

## CHAPTER ONE

### 1.0 INTRODUCTION

The focus of this study was to determine the relationship between number of languages spoken and performance on the clinical neuropsychological tests.

Zambia is a country endowed with many languages. As a result, individuals in Zambia tend to know at least one local language or more. Ponton et al (1999) state that language becomes a core issue to consider in the area of assessment. This is usually the case because most assessment tests are usually administered in a language that is non-native or non dominant in the test taker's lives. Not only are the tests administered in the language that is non-native or non dominant in individuals' lives, but such tests do not also have the norms of certain societies represented. This trend includes the neuropsychological assessment tests. These tests are usually established and normed by the native monolingual English speakers of the West. As such, disparities in patterns of performance are noticed among people speaking different numbers of languages.

For instance, performance among the different language groups (the monolinguals, bilinguals and the multilingual) would be different. Kroll et al (2008) attribute this to the evidence that has

been shown by most research that when an individual who speaks more than one language is using a language that is especially non dominant in his or her life, other languages that he or she speaks also become active even when they are not the ones the individual is targeting. Research shows that this usually gives a monolingual an advantage over those who speak many languages with regard to performance on the neuropsychological tests.

Language is conceptually defined in a similar way. Crystal (1995) in Hoff (2009) defines language as a form of communication or self-expression that comes in different forms such as spoken, written and or gestures that is based on a system of symbols in a systematic and conventional manner. It is highly ordered and organized. The order and organization of language has five rule systems that allow individuals to sequence their words properly so that their ideas can be well expressed and understood by others, (Solso et al 2008). The five rule systems are phonology, morphology, syntax, semantics and pragmatics, (Hoff, 2009). For the purposes of this research paper however, semantics and phonology will commonly be used. This is because the two rule systems are embraced by grammar and structure of language in explaining the differences that may occur in performance on neuropsychological tests as a result of the different number of languages individuals speak.

Phonology is defined as the combination of sounds of a language or simply the basic sound system or phonemes of a language, (Solso et al 2008:300). While, semantics is defined as the meaning of words and sentences, (Hoff 2009).

For the purposes of this study, it is also imperative to define who monolinguals, bilinguals and multilinguals are. A monolingual is an individual who speaks one language only and that, is usually a native language, (Portocarrero et al, 2007).

Romaine (1995) in Portocarrero et al (2007) pointed out that bilingualism is defined in many ways for which some define it as the ability of a speaker of one language to produce utterances in another language which are meaningful. By contrast, other researchers argue that for an individual to be bilingual they should have acquired equal mastery of both languages in all domains. Bloomfield (1993) in Portocarrero et al (2007) argued that attaining “native like” control of both languages is when an individual can be considered bilingual. However, Grosjean (1982) argued that the bilingual is not the total sum of two complete monolinguals, rather he or she is one who has a unique and specific linguistic configuration.

In respect of the above, one would wish to state that similar arguments may arise when defining who a multilingual individual is. However, little research has been done on multilingualism with regard to performance on the neuropsychological tests. Nevertheless, in general terms, a multilingual person is defined as an individual who has the ability to speak, read, and write in several languages, (Grosjean, 1982)

According to the Zambia Analytical Report (ZAR) (2000) there are 72 ethnic groups in Zambia. Banda (1998) points out that each of the ethnic groups speaks a dialect of the ten language

cluster groups. These language cluster groups are Bemba, Kaonde, Lozi, Luvale, Nyanja, Tonga, Mambwe, Tumbuka, Nsenga and Lunda. However, ZAR (2000) points out that out of the ten language cluster groups, only seven are used apart from English for official purposes such as broadcasting, literacy campaigns as well as for official dissemination of information. The ZAR (2000: 41) points out that “although language is not invariably synonymous with tribe, it would be a fair assumption to consider the number of dialects of a language in the clusters as equal to the number of tribes”.

As of the year 2000, the ZAR (2000) report showed that the predominant spoken language in Zambia was Bemba with 30.1 percent. This was followed by Nyanja and Tonga with 10.7 and 10.6 respectively. Lozi was spoken by 5.7 percent of the population. Chewa, Nsenga and Tumbuka were spoken by 4.9, 3.4 and 2.5 percent of the population respectively. Lunda was spoken by 2.2 percent of the population. Kaonde and Lala had the same percentage of 2.0. Lamba and Luvale had percentages of 1.9 and 1.7 respectively. Other tribes were reported with percentages below 1.7.

Considering that there are many local languages spoken in Zambia, and individuals are likely to know more than one local language, it was important to find out whether the number of languages an individual speaks may affect his or her performance on the neuropsychological tests administered in English language, (a language that is non-native in an individual’s life).

Essential to mention are the tests that are highly sensitive and specific in the measure of language in the neuropsychological test battery. These are the verbal fluency tests. Brucki and Rocha (2004) state that verbal fluency tests are an important component in the neuropsychological evaluation as they measure language and other cognitive functions. Ostrosky-Solis et al (2007) state that the tests specifically measure the generation of as many words as possible at a phonological and semantic level. This means that they focus on phonemic and semantic fluency. Ruff et al (1997) in Ostrosky-Solis et al (2007) state that verbal fluency generally assesses language functioning, response speed and ease at which one produces words. Equally, it measures the mental organization, search strategies and memory.

Individuals made to take a test in a language that is not dominant in their lives are reported to have problems with semantic fluency category tasks. Rosselli et al (2000) have shown that bilinguals had difficulties in tasks involving semantic fluency. They attributed this to the fact that an individual has to recall concrete words and in order to recall such words one should have attained mastery and good command of that language.

Rosselli et al (2000) state that one may recall words from a language that is dominant in his or her life because lexical accessibility is easier for such words as there is less interference. Due to interference from other languages there may also arise the problems of tip-of-the-tongue retrieval failures as the individual may be trying to recall the word in the language of test administration. Gollan and Brown (2006) in Mindt et al (2008) state that bilinguals tend to have more tip-of-the

tongue retrieval failures. As such an individual who speaks one or fewer languages may have an advantage over one who speaks more languages. This is one of the reasons this paper attempted to establish the relationship that may exist between the number of languages an individual speaks and performance on the neuropsychological tests.

Verbal fluency tasks are not only influenced by the number of languages an individual speaks but are also influenced by other variables. Rosselli et al (2000) state that cross language interference appears more in semantic fluency than in phonemic fluency because phonemic fluency is not limited to concrete words. As such, researchers have implicated the aspect of education in explaining the individual differences in performance on verbal fluency tests especially at phonological level.

Ardila, Ostrosky-Solis, Roselli and Gomez (2000) have shown that educational levels have effect on performance on several neuropsychological tests, (Ostrosky-Solis et al, 2007). They have further shown that levels of education also influence the modification of the brain's functional organization that takes place when an individual is subjected to tests involving reading and writing.

Nevertheless, despite having notable levels of education; and English being the official language of instruction in all schools in Zambia (ZAR, 2000), people only learn English language for official communication and mostly for career enhancement, (Portocarrerro et al 2007).

Cummings (1984) in Mindt, (2008: 4) also argued that while English language is learnt in schools to improve individuals fluency and to enhance careers, in as much as bilinguals can learn English “they fail short of the higher order fluency required for cognitive functioning in a context reduced situation such as the neuropsychological assessment”.

Rosselli et al (2000) argue that because assessments are in English language, lexical accessibility may become difficulty in people speaking more than one language, especially for tests that involve verbal fluency. Hence, such individuals would appear “dull” or cognitively impaired despite having a notable level of formal education; and this may affect the interpretation of the findings and recommendations made by the examiner. Hence, the purpose for carrying out this study was to establish the relationship that may exist between the number of languages an individual speaks and performance on neuropsychological tests on the individuals speaking different number of languages in Zambia considering the fact that Zambia is a multilingual state.

What a researcher should ask oneself is: “In what particular domains of the test do individuals with different number of languages encounter difficulties?” However even with such a question what should be noted is that the neuropsychological tests are mostly administered in English language, (a language that is foreign). What makes it more difficult is the fact that the tests usually have the norms representing monolingual English speakers of the West.

## **1.1 STATEMENT OF THE PROBLEM**

Assessing individuals using neuropsychological tests that are in English language (a language that maybe non native to the Zambian population), would bring about questions regarding the validity of the findings. Such individuals are likely to encounter problems such as interference from other languages which could affect performance on the test. This could result in having results that may not be representative of the actual performance of the population. Hence this may affect the interpretation and recommendation made by the examiner.

In this study the neuropsychological test battery was in English language and was administered to individuals speaking different languages in Zambia. As such, this study attempted to investigate whether individuals speaking a certain number of languages would have an advantage over others with different number of languages spoken pertaining to performance on the clinical neuropsychological tests. By so doing, norms will be created that will be representative and helpful in the interpretation of the neuropsychological tests in Zambia.



## **1.2 OBJECTIVES**

### **1.2.1 General Objectives**

1. To determine the relationship between an individual's number of languages spoken and performance on the clinical neuropsychological tests.

### **1.2.2 Specific Objective**

To establish whether greater proficiency in English language is related to better performance on the neuropsychological tests.

## **1.3 RATIONALE OF THE STUDY**

Studying language and how it may influence performance tends to be difficult because of the different views researchers have shown. Ostrosky-Solis et al (2007) have argued that individuals speaking one language are more likely to perform better on the neuropsychological tests than those with 2 or more languages as already stated above. A number of reasons have been attributed to this pattern of performance.

According to Kroll et al (2008) there is cross language interference or competition between languages when a bilingual is using a non dominant language. Hence they are outperformed by their monolingual counterparts. This is so because the dominant language is generally more accessible and may need to be suppressed to have a bilingual perform better on the tests, (Green, 1998). This study determined whether the different number of languages individuals speak in

Zambia would bring out a different pattern of performance due to such arguments mentioned above as competition between languages increase, and or as difficulties in accessing words for those who speak many languages also increase.

Poor performance of individuals with several languages has also been attributed to the age at which one acquired the language in which the test is being administered. Research has shown that early age acquisition of language would help one to attain high proficiency in the particular language, and as such interference could be reduced. Krashen et al (1992) in Mindt (2008) showed that the earlier the age of arrival to a country that speaks (for example English) the greater the proficiency one would attain.

Mindt et al (2008) have shown other issues as frequency of use of the language in which the test is being administered as also having a role to play in performance. Individuals in Zambia are exposed to many languages and the type of language they use depends on the people they frequently interact with. Mindt et al (2008) argue that by virtue of using a language occasionally individuals with more than one language tend to use a particular language less frequently compared to monolinguals who only use one language all the time. Gollan et al (2008) point out that the imperative feature of bilingual representation is the “weaker links” that are established within the network because of using each language less frequently. Oldfield and Wingfield (1965) in Mindt et al (2008) state that lexical accessibility is easier and quicker and more accurate for frequently used words than in less used words. This paper established whether such

factors as age at which one acquires language and also frequency of use of certain languages would bring out the difference in performance among individuals speaking different number of languages.

People speaking many languages could be viewed as having a large vocabulary size because of the many languages they speak. However, Mindt et al (2008) have argued that even as they may appear to have a large vocabulary size, within each of the languages they speak, their vocabulary size is small in comparison to an individual who may only be a speaker of one or fewer languages. This was seen in a study by Pearson et al (1993) among children aged 8 to 30 months in which they found that the number of words was smaller in each of the languages for children who knew more languages compared to the monolingual learners. This study was with the view to determine how many words children knew in each of the languages they had been exposed to.

Bialystock and Feng (2008) have shown that bilinguals have a smaller vocabulary size relative to monolinguals in their one respective language. Bialystock et al (2010) state that this trend persists into adulthood. They, therefore, attribute poor performance of bilinguals on the neuropsychological tests to inadequate vocabulary size which could help them in tests; especially those involving verbal fluency or word production. Therefore, this paper also attempted to establish whether such would be found among individuals speaking different numbers of languages in Zambia or not.

Most importantly, most of the studies on how the number of languages an individual speaks is related to neuropsychological test performance were conducted among bilinguals and monolinguals only. This study was unique because it also investigated multilingual individuals' performance on neuropsychological tests. Hence, the research findings will not only be important to Zambia but also to the world in the area of research in neuropsychology. This study has also never been carried out in Zambia before.

#### **1.4 HYPOTHESES**

**1.4.1** Individuals with more languages are less likely to perform better on the neuropsychological tests than those with fewer languages.

**1.4.2** There is a positive relationship between proficiency in English and performance on the clinical neuropsychological tests.

#### **1.5 RESEARCH QUESTIONS:**

**1.5.1** Is there a difference in performance among individuals speaking different number of languages on neuropsychological tests?

**1.5.2** Is there a relationship between greater proficiency in English language and performance on the neuropsychological tests?

## 1.6 Variables

### 1.6.1 Independent variables

1. number of languages spoken
2. proficiency in English

### 1.6.2 Dependent variable

1. Performance on the neuropsychological tests

## 1.7 Operational Definitions

Variable	Definition
i) Number of languages spoken	The languages that an individual speaks fluently
ii) proficiency in English	Having a good command of English for both informal and formal instructions (use)

## CHAPTER TWO

### 2.1 LITERATURE REVIEW

Studies on the number of languages individuals speak and how they may influence performance focus on individual proficiency in the particular language of administration, (for example English language), cross language interference, difficulties in accessing the lexical systems by bilinguals and also on the aspect of tip-of-the tongue retrieval failures. Tip-of-the tongue retrieval failure is often characterized by a feeling of imminent recall and the ability to report some distinctiveness about a word, (Gollan et al 2002). The differences in performance are mostly noticed on vocabulary production tasks or verbal fluency tasks. An important point to mention in this study is that most of the studies were conducted in the western countries among the bilinguals and the monolinguals. Most such research focused on how an individual who speaks two languages would have interference from another language when the language he or she is targeting is non dominant; and how the prevalence of the switching from one language to the next would be.

Examples of such studies are by Rosselli et al (2000) who found that bilinguals were outperformed by monolinguals in verbal fluency tests. Monolinguals performed significantly higher on semantic fluency tasks which involve the generation of concrete words. Individuals who spoke one language may have performed well because they did

not have interference from any language as they spoke one language only and, lexical accessibility was easier than in those speaking many languages.

Portocarrero et al (2007) also conducted a study among the college students who were either bilinguals born from a foreign country or monolingual speakers of English language. The study had 39 monolingual subjects and 39 bilingual subjects. Significant group differences were found in receptive and expressive vocabularies. Despite having arrived early in the USA, bilinguals were found to perform poorly with 0.5 standard deviation below the monolingual native speakers of English. On phonetic fluency however, there was no noticed difference in performance between the two language groups whereas in semantic categories, bilinguals were found to perform significantly lower than the native monolingual English speakers particularly in the animal production task.

In another study by Artiola et al (1997), significant findings were noticed on a Spanish word-production task showing that participants who spent many years in the USA produced lesser words than the Spaniards. It was a study conducted between two Spanish Speaking populations from different regions. It was administered in Spanish language. There were 185 US-Mexico Borderland and 205 participants from Spain. In the groups that were compared, performance differed in fluency even after controlling for age and

formal education. For example, US born participants differed from their Mexican born counterparts only in fluency.

Given situations in which bilinguals and monolinguals are subjected to a variety of verbal tasks, in a layman's understanding, one may assume that the bilinguals would outperform their monolingual counterparts. Instead, results are almost always that monolinguals would get more correct responses. This was proved in a study by Gollan, Montoya and Werner (2002). It involved 30 college aged Spanish English speaking bilinguals whose primary language was English whereas the other group comprised 30 English speaking monolinguals. The tasks administered to both groups were a 12 semantic, a 10 letter and a 2 proper name category tests. The aim of the study was to determine the impact of bilingualism on verbal fluency tests. The bilingual performance was found to be significantly lower than that of the monolinguals. The results the researchers found to be fascinating was that monolinguals produced more correct responses on the semantic categories while their counterparts produced more correct responses on the letter categories.

In a study by Gollan and Brown (2006) bilinguals were reported to have had more tip-of-the tongue retrieval failures than monolinguals; and this was mostly on easier items. This was also attributed to the claim that bilinguals or individuals who speak many languages have a smaller vocabulary size even though by layman's



explanation one may say their vocabulary size is larger than that of individuals who only speak fewer or one language. This study was done among the young adult bilinguals which might have implied that age might be an important factor to consider when studying the different patterns of performance on neuropsychological tests. However, Bialystock et al (2008) observed that both young and older bilingual adults performed poorly compared to their monolingual counterparts on the Peabody picture vocabulary test.

In other studies by Gollan et al (2008) in Mindt et al (2008) bilinguals were found to name pictures more slowly than monolinguals and they encountered difficulties in naming pictures correctly on the Boston Naming Test (BNT). Mindt et al (2008:5) found the above study as fundamental to note when studying language as they felt that comprehension precedes production in lexical accessibility and as such “any differences that would be noticed on comprehensive based measures will be present in tasks that require language production”.

There has however been some notable literature arguing that bilinguals perform better on the neuropsychological battery of tests. Studies by Mohanty (1982), Southworth (1980) (among others) showed that bilinguals outperformed monolinguals in general intellectual and cognitive functions. However, a lot of evidence has shown that individuals speaking many languages are outperformed by those with fewer or one language especially on tests

involving verbal fluency. Solso (2008) has shown that language is an important component of most of the cognitive functions. As a result, it is involved in the general cognitive functioning of an individual on the tests; hence, this may imply poor performance if an individual does not know a language of the test administration to mastery or if the individual speaks many languages.

For this reason and more, the study hypothesized that the number of languages an individual speaks may affect performance adversely on an English language test battery, especially those who speak many languages. Other studies have also shown that despite controlling for such variables as culture, social economic status (SES) bilinguals are still seen to perform poorly. Morton and Harper (2007) in Mindt et al (2008) showed that bilinguals did not have an advantage over the monolinguals in executive functioning tasks even after controlling for (SES) and ethnicity. This was noticed in a study among the bilinguals of French-English and the English monolingual speakers.

## CHAPTER THREE

### 3.0 METHODOLOGY

#### *3.1 Study Design:*

This was a cross sectional quantitative study design. It tested the variable of number of languages spoken and made an assessment of how the number of languages individuals speak can influence their performance on the neuropsychological tests.

#### *3.1.1 Sample:*

Participants were 302, comprising 146 males and 156 females. They were recruited from both rural and urban areas with ages ranging from 18 to 65 years. Their formal education ranged from 5 to 13 years and more.

The sample was HIV negative and was at least capable of speaking English language.

#### *3.1.2 Procedure:*

Participants were recruited from both rural and urban clinics. The rural sites were Kafue, Chongwe and Chibombo districts. Among these clinics were Mount Makulu, Chongwe, Chalimbana and Liteta. The study targeted individuals that do their regular visits to the named clinics from neighbouring rural areas. The urban participants were recruited from Kalingalinga, University of Zambia, Chilenje, Mtendere and Chelstone clinics.

There were a number of stages that were followed in the recruitment of research participants. These included neuromedical evaluations and Psychiatric and Drug Abuse Assessment. Questionnaires assessing experiences of cognitive difficulties in a subject's everyday life; any change in employment; and any decrease in the independence with which they perform instrumental activities of daily living were administered. This was so as to explore the impact of HIV associated with neurocognitive impairments in the population. The Academic Skills Questionnaire was included to assess quality of education and opportunities to use academic skills.

Stage 1: This involved recruiting individuals from the named clinics. It was done with the help of the medical personnel. They did so by asking the patients or the people accompanying the patients if they were willing to take part in the study. Those who were willing were asked to come back on a given date and time to meet up with the researchers.

Stage 2: The individuals who turned up were then asked to complete a baseline visit sheet, as well as an informed consent.

Stage 3: Medical screening involving neuromedical evaluations and HIV testing were carried out. This was so as to enable this study to have a "normal" sample. The medical assessments were conducted in the laboratory and the results were then availed to the study investigators. Neuromedical instruments were adapted from ongoing AIDS Clinical Trials Group (ACTG) studies which were used to do the neuromedical examination. Participants were asked to complete an HIV-1 antibody test. Blood was collected using a finger stick sterile method. Neuromedical examination involved a systematic review of

past medical and neurological histories, history of any current or past antiretroviral medications and their side effects as well as a brief medical and neurological examinations.

Stage 4: This stage involved the completion of questionnaires involving the following:

#### ***Psychiatric and Drug Abuse Assessment***

The Psychiatric and Drug Abuse Assessment involves the Composite International Diagnostic Interview (CIDI). The CIDI provides results in terms of presence or absence of DSM/ICD diagnosis for the present or past depression and substance disorders. This assessment requires 30-60 minutes.

#### ***Everyday Functioning Assessment***

The everyday functioning assessment included the Frontal Systems Behaviour Scale (FrSBe), Independent Activities of Daily Living Scale (ADL) questionnaire, and the Patient's Assessment of Own Functioning Inventory (PAOFI). The FrSBe is a 46-item self-report behavioural scale. It is a measure of the behavioural sequelae associated with frontal systems damage. The PAOFI is a 41-item questionnaire in which the participant reports the frequency with which he or she has difficulties with memory, language and communication, use of his/her hands, sensory-perception, higher level cognitive and intellectual functions, work and recreation. This instrument focuses on cognitive

symptoms and is used, together with the ADL questionnaire, in the determination of neuropsychological impairments.

All those who were found to be HIV negative and neurologically stable proceeded to the next stage. In which they responded to the language questionnaire and subsequently the battery of tests was administered. The study relied on the “self report” of individuals (where they rated themselves on the languages they were competent in). (*See appendix A for language questionnaire*). (*See appendix B for test battery*).

In general, individuals did the test in English language without help from the examiners. This was to help learn whether there would be a disparity in the pattern of performance among different language groups.

To test for fluency among the groups speaking different languages and how this may influence performance on an English language test battery, this study used what many researchers refer to as frequency of rule violations. This particularly applied to the phonemic (F.A.S) test and Semantic fluency test (animal and actions word production tasks). To do this, perseverations and intrusions were assessed. The most common given example of an intrusion in the F.A.S task is when an individual produces a word “phone” for the letter “F”. A practical example in the Zambian scenario is that one may come across an individual who may produce the word “house” for the letter “A”. This is reported to be common among individuals speaking certain

languages in Zambia. They may produce such a word in their effort and panic to produce as many words as possible in one minute.

### **3.1.3RELIABILITY OF THE INSTRUMENT USED**

#### ***HOPKINS VERBAL LEARNING TEST-REVISED (HVLTR)***

This is a test of learning ability and immediate recall on verbal information across trials. Equally, it measures an individual's capacity. Woods et al (2005) in Lezak et al (2000) contend that literature supports the reliability and constructs validity of the standard learning and recall measures on the HVLTR.

From a normative test which was carried out, it was found that age had the largest effect of 19%, but there was no formal education and gender effect.

#### ***BRIEF VISUOSPATIAL MEMORY TEST REVISED (BVMT-R)***

This test measures visual learning and memory using a multiple-trial learning paradigm. It is a figural learning test developed by Benedict (1997), and Groninger (1995) (Strauss et al 2006:701).

Literature suggests that IQ is moderately related to most of BVMT-R measure. For this reason, poor performance must be interpreted with people with below average IQ (Strauss et al 2006).

Despite some studies which have been done on both the HVLTR and the BVMT-R showing that the test may not be applicable to certain societies due to cultural issues, literacy, and formal education as well as age, Cherner (2007) argues that there are no significant effects of age. All in

all, the BVMT-R and the HVLT-R are said to be useful tests for both in clinical practice and research.

### ***HISCOCK DIGIT MEMORY TEST (HDMT)***

This test was designed to detect an individual perceived to be purposefully faking memory impairment. It is reported to be in three versions and one of them is the eighteen item HDMT. Specificity and sensitivity was found to be high in studies that were done on this test. Woods et al (2004) in Lezak et al (2000) shows that only few positive errors were found in these studies. Sensitivity and specificity is highly increased when the HDMT is administered concurrently with multiple other standardized tests.

The cut off point for this test is 50% indicating that those who get below 50% are definitely malingering. This shows validity and reliability; especially for the neurologically normal for detecting malingering. For this reason, results from many research have suggested that, it would be imperative to empirically determine how neurologically impaired groups performed on the HDMT.

### ***STROOP COLOUR TEST***

The Stroop Colour and Word Test is a measure of the ability to shift cognition set by acquiring the active inhibition of previously learned responses that are highly automatic.

The most common reliability test that is done on the Stroop test is the Test Retest reliability. This is so because, there are assertions that there would be high practice effect in such a test.



Prenerly (1998) in Cave (2008) (in his studies) found Test Retest reliability to be high at  $r = 0.90$ . Much other research found similar reliability in their normative data samples. However, in Levine (2004) study only the colour task did not produce decline in completion time between the second and third test sessions. The Stroop Test for the above reasons, has been found not to be as reliable when it comes to literacy and cultural issues.

In consonance with the above, in terms of validity a bilingual group of individuals demonstrated that proficiency in the language of administration significantly affects the Stroop Test performance. Age as well is one variable that is affected. To reduce on such effects adaptation of the tests has to be done so as to have norms of the particular cultures in which tests are being administered represented.

### ***DIGIT SYMBOL AND SYMBOL SEARCH TESTS***

The Digit Symbol and Symbol Search Tests are designed to measure the processing speed index. They are also said to measure attention and working memory, (Strauss et al 2006).

When examination validity and reliability, the two tests are not treated independently of the WAIS III. The many studies that have been done across cultures confirmed the validity and reliability of the two tests. Validity was also found in areas of measuring cognitive decline in old age. Processing speed is said to be the most affected in terms of measuring brain injuries. Certain studies have indicated that in order for the tests to have more reliability and validity there is need to supplement them with other tests.

### ***FAS AND CATEGORY TEST***

The two tests are the measures of verbal fluency. They also measure executive functioning in terms of verbal fluency. The two tests measure semantic and phonemic fluency. The former is specifically measured using FAS Test while the latter is measured using the Category Fluency Test.

Internal reliability was found to be moderately high with the FAS Test. Test Retest in one study was relatively high at 0.70 and above. Most of the findings in the normative samples suggested that relatively large changes in performance would be required to conclude that real decline or improvement has occurred as opposed to being due to the effects of practice and random measurement in terms of Test Retest reliability for Phonemic Fluency.

For Category Tests some practice effects were noticed. Wilson (2000) in Lezak et al (2000) observed that practice effects can be reduced by changing the letter or category on each of the test occasions.

Validity wise, the tests have been reported to measure what they purport to measure. However, many studies by Portocarrero (2007) and others, on bilingualism and performance on the neuropsychological tests have shown that verbal fluency tests are culturally biased. This is so because there comes an aspect of language barrier to those who are not native English speakers. And to those who speak many languages studies have indicated that problems of interference from other languages come about. This usually happens when they are targeting a language

which is non dominant in their lives. The dominant language interfere thereby denying accessibility of the non dominant language.

Kroll et al (2008) pointed out that compelling evidence has shown that all the languages an individual speaks become active when they are trying to speak one language only. This language is usually the non dominant.

However, compelling evidence again has shown that validity and reliability is high when the two tests are administered concurrently with other tests of the neurobehavioral battery. On the other hand the tests validity and reliability can be controlled for by having the tests adapted there by representing the norms of the population being tested.

### ***WECHSLER MEMORY SCALE (W M.III SPATIAL SPAN)***

This test is used to measure learning and memory. It is a visual test of attention and memory and was derived from the corsi blocks test. Spatial span is a valid measure of visual spatial memory. However, results from several studies have shown that it is not that valid. A study was done to assess performance of a clinical population on the Wechsler spatial span subtests consisting of 44 participants. 75 percent of participants performed poorly on the backward test, but some also performed poorly on the forward component. As a result, recommendations have been made that caution should be made when interpreting results for the spatial span because even the “normal” performed poorly.

Despite the above, reliability is said to be high on the spatial span. This is in such tests of recurrent assessment of cognitive degeneration because it has a negligible practice effect, (green

et al 2008). On the other hand however, it shows reliable change indices when there is deterioration in cognition. Generalisation of this test is possible because practice effect is minimal. And not only is it generalizable but can also be used in different contexts, because verbal instructions are fewer. It is mostly visual.

### ***CATEGORY TEST***

This test was developed by Halsted (1974) to assess the ability to conceptualize qualities such as size, shape, number, position and colour. In a study on test-retest reliability of a sample of 354 neurologically “normal” individuals the results were found to have better clinical than psychometric reliability.

However, in the many studies done on the category test, there has been a notable fairly acceptable level of its reliability and validity. Straus et al (2008) have shown that the test is highly sensitive to brain damage hence, making it a good measure of abstraction.

### ***PACED AUDITORY SERIAL ADDITION TEST (PASAT)***

The test is used for measuring attention deficits including concentration, speed of processing, mental calculation and mental tracking. Straus, Sherman and Spreen (2006) pointed out that the PASAT, with regard to reliability Cronbach's alpha for the 4 PASAT trials in adults, was very high at  $r=0.90$  and that in children CHIPASAT (test for children) a split half reliability was high at  $0.90$  at different ages.

Validity was also seen in a health sample. Researchers have however indicated that there is need to assess its validity on a larger sample. It is, however, said to correlate highly with such tests as the stroop, digit span and others in the neurobehavioral test battery.

### ***COLOUR TRAILS TEST***

Trial making test A and B are used to measure attention, visual searching, mental processing, speed, and the ability to mentally control simultaneous stimulus patterns.

These tests are said to be culture fair tests of visual attention, graphic motor sequencing and effortful executive processing abilities, (Lezak et al, 2000).

### **3.2 ETHICAL CONSIDERATIONS**

Participants were given an informed consent which they were asked to read.

The contents in the informed consent involved a brief description of the reasons the research was being conducted. For example,

- i) the reason for this particular research study was to determine whether there would be a relationship between the number of languages an individual speaks and performance on the neuropsychological tests.
- ii) It gave a brief description of the activities an individual was expected to engage in. For this particular research there were such activities as medical

examinations such as HIV testing and other evaluations during the recruitment process. They were also informed about the actual study which involved neurobehavioral evaluations.

- iii) They were informed about the risks they were likely to encounter in the study such as knowing about their HIV status.
- iv) They were made aware of what they were likely to encounter during the actual study such as demeaning, annoying, unpleasant and or boring items. For all the anticipated risks individuals were assured that the study was not meant to make them feel bad in any way.

Participants were told to feel free to withdraw from participating at any time they would wish to during the study without any penalty. However, they were informed on how important it was that they stayed in the study up to the end. The participants were told about how the information collected from them will be treated with full confidentiality.

They were also told about the benefits and opportunities they might receive as a result of participating in the study. They were encouraged to ask questions and they were to sign only after understanding the contents in the informed consent. Information regarding how they might contact the researcher during and after the research study was also given. (*Refer to appendix C for the informed consent*).

### **3.3 DATA ANALYSIS**

Participants were grouped according to the number of languages they spoke yielding groups of 2-3, 4-5, and 6 and above languages. The majority, 153 (50.7%) of the participants spoke between 4 to 5 languages followed by 110 (36.4%) of them who spoke between 2 and 3 languages. The least were those who spoke 6 languages and above representing 39 (12.9%).

Analysis of variance (ANOVA) was employed to determine whether there was any difference in performance on the tests among the groups.

Correlations were also performed to assess whether there was an association between proficiency in English and performance on the tests

The data used for analysis was corrected for age and education.

## **CHAPTER FOUR**

### **RESULTS**

#### **4.0 Introduction**

This chapter presents the findings of the study aimed at investigating the relationship between an individual's number of languages spoken and performance on the neuropsychological tests. The findings are presented according to the hypotheses of the study. The hypotheses of the study were (i) Individuals with more languages are less likely to perform better on the clinical neuropsychological tests than those with fewer languages and (ii) there is a positive relationship between proficiency in English and performance on the clinical neuropsychological tests.

#### **4.1 NUMBER OF LANGUAGES SPOKEN AND PERFORMANCE ON THE NEUROPSYCHOLOGICAL TESTS**

The study sought to find out whether individuals with more languages are less likely to perform better on the neuropsychological tests than those with fewer languages. The results of the study are presented below.

The statistical analysis employed was a one way between-subject Analysis of Variance (ANOVA) to be able to assess whether there is a statistically significant effect of number of languages spoken on performance. The variable of number of languages spoken was divided into three groups according to the number of languages participants spoke yielding three groups of 2-3, 4-5, and 6 and more.



#### **4.1.1 Executive functioning:**

As regards performance among the three groups on executive functioning, there was no statistically significant effect of number of languages spoken. The means were at 49.9 for the group that spoke 2-3 languages and the group that spoke 4-5 languages, while the group that spoke 6 languages or more had the mean at 50.1. The F value was ( $F(2, 299) = .16, p > .05$ ).

#### **4.1.2 Fluency:**

Number of languages spoken by participants also did not have any statistically significant effect on performance on fluency tests. The means for fluency tests were at 48.9 for 2-3 languages spoken, 49.5 for 4-5 languages spoken and 51.2 for the group that spoke 6 languages or more. The F value was ( $F(2, 299) = 1.623, p > .05$ ).

#### **4.1.3 Working Memory:**

The means for the memory test domain were at 49.1 for the group that spoke 2-3 languages, 49.6 for the group that spoke 4-5 languages and 51.2 for the group that spoke 6 or more languages while the F value was ( $F(2, 299) = 1.154, p > .05$ ). The result was not statistically significant.

#### **4.1.4 Visual Episodic Memory:**

Visual episodic memory test domain was also not affected by the number of languages participants spoke. The means were at 50.0 for the group that spoke 2-3 languages, 49.6 for the group that spoke 4-5 languages whereas 51.2 was the mean for the group that spoke 6 or more languages. The F value was ( $F(2, 299) = .417, p > .05$ ).

#### **4.1.5 Verbal Episodic Memory:**

As regards verbal episodic memory tests, there was equally no statistically significant effect of number of languages participants spoke. The means were at 49.5 for the group that spoke 2-3 languages, 50.2 for the group that spoke 4-5 languages, with the group that spoke 6 or more languages having the mean at 48.1. The F value was  $(F(2,299)=.865, p>.05)$ .

#### **4.1.6 Motor dexterity:**

The means were calculated at 50.6 for the group that spoke 2-3 languages, 48.9 for the group that spoke 4-5 languages and 50.2 for the group that spoke 6 or more languages. The F value was  $(F(2,299) =1.125, p>.05)$ . The result was not statistically significant.

#### **4.1.7 Speed of information processing memory:**

The means for speed of information processing memory were at 49.2, 50.0 and 50.4 respectively for the groups that spoke 2-3 languages, 4-5 languages and 6 or more languages with the F value of  $(F(2,299) =.630, p>.05)$ . The finding was not statistically significant. See table 1 below for the summary of results.

**Table1: Number of languages spoken and performance on neuropsychological test domains**

Type of Domain	Number of Languages	Means	F value	Sig. (p)
Executive functioning	2-3	49.9	.16	.980 NS
	4-5	49.9		
	6+	50.1		
Fluency	2-3	48.9	1.623	.199 NS
	4-5	49.5		
	6+	51.2		
Working Memory	2-3	49.1	1.154	.317 NS
	4-5	49.6		
	6+	51.2		
Visual episodic memory	2-3	50.0	.417	.659 NS
	4-5	49.6		
	6+	51.2		
Verbal Episodic memory	2-3	49.5	.865	.422 NS
	4-5	50.2		
	6+	48.1		
Motor dexterity	2-3	50.6	1.125	.326 NS
	4-5	48.9		
	6+	50.2		
Speed of information processing	2-3	49.2	.630	.533 NS
	4-5	50.1		
	6+	50.5		

NS- Not Significant

#### 4.2 Number of languages spoken and performance on fluency subtests

ANOVA was computed for the fluency domain subtests which comprised very few items. The few items led to the drastic drop of the means.

#### **4.2.1 FAS test:**

The means for the FAS were at 3.18 for those who spoke 2-3 languages, 3.04 for those with 4-5 languages and 3.21 for the group that spoke 6 or more languages. The F value was ( $F(2, 299) = 1.264, p > .05$ ). The finding was not statistically significant.

#### **4.2.2 Actions category fluency test:**

There was no statistically significant effect of number of languages spoken on the actions category fluency test. The mean for the group that spoke 2-3 languages was at 2.91, for the group that spoke 4-5 languages the mean was at 2.81, while for the group that spoke 6 or more languages the mean was at 3.08. The F value was ( $F(2,299) = .414, p > .05$ ).

#### **4.2.3 Animal category fluency test**

The number of languages participants spoke had a statistically significant effect on performance on the animal category test with the F value of ( $F(2, 299) = 6.270, p < .01$ ). The means were at 2.65, for those who spoke 2-3 languages, 2.97 for the group that spoke 4-5, while those with 6 or more languages had the mean of 3.26. See table 2 below for the summary of results.

**Table 2: Number of languages spoken and performance on individual fluency tests**

Type of test	Number of Languages	Means	F value	Sig. (p)
FAS test	2-3	3.18	1.264	.284 NS
	4-5	3.04		
	6+	3.21		
Animal category	2-3	2.65	6.270	.002*
	4-5	2.97		
	6+	3.26		
Actions category	2-3	2.91	.885	.414 NS
	4-5	2.81		
	6+	3.08		

NS: Not significant

\*Correlation was significant at the .01 (level 2tailed)

### **4.3 PROFICIENCY IN ENGLISH AND PERFORMANCE ON THE NEUROPSYCHOLOGICAL TESTS.**

The study also sought to find out whether greater proficiency in English language was related to better performance on neuropsychological tests. The results of the findings are presented below.

#### **4.3.1 Executive functioning:**

As regards to whether there was association between greater proficiency in English language and performance on the executive function domain or not, the findings of the study showed that there was no significant relationship,  $r=.019$ ,  $p > .05$ .

#### **4.3.2 Fluency:**

As regards association between proficiency in English language and performance in fluency, the study showed that there was a positive and significant relationship between the two variables,  $r = .17$ ,  $p < .01$ .

#### **4.3.3 Working Memory:**

When greater proficiency in English language was correlated with working memory, the results showed that there was no significant correlation between the two variables,  $r = .08$ ,  $p > .05$ .

#### **4.3.4 Visual Episodic Memory:**

Correlating proficiency in English language and visual episodic memory tests revealed no significant relationship between the two variables,  $r = .06$ ,  $p > .05$ .

#### **4.3.5 Verbal Episodic Memory:**

The results of this test showed that there was no significant relationship between greater proficiency in English language and verbal episodic memory mean,  $r = .02$ ,  $p > .05$ .

#### **4.3.6 Motor dexterity:**

As regards whether there was any association between greater proficiency in English language and motor functioning or not, the findings of the study showed that there was no significant association between the two variables,  $r = .05$ ,  $p > .05$ .

#### **4.3.7 Speed of information processing memory:**

When proficiency in English was correlated with performance in speed of information processing, the findings of the study revealed that there was no significant correlation between the two variables,  $r = .10$ ,  $p > .05$ . Table 3 below shows the summary of the results.

**Table 3 showing correlations between proficiency in English & performance on neuropsychological tests**

Type of test	Pearson (r)	Correlation	Sig (p)
<b>Executive function</b>	.019	.738	NS
<b>Fluency</b>	.170*	.003*	
<b>Working memory</b>	.086	.135	NS
<b>Visual episodic memory</b>	.061	.290	NS
<b>Verbal Episodic memory</b>	.023	.694	NS
<b>Motor Dexterity</b>	.051	.379	NS
<b>Speed of information processing</b>	.102	.076	NS

\*Correlation was significant at the .01 level (2-tailed)

NS: Not significant

## **CHAPTER FIVE**

### **DISCUSSION**

#### **5.0 Introduction**

This chapter discusses the findings of the study aimed at investigating the influence of the number of languages spoken by an individual on the performance on the neuropsychological tests. The discussions are presented in line with the hypotheses of the study.

#### **5.1 NUMBER OF LANGUAGES SPOKEN AND PERFORMANCE ON THE NEUROPSYCHOLOGICAL TESTS**

The number of languages individuals spoke was not found to have any statistically significant effect on the performance on the clinical neuropsychological tests. The finding is contrary to the earlier findings in most literature which has shown that individuals with multiple languages are likely to perform poorly compared to their counterparts with one or fewer languages. Such findings are attributed to the assertions that individuals with multiple languages face competition or interference from other languages (as they usually fail to inhibit the nontarget language or failure to effect control over the selection process on which language to use in that particular context) and proficiency in the language of test administration. Some of the prominent researchers who found that number of languages spoken had a statistically significant effect on performance are Rosselli et al (2007); Artiola et al (1997); Gollan, Montoya and Werner (2002) and; Portocarrero et al (2007). They found a statistically significant effect of number of languages individuals spoke on the verbal fluency domain in particular. Some of the verbal tests they used were FAS, animal category and actions category fluency tests.



Earlier, individuals who learnt or spoke multiple languages had for a long time been viewed as having a cognitive disadvantage, (Kroll et al 2008). However, emerging studies have shown that speaking many languages does not necessarily mean having a disorder, (Bialystock et al 2010). Instead, individuals who speak many languages have been found to have an advantage over those with fewer languages especially in the domains of executive functioning and memory. Bialystock et al (2010) stress that this advantage of individuals with multiple languages generalises across different languages and cultural contexts even after correcting for education and the environment in which they were nurtured. In addition, a study by Kovacs and Mehler (2009) demonstrated that individuals with more languages are more flexible in the learning of phonological tasks unlike monolinguals. These reasons would therefore help in understanding the findings in the present study which revealed that number of languages participants spoke did not have any significant effect on performance on the neuropsychological tests including the fluency domains.

There was hardly any difference in performance among the three groups in our study. Bialystock et al (2010) point out that individuals with more languages have the need to control linguistic interference with corresponding demands to monitor and adapt behaviour. Hence, it helps them to perform practically the same or even better than individuals with fewer languages. The mental flexibility of the subjects with more languages in our study might have enabled them to switch easily and monitor which language was being spoken in the particular context compared to those with fewer languages just as Bialystock et al (2010) argued.

The good control of executive functioning might have helped individuals with more languages to effect the good selection of words in the language of test administration by suppressing interference of other languages. This is unlike the usual argument by Kroll et al (2008) that individuals with more languages face difficulties inhibiting languages that interfere when they are trying to speak a language that is especially non dominant.

Cross language interference may not be present in our study because English language is a medium of formal instruction in which individuals learn terms that cannot be easily and or directly translated in the local languages hence, interference may be less or it may not be present at all. However, issues of cross language interference may be well thought-out when administering the tests in one of the local languages as these local languages are interrelated. For example, if the tests were administered in Namwanga (one of the local languages in Zambia), it is likely that interference might come from Mambwe as the languages are very similar or even from many other local languages as these languages seem to share many basic terms. But, if administered in English language, the likelihood that there would be interference is low as English is learnt for formal and academic purposes in Zambia hence terms that are learnt are context dependent and may not be easily or directly translated to a home language. In this case, proficiency in the language of test administration might be a bigger factor in explaining the difference in performance than the number of languages spoken.

It is imperative to note however, that this study also compared the performance of the three groups on individual tests of the fluency domain to ascertain whether there indeed would not be any differences. These tests are the FAS, the animal category and the actions category fluency tests.

The FAS test and the actions category revealed no significant effect of number of languages spoken in performance among the groups with  $p > .05$ . The animal category fluency test however, revealed that number of languages participants spoke had a statistically significant result with the  $p < .01$ . This result (for the animal category fluency test) was quite intriguing in the sense that individuals with 6 or more languages were the ones that actually had the largest mean of 3.26 compared to their counterparts who had means of 2.97 for the group that spoke 4-5 languages and 2.65 for the group that spoke 2-3 languages. Table 2 illustrates the findings. This result showed that those with more languages performed better than those with fewer languages. This therefore, contradicts our hypothesis and the findings by Rosselli et al (2000); Portocarrero (2007); Artiola et al (1997); and Gollan, Montoya and Werner (2002) among others who found that individuals with fewer languages, in particular monolinguals performed better than bilinguals on the animal category fluency test.

Although the results of these studies on number of languages spoken and performance on the animal category test contradict the studies of Rosselli et al (2000) and other authors, they however lend support to many other studies. Mohanty et al (1982) found among the Kondi of

India that bilinguals outperformed monolinguals on a number of cognitive and metalinguistic tasks. And, in another study by Southworth (1980) among the 1300 children of India, bilinguals performed better than monolinguals. Selagowitz (1981) attributed these findings to the assertion that lexical items and linguistic structures of different languages influence the thought processes of bilinguals by enriching their experience in diverse ways. Leopold (1939 to 1949) in his longitudinal study on his bilingual daughter observed that bilingualism accelerates the separation of sound and meaning or name and object. He contended that this results from the parallel exposure to two linguistic terms to refer to the same object. Further, in line with these studies, Mohanty (1994) pointed out that bilinguals have greater proficiency in detecting structural indistinctness in sentences and also a greater sensitivity in intonational cues and that, such cues make them to successfully recognize the intonation-appropriate meaning of sentences.

The findings of this study are also in line with the study by Kave et al (2008) in which they reported that participants with more than 2 languages (trilinguals) had a greater general cognitive level than those with two languages and, those with four languages outperformed the trilinguals.

It is in light of the above that the null hypothesis, “individuals with more languages are less likely to perform better on the neuropsychological tests than those with fewer languages was rejected”.

## **5.2 PROFICIENCY IN ENGLISH AND PERFORMANCE ON THE NEUROPSYCHOLOGICAL TESTS**

As regards to whether greater proficiency in English language had a positive relationship with clinical neuropsychological tests or not, generally, the study found that there was no significant correlation on most of the domains except for the fluency domain which had a significant correlation of .17. Participants might have been able to perform well on the fluency domain most probably because most people in Zambia use English language as a medium of communication in almost all sectors. This, therefore, improves their proficiency such that they are able to perform notably well even in a context reduced situation like a neuropsychological session.

Additionally, in recent years in Zambia, especially in urban areas, the first language that most parents introduce to their children is English. A few years ago, such children usually came from homes of high (SES) but, in recent years even parents from medium income homes have been embracing the idea of speaking English language in their homes. For the reason that a child is brought up in an English speaking environment, his or her reasoning, decision making, dreams and thoughts are expressed in a language in which he or she is well versed (English). Subsequently, parents take these children to schools that use English language as the medium of communication and instruction in all situations.

The trend of using English language at all levels persists into adulthood and as such, these individuals build ideas and conduct all their daily affairs such as business, visits, play etc. in English language. And, this makes their proficiency in English language to become increasingly good. They become so conversant with the language that they are able to comprehend everything that is said and written in the English language. As a result, they are able to perform well on the verbal fluency test domain without any strain. This therefore might be one of the reasons participants in this study performed well on the fluency domain. And, it has been noticed in some studies that proficiency in the language of test administration usually has a significant effect on performance on the neuropsychological tests, particularly the fluency tests. For example, Bethlehem, de Piccioto and Watt (2006) showed that individuals with English language as a medium of instruction who were tested in English performed slightly better than those who were tested in Zulu but whose medium of instruction was English on verbal fluency tests. This was in a study done among the South African English-Zulu speakers.

Similarly, a study by Gasquoine et al (2007), found that language of test administration produced high scores in the dominant language of Spanish speakers when administered in Spanish language and, of English language speakers when administered in English language. For the balanced bilinguals, they did not find any significant difference in performance between the groups. This finding shows that proficiency in the language of test administration plays a cardinal role on performance.

The present findings are also in line with the study by Shuttleworth-Edwards et al (2004) among the South African white-English first language speakers whose medium of educational instruction was English language. They found that those with the same quality of education performed as well as the United States (US) standardization sample as their proficiency in English language was comparable. These findings entail that individuals tested in a language in which they are highly proficient, are likely to perform better especially on the verbal fluency tests.

In the present study, the tests were administered in English language to individuals who had a certain level of English language proficiency and consequently the findings showed that good proficiency in the English language correlated positively with the verbal fluency test domain.

## CHAPTER SIX

### 6.0 CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

#### 6.1 Conclusion

The present study showed that the number of languages individuals spoke hardly had any significant effect on performance. This finding was however, counter to a large body of studies conducted previously. Nonetheless, the study also revealed that the number of languages spoken by individuals has to some extent got an influence in performance as far as the verbal fluency tests are concerned, particularly the animal category fluency test. This study however, did not conform to most of the studies that show that individuals with more languages are usually outperformed by individuals speaking fewer languages. Earlier studies asserted that individuals with multiple languages face competition or interference from other languages (as they usually fail to inhibit the nontarget language) and this, usually leads to their poor performance.

However, the findings in our study revealed that individuals with more languages to an extent outperformed those with fewer languages. A number of reasons attributing to this intriguing finding have been advanced. Bialystock et al 2010 argue that individuals with multiple languages have an advantage over those who speak fewer languages in domains of executive functioning and memory and that, the advantage extends to their performance on verbal fluency tests. Individuals speaking many languages tend to be more flexible in learning of the phonological tasks and have the need to control linguistic interference with corresponding demands hence, interference or competition between languages is reduced. In addition, cross language



interference is low as English is learnt for formal and academic purposes in Zambia hence; terms that are learnt are context dependent and may not be easily translated to a home language. Therefore, proficiency in the language of test administration could explain the difference in performance better than the number of languages spoken. The manner in which the participants acquired the languages and the degree of use of languages they spoke might have also attributed to the findings of the present study. These factors should carefully be thought-out in future studies.

Further, the study has shown that greater proficiency in English language does have a bearing on the performance on one of the clinical neuropsychological test domains, fluency domain in particular. Comprehension is easier and more precise for individuals who are highly proficient in the language of test administration, in this case English language. This finding conformed to previous studies that have found that proficiency in the language of test administration plays a role in performance on neuropsychological tests especially the fluency tests.

## **6.2 Limitations of the Study**

The study used self reports to rate the participants' competency in their languages. This may not have been reliable enough. However, there are studies which have shown that self-report questionnaires of language are reliable. For example, Marian et al (2007) carried out a study to determine whether the language experience and proficiency (LEAP-Q) questionnaire was reliable. This study was conducted among the bilinguals and the multilinguals. The factors

contained in the LEAP-Q were acquisition history of language, context of acquisition, language preference, and proficiency self- ratings as well as present language use. This study showed a high validity in terms of self-reported proficiency in spoken, reading, and understanding of the languages.

### **6.3 Recommendations**

Based on the findings of this study the following recommendations are hereby suggested:

- (i) The neuropsychological tests should be simplified so as to enable the respondents to easily understand what is required of them.
- (ii) Government of the Republic of Zambia through its relevant organs such as the Ministry of Health and Ministry of Education should ensure that norms are created that will be representative of the Zambian population with regards to neuropsychological tests.
- (iii) A nationwide sample should be used in future research for the results to be generalised to the Zambian population.
- (iv) A longitudinal study should be considered to address questions that have not been answered in this study.

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