the Rhodes University casual support staff members within the occupational level F. Level F is specified by the South African Employment Equity Act as an unskilled and defined decision making occupational level (S. Robertson, personal communication, October, 2007). Participants primarily worked within the housekeeping and grounds and gardens departments. Seven of the participants held jobs as waiters or kitchen staff at a fast food outlet in Grahamstown, and the remainder of the sample (n=7) were unemployed at the time of the study.

3.1.1 <u>Language</u>

To ensure homogeneity of the sample in respect of language, all participants included spoke isiXhosa as their first language and, since all of the tests included in this study were administered in English, all participants were further required to have a satisfactory level of English proficiency. Level of proficiency in English was assessed based on the participants' demonstrated ability to work in an English environment, their regular usage of the English language, a subjective account of English proficiency and their Grade 12 marks for English as second language. These marks were accessed by reviewing the participant's school reports and/or Grade 12 certificates. It is important to note that those participants unemployed at the time of the study had previously held jobs in an English environment and were regularly required to communicate in the English language. Additionally, researchers also assessed each participants level of English proficiency, recording their clinical judgements of the participant's English ability in a section provided in the pre-screening questionnaire (See Appendix C). It was not considered necessary to exclude any participants on the basis of observed poor fluency in English by the researchers who carried out the testing.

3.1.2 Level of Education

All participants were required to have a minimum Grade 11 level of education, with no tertiary education. This inclusion criterion ensured the representation of the educational level of the normal population. Equivalence of distribution of participants with Grade 11 and Grade 12 education was ensured between all comparison groups via Pearson Chi Square analyses ($p = < 0.05$, in all instances). Distribution tables and Pearson Chi Square data are represented below under sections age (table 2) and gender (table 4).

3.1.3 Quality of Education

Given the noted important relationship between quality of education and cognitive test performance, efforts were made to collect information characterising the educational experiences of the prospective participants, in addition to the highest level of education obtained. This was to ensure that the sample adhered to the inclusion criteria of attainment of education from a township or a former DET type educational institution and specifically a former DET type institution within the Eastern Cape. As indicated above, the decision to draw participants from the Eastern Cape region specifically was that it has been identified as a region where the quality of education is particularly poor, when compared to that obtained from former DET-type schools in other provinces (Matomela, 2008). Therefore, although the DET education system has long since been officially dismantled, the legacy of segregated education still plagues former DET type schools, with those schools in the townships or locations offering relatively disadvantaged education in relation to other state or private schools in the country.

3.1.4 Age

The age range of 18-40 was identified for the purposes of study because this age range represents the age range of the group most likely to be at risk for traumatic brain injury (Nell & Ormond-Brown, 1991). The sample was stratified into two age groups, being 18-29 and 30-40 years. There was no significant difference in terms of distribution of gender between these two age groups (*p*=.554). Similarly, there were no significant differences in terms of distribution of highest grade obtained between the two age groups (*p*=.619). Distribution tables and Pearson Chi square data for gender and highest grade obtained is presented below in tables 1 and 2 respectively.

Table 1

Distribution of Gender in the Two Age Groups (18-29, 30-40)

Age Group		Gender		
		Female	Male	Total
18 – 29	*N*	10	7	17
	% within Age Group	58.8%	41.2%	100.0%
30 – 40	*N*	11	5	16
	% within Age Group	68.8%	31.2%	100.0%
Total	*N*	21	12	33
	% within Age Group	63.6%	36.4%	100.0%

Note. There was no significant difference in gender distribution across the two age groups ($p = 0.554$)

Table 2

Distribution of Highest Grade Obtained in the Two Age Groups (18-29, 30-40)

Age Group		Highest Grade		
		11	12	Total
18 - 29 yrs	*N*	4	13	17
	% within Age Group	23.5%	76.5%	100.0%
30 - 40 yrs	*N*	5	11	16
	% within Age Group	31.2%	68.8%	100.0%
Total	*N*	9	24	33
	% within Age Group	27.3%	72.7%	100.0%

Note. There was no significant difference in level of education distribution across the two age groups (p = .619)

3.1.5 Gender

The sample of 33 participants was stratified into two groups according to gender. This stratification was deemed necessary in order to explore a possible effect of gender on test performance. The female group comprised of 21 participants, with a mean age of 28.90 years (SD=6.7) and a mean level of education of 11.76 years (SD=0.436). The male group comprised of 12 participants, with a mean age of 27.50 (SD=4.622) and a mean level of education of 11.67 years (SD=0.492). There were no significant differences in the distribution of age (p=.554) or the distribution of highest grade obtained (p=.555) between these two gender groups. Distribution tables and Pearson Chi-Square data for age and highest grade obtained in the two gender groups are presented below in tables 3 and 4 respectively.

Table 3

Distribution of Age in the Two Gender Groups

Gender		Age Group		
		18 - 29 yrs	30 - 40 yrs	Total
Female	*N*	10	11	21
	% within Gender	47.6%	52.4%	100.0%
Male	*N*	7	5	12
	% within Gender	58.3%	41.7%	100.0%
Total	*N*	17	16	33
	% within Gender	51.5%	48.5%	100.0%

Note. There was no significant difference in age distribution across the gender groups (p = .554)

Table 4

Distribution of Highest Grade Obtained in the Two Gender Groups

Gender		Highest Grade		
		11	12	Total
Female	*N*	5	16	21
	% within Gender	23.8%	76.2%	100.0%
Male	*N*	4	8	12
	% within Gender	33.3%	66.7%	100.0%
Total	*N*	9	24	33
	% within Gender	27.3%	72.7%	100.0%

Note. There was no significant difference in level of education distribution across the gender groups (p = .555)

3.1.6 Exclusion Criteria

The following criteria excluded participation in this study: a reported history of any neurological disorder or any traumatic brain injury resulting in more than an hour of unconsciousness; any current psychiatric illnesses; current use of psychotropic medications; a diagnosis of substance abuse; a history of learning disability; a history of prenatal or birth complication; a need for special education; two or more repeated school grades; and/or any physical impairment which would interfere with test performance. A self report biographical questionnaire (see Appendix B for biographical questionnaire) was completed by each prospective participant at the research presentations and a detailed screening questionnaire was conducted by the researcher on the day of the testing in order to ensure that the sample stringently adhered to exclusion criteria (see Appendix C pre-screening questionnaire).

3.2 Procedure

This research project was conducted in Grahamstown, Eastern Cape and Rhodes University was selected as a research site for convenience purposes. Permission was acquired from the Registrar to utilise the University as a research site. In consultation with the Human Resources Department it was established that the pool of casual workers at Rhodes University would most likely meet stipulated inclusion criteria. The human resources department granted researchers access to the casual workers data base. A list of casual workers with Grade 11/Grade 12 education levels was then compiled and these prospective participants were contacted, informed about the research initiative and invited to attend preliminary research presentations. These presentations served to disseminate information about the nature and purpose of the study and encourage prospective participants to fill out a biographical questionnaire (see Appendix B for biographical questionnaire). Voluntary participation, anonymity and confidentiality were stressed. Therefore, only the members of the research team, including supervisors, would have access to information gleaned throughout the research process. Guided by the information given in the biographical questionnaire, those prospective participants who met the inclusion criteria were contacted and invited to participate in the research project. Once prospective participants agreed to participate, written informed consent (see Appendix D for consent form) was acquired and permission for their participation was obtained from their respective departmental managers. This process failed to generate an adequate sample size required for this study. Subsequently, the researchers utilised snowball sampling in that the existing sample was asked to identify further prospective participants (Terre Blanche, Durrheim, & Painter, 2006). Those identified were then contacted and asked to complete the biographical questionnaire and those who met the stipulated inclusion criteria were invited to participate. All participants were given a R100 Steers voucher to facilitate participation and as a token of gratitude for their participation.

3.2.1 Data Collection

Three training clinical psychologists and one training counselling psychologist (the present researcher) administered the test battery, which included 16 neuropsychological measures covering six functional modalities of which numbers 2 and 6 were focused on for analysis in the present study: 1) Attention & Concentration: Visual and Auditory: Stroop Test (Golden, 1978), Trail Making Test (Reitan, 1956); 2) Language: Words in One Minute: Unstructured Verbal Fluency Test (Baker, & Leland, 1967), "S"-Words-In-One-Minute: Structured Phonological Verbal Fluency Test (Benton, Hamsher, & Sivan, 1994); 3) Visual Perception: Rey Complex Figure Copy (Osterreith, 1944); 4) Verbal Memory: Digit Span Forwards and Backwards (Wechsler, 1997), Wechsler Memory Scale (WMS) Paired Associates Immediate and Delayed Recall (Wechsler, 1945); 5) Visual Memory: WMS Reproduction for Designs Immediate and Delayed Recall (Wechsler, 1945), Rey Complex Figure Delayed Recall (Osterreith, 1944) and; 6) Motor Function: Successive Finger Tapping Test (Denckla, 1973), Purdue Pegboard (Tiffin, & Asher, 1948). In addition, there were two tests for malingering, being the Rey 15-Item Memory Test (Rey, 1964) and the Test of Memory Malingering (TOMM) (Tombaugh, 1996), (see Appendix E for order of presentation of tests).

The total sample was randomly and equally divided amongst the four researchers into four sub groups of research participants. The test battery was administered, in English, to the subgroups of participants in the same order, utilising the standardised formats. Prior to the administration of the test battery, the researchers met and thoroughly ran through the standardised procedures together, further ensuring standardised administration. Participants were tested individually in the offices of the researchers, situated at Fort England Hospital and at the Rhodes University Counselling Centre, which provided a quiet environment with limited distraction which ensured optimal testing conditions. All training psychologists had been trained by and were under the instruction and supervision of an experienced clinical neuropsychologist, Professor Ann Edwards.

3.2.2 Materials

The results obtained for the following measures, which have been reviewed and described in the literature review, were isolated for analysis in this study: **1)Hand Motor Function (Non- Verbal)**: Successive Finger

Tapping Test (Denckla, 1973), Purdue Pegboard (Tiffin & Asher, 1948).**2) Language (Verbal)**: Words-In-One-Minute (Baker & Leland, 1967); "S"-Words-In-One-Minute (Benton et al., 1994). The table in appendix E displays the order of presentation of tests in the overall neuropsychological test battery, as they were administered on all test occasions. Emphasis indicates the tests that were isolated for analysis in this study, with the other tests being divided up for analysis in a series of other studies.

3.2.2.1 The Successive Finger Tapping test: Administration and scoring.

Administration and scoring as stipulated by Denckla (1973) was adhered to in this study (see Appendix F for test protocol). The Successive Finger Tapping Test consists of two trials: Preferred hand and Non-Preferred hand. The preferred hand is tested first and then the non-preferred hand.

Preferred Hand Trial.

The examinee is instructed to place both hands on the table and with their preferred hand they are instructed to touch each finger to their thumb in turn starting with their index finger. They are encouraged to do this as fast as they can until they are instructed to stop. The manoeuvre is modelled by the examiner, ensuring that the examinee is aware that each finger needs to be touched and that they should always start with the index finger never going backwards. A short practice before the initiation of the trial is admissible. The score is considered to be the time taken in seconds to perform 20 taps (5 sets of 4 taps).

Non-Preferred Hand.

The procedure described above is followed for the non-preferred hand.

3.2.2.2 The Purdue Pegboard: Administration and scoring

The Purdue Pegboard Test was administered and scored according to the standard guidelines set out in the test manual (Tiffin & Asher, 1948; see Appendix G for test protocol). The Purdue Pegboard Test consists of four trials: preferred hand trial, non-preferred hand trial and both hands trial and assemblies, however for the purposes of this study only the first three trials were administered. The preferred hand is tested first, then the non- preferred hand and finally both hands. A time limit of 30 seconds is delineated for each trial.

Preferred Hand Trial

The examinee is instructed to pick up one peg at a time with their preferred hand from the corresponding cup, for example if right hand is subjectively considered preferred hand, the pegs are picked up one at a time from the right hand cup, and placed into the right hand row, starting with the top. The examinee is allowed to put in three or four pegs for practice before the initiation of the trial. The examinee is allowed exactly 30 seconds to put in as many pegs as fast as they can. The score is considered to be the number of pegs inserted with the preferred hand in the 30 seconds period.

Non-Preferred Hand Trial

The procedure described above is followed for the non-preferred hand.

Both Hands Trial

This trial tests both hands working together. The examinee is instructed to simultaneously take a peg from the right hand cup with the right hand and a peg from the left hand cup with the left hand. The examinee then simultaneously places both pegs in the two rows of holes as fast as they can, starting with the pair of holes farthest away from the examinee. The examinee is allowed to put in three or four pairs for practice before the initiation of the trial. The examinee is allowed 30 seconds to place as many pairs of pegs as possible, using both hands, each hand picking up and placing one peg at a time. The both hands score is considered to be the number of pairs of pegs that are placed during the 30 second test period.

3.2.2.3 "S"-Words-In-One-Minute: Administration and scoring.

Administration and scoring as stipulated in Strauss et al. (2006) was adhered to (see Appendix H for test protocol). Examinees' are instructed to say as many words beginning with the phenome "S" as fast as they can. Instructions concerning admissible words are given prior to the initiation of the task. One minute is allowed for this task and should the participant discontinue before the minute is up the participant is encouraged to produce more words as fast as they can. If there is a silence of 8 seconds, the basic instruction is repeated. The score is considered to be the number of admissible words produced in one minute. Under these scoring instructions slang words and foreign words that are part of standard English language were deemed admissible however inadmissible words included proper nouns, repetitions, variations of the same word and wrong words. Additionally counting and sentences were not allowed.

3.2.2.4 Words-In-One-Minute: Administration and scoring.

Administration and scoring as stipulated by Baker & Leland (1967) were adhered to (see Appendix I for test protocol). The examinees' are instructed to say as many different, unconnected words as fast as they can. Instructions concerning admissible words are given prior to the initiation of the task. One minute is allowed for this task and should the examinee discontinue before the minute is up the participant is encouraged to produce more words as fast as they can. If there is a silence of 8 seconds, the basic instruction is repeated. The score is considered to be the number of admissible words produced in one minute. Under these scoring instructions the following words were considered to be inadmissible: proper nouns, repetitions and variations of the same word. Additionally, counting and sentences were not allowed.

3.2.3 Data Processing

The tests were scored according to the standardised format advised in the respective administrative and scoring manuals. Each intern psychologist scored, their allocated participants, full battery of tests. Rigorous measures were put in place to ensure standardisation of scoring. Firstly, scoring was thoroughly cross-checked by a co-researcher and any discrepancies noted were addressed between the two scorers, with the guidance of the Supervising Clinical Psychologist, Professor Ann Edwards. Secondly, two participant test batteries were randomly selected and rescored by a third member of the research team.

3.2.4 Data Analysis

In accordance with the research aim to obtain preliminary normative data in respect of a non-clinical sample of isiXhosa speaking, black South Africans with a relatively disadvantaged quality of education, the results of each test were analyzed using descriptive statistics. To this effect, standard deviations and means were calculated for each test and normative data tables were then delineated. The sample group was stratified into two age groups (18-29 and 30-40) and distribution of gender and level of education was controlled for between the two age groups. Independent *t*-test analyses were then conducted to investigate possible age effects. Similarly, the sample group was stratified by gender and the distribution of age and level of education was controlled for between the two gender groups. Independent *t*-test analyses were then conducted to investigate possible gender effects. An alpha level of .05 was used for all statistical tests, to establish significance of results. Descriptively, the present study preliminary normative indications, for the two age groups, for each test, were compared with available international and local normative data. The available international and local normative data were gleaned from a comprehensive review of seminal texts in neuropsychological assessment (Mitrushina et al., 2005; Strauss et al., 2006), computerised databases ("Academic Search Premier", "PsychArticles", "PsychInfo", and "Medline) and, available, largely unpublished local literature. This search for available international and local normative data was guided by the following criteria of inclusion: age range stratified in an equivalent manner to the present study, i.e., 18-29 and 30-40; study participants were healthy subjects without neurological or psychiatric conditions; the availability of reported standard deviations and means; a reported sample number for each age range; reported information regarding level of education; reported information regarding administration and scoring procedures.

4. Results

The results for each of the hand motor function tests, being the Successive Finger Tapping Test and the Purdue Pegboard, and each of the verbal fluency tests, being the "S"-Words-In-One-Minute test and the Words-In-One-Minute test, will be discussed, in turn, below. For each test, the performances of the two age groups, being 18-29 years and 30-40 years, will be compared to determine any significant differences between the age groups. Further, the performances of the two gender groups, being male and female, will be compared to determine any significant differences between the gender groups.

4.1 Successive Finger Tapping Test

4.1.1 Comparison of Successive Finger Tapping Test Performance across Two Adult Age Groups (Table 5)

The *t*-test comparisons of the two age groups are presented in table 5 below for both the preferred hand trial and non-preferred hand trial score. A significant difference in performance with the younger age group outperforming the older age group in both, the preferred (p=.027) and, non-preferred hand (p=.018) trial, can be noted. These results indicate an age effect in the direction of the younger age group performing better than the older age group on both trials of the Successive Finger Tapping test.

Table 5

***T*-Test Comparison of Successive Finger Tapping Test Performance across Two Adult Age Groups (18 – 29, 30 – 40)**

	18 – 29 years Mean education: 11.76 years			30 – 40 years Mean education: 11.69 years			
Task	***N***	**M**	**(SD)**	***N***	**M**	**(SD)**	***P***
Preferred Hand	17	5.98	0.89	16	6.79	1.11	.027
Non-Preferred Hand	17	6.2	0.98	16	7.10	1.09	.018

Note. Means (M) and Standard Deviations (SD) represent time in seconds to complete 20 taps (5 sets of 4 taps)

4.1.2 Comparison of Successive Finger Tapping Test Performance across Two Gender Groups (Table 6)

The *t*-test comparisons of the two gender groups are presented in table 6 below for both the preferred hand trial and non preferred hand trial score. No significant differences were found between the two gender groups on both trials. However, the non-preferred hand trial results, while not approaching a significant difference, reveal a slightly better performance by the female gender as compared to the male gender (p=.378). Overall, these results indicate no significant gender effect on preferred hand trial and non-preferred hand trial performance but reveal a marginal tendency for females to perform better on the non-preferred hand trial than males.

Table 6

***T*-Test Comparison of Successive Finger Tapping Test Performance, by Gender**

	Male Mean education: 11.67 years			Female Mean education: 11.76 years			
Task	***N***	**M**	**(SD)**	***N***	**M**	**(SD)**	***P***
Preferred Hand	12	6.39	1.19	21	6.36	1.03	.938
Non-Preferred Hand	12	6.86	1.10	21	6.50	1.13	.378

Note. Means (M) and Standard Deviations (SD) represent time in seconds to complete 20 taps (5 sets of 4 taps).

4.1.3 Synthesis of Successive Finger Tapping Results

A comparison of the two age groupings revealed an age effect in the direction of the younger age group outperforming the older age group on both trials of the Successive Finger Tapping test. A comparison of the two gender groupings revealed no gender effect in that there were no significant differences between the performance of the two gender groups on both trials and no consistent trends were identified.

4.2 Purdue Pegboard

4.2.1 Comparison of Purdue Pegboard Performance across Two Adult Age Groups (Table 7)

The *t*-test comparisons of the two age groups are presented in table 7 below for the preferred hand trial, non-preferred hand trial and, both hands trial, scores. No significant differences between the two age groups can be noted on all three of the trials. However, a marginal but consistent trend can be noted with the younger age group slightly outperforming the older age group on all three trails.

Table 7

***T*-Test Comparison of Purdue Pegboard Performance across Two Adult Age Groupings (18 – 29, 30 – 40)**

	18 – 29 years Mean education: 11.76 years			30 – 40 years Mean education: 11.69 years			
Task	***N***	**M**	**(SD)**	***N***	**M**	**(SD)**	***P***
Preferred Hand	17	15.53	2.10	16	15.00	1.82	.442
Non -Preferred Hand	17	14.35	2.21	16	14.00	1.67	.610
Both Hands	17	11.59	1.84	16	11.56	1.63	.966

Note. Means (M) and Standard Deviations (SD) represent number of pegs

4.2.2 Comparison of Purdue Pegboard Performance across Two Gender Groups (Table 8)

The *t*-test comparisons of the two gender groupings are presented in table 8 below, for the preferred hand trial, the non-preferred hand trial and, both hands trial, scores. With regard to the non-preferred hand trial the difference between the gender groups strongly approached significance (p=.057), with the female gender outperforming the male gender. While not approaching significance, the preferred hand trial scores reveal a slightly better performance on the part of the female gender compared to the male gender (p=.434). Finally, a significant gender difference in performance for the both hands trail is evident (p=.019), with female gender again performing better than the male gender.

Table 8

***T*-Test Comparison of Purdue Pegboard Performance, by Gender**

	Male Mean education: 11.67 years			Female Mean education: 11.76 years			
Task	***N***	**M**	**(SD)**	***N***	**M**	**(SD)**	***P***
Preferred Hand	12	14.92	1.68	21	15.48	2.09	.434
Non-Preferred Hand	12	13.33	1.83	21	14.67	1.88	.057
Both Hands	12	10.67	1.37	21	12.10	1.70	.019

Note. Means (M) and Standard Deviations (SD) represent number of pegs

4.2.3 Synthesis of Purdue Pegboard Results

A comparison of the two age groups revealed no significant differences between the age groups on all three trials. However, a marginal but consistent tendency in terms of an age effect was noted, in that the younger age group slightly outperformed the older age group on all three trials. A comparison of the two gender groupings revealed a gender effect in the direction of females outperforming males, in that the difference in performance between the two gender groups reached significance in the both hands trial and strongly approached significance in the non-preferred hand trial. This was further supported by a tendency on the preferred hand trial towards a gender effect in the same direction.

4.2.4 Overall Synthesis of Results of Hand Motor Function Tests

With respect to both tests of hand motor function (Successive Finger Tapping test and Purdue Pegboard), overall consistency in terms of age effects in the direction of the younger age group outperforming the older age group, was noted. Younger age group superiority reached significance on both trials of the Successive Finger Tapping test and a marginal but consistent tendency of younger age group superiority was noted across all three trials of the Purdue Pegboard. No significant gender effects were noted on the Successive Finger Tapping test however the results of the Purdue Pegboard test revealed a gender effect in the direction of females outperforming males.

4.3 "S"-Words-In-One-Minute

4.3.1 Comparison of "S"-Words-In-One-Minute Performance across Two Adult Age Groups (Table 9)

The *t*-test comparisons of the two age groups are presented in table 9 below. The presented results reveal no significant difference in performance between the two age groups (p=.230). However, while not approaching significance a slightly better performance of the younger group compared to the older group can be noted.

Table 9

***T*-Test Comparison of "S"-Words-In-One-Minute Performance across Two Adult Age Groups (18 – 29, 30 – 40)**

	18 – 29 years			30 – 40 years			
	Mean education: 11.76 years			Mean education: 11.69 years			
Task	***N***	**M**	**(SD)**	***N***	**M**	**(SD)**	***P***
	17	11.53	2.85	16	10.19	3.43	.230

Note. Means (M) and Standard Deviations (SD) represent number of words

4.3.2 Comparison of "S"-Words-In-One-Minute Performance across Two Gender Groups (Table 10)

The *t*-test comparisons of the two gender groups are presented in table 10 below. There is no significant difference in performance between the two gender groups (p=.863).

Table 10

***T*-Test Comparison of "S"-Words-In-One-Minute Test Performance, by Gender**

	Male			Female			
	Mean education: 11.67 years			Mean education: 11.76 years			
Task	***N***	**M**	**(SD)**	***N***	**M**	**(SD)**	***P***
	12	10.75	2.96	21	10.95	3.35	.863

Note. Means (M) and Standard Deviations (SD) represent number of words

4.3.3 Synthesis of "S"-Words-In-One-Minute Results

There were no significant differences in performance between the two age groups, however a small tendency in terms of an age effect was noted in that the younger age group performed slightly better than older age group. There were no significant differences between the performances of the two gender groups.

4.4 Words-In-One-Minute

4.4.1 Comparison of Words-In-One-Minute Performance across Two Adult Age Groups (Table 11)

The *t*-test comparisons of the two age groups are presented in table 11 below. The presented results reveal no significant difference in performance between the two age groups (p=.500). However, while not approaching significance a slightly better performance of the younger group compared to the older group can be noted.

Table 11

***T*-Test Comparison of Words-In-One-Minute Test Performance across Two Adult Age Groupings (18 – 29, 30 – 40)**

	18 – 29 years Mean education: 11.76 years			30 – 40 years Mean education: 11.69 years			
Task	***N***	**M**	**(SD)**	***N***	**M**	**(SD)**	***P***
	17	21.71	8.18	16	19.88	7.145	.500

Note. Means (M) and Standard Deviations (SD) represent number of words

4.4.2 Comparison of Words-In-One-Minute Performance across Two Gender Groups (Table 12)

The *t*-test comparisons of the two gender groups are presented in table 12 below. The presented results reveal no significant difference between the performances of the two gender groups.

Table 12

***T*-Test Comparison of Words-In-One-Minute Test Performance, by Gender**

	Male			Female			
	Mean education: 11.67 years			Mean education: 11.76 years			
Task	***N***	**M**	**(SD)**	***N***	**M**	**(SD)**	***P***
	12	21.42	6.47	21	20.48	8.36	.739

Note. Means (M) and Standard Deviations (SD) represent number of words

4.4.3 Synthesis of Words-In-One-Minute Results

There were no significant differences in performance between the two age groups; however a small tendency in terms of an age effect was noted in that the younger age group performed slightly better than older age group. There were no significant differences between the performances of the two gender groups.

4.4.4 Overall Synthesis of Results for the Verbal Fluency Tests

With respect to both tests of verbal fluency ("S"-Words-In-One-Minute and Words-In-One-Minute), there were no significant differences in performance between the two age groups, however across both tests there was a consistent small tendency noted in the direction of the younger age group outperforming the older age group. For both tests of verbal fluency there were no significant differences between the performances of the two gender groups.

5. Discussion

The aim of this research study was to obtain preliminary normative data (means and standard deviations) for two tests of hand motor function, being Successive Finger Tapping test and Purdue Pegboard and two tests of verbal fluency, being "S"-Words-In-One-Minute and Words-In-One-Minute, administered in English on a population of black, South African, isiXhosa speaking people who attended a former DET type school in the Eastern Cape, with a grade 11 or 12 education level and age range of 18-40. In addition, the study aimed to investigate any differences between younger and older age (18-29 versus 30-40) and, gender performance. A discussion of the present study findings regarding age and gender effects, with respect to each of the tests, is presented below in section 5.1. This discussion of within study indications of age and gender effects is guided by a set of hypotheses (see section 2.6) as derived from and informed by the literature review. Further, the normative indications garnered in the present study were compared with available international and local normative data sets. The findings regarding this descriptive comparison will be discussed, in the context of level and quality of education, in section 5.2 below.

5.1 Within Study Indications: An Examination of the Effects of Age and Gender

5.1.1 Age Indications: Tests of Hand Motor Function

With respect to age effects, it was hypothesized that, for both tests of hand motor function, there would be no significant differences between the two age groups (18-29 and 30-40). The results for the Successive Finger tapping test are not in support of this hypothesis and seem to be contrary to available international data trends for age effects on other finger tapping measures, such as the Finger Tapping Test (Rietan, 1969). As mentioned, in the literature review, the point at which slowing becomes most prominent for the Successive Finger Tapping test has not been confirmed however available international literature on other finger tapping measures, such as the Finger Tapping Test, indicate that age related slowing typically only becomes most prominent from the 5th decade onwards (Lezak et al., 2004). The results from the present study reveal a significant difference in performance in the direction of the younger age group outperforming the older age group on both preferred (p=.027) and non-preferred trials (p=.018) of the Successive Finger Tapping test. It is therefore, with caution, that these results are seen to reflect an earlier than anticipated age effect on Successive Finger Tapping test performance.

The results for the Purdue Pegboard are however in support of the hypothesis and are commensurate with international data trends that highlight no significant age effects on the Purdue Pegboard for the age range

18-40 years. Investigations into age related change in performance on the Purdue Pegboard reveals slowing with advancing age (Strauss et al., 2006), with decline only expected beyond the age range, 18-40 years, as demonstrated in the present study. With respect to all three trials of the Purdue Pegboard test, no significant differences in performance between the two age groups were noted. However, a marginal but consistent tendency in terms of an age effect was noted with the younger age group slightly outperforming the older age group on all three trails. This serves to suggest the beginnings of an early age effect in the direction anticipated.

5.1.2 Age Indications: Tests of Verbal Fluency

The literature review identified that structured phonological verbal fluency measures, like "S"-Words-In-One-Minute are sensitive to the effect of age, with mild decline only anticipated from 40 years onwards. This decline only becomes most significant at more advanced ages (Loonstra et al., 2001; Mitrushina et al, 2005; Strauss et al., 2006). Due to the lack of information regarding age effects on unstructured verbal fluency measures like Words-In-One-Minute, at what point, peak performance can be expected or, age related decline becomes most prominent, is unclear. In the context of this dearth of comparative demographic indications for unstructured verbal fluency, broad based parallels to structured phonological verbal fluency were assumed with caution and it was hypothesized that there would be no significant age effects on either "S"-Words-In-One-Minute or Words-In-One-Minute, since the age range of focus in the present study is that of 18-40.

The results, of the present study, are commensurate with the trends elucidated in the literature review and support the proposed hypotheses, in that, no significant differences between the two age groups were noted on either the "S"-Words-In-One-Minute (p=.230) or Words-In-One-Minute (p=.500). However, albeit non-significant a marginal but consistent trend was noted, in that, with respect to both measures, the younger age group slightly outperformed the older age group. This suggests the beginnings of an early age effect in the direction anticipated.

5.1.3 Synthesis of Age Indications: Hand Motor Function Tests and Verbal Fluency Tests

Overall, the examination of within study age indications, revealed significant and earlier then anticipated age effects with respect to the Successive Finger Tapping test and a tendency towards slowing at an earlier age stage, than proposed by the available literature, for the Purdue Pegboard, "S"-Words-In-One-Minute and Words-In-One-Minute. For the same sample, a similar earlier than anticipated age effect on Trail Making performance was also noted (Andrews, 2008). A possible explanation, for the consistent tendency towards slowing at an earlier age stage, than proposed by the available literature, for both tests of hand motor function, both tests of verbal fluency and Trail Making, is seated in the tenets of Brain Reserve Capacity (BRC) theory (Satz, 1993) and Cognitive Reserve (CR) theory (Stern, 2002). According to proponents of BRC theory and CR theory, individuals with relatively disadvantaged education in terms of both quality and level of education, such as those individuals represented in the present study, are more at risk to functional impairment associated with the ageing process and more vulnerable to revealing age related decline in cognitive test performance, at an earlier age stage, than individuals with a higher level and quality of education. Further, the hypothesis of task challenge, proposed by Satz (1993) serves to explicate why between the two tests of hand motor function, the age related decline in test performance is more prominent for Successive Finger Tapping test than for the Purdue Pegboard. The sequential nature of the Successive Finger Tapping test demands left to right tapping, always beginning with the index finger, successful performance requires the participant to keep the task structure in their mind therefore increasing task challenge. Whereas arguably, the Purdue Pegboard presents relatively less task challenge, as the board represents a concrete stimulus of the task structure and therefore the subject does not have to hold the task structure purely in their mind, and nor is there a relatively more complex sequential task demand. According to Satz (1993), a pathological process such as age related cognitive decline, may remain undetected until an appropriate assessment challenge is introduced.

5.1.4 Gender indications: Hand Motor Function Tests

With respect to gender effects on hand motor function tests, no information is available regarding gender effects on Successive Finger Tapping test performance, amongst adult populations. However, international data trends elucidate gender effects, in the direction of males outperforming females for other finger tapping measures such as the Finger Tapping Test (Bornstein, 1985; Mitrushina et al., 2005; Reitan, 1969; Ruff & Parker, 1993; Yeudall et al., 1987), and, in the direction of females outperforming males for the Purdue

Pegboard (Strauss et al., 2006). The trend of male superiority for finger taping measures is understood to correlate with general male superiority in speeded tasks. A positive association between female gender and better performance on the Purdue Pegboard test speaks to female superiority in tasks of fine motor dexterity and is argued to be confounded by gender differences in finger size (Peters et al., 1990).Due to the lack of information regarding direction of gender effects on the Successive Finger Tapping test, a hypothesis with respect to gender effects on this test was not stated. However, it was hypothesized that there would be significant gender effects in the direction of females outperforming males for the Purdue Pegboard.

The results of the Successive Finger Tapping test revealed no significant differences between the gender groups for both the preferred hand ($p= .938$) and non-preferred hand trial ($p=.378$), however for both trials marginally poorer performance was noted for the male gender group. The absence of significant gender effects on Successive Finger Tapping performance, in the present study, is contrary to international data trends of other finger tapping measures (Finger Tapping Test; Rietan, 1969) that highlight gender effects in the direction of males outperforming females. Regarding gender effects on Purdue Pegboard performance, the results of the present study support the hypothesis posed and, reveal a significant difference on the both hands trial ($p=.019$), with the difference strongly approaching significance in the non-preferred hand trial ($p=.057$), in the direction of the female gender outperforming the male gender. Further, although not approaching significance the female gender is noted to perform slightly better in the preferred hand trial ($p=.434$). These results are commensurate with international data trends that highlight gender effects in the same direction and serve to confirm that preferential female gender effects are a robust feature of influence on this test.

5.1.5 Gender indications: Verbal Fluency Tests

Varying results, regarding the effect of gender on structured phonological verbal fluency measures, like "S"-Words-In-One-Minute are presented in the literature. Some studies indicate no differences between male and female performance (Tombaugh, et al. 1999; Yeudall et al., 1986) and others indicate a marginal difference in performance in the direction of females outperforming males (Loonstra et al. 2001). However, no local or international literature regarding gender effects on unstructured verbal fluency measures, like Words-In-One-Minute, could be identified. Therefore, it was with caution that a parallel gender effect to that of structured phonological verbal fluency was assumed. Based on the available literature it was hypothesized that there would be no significant gender effects on "S"-Words-In-One-Minute or Words-In-One-Minute. The results for "S"-Words-In-One-Minute are in support of the hypothesis and are commensurate with the findings of

Tombaugh, et al. (1999) and Yeudall et al. (1986) in that there were no significant differences in performance between the two gender groups (p=.863). Similarly, the results for Words-In-One-Minute are also in support of the hypothesis in that there were no significant differences in performance between the two gender groups (p=.739).

5.1.6 Synthesis of Gender Indications: Hand Motor Function Tests and Verbal Fluency Tests

Overall, the examination of within study gender indications revealed no significant gender effects for either trial of the Successive Finger Tapping test, "S"-Words-In-One-Minute or Words-In-One-Minute but did reveal gender effects for the Purdue Pegboard. The absence of significant gender effects on Successive Finger Tapping performance, in the present study, is contrary to international data trends for other finger tapping measures (Finger Tapping Test; Rietan, 1969) that are based on samples with advantaged education and highlight gender effects in the direction of males outperforming females. The lack of male superiority in Successive Finger Tapping performance, in the present study, could be explicable in terms of BRC theory and seen as a result of the cumulative effect of vulnerability factors, being male gender membership, a low level of education and poor quality of education (Satz, 1993). Essentially, the male individuals of the present study sample are at a higher risk of revealing slowing due to the aggregate effect of the vulnerability factors of male gender membership, low levels of education and poor quality of education. Further research is necessary to ascertain if this finding of lack of male superiority in Successive Finger Tapping would be replicated. The presence of gender effects on the Purdue Pegboard in the direction of females outperforming males is however commensurate with international data trends that highlight gender effects in the same direction and, serves to confirm that preferential female gender effects are a robust feature of influence on the Purdue Pegboard test. Finally, the absence of gender effects, across the two tests of verbal fluency, "S"-Words-In-One-Minute and Words-In-One-Minute, suggests that gender is *not* a significant feature of influence on structured *or* unstructured verbal fluency measures.

5.2 Comparisons of Present Study and Other Available Normative Indications

Descriptively, the preliminary normative indications garnered in the present study for the two tests of hand motor function and two tests of verbal fluency, will be compared with available international and local normative data. This descriptive comparison will be discussed in the context of level and quality of education. As indicated in the method section, a comprehensive review of seminal texts in neuropsychological assessment (Mitrushina et al. , 2005; Strauss et al., 2006), and a search of computerised data bases ("Academic Search Premier", "PsycArticles", "PsycInfo", and "Medline") was conducted to identify articles of normative data, for each test, with the following criteria of inclusion: age range stratified in an equivalent manner to the present study, i.e., 18-29 and 30-40; study participants were healthy subjects without neurological or psychiatric conditions; the availability of reported standard deviations and means; a reported sample number for each age range; reported information regarding level of education; reported information regarding administration and scoring procedures.

5.2.1 Comparison of Present Study Results and Other Available Normative Indications for Tests of Hand Motor Function

5.2.1.1 Successive Finger Tapping test.

Normative data, for the Successive Finger Tapping test are presented below (table 13) and include small, miscellaneous, largely unpublished, collections of *local* normative data. The extensive review revealed no *international* normative data pertaining to the age group 18-40 years. International normative data sets are however available for children between the ages 5-14 and include normative data from the original standardisation of the test (Denckla, 1973), and a set of miscellaneous normative data presented in a published research study (Larson et al., 2007). Research findings, highlighting significant improvements in timed motor performance with age, caution against the use of normative data sets available for children for adult populations, especially with regard to those motor tasks that rely on patterned movements such as the Successive Finger Tapping test (Larson et al., 2007; Largo et al. as cited in Larson et al., 2007). Therefore, those normative data sets for age groups younger than the age band considered in the present study were not included. The age range available for comparison in the Shuttleworth- Jordan & Bode (1992) is 20-39 and for descriptive comparison purposes the mean performance, of the present study, for the age range 18-40, was calculated by adding the mean scores of the younger age group to the older age group and dividing by two. This was done for both the preferred hand and non-preferred hand trial.

Education has traditionally been considered to impart negligible influence on non-verbal tests of motor function. However, recent cross-cultural research (Ardila & Morena, 2001; Rosselli & Ardilla, 2003) has highlighted that even non-verbal tests of motor function are influenced by cultural and educational variables, especially those measures that are time restricted or rely on speed of performance such as, Successive Finger Tapping test. Bornstein (1985) acknowledges that finger tapping performance tends to improve with more years of education and a review by Mitrushina et al. (2005) reports that there is considerable consistency in the data across different studies of decreasing tapping rate as a function of low levels of education. Similarly, Rosselli et al. (1990) found level of education to be a significant variable predicting performance on praxic ability tests such as those requiring finger alternating movements. Shuttleworth-Edwards et al. (2004) WAIS III research serves to highlight the negative impact of disadvantaged education on cognitive test performance. It stands to reason that normative studies based on samples with higher levels of education and advantaged education are likely to overestimate Successive Finger Tapping performance of subjects with a lower level of education and disadvantaged education. All those comparable local normative data sets, presented in table 14 below, are based on samples with a higher level of education. Additionally, all the comparison samples have advantaged education relative to the present study sample. It was hypothesized that the lower level of education and disadvantaged education of the present study sample would negatively impact Successive Finger Tapping test performance and result in poorer scores relative to the advantaged education sample scores.

A comparison of present study sample scores to the scores presented by Shuttleworth-Jordan (1992a) and Ancer (1999) reveals marginal but consistent decrement in the direction of poorer scores for the present study sample; present study sample scores fall within 1 standard deviation *below* the scores of these comparative normative data sets. However, in comparison to the Shuttleworth-Jordan & Bode (1992) sample scores, the present study sample scores are notably depressed and fall approximately 2 standard deviations (beyond 1 standard deviation considered as impairment) *below*. Overall, this descriptive comparison, across all ages and for both the preferred hand and non-preferred hand trail scores, reveals consistent decrement in the direction of poorer scores for the present study sample.

Table 13

Successive Finger Tapping Test (Denckla, 1973): A Comparison of Present Study Results and Other available Normative Indications for Two Adult Age Groupings (18 – 29, 30 – 40)

Study	Sample *	N	Age Group	Education in years	Preferred Hand M (SD)	Non- Preferred Hand M (SD)
Shuttleworth Jordan (1992a)	Non-clinical sample of white, English first language speaking, South African undergraduate and graduate psychology students with advantaged education. Largely right handed.	27	18-25	>12	4.85 (1.23)	5.07 (1.17)
	Non-clinical sample of black, African first language speaking undergraduate and graduate psychology students with advantaged education. Largely right handed.	18	18-25	>12	5.70 (1.34)	5.79 (1.48)
	Non-clinical sample of white, English first language speaking South African undergraduate and graduate psychology students with advantaged education. Largely right handed.	14	40-49	>12	5.97 (1.41)	5.75(1.36)
Shuttleworth Jordan & Bode (1992)	Non-clinical sample of white, English first language speaking South Africans with relatively advantaged education. Largely right handed.	23	20-39 29.39(6.45)	15.91(1.90)	5.17 (0.68)	5.19 (0.70)
		21	40-59 47.76(5.76)	15.10(2.79)	5.66 (1.07)	5.45 (0.92)
Ancer, 1999	Non-clinical sample of predominately white, English first language speaking South African professional non-contact sportsmen with relatively advantaged education. Largely right handed.	21	27.1	13.7	5.86 (0.77)	5.75(0.68)
Present Study	Non-clinical sample of black, isiXhosa first language speaking South Africans. Unskilled workers with relatively disadvantaged education. Largely right handed.	17	18-29	11.76(0.44)	5.98 (0.89)	6.20 (0.98)
		16	30-40	11.69(0.48)	6.79 (1.11)	7.10 (1.09)

*Unless otherwise specified the samples presented are of mixed male and female gender

5.2.1.2 **Purdue Pegboard test.**

That set of *international* normative data deemed appropriate for descriptive comparison is presented below (Table 14). The extensive literature search revealed no published *local* normative data for the Purdue Pegboard test for the age range 18-40 years. As stated in the literature review there seems to be empathic agreement across the international studies reviewed that education is unrelated to performance on the Purdue Pegboard test. However, the research studies supporting such a contention are based on samples with high levels of education. Recent cross-cultural research (Ardila & Morena 2001; Rosselli & Ardilla, 2003) has highlighted that even non-verbal tests of motor function are influenced by cultural and educational variables, especially those measures that are time restricted and rely on speed of performance such as, the Purdue Pegboard test. However, in these research studies, the effect of education on non-verbal tests of motor function was evident for samples with much lower levels of education than that of the present study sample and there do not seem to be any *published* studies looking at the effect of education on samples with equivalent levels of education to the present study sample It was therefore hypothesized that the lower level of education and relatively disadvantaged education of the present study sample would serve to negatively impact Purdue Pegboard performance and be reflected in poorer scores relative to the advantaged sample of the comparative normative data study.

Across all age groups, the preferred hand, non-preferred hand and both hand trial scores of the present study sample, fall mostly within 1 standard deviation and not more than 2 standard deviations *below* the advantaged sample scores. Overall, a marginal but consistent decrement, in the direction of poorer scores for the present study sample, is evident.

Table 14

Purdue Pegboard (Tiffin & Ahser, 1948): A Comparison of Present Study Results and Other Available Normative Indications for two Adult Age Groups

Study	Sample*	N	Age Group	Education in years	Preferred Hand M (SD)	Non- Preferred Hand M (SD)	Both Hands M (SD)
Yeudall, Fromm, Reddon, and Stefanyk (1986)	Non-clinical sample of predominately white, English fist language Canadian residents with relatively advantaged education. Largely right handed	73	21-25 22.70(1.40)	14.82 (1.88)	16.04 (2.11)	15.49 (1.91)	13.36 (1.42)
		42	31-40 34.38(2.46)	16.50 (3.11)	15.57 (1.68)	15.31 (1.81)	12.69 (1.55)
Present Study	Non-clinical sample of black, isiXhosa first language speaking South Africans. Unskilled workers with relatively disadvantaged education. Largely right handed.	17	18-29	11.76 (0.44)	15.53 (2.10)	14.35 (2.21)	11.59 (1.84)
		16	30-40	11.69 (0.48)	15.00 (1.82)	14.00 (1.67)	11.56 (1.63)

*Unless otherwise specified the samples presented are of mixed male and female gender

5.2.1.3 Synthesis of descriptive comparison findings- Tests of hand motor function.

Overall, the descriptive comparison of present study sample scores to comparative normative data sets, for both tests of hand motor function, reveals marginal but consistent decrement in the direction of poorer scores for the present study sample. Scores for the present sample, across all age groups and for every trial within the hand motor tests, fall mostly within 1 standard deviation and not more than 2 standard deviations, *below* the scores of the English first language, advantaged education sample groups.

5.2.2 Comparison of Present Study Results and Other Available Normative Indications for Tests of Verbal Fluency

5.2.2.1 "S"-Words-In-One-Minute.

Collated normative data, for "S"-Words-In-One-Minute, is presented in table 15 below and includes those published international normative indications suitable for comparison and, small miscellaneous, largely unpublished, collections of local normative data. As was explicated in the literature review, higher rates of word generation are associated with higher education levels (Ardila et al., 2000; Gladsjo et al. as cited in Mitrushina et a.l, 2005; Loonstra et al., 2001; Tombaugh et al., 1999; Troyer, 2000). Those aggregate statistics of FAS totals by education provided by Loonstra et al. (2001) indicate better performance by those with an education level beyond 12 years. Therefore, normative indications for samples with a high level of education and advantaged education are likely to overestimate expected performance for individuals with lower levels and quality of education. The education levels, of all of the comparative samples, are over 12 years. It was therefore hypothesized that, in the present study, quality of education and lower education level would negatively affect test performance and result in depressed scores in comparison to the available data for advantaged education groups.

The hypothesis is supported by the present study results in that the effect of level and quality of education can be seen to combine to negatively influence "S"-Words-In-One-Minute test results in the direction of poorer scores for the present study participants when compared to the scores of the English first language participants with advantaged education in terms of level and quality. A comparison of present study sample scores to that of the *English first language* speaking samples with *advantaged education* and a *higher level of education* (12-17 years; Ancer, 1999; Ferrett et al., 2010 Yeudall et al., 1986) reveals notably poorer performance in the direction of poorer scores for the present study sample; scores fall within 2 standard deviations below (beyond 1 standard deviation considered impairment). A comparison of the present study sample scores to that of the *English first language* speaking sample with *disadvantaged education* but a *higher level of education* reveals a similar tendency of depressed scores in the direction of poorer scores for the present study sample.

Table 15

"S"-Words-In-One-Minute (Benton et al., 1994): A Comparison of Present Study Results and Other Available Normative Indications for Two Adult Age Groupings (18 – 29, 30 – 40)

Study	Sample*	N	Age Group	Language	Quality of Education	Education in years	"S" Words in a Minute
Yuedall, Fromm, Reddon, and Stephanyk, 1986	Non-clinical sample of predominately white, English fist language Canadian residents with relatively advantaged education.	73	21-25 22.70(1.40)	English	Advantaged	14.82 (1.88)	16.63 (4.97)
		42	31-40 34.38(2.46)	English	Advantaged	16.50 (3.11)	18.10 (4.89)
Ancer, 1999	Non-clinical sample of predominately white, English first language speaking South African professional non-contact sportsmen with relatively advantaged education.	21	27.1	English	Advantaged	13.7	17.10 (5.10)
Ferrett, 2010	Non-clinical sample of predominately white, English first language speaking South African learners garnered from Western Cape schools.	163	18-25	English	Advantaged	12-17	17.02 (4.18)
			18-25		Disadvantaged	12-17	13.83 (3.06)
Present Study	Non-clinical sample of black, isiXhosa first language speaking South Africans. Unskilled workers with relatively disadvantaged education	17	18-29	isiXhosa[1]	Disadvantaged	11.76(0.44)	11.53 (2.85)
		16	30-40			11.69(0.48)	10.19 (3.43)

*Unless otherwise specified the samples presented are of mixed male and female gender

5.2.2.2 <u>Words-In-One-Minute.</u>

Due to the fact that the test is seldom used, in international settings, for adult populations, as evidenced by its exclusion from those seminal texts in neuropsychological assessment (Lezak et. al, 2004; Mitrushina et al., 2005; Strauss et al., 2006), well stratified miscellaneous norms for this test of unstructured verbal fluency do not seem to be available internationally. Therefore, only small, miscellaneous, largely unpublished, collections of local normative data are available for comparison. This normative data is presented in table 16 below. Higher rates of word generation are associated with higher levels of education (Ardila et al., 2000; Gladsjo et al. as cited in Mitrushina et al, 2005; Loonstra et al., 2001; Tombaugh et al., 1999; Troyer, 2000). The education levels, of the norm studies reviewed and deemed appropriate for comparison to the present study, all have a higher education level than the present study sample. Similarly, all of the studies utilised samples with advantaged education. Therefore, normative indications from these studies are likely to overestimate expected performance for individuals with lower levels and quality of education. It is therefore hypothesized that, in the present study, the aggregate effect of quality of education and lower education level will negatively effect test performance and result in depressed scores in comparison to the available data for advantaged education samples. The scores garnered in the present study are in support of this hypothesis, in that, they are significantly depressed and the poorest of those available for comparison. The present study scores fall within 3 standard deviations below the scores of the English first language advantaged groups. Even when compared to the other African first language speaking participants of the Shuttleworth-Jordan (1992b) study, the scores of the present study participants are significantly depressed (within 2 standard deviations below; beyond one standard deviation considered impaired).

Table 16

Words-In-One-Minute (Baker & Leland, 1967): A Comparison of Present Study Results and Other Available Normative Indications for Two Adult Age Groupings (18 – 29, 30 – 40)

Study	Sample*	N	Age Group	Education in years	Words-in-One-Minute M(SD)
UCT; Child Guidance Clinic, 1956.	Collected in the 1950's at the Child Guidance clinic which serviced a white English speaking community. No further demographic information available.		15		41
Shuttleworth-Jordan, 1992b	Non-clinical sample of white, English first language speaking South African undergraduate and graduate psychology students with relatively advantaged education.	16	18-25	University Students >12	49.5 (10.22)
	Non-clinical sample of black, African first language speaking undergraduate and graduate psychology students with relatively advantaged education.	15	18-25	University Students >12	42.73 (12.03)
	Non-clinical sample of white, English first language speaking South African undergraduate and graduate psychology students with relatively advantaged education.	16	40-49	University Students >12	50.06 (12.09)
Ancer, 1999	Non-clinical sample of predominately white, English first language speaking South African professional non-contact sportsmen with relatively advantaged education.	21	27.1	13.7	39.48 (7.14)
Present Study	Non-clinical sample of black, isiXhosa first language speaking South Africans. Unskilled workers with relatively disadvantaged education	17	18-29	11.76(0.44)	21.71(8.18)
		16	30-40	11.69(0.48)	19.88 (7.15)

*Unless otherwise specified the samples presented are of mixed male and female gender

5.2.2.3 <u>Synthesis of descriptive comparison findings- Tests of verbal fluency.</u>

Overall, the descriptive comparison of present study sample scores to comparative normative data sets, for both tests of verbal fluency, revealed consistent decrement in the direction of poorer scores for the present study sample. Present study sample scores for each of the verbal fluency tests, across all age groups, fall mostly within 2 and 3 standard deviations *below* the scores of the English first language, advantaged education sample groups and within 2 standard deviations *below* the scores of the African first language, advantaged education sample groups. This fall off is greater for the unstructured verbal fluency test, Words-In-One-Minute, than for the structured phonological verbal fluency test, "S"-In-One-Minute, in that, Words-In-One-Minute scores fall within 3 standard deviations *below* the scores of the advantaged education sample groups. This dissociation could be understood to be a reflection of the varying levels of structure each test provides, in that, the Words-In-One-Minute test offers the least structure for generating strategies in the search for words, thereby calling upon frontal lobe abstraction abilities more than the structured verbal fluency task and by design presents as a more challenging task (Lezak et al., 2004). Further investigation is necessary to ascertain if this trend would be replicated.

5.3 <u>Overall Synthesis of Findings</u>

In summation, an examination of within study age indications, revealed significant and earlier than anticipated age effects on both the preferred hand and non-preferred trials of the Successive Finger Tapping test but no significant age effects on, any of the trials of the Purdue Pegboard test, "S"-Words-In-One-Minute or Words-In-One-Minute. However, a marginal but consistent tendency towards slowing at an earlier age stage, than proposed by the available literature, was noted for the Purdue Pegboard, "S"-Words-In-One-Minute and Words-In-One-Minute. Essentially, both tests of hand motor function and both tests of verbal fluency revealed a consistent tendency toward slowing at an earlier age stage than documented in the literature. For the same sample, a similar earlier than anticipated age effect on Trail Making performance was also noted (Andrews, 2008). This finding is consistent with the tenets of BRC theory (Satz, 1993) and CR theory (Stern, 2002) and highlights how individuals with the demographic characteristics of the present study sample i.e. with relatively low levels of education and poor quality of education, are more vulnerable to revealing slowing at an earlier age stage than individuals with a higher level of education and better quality education.

With respect to within study gender indications, there were no significant gender effects, on either the preferred hand or non-preferred hand trials of the Successive Finger Tapping test, "S"-Words-In-One-Minute or Words-In-One-Minute. However, as hypothesized, there were gender effects on the Purdue Pegboard, in that, there was one significant gender effect in the direction of females outperforming males for the both hands trial and a result that strongly approached significance, in the same direction, for the non-preferred hand trial. In addition, although not approaching significance, the female gender was again noted to perform slightly better in the preferred hand trial. These results are commensurate with international data trends that highlight gender effects in the same direction and serve to confirm that preferential female gender effects are a robust feature of influence on the Purdue Pegboard test.

Finally, as hypothesized, for both tests of hand motor function being, the Successive Finger Tapping test and Purdue Pegboard and, both tests of verbal fluency being, "S"-Words-In-One-Minute and Words-In-One-Minute, a descriptive comparison of the present study results to available international and local normative data revealed a lowering of performance, across all age groups, for present study participants. Present study sample scores, across all age groups and for every trial within the hand motor tests, fall mostly within 1 standard deviation and not more than 2 standard deviations, *below* the scores of the English first language, advantaged education sample groups. Similarly, present study sample scores for each of the verbal fluency tests, across all age groups, fall mostly within 2 and 3 standard deviations *below* the scores of the English first language, advantaged education sample groups and within two standard deviations *below* the scores of the African first language, advantaged education sample groups. The participants of the present study have the lowest level of education and relatively disadvantaged education as compared to that of the participants in the other studies and the consistent decrement in comparison with advantaged education sample groups, serves to support the hypothesis that the educational variables of level and quality of education would serve to negatively impact performance on not only verbal but also non-verbal neuropsychological tests. Therefore, those available normative indications based on samples with a high level of education and advantaged education are likely to overestimate expected performance for individuals with the demographic characteristics of the present study sample, resulting in the possibility of these individuals being misclassified as impaired.

Essentially, the findings of the present study are in support of, literature that highlights the potent effect of educational variables on verbal neuropsychological test performance *and*, recent cross-cultural research indications that have highlighted the influence of educational variables on non-verbal neuropsychological test performance. The clinical implication of this is that non-verbal tests are not protected from the deleterious effect of relatively low levels and, poor quality, of education and should not necessarily be considered more appropriate than verbal tests for use with populations from diverse cultures and different educational experiences. Similarly, demographically specific normative data sets should be considered for *both* verbal and non-verbal neuropsychological tests.

6. Evaluation and Recommendations for Future Research

6.1 Critical Evaluation

A critical evaluation of the validity of findings involves a review of sample size and sample recruitment procedures. Sample size is important to note due to the fact that results yielded from a small sample may not be representative of a broader population but may reflect characteristics unique to the sample. However, it is argued that findings based on well stratified albeit small samples provide robust data which have relevance for the particular population represented by the sample (Mitrushina et al., 2005). The sample group utilised in this study can be considered as well-defined and well-stratified, in that it is stratified by, age, first language spoken, level of education, quality of education, area of residence and nationality. With respect to recruitment procedures, the participants were drawn from a specific area in the Eastern Cape. It is this specificity of the geographical area that may limit the wider applicability and generalisabilty of the findings. Further, all participants spoke isiXhosa as their first language, an indigenous language that represents only one in nine of the official languages. Similarly, the participants of this study where recruited on the basis of grade 11 and 12 education level, many South Africans however achieve much lower levels of education. Regarding the wider applicability of the preliminary normative indications, the sample group recruited for this study does not represent the range of educational disparities that exist in the South African context, with respect to DET type schools. More specifically the geographic area from which the sample was drawn has been shown to have particularly poor quality of education, even when compared to similar DET type schools in other provinces (Matomela, 2008).

The results from this study provide norms for two verbal fluency tests and two hand motor tests that have enjoyed widespread experimental and clinical usage but have not been adequately normed for linguistically, culturally and educationally diverse populations. Previous norms for these tests have been restricted to age or educational level range, by including the demographic variables of quality of education and second language linguistic ability, the present set of norms represent a substantial improvement over those previously available. Whilst this study has its limitations its contribution to the South African research milieu can not be understated. The data from the present study should be viewed as an initial step in the development of an adequate demographically sensitive normative data base within South Africa. Development of such a normative data base will enhance clinical application of neuropsychological test procedures within South Africa.

6.2 Recommendations for Future Research

In order to validate the findings of this study and, increase their utility in clinical practice, future research endeavours are necessary. More research studies with larger sample groups and encompassing wider disparities in level and quality of education are needed. Specifically, the sample groups should include black people that have received former DET type education from other provinces in South Africa, who have achieved lower education levels than Grade 11 and Grade 12 and who speak other indigenous South African languages. Doing so would provide comparable findings and would allow for an assessment of whether the findings and preliminary normative indications can be generalised for use on similar populations in other parts of the country.

Due to the documented disparities in quality of education even within the former DET type school system it may be necessary to further investigate and operationalise a method of ascertaining quality of education on an individual level. Similarly, the classification of disadvantaged education according to schooling groups may not necessarily encompass all those educational factors, such as reading level that may contribute to depressed scores. It is argued that a direct measurement of reading level may be a particularly sensitive alternative operationalisation of quality of education. Further empirical study is recommended to firmly establish a relationship between depressed reading levels and depressed test scores. In this way a more accurate estimation of quality of education which takes into account individual differences that cannot be accounted for when quality of education is operationalised according to schooling groups.

Potentially valuable future research endeavours with regards to hand motor function tests and verbal fluency tests will now be discussed. With regard to the hand motor function tests, further research regarding the specific clinical utility of the Successive Finger Tapping test (Denckla, 1973) for use on adult populations is necessary. With regard to the verbal fluency tests, the present study provides the norm scores for the number of words generated but does not include information regarding the behavioural components that determine fluency performance and in effect the cognitive processes underlying fluency performance (Troyer, 2000). These behavioural components are identified as clustering and switching. Good performance on fluency tasks involves generating words in a subcategory and switching to a different category when it has been exhausted. Measures of clustering and switching provide useful information about the cognitive processes during performance on verbal fluency tasks, and provide information for differential diagnosis. To increase the usefulness of the verbal fluency indices in clinical and research settings, there is a need to extend these normative indications to include data on clustering and switching. Moreover, an examination of the correlation between performance in the long (i.e. "F", "A", "S") and short forms (a single letter) could be important for clinical diagnosis. Further research is necessary to elucidate the possible dissociation between measures of structured and unstructured verbal fluency in terms of their sensitivity to deficits in ability to generate strategies in the search for words. Finally, the issue of testing language with individuals who are not English first language, but considered bilingual, requires further consideration and research. This research study offers a start, in that it presents preliminary normative data for two tests of verbal fluency administered in English, for this particular sample of English second language speakers. Normative data for these tests administered in isiXhosa on a sample with equivalent demographics may shed light on interference effects and provide useful comparative information. Making reference to Spanish-English bilinguals, Ardila et al. (2001), caution that bilinguals may be at a disadvantage when using either language, in that both languages can be considered active languages and interference can then be expected to be high. The issue of heterogeneity of bilingualism in the South African context complicates the easy resolution of this issue.

References

Ackerman, R. J., & Banks, M. E. (2001). Looking for the threads: Commomalities and differences. In F.R. Ferraro (Ed.), *Minority and cross cultural aspects in neuropsychological assessment*, (pp. 387- 415). Netherlands: Swets and Zeitlinger.

Anastasi, A. (1982) *Psychological testing* (5^{th} edition). New York: Macmillan.

Ancer, R. (1999). *Cumulative mild head injury in rugby: Cognitive test profiles of professionals rugby and cricket players.* Unpublished Master's thesis, Rhodes University, Grahamstown, South Africa.

Anderson, S. J. (2001). On the importance of collecting local neuropsychological normative data. *South African Journal of Psychology, 31*(3), 29-34.

Andrews, K. A. H. (2008). *Normative indications for Xhosa-speaking unskilled workers on the Trail Making Test and the Stroop test.* Unpublished Master's thesis, Rhodes University, Grahamstown, South Africa.

Ardila, A., & Rosselli, M. (1994). Develpoment of language, memory, and visuospatial abilities in 5-12 year old children using a neuropsychological battery. *Developmental Neuropsychology, 10*, 97-120.

Ardila A., Ostrosky-Solis, F., Rosselli M., & Gomez, C. (2000). Age related cognitive decline during normal ageing: The complex effect of education. *Archives of Clinical Neuropsychology, 15,* 495-514.

Ardila, A. & Morena, S. (2001). Neuropsychological evaluation in Aruaco Indians: An exploratory study. *Journal of the International Neuropsychological Society, 7*, 510-515.

Ardila, A., Rodriguez-Menendez, G., Rosselli, M. (2001). Current issues in neuropsychological assessment with Hispanics/Latinos. In F.R. Ferraro (Ed.), *Minority and cross cultural aspects in neuropsychological assessment* (pp.161-179). Lisse Netherlands: Swets and Zeitlinger.

Ardila, A. (2005). Cultural values underlying cognitive test performance. *Neuropsychological Review, 15,* 185-195.

Baker, H. J., & Leland, B. (1967). Detroit Tests of Learning Aptitude, Test No. 11, Free Association – *Words- in-One-Minute: Unstructured Verbal Fluency Test.*

Benton, A. L., Hamsher, K. deS., & Sivan, A.B. (1994). *Multilingual Aphasia Examination* (3rd ed.). San Antonia, TX: Psychological Corporation. [FAS Test]

Bornstein, R. A. (1985). Normative data on selected neuropsychological measures from a non-clinical sample. *Journal of Clinical Psychology, 41*, 651-659.

Brauer Boone, K., & Lu, P. (2000). Gender effects in neuropsychological assessment. In E. Fletcher-Janzen, T.L. Strickland, C.R. Reynolds (Ed). *Handbook of cross-cultural neuropsychology* (pp. 73-85). New York: Kluwer Academic/Plenum.

Brickman, A. M., Cabo, R., Manly, J. (2006). Ethical issues in cross-cultural neuropsychology. *Applied Neuropsychology, 13* (2), 91-100.

Byrd, D. A., Miller, S. W., Reilly, J., Weber, S., Wall, T. L., & Heaton, R. K. (2006). Early environmental factors, ethnicity, and adult cognitive performance. *The Clinical Neuropsychologist, 20*, 243-260.

Claasen, N. C. W., Krynauw, A. H., Paterson, H., & Mathe, M. (2001). *A South African standardization of the WAIS-III for English-speaking South Africans. Modified report.* Pretoria: Human Science Research Council.

Cooper, B. (2004, July 7). "Burn-out" threat saps teacher's morale. Unions cite assessment system, workloads for discontent. *Herald*, p. 4.

Denckla, M. B. (1973). Development of speed in repetitive and successive finger movements in normal children. *Developmental Medical Child Neurology, 15*, 635-645.

Ferrett, H. L., Dowling, T., Conradie, S., Kidd, M., Carey, P. D. & Thomas, K. G. F. (2010, March) *The processes and complexities of adapting the Controlled Oral Word Association Test and the Boston naming Test Short Form for use in the South African context.* Paper presented at South African Clinical Neuropsychological Association (SACNA) 12th biennial conference, Johannesburg, South Africa.

Golden, C. J. (1978). *Stroop Color and Word Test: A manual for clinical and experimental uses.* Chicago, IL: Stoelting.

Grieve, K. W. & Viljoen, S. (2000). An exploratory study of the use of the Austin Maze in South Africa. *South African Journal of Psychology, 30*, 14-18.

Helms, J. E. (1992). Why is there no study of cultural equivalence in standardized cognitive ability testing? *American Psychologist, 47*, 1083-1101.

Hemp, F. (1989). *Neurological impairment in children following head injury*. Unpublished Doctoral thesis, University of Cape Town, Cape Town, South Africa.

Jordan, A. B. (1997). *The shuttle effect: The development of a model for the prediction of variability in cognitive test performance across the adult life span*. Unpublished Doctoral thesis, Rhodes University, Grahamstown, South Africa.

Klenberg, L., Korkman, M., & Lahti-Nuuttila, P. (2001). Differential development of attention and executive functions in 3-12 year old Finnish children. *Developmental Neuropsychology, 20*, 407-428.

Larson, J. C, Mostofsky, S. H., Goldberg, M. C., Cutting, L .E. Denckla, M. B., & Mahone, E. M. (2007). Effects of gender and age on motor exam in typically developing children. *Developmental Neuropsychology, 32*(1), 543-562.

Lezak, M. D., Howieson, D. B., & Loring, D. W. (2004). *Neuropsychological Assessment* (4th ed.). Oxford: Oxford University.

Loonstra, A. S., Tarlow, A. R., & Sellers, A. H. (2001). COWAT Metanorms across age, education, and gender. *Applied Neuropsychology, 8*(3), 161-166.

Manly, J. J., Jacobs, D. M., Sono, M., Bell, K., Merchant, C. A., Small, S. A. (1999). The effect of literacy on neuropschological test performance between African American and White elders. *Journal of International Neuropsychological Society, 8*, 341-348.

Manly J. J., & Jacobs D. M. (2001). Future directions in neuropsychological assessment with African Americans. In F. R. Ferraro (Ed.), *Minority and cross cultural aspects in neuropsychological assessment* (pp.161-179). Lisse Netherlands: Swets and Zeitlinger.

Manly, J., Byrd, D.,Touradji, P., Sanchez, D., Stern, Y. (2004). Literacy and cognitive change among ethnically older diverse elders. *International Journal of Psychology, 39*(1), 47-60.

Matomela, D. (2008, January 17). New year, same old story. *The Herald*, p. 1.

Mitrushina, M. N., Boone, K. B., & D'Elisa, L. F. (2005). *Handbook of normative data for neuropsychological assessment* (2nd ed.). New York: Oxford University.

Nell, V., & Ormond-Brown, S. (1991). Epidemiology of traumatic brain injury in Johannesburg – II morbidity, Mortality and Etiology. *Social Science Medicine, 33*(3), p.289-296

Nell, V. (1999). *Cross-cultural neuropsycholgical assessement: Theory and practice.* London: Lawrence Erlbaum.

Oberg, G. & Ramirez, M. (2006). Cross-linguistic meta-analysis of phonological fluency: Normal performance across cultures. *International Journal of Psychology, 41*(5), 342-347.

O'Bryant, S. E., O'Jile, J. R. & McCaffrey, R. J. (2004). Reporting of demographic variables in neuropsychological research: Trends in the current literature. *The Clinical Neuropsychologist, 18*(2), 229-233.

Osterreith, P. A. (1944). Le test de copie d'une figure complex: Contribution a l'étude de la perception et de la mémoire. *Archives de Psychologie, 30*, 286 – 356.

Ostrosky, F., Canseco, E., Quintanar, L., Navarro, E. Meneses, S., & Ardila, A. (1985). Sociocultural effects in neuropsychological assessment. *International Journal of Neuroscience, 27*, 53-66.

Ostrosky-Solis, F., Ramirez, M., & Ardila, A. (2004). Effects of culture and education on neuropsychological testing: A preliminary study with indigenous and non-indigenous population. *Applied Neuropsychological, 11*(4), 186-193.

Parsons, T. D., Rogers, S., Hall, C., & Robertson, K. (2007) Motor based assessment of neurocognitive functioning in resource-limited international settings. *Journal of Clinical and Experimental Neurospsychology, 29*(1), 56-66.

Peters, M., Servos, P., & Day, R. (1990). Marked differences on a fine motor skill task disappear when finger size is used as a covariate. *Journal of Applied Psychology, 75*, 87-90.

Reitan, R. M. (1956). *The Trail Making Test: Manual for administration, scoring and interpretation.* Indiana: Indiana Medical Center, Indiana University.

Reitan, R. M., (1969). M*anual for administration of neuropsychological test batteries for adults and children.* Indianapolis, IN: Indianapolis University.

Reitan, R. M., & Wolfson, D., (1985). *The Halstead-Reitan Neuropsychological Test Battery: Theory and clinical interpretation.* Arizona: Neuropsychology.

Rey, A. (1964). *L'examen clinique en psychologie (The clinical examination in psychology).* Paris: Presses Universitaires de France.

Rosselli, M., Ardila, A., & Rosas, P. (1990). Neuropsychological assessment in illiterates II: Language and praxic abilities. *Brain and Cognition, 12*, 281-296.

Rosselli, M., & Ardila, A. (2003). The impact of culture an education on non-verbal neuropsychological measurements: A critical review. *Brain and Cognition, 52*(3), 326-333.

Ruff, R. M., & Parker, S. B. (1993). Gender and age specific changes in motor speed and eye-hand coordination in adults: Normative values for Finger Tapping and Grooved Pegboard. *Perceptual Motor Skills, 76*(3), 1219-1230.

Satz, P. (1993). Brain reserve capacity on symptom onset after brain injury: A formulation and review of evidence for threshold theory. *Neuropsychology, 7*, 273-295.

Scarmeas, N.,& Stern Y. (2003). Cognitive reserve and lifestyle. *Journal of Clinical and Experimental Neuropsychology, 25*(5), 625-633.

Shuttleworth-Edwards, A., Kemp, R. D., Rust, A. L., Muirhead, J. G. L., Hartman, N. P., & Radloff, S. E. (2004). Cross-cultural effects on IQ test performance: A review and preliminary normative indications on WAIS-III test performance. *Journal of Clinical and Experimental Neuropsychology, 26*, 903-920.

Shuttleworth-Jordan, A. B., (1992a). *Normative data for Finger Tapping.* Unpublished data, Rhodes University, Grahamstown, South Africa.

Shuttleworth-Jordan, A. B., (1992b). *Normative data for Word-In-One-Minute test.* Unpublished data, Rhodes University, Grahamstown, South Africa.

Shuttleworth-Jordan, A. B., & Bode, S. G. (1992). *Normative data for Finger Tapping across the 20-89 year old adult age range.* Unpublished data, Rhodes University, Grahamstown, South Africa.

Spreen, O., & Strauss, E. (1998). *A compendium of neuropsychological tests* (2nd ed). New York: Oxford University.

Strauss, E., Sherman, E. M. S., & Spreen, O. (2006). *A Compendium of Neuropsychological Tests: Administration, Norms, and Commentary* (3rd Ed.). New York: Oxford University.

Stern, Y. (2002). What is cognitive reserve? Theory and research application of the reserve concept. *Journal of the International Neuropsycholical Society, 8*, 448-460.

Stern, Y, Hilton, H.J., Flynn, J., DeLaPaz, R., & Rakitin, B. (2003). Exploring the neural basis of cognitive reserve. *Journal of Clinical and Experimental Neuropschology, 25*(5), 691-701.

Terre Blanche, M.; Durrheim, K., & Painter, D. (2006). *Research in Practice: Applied Methods for the Social Sciences* (2nd ed.). Cape Town: University of Cape Town Press.

Tiffin, J., & Asher, E. J. (1948). The Purdue Pegboard: Norms and studies of reliability and validity. *Journal of Applied Psychology, 32*, 234-247.

Tiffin, J (1968). *Purdue Pegboard: Examiner manual.* Chicago: Science Research Associates.

Tombaugh, T. N. (1996). *Test of Memory Malingering (TOMM).* New York: Multi Health Systems.

Tombaugh, T. N., Kozak, T., & Rees, L. (1999). Normative data stratified by age and education for 2 measures of verbal fluency: FAS and animal naming. *Archives of Clinical Psychology, 14*, 167-177.

Troyer, A. K. (2000). Normative data for clustering and switching on verbal fluency tasks. *Journal of Clinical and Experimental Neuropsychology, 22*(3), 370-378.

Tucha, O. Smely, C., & Lange, K. W. (1999). Verbal and figural fluency in patients with mass lesions of the left and right frontal lobes. *Journal of Clinical and Experimental Neuropsychology, 22*(2), 229-236.

UCT Child Guidance Clinic. (1956). *Normative data for Words-In-One-Minute.* Unpublished data, University of Cape Town, Cape Town, South Africa.

Yeudall, L. T., Reddon, J. R, Gill, D. M. & Stefanyk, W. O. (1987). Normative data for the Halstead-Reitan neuropsychological tests stratified by age and sex. *Journal of Clinical Psychology, 43*(1), 346-367.

Wechsler, D. (1945). A standardized memory scale for clinical use. *The Journal of Psychology, 19*, 87-95.

Wechsler, D. (1997). *Wechsler Adult Intelligence Scale-III.* San Antonio: Psychological Corp.

Yeudall, L. T., Fromm, D., Reddon, J. R., & Stefanyk, W. O. (1986). Normative data stratified by age and sex for 12 neuropsychological tests. *Journal of Clinical Psychology, 42*, 918-946.

Yeudall, L. T., Reddon, J. R, Gill, D. M. & Stefanyk, W. O. (1987). Normative data for the Halstead-Reitan neuropsychological tests stratified by age and sex. *Journal of Clinical Psychology, 43*(1), 346-367.

APPENDIX A

General Behavioural Observations

GENERAL BEHAVIOURAL OBSERVATIONS

Participant:

Tester:

Language ability (including English fluency and articulation)

Physical appearance

Visual/auditory/motor problems (were problems corrected? E.g. with glasses, hearing aids)

Attention and concentration

1

GENERAL BEHAVIOURAL OBSERVATIONS

Attitude towards testing (e.g. rapport established, eager to speak, working habits, interest, motivation, reaction to success/failure)

Affect/Mood

Unusual behaviours/verbalisations (e.g. perseverations, stereotypic movements, bizarre and atypical verbalisations)

Other notes

2

APPENDIX B

Biographical Questionnaire

Biographical Questionnaire

General Information Questionnaire:

Please Note: All information that you write on this report is strictly CONFIDENTIAL

and will ONLY be used for the research project. It will NOT be passed onto any employers.

Your ANONYMITY will be maintained.

Demographic Information:

Name: ______________________________

Gender: ______________

Age: ________________

Date of Birth: ______________

Place of Birth (City & Country):

____

Occupation (Employment at present time):

____

E-mail Address: ____________________

Contact Number: ____________________

First Language: ____________________

Education History:

1. Name, location and dates of **High School** (s) **(Secondary School)** attended:

1: Name: ____________________	**3. Name:** ____________________
Location: ____________________	Location: ____________________
Dates: ____________________	Dates: ____________________

2. Name: ______________________ **4. Name:** ______________________

Location: ______________________ Location: ______________________

Dates: ______________________ Dates: ______________________

3. **Highest Level of Education** (Highest Grade Reached):

Tick appropriate level.

3.1. Grade 10: __________ Grade 11: ______________ Grade 12: ____________

3.2. **YEAR** that you finished school? ______________________________

3.3 If you **TICKED Grade 10** or **Grade 11**, what was the reason you left before completing Grade 12?

____

____

____

3.4 What **symbol** (eg, D, E, F) did you get for **English** at School?

____

Socio-Economic Information:

Please answer this section **WHEN YOU WERE AT SCHOOL**, not at PRESENT

Please answer YES or No/

1. When you were still at SCHOOL, did you have:

1a: Electricity at home? ______________________________

1b: Running water? ______________________________

1c: Did you have your own room? ______________________________

1d: Did you have at least 2 meals per day? ______________________

1 e: Did you have your own toys worth in total over R50? ________________

1 f: What was the attitude of your parents towards your schooling?

Positive, negative or neutral? ___________________________________

General Information:

1.a. Did you **fail or repeat** any **grades** at school? ________________________

b. If **YES, which grade** and **how many times** did you fail or repeat? _______________

2. Have you ever been diagnosed with a **learning problem** (e.g. dyslexia), or received treatment for a learning problem? Please give details.

____

3. Have you ever been admitted to a **psychiatric (mental) hospital** or unit? Please give details.

____

3. Are you currently taking any **medications** (tablets, injection) for a **psychological** or **psychiatric disorder** (mental illness)? Please give details.

____

____

4. Have you ever taken any **medications** (tablets, injection) for a **psychological** or **psychiatric disorder** (mental illness) in the **PAST?** Please give details.

____

____

6. Do you suffer or have you ever suffered from any **serious illnesses**? Please give details.

____

____

7. Have you ever suffered any form of **head injury** (eg. hit your head after falling off a bicycle, injured your head in a car accident or during sports)? Please give details, including whether or not you **lost consciousness** and for **how long** you lost consciousness (minutes or hours).

____

____

8. Do you know if there were any **complications** (things went wrong) during your mother's **pregnancy** and/or **your birth**? Please give details.

____

____

9. Do you **drink alcohol** at all? Please give specific details of **how much** you drink and **how often** (eg. 3 beers every day or 8 beers once a week etc.).

____

____

10. Have you ever used any **drugs** (eg. dagga, mandrax, ecstasy, glue or paint thinners)? Please give specific details of **frequency** (how much) of use and when you **began** using (eg. a packet of dagga every day since you were 15 etc.).

____

____

11. Is there any other **educational** or **medical** information that you think might have a detrimental (negatively or badly) affect your performance on a cognitive test? Specify.

____

____

____

____

APPENDIX C

Pre-Test Screening Questionnaire

Pre-Test Screening Questionnaire

Encourage participant to answer as accurately as possible. Tick the option that applies and elaborate when requested. If some questions do not apply to the participant or she/he does not know the answer, record N/A if not applicable, or UK if unknown. Assure participants that information obtained will be kept in the strictest confidence.

Tester: ____________________________

Biographical information

Name:				
Gender: **M**	**F**			
Age:	**Date of Birth:**			
Handedness: Right	**Left**			
First Language: **English Proficiency:**	**Poor 1**	**Average 2**	**Good 3**	**Excellent 4**
Elaborate:				
Test Date:				

General

1. Have you had something eat this morning?

- o Yes
- o No

2. Have you slept well?

- o Yes
- o No

3. Do you wear glasses?

- o Yes
- o No

4. Do you experience any problems with your eyes?

- o Yes
- o No

5. Do you have a problem with hearing?

- o Yes
- o No

6. Have you ever broken an arm?

- o Yes
- o No

7. If yes, which one?

- o Right
- o Left

Remedial treatment for learning disabilities

Did you experience any difficulties or problems with learning at school?

- o No
- o Yes

If yes, elaborate

___

___

___

Did you receive any extra help for those problems or difficulties from someone other than your teacher like an Occupational Therapist, Psychologist, Doctor etc?

- No
- Yes

Neurological

1. Have you had any head injuries or any other problem that might have effected your brain?

- No
- Yes

2. If yes,

(To researcher, if yes, indicate number of previous head injuries sustained by participants and type of head injury. (eg: MVA, fall, assault, gunshot wound etc,)

Pathology Type	**1**	**2**	**3**
Date (month/year)			
Type			
Hospitalized (Yes/No)			
Length of Unconsciousness			
Duration of stay in hospital			

3. When you left the hospital, did you have to continue to see the doctor as an outpatient?

- Yes
  If yes, for how long? ____________________
- No

4. Are you experiencing any problems related to this injury currently?

- o No
- o Yes

If yes, please give further information

____
____
____
____
____

Education

1. What was the last grade you **passed**? (NB, not just started)

- o Grade 10
- o Grade 11
- o Grade 12

2. Did you fail or repeat any grades at school?

- o Yes
- o No

3. If YES, which grade and how many times did you fail or repeat?

- o Once
- o Twice
- o 3 times or more

4. What was the reason you failed/repeated?

- o Financial
- o Family responsibilities
- o Lack of interest
- o Political unrest/Strike, School closing
- o Poor academic performance
- o Other: ____

Substance Use

1. How often do you have a drink containing alcohol?

- o Never
- o Monthly or less
- o Once a week
- o 2 or 3 times a week
- o 4 or more times a week

2. How many drinks containing alcohol do you have on a typical day of drinking?

- o 1 or 2
- o 3 or 4
- o 5 or 6
- o 7 to 9
- o 10 or more

3. How long have you been drinking in this way?

- o Within the past 6 months
- o From 6 months to 5 years
- o More than 5 years

4. How often have you needed a drink in the morning to get yourself going after a heavy drinking session?

- o Never
- o Within the past 6 months
- o From 6 months to 5 years
- o More than 5 years

5. Are there financial, legal or family problems related to your drinking?

- o No
- o Yes, but not in the past year
- o Yes, during the past year

6. Has a relative, friend, doctor or health worker been concerned about your drinking or suggested you cut down?

- o No
- o Yes, but not in the past year
- o Yes, during the past year

7. Have you ever gone to anyone for help about your drinking?

If **YES**, who? ______________________________

- o Within the past 6 months
- o From 6 months to 5 years
- o More than 5 years

8. Have you ever been admitted to hospital for substance use?

If **YES**,

- o Within the past 6 months
- o From 6 months to 5 years
- o More than 5 years

OPTIONAL as directed by information contained on questionnaire

9. Have you ever used any **drugs** (eg. dagga, mandrax, ecstasy, glue or paint thinners)?

Please give specific details of **frequency** (how much) of use and when you **began** using

(eg. a packet of dagga every day since you were 15 etc.).

____

____

____

____

____

APPENDIX D

Consent Form

RHODES UNIVERSITY

DEPARTMENT OF PSYCHOLOGY

PARTICIPANT CONSENT FORM

I, ______________________________ have been informed of the nature of the research in which I will participate. I understand that four (three clinical, one counselling) intern psychologists from Rhodes University, Karen Anne Hope Andrews, Andrea Jane Wong, Lauren Fike and Anita Da Silva Pita, will be administering some neuropsychological tests on me, and I hereby agree to participate in this project.

I understand that:

1) The above-mentioned intern psychologists are conducting research as a requirement for a Masters degree in clinical psychology at Rhodes University. Their aim is to provide preliminary normative data on various neuropsychological tests for black South African people who speak an indigenous South African language as their first language.

2) The research will involve willing, black, indigenous South African language speakers with a Grade 11 – 12 education, from a former Department of Education and Training (DET)-type school.

3) Participants will be assessed using various commonly used neuropsychological tests.

4) Participation in the research is completely voluntary and I have the right to withdraw from the study at any stage.

5) The information collected on individual participants will be strictly confidential, with no personal information being disclosed. Access to this data will be restricted to members of the research team.

6) No individual test results will be given to me or to any other person outside of the research team. The information collected will be used for research purposes only by the researchers and will not be made available to my employers under any circumstances.

7) Data arising out of this project may be used anonymously for thesis and publication purposes.

______________________________	______________________________
Signed	Date
______________________________	______________________________
Name	Email
______________________________	______________________________
Address	Contact Telephone Number(s)

APPENDIX E

Order of Presentation of Tests in the Overall Neuropsychological Test Battery with Emphasis on Tests in the Present Study.

Name of Test	Author
1. Wechsler Memory Scale (WMS) Reproduction for Designs - Immediate Recall 2. Wechsler Memory Scale (WMS) Paired Associates - Immediate Recall **3. Successive Finger Tapping Test** **4. Purdue Pegboard** 5. Trail Making Test – Trail A and Trail B 6. Wechsler Memory Scale (WMS) Reproduction for Designs - Delayed Recall 7. Wechsler Memory Scale (WMS) Paired Associates - Delayed Recall 8. Digit Span Subtest of WAIS-III - Forwards and Backwards 9. Rey-Osterreith Complex Figure – Copy and Immediate Recall 10. TOMM - Trial 1 and Trial 2 **11. Words-in-a-Minute** **12. 'S' Words-in-a-Minute** 13. Stroop Test 14. TOMM - Retention Trial 15. Rey-Osterreith Complex Figure - Delayed Recall **16.** Rey 15-Item Memory Test	Wechsler, 1945 Wechsler, 1945 Denckla, 1973 Tiffin & Asher, 1948 Reitan, 1956 Wechsler, 1945 Wechsler, 1945 Wechsler, 1997 Osterreith, 1944 Tombaugh, 1996 Baker & Leland, 1967 Benton, Hamsher, & Sivan, 1994 Golden, 1978 Tombaugh, 1996 Osterreith, 1944 Rey, 1964

APPENDIX F

Successive Finger Tapping Test Protocol

Successive Finger Tapping Test: Administration Instructions

Full Name: ________________ Clinician: ______________ Date: _____________

<u>**Requirements**</u>: Stop Watch

TIMED: Time (in seconds) to perform 20 taps (5 sets of 4 taps) per hand – No Time Limit.

<u>**Instructions**:</u>

It is important to determine which is the subject's preferred hand. First test this hand then the non-preferred hand.

> **"Place both your elbows on the table (*examiner models what is required)* and touch each finger to your thumb with your index finger (*examiner can again model what is required).* Practice that (*pause while they practice).* When I say go, I would like you to do this as fast as you can until I tell you to stop. Be sure to touch each finger and do not go backwards. Remember, do this as fast as you can. Are you ready? Go…"**

The examiner notes the time taken to do 20 taps. The subjest does not know that he is required to do a specific number of taps. They must simply tap as fast as possible, not counting there own taps, until the examiner tells them to stop.

<u>**SCORE :**</u>

Preferred hand: (RH/LH)_______________ seconds

Non-preferred hand: ___________________seconds

<u>**Notes or Observations:**</u>

APPENDIX G
Purdue Pegboard Test Protocol

Purdue Pegboard Test: Administration Instructions

Full Name: ________________ Clinician: ______________ Date: ______________

Requirements: Purdue pegboard

Pegs

Stop Watch

TIMED

Time Limit: **30"** per trial for each of the following modalities

1. Preferred hand (30")
2. Non-preferred hand (30")
3. Both hands (30")

Instructions:

Determine which is the subject's preferred hand. First test this hand, then the non-preferred and then both hands. After each trial count the number of pegs placed in the holes.

While demonstrating how to do it, say the following:

> **1. & 2. "This is a pegboard and these are the pegs. Pick up one peg at a time with your *right/left* hand from the *right/left* hand cup. Rest the other hand on your lap. Starting with the top hole, place each peg one below the other on the *right/left* hand side without skipping any holes."**
>
> **"Go ahead and practice placing a few. If you drop a peg during the testing, do not stop and pick it up. Just take another one from the cup."**

After the subject has practiced placing a few pegs (3-4pegs), place all the pegs back in the cups and then say:

> **"All right, when I say "Go", work as fast as you can. Go!"**

While demonstrating how to do it, say the following:

> **3. "Pick up one peg in each hand, from both sides, at the same time. Starting with the two holes, place the pegs next to each other and then continue to fill the holes without leaving any out."**
>
> **"Go ahead and practice placing a few. If you drop a peg during the testing, do not stop and pick it up. Just take another one from the cup."**

After the subject has practiced placing a few pegs (3-4 pegs), place all the pegs back in the cups and then say: **"All right, when I say "Go", work as fast as you can. Go!"**

SCORE:

Preferred hand: (RH/LH) __________

Non-preferred hand: __________

Both hands: __________

Notes or Observations:

APPENDIX H

"S"-Words-In-One-Minute Test Protocol

"S"-Words-In-One-Minute Test: Administration Instructions

Full Name: ______________ Clinician: ______________ Date: ______________

Requirements: Stop Watch

TIMED

Time Limit: **1 minute (60")**

Instructions:

> **"Now I would like you to say as many words as you can think of that begin with the letter "S" in one minute. You must say the words as fast as you can and I will count them. Remember that you can say any words EXCEPT proper nouns like a person's name or the name of a city. For example, you cannot say Susan, or Sarah, or Salem. You also cannot use different versions of one word. For example if you .Counting or sentences are also not allowed. In other words I am asking you to say different, unconnected words all starting with the letter "S". Do you understand? Just keep going as fast as you can. Go"**

Note:

Repeat instructions if necessary.

If subject pauses for more than 8 seconds give the following instruction:

> **"Go ahead as fast as you can. Any words starting with "S"will do "**

If subject gives sentences or counts, stop the participant and say the following:

> **"Counting/sentences are not allowed. Name separate words. Go ahead as fast as you can"**

If subject has repeated the same word, say the following

> **You've said that already, but carry on"**

Note any repeats or the subject's inability to follow these instructions

SCORE (Number of "S" words generated in 1 minute (60"): ______________

Notes or Observations:

APPENDIX I

Words-In-One-Minute Test Protocol

Words-In-One-Minute Test: Administration Instructions

Full Name: ______________ Clinician: ____________ Date: ____________

Requirements: Stop Watch

TIMED

Time Limit: **1 minute (60")**

Instructions:

> **"I would like you to say as many different words as you can think of in one minute. You must say the words as fast as you can and I will count them. You can say any words EXCEPT proper nouns like a person's name or the name of the city. For example, you cannot say Mary or Jane or Grahamstown. You also cannot use different versions of one word. For example if you say WASH, you cannot also say WASHES, WASHED, WASHING. Counting or sentences are also not allowed. In other words I am asking you to say different, unconnected words such as picture, carpet, music, dog, sky and so on. Do you understand? Just keep going as fast as you can. Go"**

Note:

Repeat instructions if necessary.

If subject pauses for more than 8 seconds give the following instruction:

> **"Go ahead as fast as you can. Any words will do "**

If subject gives sentences or counts, stop the participant and say the following:

> **"Counting/sentences are not allowed. Name separate words. Go ahead as fast as you can"**

If subject has repeated the same word, say the following

> **You've said that already, but carry on"**

Note any repeats or the subject's inability to follow these instructions

SCORE (Number of words generated in 1 minute (60") : ________________

Notes or Observations: