THE EFFECT OF QUALITY OF EDUCATION ON NEUROPSYCHOLOGICAL TEST PERFORMANCE AMONG ZAMBIAN ADULTS

By

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A dissertation submitted to the University of Zambia in partial fulfilment of the requirements for the award of Master of Science Degree in Clinical Neuropsychology.

University of Zambia

Lusaka

DECLARATION

I Edina Chirwa declare that The Effect of Quality of Education on Neuropsychological Test Performance Among Zambian Adults is my own work and all works used and cited have been acknowledged and full references have been made. This work has not been previously submitted for a degree, diploma or other qualification at this university or another university.

Signature…….

Date……...……..

CERTIFICATE OF APPROVAL

This Dissertation of Edina Chirwa has been approved as fulfilling the requirements for the award of the Masters of Science Degree in Clinical Neuropsychology by the University of Zambia.

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ABSTRACT

The relationship between education and performance on neuropsychological tests has been established (Dotson, Kitner-Triolo, Evans, and Zonderman, 2009). It has also been found that ill-educated but cognitively healthy individuals get lower scores on neuropsychology test than mildly impaired but better educated patients (Lezak, Howieson and Loring (2004). However, it is a great challenge to find an appropriate approximation of educational attainment. Therefore, this study investigated the effect of quality of education on neuropsychlogical tests among Zambian adults.

Specifically, the objectives were: 1) To establish if the study participants' quality of learning affects their neuropsychological test performance; 2) To establish if the educational quality of the teacher affects study participants' neuropsychological test performance; 3) To establish the extent to which quality of the school effects the study participants' neuropsychological test performance; 4) To establish if there is a significant difference in mean scores of neuropsychological tests between the participants who received high and those who received low quality education participants.

The study was a quantitative one involving 290 participants aged between 18 and 65 years with 8 and more years of formal education from both rural and urban places in Zambia. After screening, the participants were subjected to a series of neuropsychological tests in the Zambian Neurobehavioural Test Battery. The battery assesses seven ability domains: information processing speed, motor dominance, attention/working memory, verbal episodic memory, visual episodic, verbal fluency and executive functions. Standard Multiple Regression was applied to the scaled scores of the seven ability domains and the three indices of quality of education. Then a T-test was used to assess the difference in performance between participants who had high quality of education and those who had low quality education.

In this study, on the verbal episodic memory tests, of the participants' quality of learning predicted 15.3% of the study participants' test performance and on verbal fluency tests the predictive powers of the participants' quality of learning was 34.5%. On speed of information processing tests it was found that the predicted value was 24.9% and on executive function tests, the predicted value was 22.0%. For attention/working memory tests quality of learning had a predictive value of 18.1% while on motor tests it predicted 15.6% of the participants' test performance at a statistical significance level of $p<.05$. On all the tests, quality of learning predicted 27.8% of the participants' test performance at a statistical significance level of $p<.05$.The participants' quality of teachers had a statistically significant on verbal memory tests with a predictive power of 12.5% ($p<.05$).

Upon analysing the effect of quality of school it was found that on the verbal fluency tests the predictive powers of the participants' quality of school was 16.7% at a statistical significance level of $p<.05$ as shown in table 4.4. On the speed of information processing tests, the participants' quality of school predicted 16.0% of test performance at a statistical significance level of $p<.0.5$. When all the tests were put together, the participants' quality of school predicted 14.5% of test performance at $p<.05$.

When all the tests were put together, participants of low quality of education had a mean score of 10.11 while those of high quality of education had a mean score of 11.11. This difference in the mean scores of two groups was statistically significant ($p<.0.05$).

Having found that quality of education does have a significant effect on neuropsychological test performance, it should then be used in the interpretation of test scores to increase specificity in diagnosis.

Dedication

I dedicate this work to my beloved husband Emmanuel and my loving late father Edwin.

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CHAPTER ONE

1.0 INTRODUCTION

Neuropsychology is the study of the brain-behaviour relationship (Grieve, 1993). The field of neuropsychology is relatively new and some of the names that are associated with the birth of neuropsychology are Rey of France, Reitan, Goldstein and Halstead of the United States of America (USA) and Luria of the Soviet Union (SU) (Groth-Marnat, 2009).

In the USA, neuropsychology developed to distinguish between impaired and normal functioning while in the Soviet Union and France, Halstead tried to develop tests that measured brain functioning using patient observation and case history of the patient. Psychologists in the USA used more quantitative methods however; in Soviet Union they used more of qualitative methods. Halstead developed a battery of 10 tests and later Reitan (1955) reduced the battery to only 7 tests (Groth-Marnat, 2009). With these tests, cut-off points and norms were developed. The focus was to assess biological intelligence as they called it. These tests managed to measure brain damage and were also able to localise it in the brain and determine its nature. They ended up using these tests mostly on children (Groth-Marnat, 2009).

Meanwhile, in Europe Rey and Luria were also developing qualitative methods of assessing brain functioning. Luria developed methods where a psychologist would make systematic observations of the patient (Groth-Marnat, 2009). The two developments (from USA and Europe) emerged into two distinct approaches of neuropsychological assessment. These are the two approaches being used today by neuropsychologists in neuropsychological assessments. In addition, neuropsychologists have a broader use of neuropsychological assessment other than just the measure of intelligence.

One of the major reasons for neuropsychological assessments is referrals from medical doctors and teachers to determine brain damage. Neuropsychological assessments have

become a very big component of health services especially in developed countries. With the development of medical science it has become very apparent that apart from head trauma and degenerative diseases, there are a lot of other conditions that affect brain function. Furthermore, even with the advent of neuro-imaging, neuropsychological assessment remains a vital component of assessing brain function because some cases of brain damage may not show on neuro-imaging. Neuropsychological assessment determines suitable treatment, rehabilitation and prognosis of patients.

It is important to clearly state that as used in this paper, neuropsychological assessment refers to an evaluation method by which a neuropsychologist or other professionals in the field collect data about a patient's cognitive, motor and behavioural abilities and functioning. It gives insight into an individual's brain functioning (Miller, 1992). For the neuropsychologist to interpret the data s/he also needs information about the premorbid life about the patient. Such assessments are made for the purpose of diagnosis, treatment, prognosis and rehabilitation of the patient. The main activity of neuropsychologists is the assessment of brain functioning through structured and systematic methods of assessing the brain-behaviour relationship (Miller, 1992). Some of the psychological abilities assessed include speed of information processing, attention, memory, language, visuospatial, motor and executive functions (Lezak, Howieson and Loring, 2004). Tests are an integral part of this process (Miller, 1992). They are generally administered to one person at a time with one examiner in a quiet office without any distraction.

The above mentioned abilities are major aspects that determine a person's neuropsychological health and therefore, one's everyday functioning. It should therefore, be recognized that neuropsychology today is a very important aspect of health-care provision. For one to enjoy a good quality of life, not only should his/her physical health be optimal but also his/her neuropsychological health. Neuropsychological health determines one's quality of life because with a poor health, one is unable to function effectively even in everyday simple tasks (Tozzi, et al. 2003).

Not only has the above reason brought the realization of the importance of neuropsychology today but also the fact that it has been discovered that a lot of physical ailments and traumas do result in poor neuropsychological health. For example, some of the major causes of poor neuropsychological health include Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) (Tozzi et al., 2003), malaria (Fernando et al 2010), Hyper tension (Drachman, 2005), stroke (Saxena, 2006), brain tumours (Fox et al 2006), head traumas (Fox, Mitchell and Booth-Jones, 2006) and many more. These are common conditions.

Neuropsychological tests are specifically designed tasks used to assess cognitive and motor functioning (Miller, 1992). As mentioned above, the usual neuropsychological tests measure sensation and perception, motor skills, attention, visual spatial skills, language abilities, recall and recognition memory, and executive functions. Performance on neuropsychological tests is usually assessed by comparing to the average performance of large samples of normal individuals (Attix et al, 2008). Therefore, most tests have manuals with tables of these normal scores, often divided into groups based on demographic variables like age and education that are known to impact on cognitive functioning (Barry, 2012).

Neuropsychological tests are only an estimate of the patients' highest level of cognitive performance (Miller, 1992). To make a more accurate estimation, factors such as age, ethnicity, sex and education are taken into account when interpreting neuropsychological test results (Barry, 2012). Education is one major demographic variable that is always used in assessing clients' performance on neuropsychological tests. Years of education or level of education has been traditionally used in the interpretation of neuropsychological test performance (Lezak, Howieson and Loring, 2004). Education plays a very big role in performance on neuropsychological test. Lezak, Howieson and Loring (2004) even argue that ill-educated yet cognitively healthy individuals perform worse than well-educated individual who are mildly compromised cognitively.

While many neuropsychological studies use level of education, in this study however, the quality of education was used. The use of the quality of education was necessitated by the fact that the level of education may not be a sufficient measure of education attainment when interpreting neuropsychological test performance. For example, Lezak, Howieson and Loring (2004) propose that level of education be used together with quality of education when interpreting neuropsychological test results. Manly (2005) on the other hand proposes that quality of education alone be used as a measure of education. In a study by Manly, Jacob, Touradji, Small and Stern (2002), it was found that quality of education had effect on performance on neuropsychological tests.

It is worth noting that Quality of Education is a complex and multifaceted concept. A lot of researchers and institutions define quality of education differently. However, in this study quality of education refers to the standard, worthy and value of the whole educational experience obtained from school. This is determined by the resources available during the process of education while years of education are the actual years completed in formal education (UNICEF 2000, Pigozzi 2008, MOE 2008). In this regard for this study, three factors of quality of education were included namely: quality of learning, quality of teacher and quality of school.

Education quality has many aspects and different indicators are used by different organizations to measure it. The Ministry of Education (MOE) measures it by assessing if the educational priorities are met. The MOE's priority for basic schools for instance "…is to ensure that pupils master essential literacy and numeracy skills…" (MOE, 1996: 45) and for the upper basic schools, the priorities are that there should be "…competence in communication and mathematical skills and problem-solving…" (MOE, 1996:45). However, these are more of outcomes based indicators from particular schools and individual students therefore, some have argued that this may not be a sufficient measure. Furthermore, the current MOE guideline for educational standards in schools measures quality of a school by its environment including the number of girls/boys per toilets, desks, textbooks, pupil-teacher ratio, and contact hours in addition to the attainment of grade-appropriate skills.

Still more other measures of quality of education have been used by different organizations and researchers. For example, the United Nations Statistical Institute for Asia and the Pacific (SIAP)-Asian Development Bank (ADB) Country Training Workshops on Millennium Development Goals (MDGs) (2009) uses pupil-teacher ratio, teacher qualification, teaching materials and classroom environment while the European Commission Directorate-General for Education and Culture assesses quality of education by using attainment, success and transition, monitoring of education indicators and indicators on resources and structures.

In contrast, Pigozzi (2008) only looks at input in the learning process as a measure. The environment in which a pupil learns from cannot be overlooked as a measure of quality of education. It has been found that a small ratio of pupil-teacher indicate that pupils will have a better chance of contact with the teachers and hence a better teaching/learning process (Pigozzi, 2008; SIAP/ADB Country Training Workshops on MDGs, 2009). Teacher qualification also indicates general quality of the teaching process. "Teachers' academic qualifications, together with pre-service or in-service teacher training, correlate strongly and consistently with pupils' scholastic performance" (SIAP/ADB Country Training Workshops on MDGs, 2009). Other resources that indicate education quality are building and sanitation standards, furniture and equipment, (Pigozzi, 2008). As can be seen from the literature above and other studies (Bellel, 2009; Coles 2001; Goe & Sticker, 2008; Lonsdale, 2003; Manly, 2005 and Manly Jacobs, Touradji, Small & Stern, 2002), educational attainment is more than just number of years spent in an educational institution.

In this study, quality of learning, quality of teacher, and quality of school are used to obtain a more comprehensive measure of quality of education. These three measures are more inclusive of the most important aspects of quality of education. In this study, quality of education focuses on the quality of learning, teachers and the school. The measurement of these resources was used as a measure of quality of education. The resources measured are those that MOE requires as pivotal resources for high quality schools in Zambia.

Aspects of the environment that the MOE inspects in schools such as number of water and hand wash sinks, finely finished walls, floors, roofs and others, were not included in the measurement of quality of education as they are not the primary indicators. Aspects used in this study are those that the MOE (1997) considers pivotal and these are; pupils' learning (reading materials [ratio of one book to one pupil], textbook, supplementary readers) and the qualification of teachers (for grades 1 to 7 the teacher should hold a Zambia Primary School Certificate; for grades 8 to 9 the teacher should hold a Diploma in Education and Bachelor of Arts, Bachelor of Science or Bachelor of Education and for grades 10 to 12 the teacher should hold a Diploma in Education and Bachelor of Arts with Education, Bachelor of Science with Education or Bachelor of Education). In addition, the school environment (teacher-pupil ratio [35 pupils per class with one teacher at a time is ideal] (MOE, 1997) were also included.

Quality of learning is the standard with which pupils are involved in the learning process. This involves the active participation of the pupil. The factors needed are materials such as reading materials, reading environment [library] and other learning facilities such as laboratories. These materials and facilities are known to affect educational achievement and cognitive development (MOE 2008). The availability of libraries, books and laboratories implies that pupils are actively involved in learning therefore, their information processing and memory is developed (Stanovich and Cunningham, 1993). Studies among college students show the pupils from schools that encourage reading develop their cognitive abilities; memory, information processing, executive function and general cognitive ability (Whalen, 2010) and attention (Chateau and Jared, 2000).

Quality of teacher entails the academic and professional qualification of teachers. Research (Betts, Zau, and Rice, 2003; Ferguson and Ladd, 1996; Goldhaber and Brewer, 1997, 2000; Rowan, Chiang, and Miller, 1997) as sited by Zuzovsky (2003) and MOE (1997) show that qualification of teacher affects pupils' cognitive development and educational achievement and therefore, quality of education.

The teacher training [resulting in their qualifications] determines whether they will know the subject content and the teaching methods for the particular pupils they teach. For example, it has been found that skills development and achievement in mathematics (which involves information processing and attention), is very dependent on teacher knowledge of subject content (U.S. Department of Education, 2006).

Quality of school is another important factor to the quality of education one receives. Both negative and positive aspects in a school environment that determine the quality of education students receive from particular schools. According to Miller and Cunningham (2009), the school environment is more than just the physical component but the social and psychological aspects as well. They argue that "research beginning in the mid-1990s has focused on one or more of these aspects and has associated classroom environment variables with numerous positive and negative student outcomes," (Miller and Cunningham, 2009:1). These indeed have been found to affect the cognitive development and educational outcomes.

Regarding the school environment, theorists such as Bronfenbrenner (1977) have proposed explanations of how the environment such as one at school impact on how the person develops into adulthood. Bronfenbrenner (1977) explains the development of a human being as being the product of the interactions of different parts of his environments such as his home, school or club among others. He calls these different parts subsystems. These subsystems have different components that the individual interacts with therefore, impacts on his outcomes or development. So the school as a subsystem also has different components that influence the educational outcome of the individual.

1.1 Background of the study

This study was carried out in Zambia which is a large Sub-Saharan African country. Zambia constitutes a relatively huge part of Central and Southern Africa with a total land area of 752,614 square kilometres and a population of 13,046,508 (State House 2011). It is landlocked, with eight neighbouring countries: the Democratic Republic of Congo, Mozambique, Angola, Malawi, Namibia, Tanzania, Botswana and Zimbabwe. Zambia became an independent Republic in 1964 and is a former British colony.

Since Independence, Zambia has placed high priority on education and has seen education as the main avenue by which the country will develop its human resource, and economy therefore, bring about industrial development (Southern and Eastern Africa Consortium for Monitoring Quality of Education, 2012). Since then, Zambia has seen an increase in the school completion rate at different levels.

However, MOE (2008) regrets the drop in the quality of education at all levels. It indicates that "while the numbers that pass through an education system are an important indicator of level of access and participation … it is only when those pupils show proof of learning that the system will be said to be providing quality education" (MOE 2008:42). As is the argument of this researcher, MOE points out that high quality education results in cognitive development and thus knowledge and skills. These skills and knowledge should be useful enough that pupils are later able to use them in their own lives. For such attainment to occur, schools should have sufficient qualified teachers, learning materials, facilities such as libraries and sufficient hours of learning among others. However, Zambia has seen an erratic supply of reading materials and availability of teachers in schools (MOE, 2008). The report further indicates that Zambia also falls behind in the numbers of school hours in a year compared to the rest of Sub-Saharan Africa. However, this situation in Zambia varies widely depending on the type of school. For example, grade 10 pupils in private/mission schools spend at least 6.9 hours per day while those in public schools spend 6.3 hours and 6.2 hours in community schools a day at school (MOE, 2008).

The different kinds of schools have varying completion and passing rates. From this it is clear that the quality of education pupils receive is varied and may in turn affect what they attain from school despite having same number of years of schooling.

School environment also plays a big role in the quality of education provided. It provides an environment that is either conducive and encourages learning and teaching or does not encourage learning and teaching therefore, cognitive development. For example, the availability of a library has been found to encourage a reading culture in a school (Lonsdale, 2003; Zimmerman and Carlos, 1998). In Zambia only 314 libraries existed in secondary school: meaning that very few secondary schools have libraries, again adding to the disparity of quality of education schools provide (MOE, 2008).

After taking everything into account, it is noticeable that there exists a disparity between educational attainment and level of education in Zambia as in many other parts of the world.

That is not all, in addition to the dropping quality of education, Zambia does not have norms for the imported psychological tests it uses. The lack of suitable norms for the nation has led to the use of western norms with their tests which when used on the Zambian population do not reflect the factual test performance of individuals in such a country (Mulenga, Ahonen and Aro, 2001; Cave, 2008). This has led to the collection of Zambian norms for the Zambian Behavioral Battery. However, as traditionally done for educational attainment, only level of education norms are being collected.

This study investigated the effect of quality of education. The findings of this study will help clinicians provide tests with specificity thus reducing cases of under-diagnosis and over-diagnosis of patients.

1.2 Statement of the problem

The use of neuropsychological test in neuropsychological assessment is very reliant on normative data. In normative data, factors that affect neuropsychological tests are documented (Attix et al., 2008). This is valuable because it is only with this data that neuropsychologists can make reliable and valid interpretations of their patients' cognitive ability. A variety of factors do affect neuropsychological test performance therefore, it is imperative that such factors are investigated.

Nevertheless, Zambia does not yet have such normative data but they are currently being generated. In this vain data about education level in relation to neuropsychological test performance has been collected. However, Zambia since independence has provided different qualities of education with the help of different providers such as Christian (churches) and private providers (MOE, 1996), and in the recent past community schools (MOE, 2008). Level of education is not an appropriate measure of educational attainment (Lezak, Howieson and Loring, 2004; Manly et al., 2002, and Manly, 2005).

Furthermore, research has shown a fall in the quality of education being offered in Zambia (MOE, 2008). Some of the reasons put forward by MOE (2008) are that there is a reduction in numbers of teachers, reduction of some resources such as books and facilities such as libraries and laboratories. This has resulted in disparity between completion rates and educational attainment. For example, of all pupils who attained grade 12 in 2005 only 17.6% wrote their examinations and of these only 56.9% obtained a full school certificate, and in 2006 17.7% sat for their examinations and of these 61.25% obtained school certificates (MOE, 2008). Thus, implying that even the 82.3% pupils who did not sit for examinations will report having 12 years of education even if they do not hold school certificates. This shows a disparity between those who report to have 12 years of education and those who are considered to have acceptable educational attainment. Therefore, this study investigated whether the varied quality of education provided does affect performance on neuropsychological tests. Neuropsychological testing is very important in the provision of health care in Zambia. As the provision of

this service is increasing, there is need that all factors that affect neuropsychological test performance are investigated so that neuropsychologists can provide valid and reliable results to their patients.

1.3 Rationale

The quality of education one receives has got a great influence on what that person can do in their future life. It can actually be asserted that the quality of education is so important that it may impact on almost all spheres of a person's life. As it is well known education is very vital to the growth of the individual and economic development of a country. Individuals who have received quality education are better able to read, calculate and think analytically and therefore, they are not only able to look after themselves and benefit themselves but also contribute meaningfully to society. They are able to be in employment, farming, have healthier children and be involved in issues of governance (Moulton, 1997). For a person to achieve the above benefits, cognitive abilities have to be normal and well developed. The exposure to different qualities of education in different schools leads to different educational attainment for different individuals and therefore, can affect performance on neuropsychological tests. Abilities that are assessed in neuropsychological tests are to a great extent developed in these varied school environments resulting in varied extent of development (Manly, 2005).

When it comes to factors influencing test performance, many of the studies have focused on level of education, age, gender and ethnicity and not quality of education (Cave, 2008). What has been shown in the earlier studies is that apart from the so often used level of education, quality of education is also an important characteristic that is associated with cognitive functioning (Manly, 2002; Manly, 2005; Cave, 2008; Cave and Grieve, 2011). There is therefore, need to fully understand how quality of education relates to neuropsychological test performance especially in an environment with very varied qualities of education. Number of years completed in school does not necessarily translate into educational attainment. While much of the literature shows the effect that the level of education has on the general performance of an individual on the

neuropsychological tests, there still remains a gap in knowledge with regard to how quality of education may directly influence test performance especially in a developing country like Zambia. Undertaking this study in Zambia helps in giving better understanding of how quality of education relates to neuropsychological test performance.

More specifically, clinicians will have a reference so as to compare the clients' score to others of a similar quality of education background. Lastly, information obtained from this study will advance the field of neuropsychology in Zambia.

1.4 General objective

The overall aim of this study was to investigate how quality of education relates to performance on the Zambia Neurobehavioral Test Battery.

1.4.1 . Specific objectives

The specific objectives were:

1. To establish if the study participants' quality of learning affects their neuropsychological test performance.
2. To establish if the quality of the teacher affects study participants' neuropsychological test performance.
3. To establish if quality of the school affects the study participants' neuropsychological test performance.
4. To establish if there is a significant difference in mean neuropsychological test scores between participants who received the high quality of education and those who received low quality education.

1.4.2 . Hypothesis

The hypotheses for this study were as follows:

1. The study participants' quality of learning positively affects their neuropsychological test performance.
2. The quality of teachers positively affects the study participants' neuropsychological test performance.
3. The quality of the school has a positive effect on the study participants' neuropsychological test performance.
4. The study participants who received high quality education perform better than those who received low quality education on the neuropsychological tests.

CHAPTER TWO

LITERATURE REVIEW

2.1. Quality of Education

This study focused on three aspects of the school which are also measures of quality of education one receives. These aspects are the quality of learning, the quality of teacher and the quality of school.

High quality of learning has shown to influence development of memory, attention, information processing, executive function, general cognitive ability (Whalen, 2010), attention (Chateau and Jared, 2000) and verbal fluency. Reading is also a big component of quality of learning. The above studies investigated the degree of influence that reading had on college students' cognitive development. Both these studies found that exposure to print material had a positive effect on the students' cognitive abilities.

To promote reading, schools are supposed to stock sufficient reading materials for pupils. Reading materials in a school give pupils an opportunity to continue learning beyond what teachers teach. More learning takes place when the pupil is actively involved in the process. Reading is one such mode in which pupils get actively involved in their learning and increase educational attainment as it is well known that active learning is more effective than passive learning (McKeachie and Svinicki (2006). The MOE recognizes this and requires that schools stock sufficient reading materials. Reading materials are one of the indicators that Eeducation Standards Officers inspect in schools (MOE, 1997). A study by Stanovich and Cunningham (1993: 224) showed that "print exposure accounted for a sizable portion of variance in measures of general knowledge, even after variance associated with general cognitive ability was partialed out". This study involved exposure of the study subjects to different media such as print and television. They found that exposure to print materials had a greater predictive power of knowledge acquisition than exposure to television or general knowledge (Stanovich and Cunningham, 1993). `On the whole it has been found that having sufficient reading material does positively

affect memory, learning, and educational attainment and therefore, quality of education pupils obtain.

The quality of learning also strongly relies on reading and amount of time spent in school. A variety of studies have shown a linkage between the hours spent on learning and pupils' educational outcome. With increase in cognitive ability particularly with memory, information processing speed and executive function the pupils end up with higher educational achievement. For example, Aronson, Zimmerman and Carlos (1998: 3) hold that "majority of studies find that increasing students' time-on-task leads, at best, to modest increases in [educational] achievement."

In addition, the hours pupils spend at school strongly correlates with the time pupils spend on learning therefore, quality of learning. In another study, Bellei (2009) used an experiment study design. Bellei (2009) manipulated the pupil's learning time in different groups; in one group pupils were put in a programme at school where they had more learning hours and the other group in municipal schools pupils had the usual [less] learning hours. The study showed several findings; firstly, it was found that the pupils' achievement on the programme had a statistically significant positive effect on mathematics and language. The effect size of the programme on language and mathematic achievement was very robust contrary to the achievement of pupils in the control group. These effects were constant over time. In addition, "the program increased not only the average achievement of participants but also the dispersion of their academic achievement" (Bellei, 2009: 637). The cognitive abilities used in learning language and mathematics include verbal fluency, memory, attention, information processing speed, executive function and visual spatial. This study is a very good example of studies that indicate that measurement of educational attainment should include input into the system especially that time spent learning is an important factor. It is for this reason when measuring quality of education [learning] MOE considers contact hours (MOE, 2008).

The second factor that contributes to quality of education is quality of teachers. In this study quality of teachers is measured by the qualification of teachers. The qualification of

teachers affects the cognitive ability and in turn educational attainment of pupils. The quality of a teacher as measured by teacher qualification has a big part to contribute to the quality of education. Zuzovsky (2003) sites a number of studies (Betts, Zau, and Rice, 2003; Ferguson and Ladd, 1996; Goldhaber and Brewer, 1997, 2000; Rowan, Chiang, and Miller, 1997) that have demonstrated positive effects of degrees on the pupils' cognitive abilities hence educational outcomes. Some of these studies used experimental study designs and proved these positive effects. These effects are especially strong in cases where teachers have degrees not just in teaching but also the subject they teach (Darling-Hammond, 1999, 2000b; Goldhaber and Brewer, 2000; Guyton and Farokhi, 1987) as cited by Zuzovsky (2003). How a teacher teaches strongly depends on how prepared they are to teach. If a teacher understands very well theories of teaching, methods and subject content s/he can easily adapt a particular method depending on the class situation. This in turn contributes to the educational attainment of their pupils. MOE appreciates this fact and for that reason it has in the recent years encouraged more teachers to be trained pre- and in-service (MOE 2008).

In a study to ascertain quality of teachers, Goe and Stickler (2008) found a strong correlation existing between the attainment of secondary school pupils and subject expertise of their teachers. Subject expertise was measured by the teachers' qualifications. It should be noted here that for pupils to achieve highly in different subjects pupils need strong executive function, memory, information processing speed, attention while more practical subjects may also need strong motor and visuospatial abilities, and language needs verbal fluency. However, this relationship was seen to exist more strongly for secondary school pupils' outcome than that of primary school pupils'.

The quality of school is the final aspect of quality of education that is the focus of this study. One important component of the quality of school is the ratio of pupils to a teacher known as teacher-pupil ratio. Different schools have different teacher-pupil ratios. The teacher-pupil ratio determines educational outcome of pupils. The number of pupils a teacher manages determines the amount of attention that s/he gives to the individual pupil. The more pupils one teacher has, the less attention s/he gives to the individual

pupil, thus reducing on quality and ultimately what each pupil obtains from school. The size of the class not only affects the class management by the teacher but also the amount of attention the teacher gives each individual pupil and ultimately the amount and quality of teaching taking place in the class. Teachers tend to use the same methods of teaching for different sizes of the class even though one method may not be appropriate for a large class. The methods a teacher uses for either a large size or small size class determine whether pupils develop information process speed and executive function as explained by Manly (2005). She discusses skills such as 'test wiseness' [skills used when taking tests] which are developed in high quality schools.

As Miller and Cunningham (2009:1) argue "although teachers tend to use similar instructional strategies whether teaching large or small classes, there is some evidence to suggest that more class time is spent on administrative tasks for larger classes, leaving less time available for instruction." This results in poor quality teaching if a large class is involved. And "some research has suggested that differences in academic outcomes (are) based on class size [and that] larger classrooms are frequently accompanied by lower levels of academic achievement," (Miller and Cunningham 2009:1). Clearly this is a result of reduced teaching time and increased time spent on class management thus affecting quality of school.

Another aspect of the quality of school is the presence of facilities such as libraries and laboratories. A lot of research has been conducted about effects of presence of libraries in schools and a positive relationship has been found between the presence of libraries and achievement in school. In Lonsdale (2003) meta study, she presents an overview of the evidence that there is a strong relationship between school libraries and pupil school achievement. She lists some findings from studies conducted before 1990 and hold that these studies indicate that pupils in schools with good libraries perform significantly better on tests for basic research skills, in reading comprehension and in their ability to express effectively ideas in relation to their reading. In addition, more reading occurs when there is a school library (Lonsdale, 2003). This study shows evidence of a strong positive relationship that exist between the presence of a library in a school and

educational achievement therefore, showing us that environment of a school has a great bearing on educational outcomes rather than mere number of years spent in school.

Other studies (Zimmerman and Carlos, 1998) have further gone to assert that even the quality of a library has an effect. Such evidence should not be ignored when a measure of education is being sought.

It should be borne in mind that facilities and resources found in school do add to what an individual obtains from those schools. It is from such a premise that studies contend that private schools have a higher quality of education than public schools (Cave, 2008). Most private schools put in more resources into the school than public schools and these resources result in high quality of education (Pigozzi, 2008).

2.2. Neuropsychological Test Performance and Quality of Education

The value of neuropsychological tests is for effective diagnosis, placement, treatment and rehabilitation. As already mentioned, neuropsychological assessment is not a direct measure of brain function but estimation (Miller, 1992). As such a lot of factors affect this performance therefore, it is imperative that the effect of quality of education is given sufficient attention in the interpretation of neuropsychological test performance.

It is for this reason that Lezak, Howieson and Loring (2004) recommend the use of quality of education together with the years of education rather than years of education alone for norms because individuals with similar levels of education may attain different knowledge and skills levels due to different qualities of education obtained.

However, other researchers such as Manly recommend the use of quality of education alone. Manly (2005:173) wrote a commentary that showed “the advantages and disadvantages of establishing separate norms for African Americans and to highlight the

importance of clarifying the independent influences of race, culture, educational experience, and socioeconomic status on neuropsychological test performance". The focus was to disband ethnicity and education. Manly (2005:173) points out that a large discrepancy between years of education and quality of education exists especially so "among ethnic minorities and immigrants." She states that the use of standard norms for all races disadvantages minorities such as African Americans because of different experience, different culture, educational experience and socioeconomic status as a race. She does point out that quality of education does affect performance on neuropsychological tests. Therefore, she recommends separate norms for minorities such as African American. This point can be extended even to the Zambian population in that different sectors of this society get different educational experiences.

Different schools offer different experiences therefore, different methods of "problem-solving …knowledge, familiarity, and practice could explain why some African Americans obtain lower scores on cognitive measures even after controlling for years of education" (Manly, 2005:173). She further contends that controlling for years of education may be insufficient or improper because different ethnic groups use different measuring scales. She advocates for use of quality of education rather than years of education as a true measure of educational experience. Indeed years of education do not seem as sufficient measure of educational attainment.

Studies on this subject have been conducted in a variety of places including Africa and different authors operationalize quality of education differently. In South Africa a study by Cave and Grieve (2009), investigated the effect of quality of education on executive functioning test performance. High quality of education was measured as attending a private school and low quality was attending of a public school. In that study "the results suggest that there is a relationship between quality of education and neuropsychological test performance, particularly tests of executive functioning" (Cave and Grieve, 2009:42). They concluded that quality of education as a variable should be considered when developing neuropsychological tests, norms, when scoring and interpreting results from neuropsychological tests. They further suggest "that it is more useful to consider quality

of education," (Cave and Grieve, 2009: 45) than level of education. Such findings should not continually be ignored as doing so will continue to have a negative impact on diagnosis and treatment of cognitive impairments in patients. Neuropsychological tests are not a direct measure of the brain-behaviour relationship (Miller, 1992), so measures that make assessment more accurate should be adopted.

The South African education system, similarly to the Zambian one, has been seen to provide different qualities of education. Skuy et al (2001) assert that these differences in formerly white and formerly black schools have continued today even with the change of the government system. These differences resulted in differences in test performance seen in studies in South Africa (Skuy, 2001; Avenant, 1995 and Cave, 2008). Avenant (1995) compared the performance of black South African university students to the American standardization sample on the Wechsler Adult Intelligence Scale (WAIS). The study shows validity but a weakness of the study is that it did not actually measure quality of education systematically but relyied on literature to conclude that the American sample had received better education quality than the South African one. The American sample was said to have received better quality of education than the South African sample. The South African sample performed poorly in comparison to the American WAIS standardization sample. Poor performance was attributed to lower quality of education for the South African sample.

Shuttleworth-Edwards et al (2004) conducted a study among two South African groups across three variables and administered the Wechsler Adult Intelligence Scale (WAIS-III). The participants were either Whites whose first language was English or Black with a Black South African first language, having attained 12 years of schooling or graduate level education and either having low quality of education or high quality of education. Education quality was said to be high if one went to a white private school and low if one went to a formerly Department Education Training school. After comparing these three variables and analysing the results from the WAIS-III, it was found that there were noticeable differences in level of education, language and more so in quality of education

between the two groups. Participants with higher quality of education performed better on WAIS-III regardless of their first language or race.

On the other hand, an investigation among school going children was carried out by Cave (2008). Quality of education was measured by the kind of school participants attended: whether one attended a private school or a public school. Private schools were seen as providing higher quality of education than public schools. The comparison was made between executive function test performance of private school and public school children. Children from the private school performed better indicating that quality of education does have an effect on performance on neuropsychological tests.

Another study by Cassimjee and Murphy (2009) was done in South Africa. This study used variables of formal education and language in the South African context because of the distinctive cultural and diverse educational setting moulded by its history of apartheid. The study findings show that "there is a highly significant effect for socio-cultural factors encompassing both school and home environmental circumstances," (Cassimjee and Murphy, 2009: 3). These environmental circumstances are what actually affect quality of education and in turn educational attainment. Quality of education was measured by the quality of the school environment. From this understanding, it can be seen that quality of education affects performance on neuropsychological performance. In this study, the school environment was found to have a strong effect on measures of executive functioning and verbal ability.

Even though the effects of language used at home and language medium used at school were more persistent than those of quality of education, their findings show significant effects of quality of education on performance of executive function and abstract thinking. The above cited South African studies are comparable to the Zambian environment because of the varied providers of education and quality of education.

In a study by Manly et al (2004: 37), "the independent effects of cultural and educational experience on neuropsychological test performance were explored among 503 non-

demented African Americans aged 65 and older." The researchers administered measures of acculturation and quality of education. Quality of education was found to be the most powerful predictor of performance on neuropsychological tests. This was the case even after controlling for age, sex, years of education and level of acculturation. The other variables had an effect on performance but not as strong as quality of education. The researchers concluded that "the results suggest that quality of education and cultural experience influence how older African Americans approach neuropsychological tasks; therefore, adjustment for these variables may improve specificity of neuropsychological measures" (Manly et al 2004: 37). These findings can be applied even to other populations other than American Africans.

In another important study by Mindt et al (2008) of neuropsychological test performance among HIV-positive English speaking Hispanics, they investigated the effects of quality of education, socioeconomic status (SES) and ethnicity. The performance of the Hispanics was compared to the performance of non-Hispanic whites. It was hypothesized that Hispanics had received low quality of education in comparison to their counterparts because of low resource input into schools in their communities. In addition, it was noted that the Hispanic population in the United States of America was said to be disadvantaged in a number of areas including education and literacy. Lower quality of education and lower literacy were found to be factors that contributed to cognitive functioning and the Hispanic were also risk factors in neurocognitive abnormality for greater decline in the face of neurological disease. Wide Range Achievement Test (WRAT-3) reading scores - which were used as a measure of quality of education - obtained and neuropsychological test performance were assessed among other factors. Quality of education was operationalized as reading level. In this study, even when level of education was moderate, the Hispanics' quality of education was low. Quality of education was found to be a big predictor of neurocognitive functioning. The explanation given was that low reading skills were due to poor quality of education, and low quality of education was attributed to low resource allocation to schools which most Hispanics attended. The low quality of education put the HIV positive Hispanics at a greater risk of neurocognitive impairment. The Hispanic sample performed poorly.

Manly et al (2002) wanted to establish if differences in quality of education might be responsible for the differences in performance on neuropsychological test scores between African American and White elders who had similar years of education. The study compared the performance of African American and non-Hispanic White participants on the neuropsychological tests. The participants were diagnosed as non-demented and neurologically normal by a neurologist. The Reading Recognition (WRAT) was used as a measure of quality of education. MANOVA was used for analysis. The findings showed that "African American elders obtained significantly lower scores than Whites on the measures of word list learning and memory, figure memory, abstract reasoning, fluency, and visuospatial skill" (Manly, 2002: 341) despite having similar years of education. Nonetheless, after controlling for quality of education differences between the two groups, neuropsychological performance differences "reduced and racial differences on all tests (except category fluency and a drawing measure) became nonsignificant" (Manly et al 2002: 341). This study shows quality of education is a better measure of education attainment than years of education and that adjusting for quality of education may provide more accurate neuropsychological diagnosis.

In another study, Ryan et al (2005) investigated neuropsychological test performance, quality of education and education levels among groups of racial background with advanced-HIV cohort. The study explored the association of education level with quality of education and determined whether discrepancies between the two explained the differences in performance on neuropsychological tests between HIV positive ethnic minority and Caucasians. The study included 200 participants from the Manhattan HIV Brain Bank. Significantly lower quality of education and level of education was found among African Americans and Hispanics. Furthermore, the quality of education accounted for worse neuropsychological performance.

Ryan et al (2005: 889) argue that "as years of schooling overestimated racial/ethnic minority participants' educational quality, standard norms based on education [level of education] may inflate impairment rates among racial/ethnic minorities thus indicating

the importance of educational quality in understanding racial/ethnic minorities' test performance." This may also apply to other populations such as Zambian one where different people receive a variety of qualities of education.

Another study by Morgan and Masiske (2008) show a slightly different result from most studies done on quality of education and its effects on test performance. This study was carried out among adults and the elderly. The comparison was between African and Caucasian American. The African Americans did perform poorer than their white counterparts. After controlling for quality of education, there was still a difference which led the investigators to conclude that quality of education alone could not explain racial differences in performance. Reduction in performance only occurred for measures that tapped into verbal abilities. Seeing that quality of education had some significant effect on neuropsychological test performance it should be considered as a measure of educational attainment.

A number of studies (Avenant, 1995; Cassimjee and Murphy, 2009; Cave, 2008; Manly et al., 2002; Mindt, 2008; Morgan and Masiske, 2008; Ryan, 2005; Cave and Grieve 2009, Shuttleworth-Edwards et al., 2004) have found that quality of education does have an effect on neuropsychological test performance. However, other studies such as the one by Byrd et al (2005) have found contradicting results. In their study they investigated within group variations in the role of age, education, quality of education and performance on neuropsychological test performance among the African American adults born in the Caribbean Islands living in the United States of America. The investigators hypothesized that the Caribbean-born African Americans would perform better than American-born African Americans because the Caribbean-born had received better quality of education. Their earlier studies had shown that quality of education explain the differences in performance. This is the reason that led the study team to hypothesize that there would be no significant differences after statistically correcting scores for quality of education.

Their study used measures that assess cognitive impairment in dementia of the Alzheimer's type. Though both groups had similar levels of education, their quality of education was significantly different; in that the Caribbean-born performed better on the measure of quality education. However, the performance on neuropsychological battery was similar for both groups. This is not what the investigators expected. They had expected both quality of education and neuropsychological performance to be different between the two groups. Even though the Caribbean-born showed that they had received higher quality of education, they did not perform any better on neuropsychological measures.

Similarly, Byrd et al (2006) carried out a study about early environmental factors (including quality of education), ethnicity and cognitive performance among adults. This study hypothesized that a significant difference would be found in performance in neuropsychological tests among different ethnic groupings, even after correcting for "scores for age, gender, and years of education. It was also hypothesized that there would be significant ethnicity differences on our measure of early environment" (Byrd et al, 2006:245). In their definition of early environment, elements of quality of education were included among other elements. They further hypothesized that reports of participants' educational histories would correlate with neuropsychological test performance.

In this study a new interview-based scale was created and used in this study to find out whether retrospectively recollection of early environmental experiences [which might lead to knowledge and test-taking skills that would produce high test scores] were linked with adult cognitive ability and to what extent correction for these factors might lessen the discrepancy "in adult cognitive test performance between African Americans and Caucasians" (Byrd et al, 2006:253). The interview-based scale namely Background Interview Scale (BIS) includes questions from three sections about early educational experiences, socioeconomic factors and other factors that are thought to influence the development of cognition. "After removing BIS-related variance from age-, education-, and gender-corrected cognitive test scores, ethnicity was still a significant predictor of performance" (Byrd et al, 2006:255). This was because there was no difference in

performance between the two groups on the BIS. It was therefore, found that early environmental elements such as quality of education or reading materials at home did not explain the difference in performance in cognitive tests among adults. This may be due to the fact that the measure of early childhood experience may not be entirely accurate because the participants may not be entirely objective in giving a self-report.

Overall, there are far more studies that show an effect of quality of education on performance on neuropsychological tests.

CHAPTER THREE

3.0. METHODOLOGY

This study was part of a larger normative study for the Zambia Neurobehavioural Battery in Zambia.

3.1 Study Design

This was a quantitative study. A cross sectional comparative design was used. This was used to determine the effect of quality of education on performance on neuropsychological test performance.

3.2 Study Sample

There were 290 study participants who were selected on the basis of stratified random sampling method. These were between 18 years and 65 years of age with academic education ranging from 8 years of education to more than 13 years. Of these 241 participants had low quality of education and 49 had high quality of education. Of the total sample, 144 participants were females while 146 were males.

3.3 Study Sites

This study was conducted in both urban and rural areas of Zambia. Sites in urban areas included the University of Zambia Clinic, Mtendere Clinic, Chelstone Clinic and Chilenje Clinic. Rural areas included health posts that fall under Chongwe Health Centre, Chibombo Clinic and Kafue Clinic. The selection of rural and urban areas was according to the Ministry of Health description of rural and urban. The participants from these rural areas were coming to study sites from the deep rural places hence were seen to be appropriately and fairly representative of the Zambian rural dwellers. Of the 290 participants, 131 were from the rural areas and 159 of the participants were from urban areas of Zambia.

3.4 Inclusion and Exclusion Criteria

To be part of the study, the following inclusion and exclusion criteria was applied:

Inclusion Criteria

The individual had to:

- Be HIV negative. This was confirmed by means of a rapid HIV-1 antibody test.
- Have 8 years of education and above.
- The individual had to be aged between 18 years to 65 years.
- Understand English as per Writing and Read Ability Test results.
- Neurologically normal (i.e. having no central nervous system disorders) as per Neurobehavioral Medical Screen results.
- Be a non-drug abuser as assessed by the Substance Use and Chinese Substance Use History Questionnaire.
- Have had no history of Psychiatric illness as per Composite International Diagnostic Interview and the Beck Depressive Inventory results.

Exclusion Criteria

Individuals were excluded if found to:

- Be HIV positive.
- Have a psychiatric disorder such as depression, schizophrenia, epilepsy, etc.
- Neurologically abnormal (i.e. having central nervous system disorders) as per Neurobehavioral Medical Screen results
- Be abusing drugs.
- Have less than 8 years of education.
- Be below the age of 18 years or above 65 years.
- Be unable to read, write and comprehend English as per Writing and Read Ability Test results.

3.5 Procedure

3.5.1 Screening Procedure

Consent was initially obtained and then each participant underwent the following:

Ability to speak and understand English

All the neuropsychological assessments were conducted in English therefore, all potential participants' ability to use English was assessed using the Writing and Read Ability Test (WRAT). After scoring only participants who were scored as having sufficient ability to understand and use English were included in the study.

Psychiatric and Drug Abuse Assessment

The psychiatric and drug abuse assessment was conducted by administration of the Composite International Diagnostic Interview (CIDI). For depression the Beck Depression Inventory (BDI) (Beck, 1987) and the Brief Symptom Inventory (BSI) were administered.

Everyday Functioning Assessment

The everyday functioning assessment was conducted by use of the Frontal Systems Behaviour Scale (FrSBe), Independent Activities of Daily Living Scale (ADL) questionnaire and the Patient's Assessment of Own Functioning Inventory (PAOFI). These measured daily functioning level, one's difficulties with memory, language and communication, use of hands, sensory-perception, higher level cognitive and intellectual functions, work, and recreation.

Neuro-medical Evaluation

The neuro-medical examination was carried by systematically reviewing of past medical and neurological histories and review of systems.

Medical Screening Interview

Medical screening interview was conducted and behavioural notes summary taken during administration of the tests.

Psychiatric and Drug Abuse Assessment

The psychiatric and drug abuse assessment included the use of the Composite International Diagnostic Interview (CIDI) which provides results in terms of presence or absence of DSM-IV/ICD-9 diagnosis of present or past depression and substance disorders. The severity of depressive symptomatology was collected using the Beck Depression Inventory (BDI). The BDI is a 21-item self-report scale with each item having 4 response options of graded severity. The inventory focuses on an individual's life for two weeks prior to the assessment.

3.6 . Measure

3.6.1 . Quality of Education measures

Quality of Education three factor index

Development & Background

This measure for quality of education was developed particularly for undertaking this study. A self-reporting questionnaire (see **Appendix C**) was developed for the use of collection of information on the quality of education participant's had received. The three aspects of participants' quality of education measured using this tool were quality of learning, quality of teachers and quality of the school itself. The researcher administered a questionnaire to the individual subjects. For the purposes of scoring, scales (see in **table 3.1**) were developed and made use of in the rating of each participant's quality of education received.

Table 3.1: Indexing of Quality of Education

Low quality of learning	Having had two or more of the following: less than 6 hours learning, less than 2 hours of studying and inadequate reading materials.
High quality of learning	Having had two or more of the following: more than 6 hours learning, more than 2 hours of studying and adequate reading materials.
Low quality of teachers	Having had teacher(s) with less than Diploma qualifications.
High quality of teachers	Having had teacher(s) with a Diploma and above qualifications.
Low quality of school	School not having two or more of the following: library, laboratory and adequate desks.
High quality of school	School having two or more of the following: library, laboratory and adequate desks.
Low Quality of Education	Having two or more of the following: low quality of learning, low quality of teachers, and low quality of school.
High Quality of Education	Having two or more of the following: high quality of learning, high quality of teachers, and high quality of school.
Quality of Education	A sum total of an individual's rating on quality of learning, quality of teachers and quality of school.

To increase validity of the quality of education questionnaire only data from participants with eight years of education or more was analysed.

3.6.2 Neuropsychological measures

Neuropsychological battery

The neuropsychological measures used in the study were selected to assess cognitive functions that are typically affected by HIV/AIDS and have been shown to effectively distinguish between HIV negative and HIV positive individuals (Cysique et al, 2007).

The tests in the neuropsychological battery included Hiscock Digit Memory Test for screening effort; Hopkins Verbal Learning tests and Brief Visuals Memory Test-Revised for memory (learning and delayed recall); Trial Making Test Part A, WAIS-III Digit symbol and Symbol search for measuring information processing speed; Grooved Pegboard for motor dominance, and WMS-III Spatial Span and Paced Auditory Serial Test for assessing attention and working memory. Included in the battery are tests that measure executive functions (Wisconsin Card Sorting Test, Colour Trails, Stroop Colour Word Test and Category Test) and tests that assess language (Controlled Oral Word Association-FAS and Category Fluency [Animals, Action]). All these tests have good reliability and validity as will be seen below. For the actual tests and test administration see **Appendix D.**

The Hiscock Digit Memory Test (HDMT)

Background and development

The Hiscock Digit Memory Test has been designed to clinically identify an individual thought to be purposefully feigning or faking memory impairment (Prigatano et al, 1997). The 18-item HDMT is usually administered in order to reduce the time demands of the neuropsychological evaluation.

Reliability and validity

There is overall excellent specificity and a very low rate of false positive. The Hiscock and Hiscock (1989) validity and reliability study showed that HDMT had high validity and reliability. They ran the HDMT, Weschler adult Scale, Trails A and B, Wisconcin Card Sorting Test and other tests on a 45 year old male patient who said he had a memory

loss after a head injury. Two other subjects served as controls: a severely cognitively impaired 53 year old woman with Alzheimer‘s and a normal 5 year old girl. In another study by Prigatano et al (1993), conducted among 37 participants (with 27 who had some cognitive impairment and 10 cognitively normal participants) showed that validity and reliability was high.

The Hopkins Verbal Learning Test-Revised (HVLT-R)

Background and development

It measures an individual’s capacity to retain, reproduce and recognize information after delay (Strauss, Sherman and Spreen, 2006). The HVLT-R which was used in the Zambia Neurobehavioral Battery is comprised of 12 nouns with four words drawn from three semantic categories. Some changes have been made to some words to make the test more adaptive to the Zambian situation.

Reliability and Validity

Woods et al (2005) asserts that replicated presentation of the same items supports the reliability and construct validity of the standard learning and recall measures on the HVLT-R**.** A study by Shapiro et al. (1999), found that the HVLT-R has a strong correlation with other tests of verbal memory. This finding shows that the HVLT-R has high validity as a test of verbal learning and memory. In addition, Woods et al. (2005) also found that HVLT is both a reliable and valid test of the verbal learning and recall.

The Brief Visuospatial Memory Test-Revised (BVMT-R)

Background and development

The BVMT-R measures visual learning and memory using multiple trial lists learning model. It offers a measure of instant recall, learning rate as well as delayed recall and recognition for visuospatial information. It is essentially a test of learning figures developed by Benedict in 1997. “The BVMT-R assesses visual learning and memory after a multiple-trial list learning paradigm,” (Strauss, Sherman and Spreen, 2006:701).

Reliability and Validity

According to Cherner et al (2009), the existing BVMT-R was standardized and normalized with 588 healthy English-speaking adults ranging in age from 18 to 79 years (M=38.6 S.D = 18.0), with a mean education of 13.4 years (S.D = 1.8). Cherner et al (2007), note that demographic effects on test performance plays a significant role especially literacy and/or education factors, cultural diversity and degree of acculturation. It is for this reason that users of this test are cautioned in their interpretation of the scores.

Grooved Pegboard

Background and Development

It is a test of fine motor speed. In this test, the participant has to place 25 metal pegs into grooves on a metal board. All pegs are the same, have a square side and round just like the hole on the board. The subject starts with the dominant hand. S/he is instructed to put the pegs in the holes as quickly as she/he can. They do the same with the non-dominant hand. The time for every hand is noted down.

Trails Making Test

Background and Development

Trail Making Test A measures psychomotor speed, attention and cognitive sequencing. The Test consists of 25 numbered circles distributed over a sheet of paper. Participants sketched lines to link the numbers in ascending order. Participants connected the circles with numbers as rapidly as they could, without lifting the pen or pencil from the paper. Errors were pointed to participants and they corrected them immediately. Performance was recorded as the total amount of time it took to complete the task. The tasks were discontinued after five minutes.

Reliability and Validity

Trail Making Tests A and B are measures of attention, visual searching, mental processing speed and the ability to mentally control simultaneous stimulus patterns. These tests are sensitive to global brain status but are not very sensitive to minor brain injuries. A study by Wagner et al. (2011: 314) compared "the processing times of four

alternate versions of the Trail Making Test (TMT) A and B in patients with Major Depressive Disorder (MDD. Fifty-five subjects with DSM-IV MDD were included in the study." To avoid practice effect they used different versions. They analysed the processing times mean besides retest reliability of the four versions of TMT A and B. It was found that the mean processing times was not different amongst the four versions of TMT A and B that they used. They also found that retest reliability was between 0.76 and 0.89 for A and between 0.86 and 0.94 for B (Wagner, 2011), thus showing high reliability.

Color Trail Test (CTT):

Development and Background

The Color Trails Test (CTT) is known to be a culture-fair test of visual attention, grapho-motor sequencing and effortful executive processing abilities. It also measures visual search and motor function. In the adult test people between the ages 18 to 89 years and then for children test (CCTT) only ages 8 to 16 years are considered. This means that people of the age 17 years were not catered in these tests. Unlike the TMT, the CTT minimizes the influence that language has hence its culturally fairts. In this test Part 1 is similar to Part A of TMT. The only difference is that the numbers are in colored circles (old-numbered circles are pink and all even-numbered circles are in yellow). Likewise Part 2 is similar to TMT part B but the circles are colored (Strauss, Sherman and Spreen, 2006).

Reliability and Validity

On the subject of the validity of the tests, Maj et al., (1993) (as cited in Strauss, Sherman and Spreen, 2006) report moderate correlations between CCT Parts 1 and 2 with TMT A and B of .41 and .50, respectively.

WMS III Spatial Span

Development and Background

The WMS III spatial span test is a component of this battery specifically used to measure working memory and attention. It assesses visual attention and memory and was derived

from the Corsi blocks test developed by Corsi in the 1970s. The WMS-III Spatial Span task is a test of working memory. It specifically assesses patients' ability to hold a visual-spatial order of positions in working memory.

Reliability and Validity

Very little research has been done on this test. Research of the validity of the spatial span has proved to be very complex and in addition, the three assumptions on which it is based have been questioned by several studies. Wilde and Strauss (2008) conducted a study to assess performance of a clinical population on the WMS spatial span subtest by comparing it to the Digit span. The study sample was 44 patients of head injury, seizure disorder and surgery. The patients' neuropsychological assessment performance was reviewed and with a Glasgow coma scale of 14 and no history of unconsciousness greater than 1 hour. The samples' average was educational level of 12.4 years and mean age of 37.1 years. Results showed that the raw scores for the forward digit span were higher than those for the forward spatial span while backward digit span results were lower than those of the backward spatial span. There were also generally similar raw scores for both the forward and backward spatial span results. This raised questions as to whether the spatial span is a valid measure of visual-spatial memory or perhaps its validity would be a more complex measure. Wilde and Strauss (2008) have concluded by cautioning the interpretation of the spatial span backward scores for clinical purposes. It is important to note however, that generally those who performed poorly on the forward spatial span test also did poorly on the backward span test.

The reliability of the spatial span is a good test or common test of degeneration due to the small practice effect it has (Nuechterlein et al., 2008). It nevertheless, demonstrates reliable change indices when there is deterioration in cognition. This was found in studies done in epileptic patients in whom subtests were administered before and after surgery in order to find assessments that can be used to monitor responses to treatment. Spatial span test indicated test-retest reliability and little practice effect (Martin et al., 2002).

In terms of interpreting spatial span task results however, caution should be taken by clinicians especially concerning the backward spatial span as a measure of working memory. The backward spatial span test seems to be affected by practice effect though it is negligible (Nuechterlein et al 2008).

The Wisconsin Card Sorting Test (WCST)

Development and Background

The WCST is a test of executive function (Lezak, Howieson and Loring, 2004). An increase in perseverative errors increases among individuals with frontal lobe dysfunction. However, a ceiling effect was observed with the normal participants, which could explain the reduced number of perseverative errors among the normal participants.

WCST was originally created as a test of 'abstract behaviour and shift of set.' It was initially created as 60 card test with one to four symbols. All cards were different and there were no two identical cards. The test taker had to match one of the cards at the bottom to those that are shown among the four (Lezak, Howieson and Loring, 2004).

Reliability and Validity

Paolo et al. (1995) investigated the construct validity of the Wisconsin Card Sorting Test besides the association between WCST test scores and memory and attention. The study recruited 187 normal elderly and 181 persons with Parkinson's disease. All cognitively normal subjects that scored below 130 on the Dementia Rating Scale were excluded because they were not supposed to display any signs of dementia. A score of less than 130 is associated with early dementia.

The results indicated that there was an increased number of perseverative errors among the subjects with Parkinson's disease than the normal. Thus indicating that an increase in perseverative errors increase among individuals with frontal lobe impairment showing the validity of the test as a measure of frontal lobe functions.

Bowden et al. (1998) studied the reliability and internal validity of the WCST. The study included 75 university students as a study sample to assess the reliability of the test. The subjects were administered two forms of the test one after the other. The first set was administered in the standard form while in the second form the administration was altered. The study found no practice effects. In addition, it showed low retest reliability and alternate form reliability with an average of r=.43 on Pearson's r implying that almost 80% of the results could be attributed to error variance.

It should however, be noted that the test procedure was changed in this study and this probably had effects on the results.

The reliability of the test is not optimal and caution should be taken mainly in the administration of alternate forms of the test. Bowden et al., (1998) also contend that due to its low reliability the test does not have very good specificity even if it reports high sensitivity to frontal brain lesions.

WAIS III – Digit Symbol and WAIS III - Symbol Search

Development and Background

Adult Intelligence Scale-III is one of the most used measure in many neuropsychological batteries is the Weschler (Strauss, Sherman and Spreen, 2006). In assessing the speed of information measures of WAIS-III the digit symbol and symbol search tests are used. Weschler, (1991) hypothesizes that measures for instance letter number sequencing, symbol search were established to assess working memory and processing speed. For this reason, the WAIS-III assesses verbal comprehension, perceptual organisation, working memory and processing speed (Strauss, Sherman and Spreen, 2006).

Reliability and Validity

Most studies that investigate the validity and reliability of Digit Symbol and Symbol Search have typically been integrated in the WAIS-III as a whole measure. In Gorsuch et al (2000) study prove the four description model of the WAIS-III, established that the duplication of the four – factor structure (verbal comprehension, processing speed,

working memory and perceptual organisation) exhibit the psychometric integrity of the WAIS-III and confirm to its transferability across cultural boundaries. This has been confirmed by studies across cultures and also the validity has also been confirmed in measuring cognitive decline in old age (Clay et al., 2009). "Those subsets that measure speed of processing show the greatest difference with increasing age," (Strauss, Sherman and Spreen, 2006:.289).

A study by Paul and Kreiner (2000), also proved the reliability of the WAIS-III across cultures in both the clinical and standardization sample. Among the 11 subtests included were the digit symbol and symbol search tests. They established that "none of the reliability estimates differed significantly from those reported for in the WAIS-III. Similar Symbol search and the digit symbol have interesting clinical findings and significance. "The processing speed index (PSI) is the most affected in many forms of brain insult" (Strauss, Sherman and Spreen, 2006:300). Therefore, PSI is the most sensitive in terms of criterion validity.

Controlled Oral Word Association Test (COWAT)

Development and Background

The test measures timed production of the words in controlled search circumstances. The COWAT is often known under the general term of 'verbal fluency'. Both COWAT and Category verbal fluency tasks are said to be sensitive measures of brain dysfunction (Lezak, Howieson and Loring, 2004; Straus, Sherman and Spreen, 2006).

Assessment of verbal fluency has long been an important component of clinical neuropsychological evaluation. Verbal fluency tests are not only used as measures of language but also executive function and semantic memory.

Verbal fluency is usually assessed in letter and category domains. The most used forms of fluency tasks are semantic and phonemic fluency. Marshal (1986), drew attention to the label 'word fluency' saying it is misleading because verbal productivity in a dialogue

or in continuous sentences is not measured. For this reason, Benton et al. (1994), suggest the term 'Controlled Oral word Association' (COWA).

F, A, and S are the most commonly used letters for this test, although other letter combinations are also used (Benton et al., 1994). Some of the other letters include C, and L and P, R and W. The selection of a letter set may affect the results to some extent because of differences in letter difficulty and word frequency for each letter (Borkowski et al., 1967).

Reliability and Validity

Tombaugh et al. (1999), studied what the degree of internal reliability is between F, A, and S among other sub-tests. The correlation was high (r=0.83).

In cognitive normal people, test-retest correlation is usually exceeding 0.70, for both letter and semantic fluency in both short and long intervals. Basso et al. (1999), found no gains among 50 cognitively normal men's re-tested after a 12 month interval on F, A, S. Nevertheless, Levine et al. (2004), found gains of about three words among 2145 cognitively normal men after being tested again on the FAS at an the interval of 4 to 12 months.

Even if test-retest reliabilities are moderate for phonemic fluency, the findings show that somewhat huge changes in performance are needed to determine that real decline or improvement has happened rather than being due to the practice effect or random measurement error (Basso et al., 1999).

Category Fluency Test

Development and Background

In this study, semantic fluency the category to be used is "animals." The purpose of the 'F', 'A', 'S' test is to evaluate the spontaneous production of words within a limited amount of time (Straus, Sherman and Spreen, 2006). It was developed together with and in the similar line with COWAT. Both tests are said to be sensitive measures of brain

dysfunction and the administration of verbal fluency tasks are recognised as an important component in the comprehensive assessment of neuropsychological functioning (Lezak, Howieson and Loring, 2004; Straus, Sherman and Spreen, 2006). Even though both tasks are similar in that they require considerable language skills and they are both indicators of cognitive impairment, each task is sensitive to different disease processes and distinct neuroanatomical substrates.

Reliability and Validity

There still remains a similarity between category fluency and COWAT. Bird et al. (2004) evaluated semantic (animal) fluency and found that in most of the tests done there was some practice effect on the second administration. However, by changing the letter or category practice effects can be reduced on each administration. Wilmen et al. (1999) study on 81 cognitively normal controls found that Category test is reliable with only small practice effect. This implies that clinicians need to control for practice effect in order to make correct recommendations for patients.

The phonemic fluency task for example, the FAS and the category fluency test have high correlation. Troyer et al. (2000), contend that the two sets of letters are roughly similar through diverse situations including among different groups such as the healthy, psychiatric, suspected CNS dysfunction, with correlations ranging from 0.85 to 0.94. Correlations among forms using various semantic categories are also relatively high at 0.66 to 0.71 for groups like ‘animals and clothing’ and ‘animals and food’.

Stroop Test

Development and Background

Stroop color and word test was developed by John Ridley Stroop in1935. It measures the ability to change attention by requiring the active inhibition of previously learned responses that are highly automatic (Sacks, Clark, Pols, and Geffen, 1991). The interest is in selective attention, habitual response, automatic response suppression ability and goal oriented and used for executive function in particular response flexibility and mental

control, have resulted in its wide clinical use as a measure of cerebral dysfunction (as cited from Cohn, Dustman and Bradford, 1984), by Sacks et al (1991).

Reliability & Validity

The most studies done on the Stroop have been test-retest reliability study. This has been attributed to the significance given on practice effect and its influence on neuropsychological tests both in research and clinical populations. Levine et al. (2004) investigated reliability at three time interval with an inter-assessment in a period of 14 days. The study found that "only the colour task did not produce decrease in completion time between the 2nd and 3rd sessions" (Levine et al., 2004:292). It was found that completion time to be of greater sensitivity than error scores were due to practice effect.
Cave, (2008) reports the test-retest reliability correlation of the Stroop test to be as high as r=0.90.

King et al (2007) study sample included 22 adults with attention deficit hyperactive disorder (ADHD) in childhood and 22 healthy controls. The subjects took a block clearly cued task switching paradigm besides a Stroop color word test. The study showed that the ADHD group did worse, with more errors plus were unable to regulate interference. The small sample size of the study was a limitation. These studies show a moderate reliability and validity of the Stroop test.

Paced Auditory Serial Addition Test (PASAT)

Development and Background

PASAT is a test that gives an estimate of speed of information processing. The use of the auditory version in assessing the effects of head injury has ensured that the auditory PASAT is used more often in neuropsychology. PASAT is meant to measure attention deficits including concentration, speed of processing, mental calculation and mental tracking. It is sensitive for diagnosing cognitive impairment in individuals 16 years old and above.

Reliability and Validity

The norms were originally collected from a sample of 80 individuals in New Zealand. Strauss, Sherman and Spreen, (1988), caution that because this sample was predominantly male and not well described demographically, there is need for alternate norms. They therefore, collected norms for the Gronwall version among samples of healthy North American adults. They had 90 community volunteers between the ages of 16 to 69 years old who had about 16 years of education without a history of neurological or psychiatric disorder.

The reliability of PASAT is high. It is sensitive to mild concussion and appears to be a more sensitive indicator of information-processing capacity in head-injured patients than other standard measures of attention (Strauss, Sherman and Spreen, 2006).

Reliability of PASAT for the four trials is said to be very high in adults (r=.90) as well as in the CHIPASAT's (children's version) split-half reliability is approximately .90 thus showing high internal consistency. Test-retest correlations following short retest intervals (7-10 days) is equally high (r<.90). Strauss, Sherman and Spreen (2006), report noteworthy practice effects on the PASAT.

Wingenfield et al. (1999) hold that while more research is needed, among auditory versions, computerized and audiotape versions appear similar. Both the short and long forms correlated strongly in healthy individuals. Additionally, according to Strauss, Sherman and Spreen (2006), PASAT is sensitive to mild concussion and sensitive indicator of information-processing capacity in head-injured patients.

Halstead Category Test

Development and Background

This is another test of executive function. It assesses the ability to conceptualize qualities such as size, shape, number, position and colour developed by Halsted in 1947. In its original form it had 336 items with 9 subtests. Reitan in 1948 condensed the subtests to 7 and 208 items. Each subtest had its own sole principle which may be odd stimulus,

number of objects, spatial position and a blend of different principles among others. Participants rely on feedback coming from correct or incorrect guesses for them to find out the principle in that subtest. The test requires deduction of a "classification principle by means of response bases feedback, the use of the principle while it remains effective and to abandon the principle when it is no longer effective" (Strauss, Sherman and Spreen, 2006:425).

Reliability and Validity

The psychometric reliability is low and clinical reliability is somewhat higher. The Category Tested has been said to have a higher sensitivity to brain damage than the WCST (Strauss, Sherman and Spreen, 2006).

In a study by Dikmen et al. (1999), they found reliability coefficient of between Pearson's r=.40 to r=.85 over a median interval of 11 months. In this study it is argued that there are two types of reliability; these are the concept of clinical reliability versus psychometric reliability which are investigated in this study.

Dikmen et al., (1999:353) argued that "clinical reliability is used to consistently classify individuals' performances as normal versus impaired on the basis of cut-off scores." The results obtained on the neuropsychological measures used including the category test had better clinical than psychometric reliability which is affected by practice effects.

The Category measures various abilities such as counting, perceptual organization, set maintenance and learning facilitated performance (Simmel et al., 1957). However, the Category test has reported a moderately satisfactory level of its reliability and validity even though like the WCST it is a measure of executive functioning. The Category Test has been named to have a better sensitivity to brain damage than the WCST. It is said that the Category Test is a better measure if clinicians want to measure a more difficult and sensitive measure of abstraction ability (Strauss, The reliability of PASAT is high. It is sensitive to mild concussion and appears to be a more sensitive indicator of information-

processing capacity in head-injured patients than other standard measures of attention (Strauss, Sherman and Spreen, 2006).

3.7 Test Administration Procedure

The neuropsychological tests were administered and scored by the 9 investigators who had been fully trained in test administration and scoring in accordance with the procedures outlined in the Zambia neuropsychological tests manual. The participants' performance was then scored according to the approved HIV Neurobehavioral Research Center (2009) guidelines.

Given in **Appendix D** are all the tests in the Zambia Neurobehavioral Test Battery that were part of this research study. A full description of each test's usage and reliability and validity has been given in the above section. Information about the administration and scoring procedures of each test used in this research study have been provided together with the tests in the appendix.

The participants were recruited into the study upon obtaining informed consent. This was followed by neuropsychological tests taking, brief neuro-medical examination and self-report questionnaire on quality of education. During and after the administration of the tests the examiner was also taking behavioural notes**.**

3.8 Ethical Considerations

Before the beginning of data collection, approval from the University of Zambia Biomedical Ethical Committee was obtained. Participants were recruited from the clinics Voluntary Counselling and Testing (VCT) unit. Therefore, counsellors obtained informed consent from HIV negative clients to disclose their HIV status to the study investigators. The VCT counsellors only obtained consent from VCT unit clients if they were found to be HIV negative. After this, informed consent for participation in the study was obtained by the study investigators. Participants filled in and signed an informed consent form before they were recruited into the study. They participated only on voluntary basis and

were allowed to leave the study at any time if they felt uncomfortable for any particular reason. Confidentiality of participants is strictly being maintained. No individual information has been reported. Only a scientific report has been presented to the public. Payments for a transport refund amounting to K50, 000 only was made to participants.

When some participants felt tired or needed a break for any reason, they were free to take breaks during testing. Contribution to knowledge in the field of neuropsychology was one of the benefits of the study.

3.9 Data Analysis

Performance of all the individual participants on all the neuropsychological tests used in this study was recorded. Then the raw scores were transformed to scaled scores with a mean of 10 and standard deviation of 3. The participants' performance was then grouped into the seven cognitive ability domains on Zambia Neurobehavioral Battery then a mean score was given.

The means of each of ability domain were the performance on the dependent variables while the mean of the scaled score on quality of education (quality of learning, quality of teachers and quality of school) was the independent variable. The Statistical Package for Social Sciences (SPSS) version 15.0 was used for storage and analysis.

The three indices of quality of education were used as independent variables (quality of learning, quality of teacher and quality of school) and the seven ability domains mean scaled scores were used as dependent variable in the analysis. The grouping of the tests into the seven ability domains of the brain assessed and the neuropsychological tests of the Zambia Neurobehavioral Battery are given below in **table 3.2**.

The three predictor variables – quality of learning, quality of teachers and quality of school were analysed with the 7 neuropsychological test mean scores. The domains of the cognitive abilities assessed and the tests used are as shown in **table 3.2**.

Table 3.2: Domain Assessed and Tests Used in the Study

Domain	Tests Used
Visual Episodic Memory	Brief Visuospatial Memory Test - Learn, Delay
Verbal Episodic Memory	Hopkins Verbal Learning Test - Learn, Delay
Attention/Working Memory	Paced Auditory Serial Addition Test, & WMS-III Spatial Span
Verbal Fluency	Word Sound Fluency Test- FAS, Animals, Actions, Stroop Word Test.
Speed of Information Processing	Trails, Color Trails1, Digit Symbol, Symbol Search, & Stroop Color.
Executive Function	Color Trails2, Category Test Errors, Wisconsin Card Sorting Test - Total Errors, & Stroop Colour Word Test.
Motor Function	Grooved Pegboard - Pegs Dominant hand & Pegs Nondominant hand.
Global	All of the above

CHAPTER FOUR

4.0 RESULTS

Characteristics of the sample

The full characteristics of the sample in this study including their ages, gender, education levels, quality of education and residence are shown in **table 4.1.**

Table 4.1: Demographic Characteristics of the Sample

		rural	urban	Total
Gender	Female	63	81	144
	Male	68	78	146
Age	20-35 years	54	63	117
	36-45 years	35	49	84
	46-55 years	25	29	54
	56 years and above	17	18	35
Education	g8-g9	34	38	72
	g10-g11	34	32	66
	g12 and above	63	89	152
Quality of Education	Low quality of education	115	126	241
	High quality of education	16	33	49
Grand Total (Rural/Urban)		131	159	290

Source: Field Data

As can be seen from **table 4.1** the sample is considerably balanced on the gender basis and indeed on most of the demographic characteristics.

Even though data was collected from a total of 324 study participants, only a total of 290 participants were included in the analysis as the others had less than secondary level of education. The minimum education of level included in the analysis was grade 8. Also, there were more people (115 rural and 126 urban) who were categorised as being of low

quality of education in the rural as compared to the few people (16 in rural and 33 in urban) who were categorised as high quality of education.

Based on available literature it was hypothesised as follows:

1. The study participants' quality of learning will predict their neuropsychological test performance.

2. The participants' quality of teachers will predict their neuropsychological test performance.

3. The participants' quality of the school will predict their neuropsychological test performance.

4. The study participants who received high quality education perform better than those who received low quality education on the neuropsychological tests.

To determine the level to which the study participants' quality of learning, quality of teachers and the quality of the school predict their neuropsychological test performance as well as the statistical significance of their predictive power, standard multiple regression was used. Standard multiple regression is a statistical technique that allows for prediction of the participant's score on one variable on the basis of their scores on several other variables (Pallant, 2007). In this case, how the study participants' quality of learning, quality of teachers and the quality of the school predict their neuropsychological test performance was studied.

In using multiple regression in this research, the study participants' quality of education (quality of learning, quality of teachers and the quality of the school) was used as "independent variables" which were believed to influence the "dependent variable" being the mean scores for the respective tests including visual episodic memory, verbal episodic memory, attention/working memory, verbal fluency, speed of information processing, executive function and motor speed tests.

The Enter method of standard multiple regression in SPSS version 15.0 was used. The three indices of quality of education (quality of learning, quality of teachers, and quality of school) were used as predictor/independent variables while the mean scores for the

respective tests including visual episodic memory, verbal episodic memory, attention/working memory, verbal fluency, speed of information processing, executive function, and motor speed tests (as per **Table 3.1**), were used as dependent variables.

Hypothesis 1: The Study Participants' Quality of Learning and Neuropyschological Test Performance

On the ***visual episodic memory tests***, the predictive power of the participants' quality of learning was low leading to results not being statistically significant ($p>.05$) see table 4.2.

On the ***verbal episodic memory tests***, of the participants' quality of learning predicted 15.3% of the study participants' test performance with $p<.05$ see table 4.2.

The ***language fluency tests*** the predictive powers of the participants' quality of learning was 34.5% as shown in table 4.2.

On the ***speed of information processing*** *tests*, the participant's quality of learning predicted 24**.9**% of test performance at a statistical significance level of $p<.05$ as per table 4.2. On the ***executive function tests***, the predictive powers of the participants' quality of learning at a statistically significant level of <.05 was 22.0% as per table 4.2. On the ***attention/working memory tests***, the participants' quality of learning had a predictive value of 18.1% with $p<.05$ as shown in table 4.2.

On the ***motor tests***, the participants' quality of learning predicted 15.6% of the participants' test performance at a statistical significance level of $p<.05$ as per table 4.2. On ***all the tests***, quality of learning predicted 27.8% of the participants' test performance at a statistical significance level of $p<.05$ as per table 4.2.

Table 4.2: Prediction of Test Performance by Quality of Learning

Independent/Predictor Variable	Dependent Variables	Standardized Coefficients Beta	Sig.
Quality of Learning	Visual Episodic Memory	.039	.536
	Verbal Episodic Memory	.153	.013*
	Verbal Fluency	.345	.005*
	Speed Of Information Processing	.249	.005*
	Executive Function	.220	.005*
	Attention/ Working Memory	.181	.003*
	Motor Function	.156	.012*
	Global	.278	.005*

* Significant at $P<.05$ with 95% confidence interval.

Hypothesis 2: The Quality of Teachers and Neuropsychological Test Performance

The predictive power of the participants' quality of teachers was considerably low leading to results not being statistically significant ($p>.05$) on the **visual episodic memory tests, verbal fluency tests, speed of information processing tests, executive function tests, attention/working memory tests and motor tests** as shown in table 4.3 below.

The participants' quality of teachers had an effect only on one neuropsychological test. As shown in table 4.3, the quality of teachers predicted 12.5% of study participants' performance the ***verbal episodic memory tests*** with $p<.05$.

Table 4.3: Prediction of Test Performance by Quality of Teachers

Independent/Predictor Variable	Dependent Variables	Standardized Coefficients Beta	Sig.
Quality of Teachers	Visual Episodic Memory	.035	.561
	Verbal Episodic Memory	.125	.033*
	Verbal Fluency	.083	.122
	Speed Of Information Processing	-.017	.761
	Executive Function	.022	.707
	Attention/ Working Memory	-.013	.821
	Motor Function	-.040	.495
	Global	.036	.524

* Significant at *P*<.05 with 95% confidence interval.

Hypothesis 3: The Quality of the School and Neuropsychological Test Performance

On the ***visual episodic memory tests***, the predictive power of the participants' quality of school was low leading to results not being statistically significant (p>.05) see table 4.4. On the ***verbal episodic memory tests***, the predictive power of the participants' quality of school was low leading to results not being statistically significant (p>.05) see table 4.4.

On the ***verbal fluency tests*** the predictive powers of the participants' quality of school was 16.7% at a statistical significance level of p<.05 as shown in table 4.4. On the ***speed of information processing tests***, the participants' quality of school predicted 16.0% of test performance at a statistical significance level of p<.05 as per table 4.4.

On the ***executive function tests***, ***attention/working memory tests,*** and ***motor tests***, the predictive power of the participants' quality of school was low leading to results not being statistically significant (p>.05) see table 4.4.

When ***all the tests*** were put together, the participants' quality of school predicted 14.5% of test performance at a statistical significance level of p<.05 as per table 4.4.

Table 4.4: Prediction of Test Performance by Quality of School

Independent/Predictor Variable	Dependent Variables	Standardized Coefficients Beta	Sig.
Quality of School	Visual Episodic Memory	.068	.277
	Verbal Episodic Memory	.075	.213
	Verbal Fluency	.167	.003*
	Speed Of Information Processing	.160	.007*
	Executive Function	.028	.646
	Attention/ Working Memory	.105	.086
	Motor Function	.108	.077
	Global	.145	.013*

* Significant at $P<.05$ with 95% confidence interval.

Hypothesis 4: Low Quality of Education and High Quality of Education Performance

The fourth objective of this study was to establish if there is a difference in neuropsychological test performance between participants of low quality of education and high quality of education. Based on the literature, it was hypothesised that *participants of low quality of education would not perform better than those of high quality of education on the neuropsychological tests*. The independent sample t-test was used to compare the mean scores on the continuous variable (test performance) for two different and independent groups of people (high and low quality of education).

For differentiation purposes, the raw data was transformed and recoded so that those who had two or more of the following: below standard quality of learning, below standard quality of teachers and went to a school with below standard environment, were considered as having low quality of education. Those who had two or more of the following: standard quality of learning, standard quality of teachers and went to a school with standard environment, were considered as having high quality of education. This procedure resulted in two independent and differentiated groups of low quality of education and high quality of education. The two variables used for analyses were:

- One categorical, independent variable – low/high quality of education; and
- One continuous, dependent variable – mean test scores.

When the mean scores of study participants were compared on ***visual episodic memory tests***, the low quality of education participants had a mean score of 10.31 while those of high quality of education had a mean score of 10.44. This difference in mean scores of the two groups was not statistically significant ($p>.05$) as per table 4.5. On the ***verbal episodic memory tests*** the participants of low quality of education had a mean score of 10.00 while their high quality of education counterparts had a mean score of 11.28 on the same tests. This mean score difference between the two groups was statistically significant with $p<.05$ as per table 4.5.

On the ***verbal fluency tests***, it was found that the study participants of low quality of education had a mean score of 10.04 while the high quality of education group of participants had a mean score of 11.91. These mean score differences were statistically significant at $p>.05$ as shown in table 4.5. The participants of low quality of education had a mean score of 10.12 while their high quality of education counterparts had a mean score of 11.12 on the ***information processing tests***. Comparatively, the difference in the mean scores between the two groups as shown in table 4.5 was statistically significant at $p>.05$.

On the ***executive functioning tests,*** participants of low quality of education had a mean score of 10.17 while those of high quality of education had a mean score of 10.79. This difference in the mean scores of two groups was statistically significant ($p<.05$) as shown in table 4.5. On the ***attention/working memory tests***, participants of low quality of education had a mean score of 10.03 while those of high quality of education had a mean score of 11.16. This difference in the mean scores of two groups was statistically significant ($p<.05$) as shown in table 4.5. On ***motor tests***, participants of low quality of education had a mean score of 10.15 while those of high quality of education had a mean score of 10.63. This difference in the mean scores of two groups was not statistically significant ($p>.05$) as shown in table 4.5.

When ***all the tests*** were put together, participants of low quality of education had a mean score of 10.11 while those of high quality of education had a mean score of 11.11. This difference in the mean scores of two groups was statistically significant ($p<.05$) as shown in table 4.5.

Table 4.5: Mean Test Scores for Low & High Quality of Education Participants

	Quality of Education	N	Mean	Std. Deviation	Sig.
Visual Episodic Mean	Low Quality of Education	241	10.31	2.982	.784
	High Quality of Education	49	10.44	3.160	
Verbal Episodic Mean	Low Quality of Education	241	10.00	2.828	.004*
	High Quality of Education	49	11.28	2.640	
Verbal Fluency Mean	Low Quality of Education	241	10.04	2.157	.005*
	High Quality of Education	49	11.91	1.918	
Speed Of Information Processing Mean	Low Quality of Education	241	10.12	2.304	.005*
	High Quality of Education	49	11.12	1.977	
Executive Mean	Low Quality of Education	241	10.17	1.980	.050*
	High Quality of Education	49	10.79	2.142	
Working Memory Mean	Low Quality of Education	241	10.03	2.406	.003*
	High Quality of Education	49	11.16	2.503	
Motor Mean	Low Quality of Education	241	10.15	2.762	.259
	High Quality of Education	49	10.63	2.400	
Global Mean	Low Quality of Education	241	10.11	1.784	.005*
	High Quality of Education	49	11.11	1.649	

*** Results significant at *P*<.05 with 95% confidence**

CHAPTER 5

5.0. DISCUSSION

This study investigated the association of educational attainment with quality of education and explored whether differences in quality education could explain differences in neuropsychological test performance among Zambian adults. A quantitative research design was used and literature related to this study was reviewed.

In the paragraphs that follow, is a discussion on the findings of this study.

The Study Participants' Quality of Learning and Neuropsychological Test Performance

In this study, the participants' quality of learning was used as one of the index of quality of education. Having employed standard multiple regression to it and against the seven ability domains it was found to have a statistically significant effect on most of neuropsychological test performance.

On the **verbal episodic memory tests**, of the participant's quality of learning predicted 15.3% of the study participants' test performance with $p<.05$. These finding show that quality of learning does have a statistically significant effect on an individual's performance on tests of verbal episodic memory. This can be explained that in schools that promote high learning quality they encourage reading. It can be theorized that the process of increased reading, verbal episodic memory abilities are developed. The Hopkins Verbal Learning Test-Revised (HVLT-R) which was used as a test of verbal episodic memory assesses learning ability and immediate recall on verbal information across multiple trials. It also measures an individual's capacity to retain, reproduce, and recognise information after delay (Strauss et al., 2006). During the test a list of 24 words - which were items that were presented originally in the same semantic class were read out. One's ability to recognize the semantic classes, retain them and reproduce them could have been strongly aided by the quality of learning they received in school.

For the **verbal fluency tests,** the predictive power of the participants' quality of learning was 34.5%. Similarly to verbal episodic memory, the development of this ability is a strongly influenced by quality of learning through reading. Reading enables pupils not only to learn new words but also how they are spelt.

Tests that assess verbal fluency require test takers to produce a maximum number of words according to instructions in very limited time. For instance in the COWAT, the test taker is asked to say as many words as possible within 60 seconds that begin with the letters F, A, and S. 60 seconds are given for each letter. For one to produce many words, they should know a lot of word and how they are spelt or at least the letter they begin with. It therefore, goes without saying that the participants' quality of learning significantly affected how fast they produced within the 60 seconds given for each letter. It could be said that how much time the participants spent at school reading, improved their vocabulary and consequently made them perform better or poorly on the verbal fluency tests. The effect of reading on language development was also found in the Bellei (2009) and Stanorvich and Cunningham (1993).

On the **speed of information processing tests**, the participants' quality of learning predicted 24.9% of test performance at a statistical significance level of $p<.05$. These findings imply that quality of learning has a statistical significant effect on speed of information processing. These findings are not unanticipated because previous research has proved that high quality learning requires that pupils are active participants of the learning process. This enables the development of information processing abilities in an individual. For example, McKeachie and Svinick (2006) found active learning increased educational achievement. Furthermore, Zimmerman and Carlos (1998) found that increasing time on-task learning also increases educational achievement.

On the **executive function tests**, the predictive power of the participants' quality of learning at a statistically significant level of $p<.05$ was 22.0%. Executive function of the brain is the coordinating ability of the brain that enables one to use the other abilities effectively. It involves problem solving, planning, decision making and organizing,

strategizing. How one goes about problem solving, planning and making decisions, requires some level of knowledge. It could be said how much the participants used to learn at school helped them to acquire more knowledge and also increased their level of executive functioning abilities. Even in other studies like that of Stanorvich and Cunningham (1993), it has also been found that reading leads to increased general knowledge.

On the **attention/working memory tests**, the participants' quality of learning had a predictive value of 18.1% with $p<.05$.The fact that high quality learning for instance requires one's personal involvement in the learning process; it has the potential to develop attention. For example, a pupil who is involved in scientific experiments in a laboratory will be forced not only to develop attention to detail but also hold the information they observe in their immediate memory as they continue recording and observing the outcomes. Increase on task learning such as mathematical problem also requires the development of working memory which is why quality of learning could have had the observed effect on the participants' performance on the executive tests.

On the **motor tests**, the participants' quality of learning predicted 15.6% of the participants' test performance at a statistical significance level of $p<.05$. This ability can also be developed with on task learning especially with subjects and activities that require hand-brain coordination. Such may include experiments and practical subjects that require high hand dexterity.

On the **visual episodic memory tests**, the predictive power of the participants' quality of learning was low leading to results not being statistically significant ($p>.05$). It is not very surprising that visual episodic memory was not statistically significant influenced by quality of learning. Skills that have to do with visual memory may probably not be emphasized as much as of language skills and mathematics in schools (McKeachie and Svinicki: 2006). The result show that not difference in visual episodic memory development result due to quality of learning.

On all the tests, quality of learning predicted 27.8% of the participants' test performance at a statistical significance level of $p<.05$, showing that overall, quality of learning does have a statistically significant effect on neuropsychological test performance.

The Quality of Teachers and Neuropsychological Test Performance

The quality of teachers as one of the indices of quality of education was found to have a statistically significant effect **Verbal Episodic Memory**. It was found that its effect was statistically significant on one cognitive domain -verbal episodic memory- where $p>0.05$. To tests for the participants' verbal episodic memory, the Hopkins Verbal Learning Test was used. The measures one's learning ability and immediate recall on verbal information across multiple trials. It also measures an individual's capacity to retain, reproduce, and recognise information after delay (Strauss et al., 2006). The participants for instance, were read a list of 12 words over three trials and after that they were required to say back the items on the list in any order. For the recognition task, the test administrator read out a list of 24 words which were items that were presented originally in the same semantic class as well as new unrelated words. The participants were required to answer "yes" or "no" depending on whether or not they believed the word read out to them was in the original list of words.

It can be said with confidence that the quality of teachers, for instance those that are highly trained in proper teaching methods do assist their students well in learning new information and how best to classify the new information they learn for them to be able to remember it after some times. This is the more reason why the Ministry of Education does emphasise that teachers should have approved teaching certification for each specific level of students. One who received good training from their teachers for instance, would easily classify the items on the Hopkins Learning Test into such categories like minerals, animals, shelter, etc for them to recall the items later.

Research (Darling-Hammond, 1999, 2000b; Goldhaber and Brewer, 2000; Guyton and Farokhi, 1987) as cited by Zuzovsky (2003) shows that teachers quality effects are especially strong in cases where teachers have degrees not just in teaching but also the

subject they teach. In another study, Goe and Stickler (2008) found a strong correlation existing between the attainment of secondary school pupils and subject expertise of their teachers.

While the quality of education had an effect on the Verbal Episodic Memory, it did not have the same effect on the six ability domains. It is possible that results turned out this way due to the fact that the teachers' qualifications being referred to in this study were those that the participants reported they believed their former teachers had. It is very likely that due to the time between this study and the time the participants were in school, the participants may have not remembered the specific personal qualifications of the teachers. People are more like to forget information that is not personal in nature. To this effect, though the quality of teachers did not have a statistically significant effect on the participants' performance on the six ability domains, this may not out rightly imply that the quality of teachers does not influence performance on neuropsychological tests. In addition, it could also be inferred that maybe some of the participants did not know very well their teachers' qualifications when they were pupils.

It is the conviction of the researchers in this study that though the quality of teachers did not show an effect on the six ability domains, this quality of education index is still important as it showed a significant effect on the Verbal Episodic Memory of the participants. Furthermore, enough research (Betts, Zau, and Rice, 2003; Ferguson and Ladd, 1996; Goldhaber and Brewer, 1997, 2000; Rowan, Chiang, and Miller, 1997) as cited by Zuzosky (2003) has demonstrated positive effects of teacher qualification on the pupils' cognitive abilities.

The Quality of the School and Neuropsychological Test Performance

Quality of school which looked at availability of such things like school libraries, laboratories and desks among others had a statistically significant effect on two (language fluency and speed of information processing) of the seven cognitive ability in the Zambia Neurobehavioral Battery.

On the **verbal fluency tests**, the predictive power of the participants' quality of school was 16.7% at a statistical significance level of $p<.05$. It is not surprising that verbal fluency was affected by the quality of school since high quality school emphasis an atmosphere and facilities that encourage reading – a skill that needs verbal fluency. Some of the facilities and resources found in adequate volumes in high quality schools are libraries and sufficient books. These facilities encourage reading. Reading not only require verbal fluency but also contributes to its development (Bellei, 2009 and Stanorvich and Cunningham, 1993). Furthermore, English [the language used in the Zambia Neurobehavioral Battery] is used and emphasized more in high quality schools than it is in low quality schools.

On the **speed of information processing tests**, the participants' quality of school predicted 16.0% of test performance at a statistical significance level of $p<.05$. Lonsdale (2003) lists some findings from studies conducted before 1990 and hold that these studies indicate that in schools with good libraries perform significantly better on tests for basic research skills, in reading comprehension and in their ability to express effectively ideas in relation to their reading. Basic research skills and comprehension are skills that require speed of information processing.

When all the tests were put together, the participants' quality of school predicted 14.5% of test performance at a statistical significance level of $p<.05$. Quality of school had a statistically significant effect on the Zambia Neurobehavioral Battery globally after putting all tests together. This therefore, establishes the hypothesis that quality of the school affects the study participants' neuropsychological test performance.

Test Performance of High Quality Education and low Quality Education Participants

Concerning the hypothesis that the study participants who received high quality education will perform better than those who received low quality education on the neuropsychological tests, it was found that participants with high quality of education performed better than participants with low quality of education. The difference in the

mean scores between those who received low quality of education and those who had high quality of education was statistically significant in all cases except for visual episodic memory tests where the differences in means of tests scores were not statistically significant.

On the verbal episodic memory tests the participants of low quality of education had a mean score of 10.00 while their high quality of education counterparts had a mean score of 11.28 on the same tests. This mean score difference between the two groups was statistically significant with $p<.05$. Schools that provide high quality education have been seen to adequate facilities and resources that contribute to the development of such ability. As already explained earlier, reading and qualified teachers can highly contribute to the understanding sematic classification of items and retention used in the Hopkins Verbal Learning test therefore, enhance verbal memory.

On the verbal fluency tests, it was found that the study participants of high quality of education performed better than those of low quality of education at a statistically significant level. It is not surprising to get such finding as schools that provide high quality education emphasis good use of language and encourage reading. These in turn contribute to the improvement of verbal fluency. Similarly, participants of high quality of education performed better than those of low quality of education at a statistically significant level on the information processing tests. High quality education that the participants received could be said to have fostered the advancement of information processing abilities in the participants through increased pupil participation in the learning process, provision of a school environment that foster active learning and provision of adequate qualified teachers.

Participants of high quality of education also performed better than those of low quality of education at a statistically significant level on the executive functioning tests. This could be attributed to the fact that high quality education provides more opportunities for knowledge acquisition. For example, it has been found that tests of executive function tap in problem solving skills such as test taking skills (Manly, 2005). These skills are

fostered in the presence of high quality education. Test taking skills [test-wiseness] may also be lacking in patients with low quality of education as tests are not taken often in low quality schools (Manly, 2005). Additionally, different school environments may foster different problem solving strategies such that high quality education may help in the advancement of skills. It is important to note that this skill very dependent on executive function. The same can be said to be true even when it comes to other brain functions like attention/working memory. High quality education helps develop certain abilities in learners including reading and attention among several others.

The only two domains that seemed to be less affected by the participants' quality of education were visual episodic memory and motor skills. This could be attributed to the fact that no emphasis is placed on the development of such ability in schools. In as much as quality of education could be said to have less effect on the visual episodic memory and the motor skills of an individual, quality of education had an effect on most of the tests including when all the tests were put together. It is clear that from these results that quality of education does have an effect on neuropsychological test results of an individual. It can therefore, be safely said that quality of education is a good predictor of neuropsychological test performance. Indeed, there is consistence between the findings of this research and most literature reviewed in their findings about the effect that quality of education has on neuropsychological test performance. For example, Hester et al (2005) assessed motor speed and executive function; Mindt et al (2008) assessed executive function, working memory, processing speed, motor speed, memory and verbal skills while Manly et al (2002) assessed executive function, verbal memory and fluency. All these studies found that quality of education influence performance on neuropsychological tests. Furthermore, Avenant (1995) and Shuttleworth-Edwards et al (2004) used the whole WAIS Battery and found that quality of education had an effect.

CHAPTER 6
6.0. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The aim of this study was to investigate how quality of education relates to performance on the Zambia Neurobehavioral Test Battery. The quantitative study design was used. The participants were recruited into the study upon obtaining informed consent. This was followed by brief neuro-medical examination, neuropsychological test taking and self-report questionnaire on quality of education.

From the findings of this study, it can be concluded that quality of education does have an effect test performance on a number of ability domains. The effect of various indices of quality of education is apparent on tests of executive function, speed of information processing, working memory, verbal fluency, verbal episodic memory and motor speed. It is therefore, important that neuropsychologists in Zambia take the quality of education in interpreting neuropsychological test results. These findings will help neuropsychologists to increase specificity in their diagnosis of patients.

Strengths of the Study

This study's strengths are as follows:

1. The neuropsychological tests in the Zambia Neurobehavioral Battery that were used are reliable and valid. This is evident from chapter 3 of this study.
2. The test examiners on this study were satisfactorily trained and certified in the administration and scoring procedures for the tests. This contributed to the reliability and validity of the test scores.
3. Inclusion of participants from both rural (although they were from rural areas along the line of rural) and urban made the sample representative of the Zambian population.

4. The use of three indices of quality of education gave the study a broader and good measure of quality of education.
5. The sample size was big enough therefore, good for generalization of results.

Limitation of the Study

The use of retrospective self-reporting items on measuring qualification of teachers could be said to have affected the results to some degree more specifically when it came to reviewing the effect of the quality of teachers since some of the study participants may have not clearly remembered the qualification of their teachers.

6.2. Recommendations

Based on the findings, the following recommendations are hereby made:

1. Neuropsychologists should include quality of education as a measure of education in their interpretation of neuropsychological test results. To assess quality of education of patients, clinicians could use the table 6.1 below. This table can be applied to patients with 8 years of education or more and 20 years of age and above.

Table 6.1.: Quality of education

Low quality of education	Having four or more of the following: less than 6 hours of learning, less than 2 hour of studying, no library, no laboratory, inadequate desks and teachers who had a less than Diploma qualification.
High quality of education	Having four or more of the following: 6 or more hours of learning, 2 or more hours of studying, a library, a laboratory, adequate desks and teachers who had a Diploma or higher qualification.

2. Regarding research, in future research a wider geographical area should be considered. Participants should be taken from different districts in urban areas (other than Lusaka) and more rural towns that are away from the line of rail to have a more representative of Zambian population.

3. Future studies on this subject could deliberately enrol participants from both clearly high quality of education and low quality of education to ensure that a clear distinction between groups of participants who have received high quality of education and those with low quality of education.

REFERENCES

Aronson, J., Zimmerman, J. and Carlos, L., (1998) Improving Student Achievement by Extending School:Is It Just a Matter of Time? *WestEd* obtained on 09/02/2012 from www.wested.org

Attix, D. K., Story, Tyler J., Chelune, G. J., Ball, J. D., Stutts, M. L., Hart, R. P. & Barth, J. T.(2008). The prediction of Change: Normative neuropsychological trajectories, *The Clinical Neuropsychologist*, 23,(1)21-38

Avenant, T.J., (1995). Directions of research in cross-cultural neuropsychology, *Journal of Clinical and experiment neuropsychology*, 77,(1) 143-150

Barry, D. M. S. http://www.minddisorders.com/Kau-Nu/Neuropsychological-testing.html#ixzz1l80DsPcs, obtained 01/02/12

Bellei, C. (2009). Does lengthening the school day increase students' academic achievement? Results from a natural experiment in Chile. *Economics of Education Review* 28 629–640

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist* 32 513-31

Byrd, D. A., Sanchez, D. & Manly, J. J.(2005).Neuropsychological Test Performance Among Caribbean-born and U.S.-born African American Elderly: The Role of Age, Education and Reading Level, *Journal of Clinical and Experimental Neuropsychology*, 27, (8)1056-1069

Byrd, D. A., Miller, S. W., Reilly, J., Weber, S., Wall, T. L. and Heaton, R. K. (2006). Early Environmental Factor, Ethnicity and Adult Cognitive Test Performance, *The Clinical Neuropsychologist* 20, (2) 243 - 260

Cave, J. (2008). (master's thesis, University of South Africa) The effect of quality of education on Neuropsychological test performance, South Africa.

Cave, J. and Grieve, K. (2009). The effect of quality of education on Neuropsychological test performance, Obtained on 02/02/2012 from *http://www.unisa.ac.za/contents/faculties/humanities/psy/doc*

Chateau, D. and Jared, D. (2000). Exposure to print and word recognition processes *Memory & Cognition*. 28 (1).143-153

Central Statistics Office (2009). 2000 Census obtained in March 2009 from www.zamstats.gov.zm/census.html

Cysique, L. A., Jin, H., Franklin, D. R., Morgan, E. E., Shi, C., Yu, X., Wu, Z., Talor, M. J., Marcotte, T. D., Letendre. S. A., Ake, C., Grant, I. and Heaton R. K. (2007). *Journal of the International Neuropsycholocal Society.* 13 (5) 781 - 790

Dotson V.M., Kitner-Triolo M.H, Evans M.K., and Zonderman A.B. (2009). Effects of Race and Socioeconomic Status on the Relative Influence of Education and Literacy on Cognitive Functioning *Journal of International Neuropsychological Society*. 15(4): 580–589.

Evans D. (2010). *HIV in the Brain Usually Matches Levels in the Blood.* Obtained on November 2010 from www.poz.com/articles/brain-csf-cognitive-761-1805

European Commission Directorate-General for Education and Culture (2000). European Report on the Quality of School Education Sixteen Quality Indicators

Fernando, S.D., Rodrigo, C. and Rajapake, S. (2010). The 'hidden' burden of malaria: cognitive impairment following infection. *Malaria Journal*, 9 366

Fox, W.S., Mitchell, S.A. and Booth-Jones, M. (2006). Cognitive impairment in patients with brain tumors: assessment and intervention in the clinic setting. Clinical Journal Oncology Nursing 10 (2) 169 - 176

Goe L. and Stickler M. L., (2008). *National comprehesion for teacher quality* obtained on15/02/2012 from www.NCCTQ.ORG

Grieve, J. (1995) *Neuropsychology for Occupational Therapists: Assessment of Perception and Cognition*. Victoria, Australia: Blackwell Science.

Groth-Marnat, G. (2009) *Handbook of psychological assessment*, New York: Wiley-Interscience

Heaton R.K., (2000). *Clinical neuropsychological tests and assessment techniques;* In F. Boller, J. Getfman and G. Rizzolatti (Eds). Handbook of Clinical neuropsychology. USA: Elsiever

Hester, R. L., Kinsella, G. J., Ong, B. and McGregor, J. (2005).Demographic Influences on Baseline and Derived Scores from the Trail Making Test in Healthy Older Australian Adults, *The Clinical Neuropsychologist*,19, (1)45 – 54

HIV Neurobehavioral Research Center. (2009). *Zambia Neurobehavioral Test Battery*. San Diego, CA: University of California, Department of Psychiatry

Huajin, L.C., Franklin, D.R., Morgan E.E., Shi C., Yu, X., Wu, Z., Taylor, M.J., Marcotte, T.D., Letendre, S., Ake, C., Grant, I., Heaton R.K. & the HNRC Group (2007).

Neurobehavioral effects of HIV-1 infection in China and the United States: A pilot study *Journal of the International Neuropsychological Society*, 13, 781-790

Lezak, M. D., Howieson, D. B., & Loring, D. W. (2004). *Neuropsychological assessment*. New York: Oxford University Press

Lipton, S. A. & Gendelman, H. E. (1995). Dementia Associated with the Acquired Immunodeficiency Syndrome. *The England Journal of Medicine*. 332 (14) 934 - 940

Manly, J.J. (2005) Advantages and Disadvantages of Separate Norms for African Americans, The Clinical Neuropsychologist, 19 (2) 270 – 27

Manly, J. J., Byrd, D.A., Touradji P & Stern, Y. (2004). Acculturation, reading level and Neuropsychological test performance among African American Elders, *Applied Neuropsychology*, 11, (1)37-46

Manly, J. J., Jacob D.M., Touradji, P., Small S.A. & Stern, Y. (2002). Reading level Attenuates differences in Neuropsychological test performance between African American and white Elders, *Journal of the International Neuropsychological Society*, 8, 341-348

McKeachie, W.J. and Svicicki, M. (2006). Teaching tips: Strategies, research and theory for college and university teachers. Belmont, CA. Wadsworth.

Miller, A. and Cunningham, K. (2009). The classroom environment. Gale Inc. obtained on 09/02/2012 from www.education.com/reference/article/classroom-environment .

Miller, E. (1992). Some basic principles of neuropsychological assessment. In J.R. Crawford, D.M. Parker, W.M. McKinlay (Eds) *A handbook of neuropsychological assessment*. London: Hove: Laurence Erlbaum Associates.

Mindt, M. R., Byrd, D., Ryan, E. L., Robbins, R., Monzones, J., Arentoft, A., Germano, K., Henninger, D., Morgello, S. & the Manhattan HIV Brain Bank, (2008). Characterization and Sociocultural Predictors of Neuropsychological Test Performance in HIV+ Hispanic Individuals *Culture Divers Ethnic Minor Psychology*, 14,(4)315-325

Ministry of Education. (1996). *Educating Our future*, Lusaka: Ministry of Education.

Ministry of Education. (1997). *Standards and Evaluation Guidelines*, Lusaka: Ministry of Education

Ministry of Education. (2008). *Educational Statistical Bulletin*, Lusaka: Directorate of Planning and Information, Ministry of Education

Morgan A.T.A & Marsiske M. (2008). Characterizing and explaining different in cognitive test performance between African American and European older adults, *Exp Aging Res.* 34,(1)80-100

Moulton J. (1997). Formal and Nonformal Education and Empowered Behavior: A Review of the Research Literature Obtained 10th February 2012 from pdf.usaid.gov/pdf_docs/pnacb230.pdf

Mulenga, K., Ahonen, T., & Aro, M. (2001). Performance of Zambian children on the NEPSY: a pilot study. Developmental Neuropsychology, 20 (1), 375-383

Pallant, J. (2007). *SPPS Survival Manual: A Step-by-step Guide to Analysing using SPSS Version 15*. Berkshire: McGraw-Hill Education

Pigozzi, M.J. (2008, June) Indicators of Quality Education Paper presented at IWGE

Prigatano, G.P., and Amin, K. (1993). Digit memory: unequivocal cerebral dysfunction and suspected malingering. Journal of Clinical and Experimental Neuropsychology, 15, 537–546.

Ryan EL, Baird R, Mindt MR, Byrd D, Monzones J, Bank SM, Manhattan HIV Brain Bank. (2005). Neuropsychological impairment in racial/ethnic minorities with HIV infection and low literacy levels: effects of education and reading level in participant characterization. *Journal of International Neuropsychological Society* 11 (7): 889–898

Saxena, S.K. (2006). Prevalence and Correlate of cognitive impairment in stroke patients in a rehabilitation setting. *International Journal of Psychosocial Rehabilitation*, 10 (2) 37 - 42

Skuy, M., Schutte, E., Fridjhon P. & O'Carroll, S. (2001). Suitability of published neuropsychological norms for urban Secondary School Students in South African, Personality and Individual Differences, 30, 1413-1425

Shuttle-Edwards, A.B., Kemp, R.D., Rust, A.L., Muirhead, J,G.L., Hartman, N.P., and Radloff, S.E. (2004). Cross-cultural effects on IQ test performance: A review and preliminary normative indications on WAISS-III test performance. *Journal of Clinical and Experimental Neuropsychology*, 26 (7), 903 - 920

Southern and Eastern Africa Consortium for Monitoring Quality of Education. *Education in Zambia* Obtained 10 February 2012 from www.sacmeq.org

Stanovich, K. E., & Cunningham, A. E. (1993). Where does knowledge come from? Specific associations between print exposure and information acquisition. *Journal of Educational Psychology*, 85, 211-229.

Touradji, P., Manly, J. J., Jacobs, D. M. and Stern, Y. (2001). Neuropsychological Test Performance: A Study of Non-Hispanic White Elderly. *Journal of Clinical and Experimental Neuropsychology*. 23(5)643-649

Tozzi, V., Balestra P., Galgani, S., Murri, R., Bellagamba, R., Narcoso, P., Antinori, A., Giulianelli, M., Tosi, G., Coasta, A., Sampaolesi, A., Fantoni, M., Noto, P. & Ippolito G. (2003). Neurocognitive performance and quality of life in patients with HIV. *AIDS Research and Human Retroviruses*, 19 (8) 643 -652

United Nations Children's Fund, Programme Division Education (2000). *Defining Quality in Education.* UNICEF New York.

UNICEF (2010). *HIV Statistics by country.* Obtained November 2010 from www.unicef.org/info-country/zambia-statistics.ntml

United Nations Statistical Institute for Asia and the Pacific (SIAP) Asian Development Bank (ADB) Country Training Workshops on MDGs and Use of Administrative Data Systems for Statistical Purposes (2009, January): Compilation of Education Indicator

U.S. Department of Education, Institute of Education Sciences (2006). *Teacher Qualifications, Instructional Practices and Reading and Mathematics Gains of Kindergartners Research and Development Report* U.S. Department of Education

Wagner, S., Helmreich, I., Dahmen, N., Lieb K. and Tadić, A. (2011). Reliability of Three Alternate Forms of the Trail Making Tests A and B. *Archives of Clinical Neuropsychology* 26 (4): 314-321

Whalen, L.M., (2010). Reading narratives supports cognitive development among college students *Linguistic and Literary Broad Research and Innovation* 1 (1)

Woods S. (2005). Construct validity of Hopkins Learning Test-Revised Component Measures in an HIV-1 sample. Archives of Clinical Neuropsychology, 20 (8) :1061 – 1071

Zillmer, EA., Spiers, MV., & Culbertson, WC. (2008). *Principles of Neuropsychology* (2nd Ed.). California: Wadsworth, Cengage Learning

Zuzosky, R., (2003). Teachers' qualifications and their impact on student achievement: Findings from timss 2003 data for Israel. *Center for Science and Technology Education, Tel Aviv University,*

APPENDICES

Appendix A: Research Protocol and approval

All Correspondence should be addressed to the
Permanent Secretary
Telephone: +260 211 253040/5
Fax : +260 211 253344

In reply please quote:

No.....

REPUBLIC OF ZAMBIA

MINISTRY OF HEALTH

NDEKE HOUSE
P. O. BOX 30205
LUSAKA

13th May 2010

School of Medicine,
Department of Pediatrics and Child Health
P.O Box 50110,
Lusaka

Dear Prof. MPS Ngoma,

Re: Request for Authority for Dissertation Proposals in respect of nine Neuro-Psychology Students

The Ministry of Health is in receipt of your request on behalf of Neuro-Psychology Students to conduct research in the following areas:

1. Neuro-cognitive functioning in Hypertension; Measured in battery – A Pilot Study.
2. The Relationship between Literacy and Neuropsychology Test Performance among Adults in Zambia
3. The Relationship Between individual's Number of Languages Spoken and Performance on the Clinical Neuropsychological Test Battery
4. Influence of Education and age in Performance on the Zambia Neurobehavioral Test Battery with the Zambia Achievement Test as a Measure of Educational Attainment.
5. Social Economic Status and Neuropsychological Assessment in Zambia
6. Cultural Influence on Neuropsychological Test in Zambia
7. Effect of Quality of Education on Neuropsychological Tests performance Among Zambian Adults
8. The Relationship between Moderate Alcohol Consumption and Cognitive function
9. Performance of Urban and Rural Adults in Neuropsychological Tests in Zambia

I wish to inform you that following submission of your research proposals and subsequent communication to my Ministry, our review of the same and in view of the ethical clearance, my Ministry has granted you authority to carry out the studies on condition that:

1. The relevant Provincial and District Directors of Health where the study is being conducted are fully appraised
2. Progress updates are provided to MOH quarterly from the date of commencement of the study.
3. The final study report is cleared by the MoH before any publication or dissemination within or outside the country.

Yours sincerely,

Dr. Peter Mwaba
Permanent Secretary

THE UNIVERSITY OF ZAMBIA

BIOMEDICAL RESEARCH ETHICS COMMITTEE

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Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

Assurance No. FWA00000338
IRB00001131 of IORG0000774

12 April, 2010
Ref.: 015-02-10

Ms Edina Chirwa
Department of Physiological Sciences
School of Medicine
University of Zambia
LUSAKA

Dear Ms Chirwa,

RE: SUBMITTED RESEARCH PROPOSAL: **"EFFECTS OF QUALITY OF EDUCATION ON NEUROPSYCHOLOGICAL TESTS PERFORMANCE AMONG ZAMBIAN ADULTS"**

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 16 February, 2010 where changes/clarifications were recommended. We would like to acknowledge receipt of the corrected version with clarifications. The proposal is now approved.

CONDITIONS:

- This approval is based strictly on your submitted proposal. Should there be need for you to modify or change the study design or methodology, you will need to seek clearance from the Research Ethics Committee.
- If you have need for further clarification please consult this office. Please note that it is mandatory that you submit a detailed progress report of your study to this Committee every six months and a final copy of your report at the end of the study.
- Any serious adverse events must be reported at once to this Committee.
- Please note that when your approval expires you may need to request for renewal. The request should be accompanied by a Progress Report (Progress Report Forms can be obtained from the Secretariat).
- **Ensure that a final copy of the results is submitted to this Committee.**

Yours sincerely,

Dr James Munthali
A/CHAIRPERSON

Date of approval: 12 April, 2010 **Date of expiry**: 11 April, 2011

Appendix B: Informed Consent for Participants

University of Zambia

Department of Psychology

PLEASE READ THIS DOCUMENT CAREFULLY. SIGN YOUR NAME BELOW ONLY IF YOU AGREE TO PARTICIPATE AND YOU FULLY UNDERSTAND YOUR RIGHTS. YOUR SIGNATURE IS REQUIRED FOR PARTICIPATION. FOR THIS PROJECT, YOU MUST BE 20 YEARS OF AGE AND ABOVE TO PARTICIPATE. IF YOU DESIRE A COPY OF THIS CONSENT FORM, YOU MAY REQUEST ONE AND WE WILL PROVIDE IT.

Description of the Study:

You are being invited to take part in this study Standardisation of Neuropsychological Tests in Zambia. The goal is to find out if quality of education does influence how people perform on neuropsychological tests (tests that measure how the brain is functioning).You will be required to answer questionnaires and take a group of tests of attention, language, motor functions and memory. The tests will involve answering questions and doing certain activities.

Time Involvement

The whole process will take approximately 2:30 to 3:00 hours to complete.

Risks and Benefits:

- You may experience fatigue due to the length of time required for the testing process. To reduce on this you are free to ask for a short break whenever you require it.

- We cannot guarantee that you will receive any direct benefits from this study though you will have an opportunity to contribute to neuropsychological assessments that will help Zambians in general by participating in this study.

Compensation for Your Time: You will be compensated for your time with a transport and meal allowance of K50, 000.

Participation Rights:

- Participation in this study is purely voluntary so that if you decide to withdraw at any point, there will be no consequences to you.
- All personal identifying information will be kept confidential and the data sheets will be kept in secured lockers in accordance with the standards of the University of Zambia Biomedical Ethics Committee. If the results of this study are required for publication as we hope, your identity will still be kept private.

Signatures

I,……(name) have read and understood the above information. As the participant in this project, my signature testifies that I understand the consent process and management of confidentiality as indicated above. I also understand that I can withdraw at any time.

Signature of Research Participants:…….Date……...

Name and Signature of Witness…….Date…….

Name and Signature of Researcher..…….Date…….

Contacts

If you any further questions about this research please contact:

The principal Investigator
Dr. A. Menon
Psychology Department
University of Zambia
LUSAKA
Cell no: 0977 846116

Researcher: ……
School of Medicine
University of Zambia
LUSAKA
Cell no. ……

Secretary to Biomedical Ethics:
Ridgeway Campus
University of Zambia
P.O.Box 50110
LUSAKA
Telephone: 256067

Appendix C: Data Collection Questionnaire

NEUROPSYCHOLOGY

DATA COLLECTION QUESTIONNAIRE

FOR OFFICIAL USE ONLY

Date:……
……
……

Clinic/Centre:……

For Official use only

AGE & GENDER

Q1. What is your age?

1.1. 20 – 35 [ ]

1.2. 36 – 45 [ ]

1.3. 46 – 55 [ ]

1.4. 56 and above [ ]

Q2. What is your gender?

2.1. Female [ ]

2.2. Male [ ]

EDUCATION

Q3. What is your highest attained level of education?

3.1. 5 – 7 years [ ]

3.2. 8 – 9 years [ ]

3.3. 10 – 12 yrs [ ]

3.4. 13 years+ [ ]

QUALITY OF EDUCATION

Q4. In general, what type of pre-tertiary school did you attend?

4.1. Primary [ ]

4.1.1. Community school [ ]

4.1.2. Private school [ ]

4.1.3. Mission [ ]

4.1.4. Public School [ ]

4.2. Secondary [ ]

4.2.1. Community school [ ]

4.2.2. Private school [ ]

4.2.3. Mission [ ]

4.2.4. Public School [ ]

For Official use only

Q5. At these levels of education, approximately how big were your classes?

5.1. Primary

5.1.1. Below 36 [ ]

5.1.2. 36 to 50 [ ]

5.1.3. More than 50 [ ]

5.2. Secondary

5.2.1. Below 36 [ ]

5.2.2. 36 to 50 [ ]

5.2.3. More than 50 [ ]

Q6. How many hours did you spend learning at school per day

6.1. Primary

6.1.1. Less than 4hrs [ ]

6.1.2. 4hrs – 5hrs [ ]

6.1.3. 6hrs and more [ ]

6.2. Secondary

6.2.1. Less than 4hrs [ ]

6.2.2. 4hrs – 5hrs [ ]

6.2.3. 6hrs and more [ ]

Q7. How many hours did you spend studying (in prep) at school per day

7.1. Primary

7.1.1. None [ ]

7.1.2. 1hr [ ]

7.1.3. 2hrs and more [ ]

7.2. Secondary

7.2.1. None [ ]

7.2.2. 1hr [ ]

7.2.3. 2hrs and more [ ]

Q8. With regards the sitting arrangement in your said classes, how many pupils sat on a three sitter desk?

8.1. Primary

8.1.1. we had no desks [ ]

8.1.2. 4/more [ ]

8.1.3. 3/ less [ ]

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8.2. Secondary

8.2.1. we had no desks [ ]

8.2.2. 4/more [ ]

8.2.3. 3/ less [ ]

Q9. How adequate were the reading materials in your classes?

9.1. Primary

9.1.1. Not available [ ]

9.1.2. Few [ ]

9.1.3. Adequate [ ]

9.2. Secondary

9.2.1. Not available [ ]

9.2.2. Few [ ]

9.2.3. Adequate [ ]

Q10. Did your school have the following:

10.1. Primary school library

10.1.1. Yes [ ]

10.1.2. No [ ]

10.2. Primary school laboratory

10.2.1. Yes [ ]

10.2.2. No [ ]

10.3. Secondary school library

10.3.1. Yes [ ]

10.3.2. No [ ]

10.4. Secondary school laboratory

10.4.1. Yes [ ]

10.4.2. No [ ]

Q11. What were the qualifications of most (≥70%) of your teachers:

11.1. Primary

11.1.1. I do not know [ ]

11.1.2. Primary teachers' Certificate [ ]

11.1.3. Secondary teachers' diploma [ ]

11.1.4. Bachelors degree [ ]

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11.2. Secondary

11.2.1. I do not know [ ]

11.2.2. Primary teachers' Certificate [ ]

11.2.3. Secondary teachers' diploma [ ]

11.2.4. Bachelors degree [ ]

11.2.5. Masters degree [ ]

Q12. Has your education been helpful in your execution of daily activities?

12.1. Yes [ ]

12.2. No [ ]

Q13. In what four major ways would you say your education has been helpful? (please indicate)

13.1. ..... [ ]

13.2. ..... [ ]

13.3. ..... [ ]

13.4. ..... [ ]

Q14. How often would you say you read (any reading material)?

14.1. Not at all [ ]

14.2. Sometimes (≤4 times in a 6 months) [ ]

14.3. Often (at least once in a week) [ ]

14.4. Very often (at least once in a day) [ ]

Q15. If you read, what materials do you most often read?

15.1. Religious materials [ ]

15.2. Political materials [ ]

15.3. Work related materials [ ]

15.4. Anything interesting [ ]

15.5. Anything as the need arise [ ]

Q16. With your currently attained education, are you considering furthering your studies?

16.1. Yes [ ]

16.2. No [ ]

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EMPLOYMENT, INCOME, & RESIDENCE

Q17. What are you currently doing?

17.1. Unemployed [ ]

17.2. Self-employed [ ]

17.3. Employed [ ]

17.4. Retired [ ]

Q18. What is your occupation?

18.1. Unskilled (e. g maid, farm labourer, etc) [ ]

18.2. Semi-skilled (e. g plumber, bus driver, etc) [ ]

18.3. Skilled (e. g, accountant, physician, etc) [ ]

18.4. Specialist (e. g consultant, economic analysts) [ ]

Q19. What is your income per year?

19.1. Less than K30 million [ ]

19.2. K30 million to less than K60 million [ ]

19.3. K60 million to less than K120 million [ ]

19.4. K120 million and above [ ]

Q20. Where do you currently live?

20.1. Low cost rural area (e. g village) [ ]

20.2. High cost rural area (e. g 'boma') [ ]

20.3. Low cost urban area (e. g high density area) [ ]

20.4. High cost urban area (e. g low density area) [ ]

LANGUAGE & TECHNOLOGY

Q21. What is your mother tongue?

21.1. Bemba [ ]

21.2. Chewa [ ]

21.3. Tonga [ ]

21.4. Lozi [ ]

21.5. Other (please indicate)..... [ ]

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Q22. How much do you use your mother tongue in communicating?

22.1. Rarely (just know and use one or two words) [ ]

22.2. Sometimes (few times at home) [ ]

22.3. Often (in home conversations) [ ]

22.4. Very often (in almost all my conversations) [ ]

Q23. Which languages would you say you fluent in and ay what age did you acquired them? (Indicate ONLY 3 or less in the order of fluency)

Language	Age
23.1.	.....
23.2.	.....
23.3.	.....

Q24. How much would you say you use the English language in communicating?

24.1. Rarely (just know and use one or two words) [ ]

24.2. Sometimes (only in formal situations) [ ]

24.3. Often (at least in one conversation in a week) [ ]

24.4. Very often (in almost all my conversations) [ ]

Q25. How often do you use computers?

25.1. Not at all [ ]

25.2. Sometimes (less than 4 times in a year) [ ]

25.3. Often (at least once in a month) [ ]

25.4. Very often (at least once in a week) [ ]

Thank you for your cooperation and contributions

APPENDIX D:

ZAMBIAN NEUROBEVIORAL BATTERY

ZAMBIA NEUROBEHAVIORAL BATTERY

_____ Handout: Beck Depression Inventory-II (CH3)
_____ Handout: Patient's Assessment of Own Functioning (NP6)
_____ Handout: Activities of Daily Living (NC2)
_____ Handout: Substance Use (CH13A)
_____ Handout: Substance Use History (CH13D)
_____ Handout: Use of Academic Skills Questionnaire (CN18)

_____ Neurobehavioral Medical Screen (CH42)
_____ Behavioral Notes (NP31)
_____ Hiscock Digit Memory Test (NC3)
_____ Hopkins Verbal Learning Test - Revised Record Form A (TB15Z)
_____ Brief Visuospatial Memory Test - Revised (TB16)
_____ WAIS-III Digit Symbol (ND16)
_____ WAIS-III Symbol Search (ND18)
_____ Grooved Pegboard Test (TB31)
_____ Hopkins Verbal Learning Test - Revised Record Form A (TB15A) - *20 min delay*
_____ Brief Visuospatial Memory Test - Revised (TB16) - *25 min delay*
_____ Trail Making Test A (NP19A)
_____ Color Trails 1 (NP41A)
_____ Color Trails 2(NP41B)
_____ WMS-III Spatial Span (ND30)
_____ Wisconsin Card Sorting Test - Computerized 64 Items
_____ Controlled Oral Word Association Test - FAS (NP23A)
_____ Category Fluency Test (NP27)
_____ Paced Auditory Serial Addition Task (NP17B)
_____ Stroop Color and Word Test (NC6-N)
_____ Halstead Category Test (NP12)

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BECK DEPRESSION INVENTORY-II

FS SCORE: ☐ BECK TOTAL: ☐

INSTRUCTIONS TO PARTICIPANT: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group.

1. **Sadness**
   - I do not feel sad 0
   - I feel sad much of the time 1
   - I am sad all the time. 2
   - I am so sad or unhappy that I can't stand it. 3

2. **Pessimism**
   - I am not discouraged about my future 0
   - I feel more discouraged about my future than I used to be 1
   - I do not expect things to work out for me 2
   - I feel my future is hopeless and will only get worse 3

3. **Past Failure**
   - I do not feel like a failure 0
   - I have failed more than I should have 1
   - As I look back, I see a lot of failures 2
   - I feel I am a total failure as a person 3

4. **Loss of Pleasure**
   - I get as much as I ever did from the things I enjoy 0
   - I don't enjoy things as much as I used to 1
   - I get very little pleasure from the things I used to enjoy 2
   - I can't get any pleasure from the things I used to enjoy 3

5. **Guilty Feelings**
   - I don't feel particularly guilty 0
   - I feel guilty over many things I have done or should have done 1
   - I feel quite guilty most of the time 2
   - I feel guilty all of the time 3

6. **Punishment Feelings**
   - I don't feel I am being punished. 0
   - I feel I may be punished 1
   - I expect to be punished 2
   - I feel I am being punished 3

7. **Self-Dislike**
   - I feel the same about myself as ever 0
   - I have lost confidence in myself. 1
   - I am disappointed in myself 2
   - I dislike myself 3

8. Self-Criticalness

I don't criticize or blame myself more than usual 0
I am more critical of myself than I used to be 1
I criticize myself for all my faults 2
I blame myself for everything bad that happens 3

9. Suicidal Thoughts or Wishes

I don't have any thoughts of killing myself 0
I have thoughts of killing myself, but I would not carry them out 1
I would like to kill myself 2
I would kill myself if I had the chance 3

10. Crying

I don't cry any more than I used to 0
I cry more than I used to 1
I cry over every little thing 2
I feel like crying, but I can't 3

11. Agitation

I am no more restless or wound up than usual 0
I feel more restless or wound up than usual 1
I am so restless or agitated that it's hard to stay still 2
I am so restless or agitated that I have to keep moving or doing something 3

12. Loss of Interest

I have not lost interest in other people or activities 0
I am less interested in other people or things than before 1
I have lost most of my interest in other people or things 2
It's hard to get interested in anything 3

13. Indecisiveness

I make decisions about as well as ever 0
I find it more difficult to make decisions than usual 1
I have much greater difficulty in making decisions than I used to 2
I have trouble making any decisions 3

14. Worthlessness

I do not feel that I am worthless 0
I don't consider myself as worthwhile and useful as I used to 1
I feel more worthless as compared to other people 2
I feel utterly worthless 3

15. Loss of Energy

I have as much energy as ever 0
I have less energy than I used to have 1
I don't have enough energy to do very much 2
I don't have enough energy to do anything 3

16. Changes in Sleeping Pattern

I have not experienced any change in my sleeping pattern 0
I sleep somewhat more than usual 1a
I sleep somewhat less than usual 1b
I sleep a lot more than usual 2a
I sleep a lot less than usual 2b
I sleep most of the day 3a
I wake up 1-2 hours early and can't get back to sleep 3b

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17. Irritability

I am no more irritable than usual 0
I am more irritable than usual 1
I am much more irritable than usual 2
I am irritable all the time 3

18. Changes in Appetite

I have not experienced any change in my appetite 0
My appetite is somewhat less than usual 1a
My appetite is somewhat greater than usual 1b
My appetite is much less than before 2a
My appetite is much greater than usual 2b
I have no appetite at all 3a
I crave food all the time 3b

19. Concentration Difficulty

I can concentrate as well as ever 0
I can't concentrate as well as usual 1
It's very hard to keep my mind on anything for very long 2
I find I can't concentrate on anything 3

20. Tiredness or Fatigue

I am no more tired or fatigued than usual 0
I get more tired or fatigued more easily than usual 1
I am too tired or fatigued to do a lot of the things I used to do 2
I am too tired or fatigued to do most of the things I used to do 3

21. Loss of Interest in Sex

I have not noticed any recent change in my interest in sex 0
I am less interested in sex than I used to be 1
I am much less interested in sex now 2
I have lost interest in sex completely 3

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PATIENT'S ASSESSMENT OF OWN FUNCTIONING

INSTRUCTIONS TO PARTICIPANTS: Please answer each of the following questions by circling the number that best describes your response to each of the following statements. There is no right or wrong answer. Express how you have been feeling lately. It will tell us more about your daily functioning and any problems you might be having in your daily living.

Manner of Inventory Administration:

[ ] Participant read and answered items independently.
[ ] Items read by examiner.
[ ] Examiner read items, and marked verbal given answers.
[ ] Examiner marked answers given verbally.

SCALE I: MEMORY

	Almost Always	Very Often	Fairly Often	Once In A While	Very Infrequently	Almost Never
1. How often do you forget something that has been told to you within the last day or two?	1	2	3	4	5	6
2. How often do you forget events which have occurred in the last day or two?	1	2	3	4	5	6
3. How often do you forget people whom you met in the last day or two?	1	2	3	4	5	6
4. How often do you forget things that you knew a year or more ago?	1	2	3	4	5	6
5. How often do you forget people whom you knew or met a year or more ago?	1	2	3	4	5	6
6. How often do you lose track of time, or do things either earlier or later than they are usually done or are supposed to be done?	1	2	3	4	5	6
7. How often do you fail to finish something you start because you forgot that you were doing it? (Include such things as forgetting to put out cigarettes, turning off the stove, etc.)	1	2	3	4	5	6
8. How often do you fail to complete a task that you start because you have forgotten how to do one or more aspects of it?	1	2	3	4	5	6
9. How often do you lose things or have trouble remembering where they are?	1	2	3	4	5	6
10. How often do you forget things that you are supposed to do or have agreed to do (such as putting gas in the car, paying bills, taking care of errands, etc.)?	1	2	3	4	5	6

SCALE II: LANGUAGE AND COMMUNICATION

	Almost Always	Very Often	Fairly Often	Once In A While	Very Infrequently	Almost Never
11. How often do you have difficulties understanding what is said to you?	1	2	3	4	5	6
12. How often do you have difficulties recognizing or identifying printed words?	1	2	3	4	5	6
13. How often do you have difficulty understanding reading material which at one time you could have understood?	1	2	3	4	5	6
14. Is it easier to have people show you things than it is to have them tell you about things?	1	2	3	4	5	6
15a. When you speak, are your words indistinct or improperly pronounced?	1	2	3	4	5	6
15b. If this happens, how often do people have difficulty understanding what words you are trying to say?	1	2	3	4	5	6
16. How often do you have difficulty thinking of the names of things?	1	2	3	4	5	6
17. How often do you have difficulty thinking of the words (other than names) for what you want to say?	1	2	3	4	5	6
18. When you write things, how often do you have difficulty forming the letters correctly?	1	2	3	4	5	6
19. Do you have more difficulty spelling, or make more errors in spelling, than you used to?	1	2	3	4	5	6

SCALE III: USE OF HANDS

	Almost Always	Very Often	Fairly Often	Once In A While	Very Infrequently	Almost Never
20. How often do you have difficulty performing tasks with your right hand (including such things as writing, dressing, carrying, lifting, sports, cooking, etc.)?	1	2	3	4	5	6
21. How often do you have difficulty performing tasks with your left hand?	1	2	3	4	5	6

SCALE IV: SENSORY-PERCEPTUAL

	Almost Always	Very Often	Fairly Often	Once In A While	Very Infrequently	Almost Never
22. How often do you have difficulty feeling things with your right hand?	1	2	3	4	5	6

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	Almost Always	Very Often	Fairly Often	Once In A While	Very Infrequently	Almost Never
23. How often do you have difficulty feeling things with your left hand?	1	2	3	4	5	6
24a. Lately do you have more difficulty than you used to in seeing all of what you are looking at, or all of what is in front of you (in other words, are some areas of your vision less clear or less distinct than others)?	1	2	3	4	5	6

	To The Right	To The Left	Cannot Tell Whether One Side Is Worse Than The Other
24b. If you are having this kind of trouble with your vision, is it more difficult to see things located to your right or to your left?	1	2	3

SCALE V: HIGHER LEVEL COGNITIVE AND INTELLECTUAL FUNCTIONS

	Almost Always	Very Often	Fairly Often	Once In A While	Very Infrequently	Almost Never
25. How often do your thoughts seem confused or illogical?	1	2	3	4	5	6
26. How often do you become distracted from what you are doing or saying by insignificant things which at one time you would have been able to ignore?	1	2	3	4	5	6
27. How often do you become confused about (or make a mistake about) where you are?	1	2	3	4	5	6
28. How often do you have difficulty finding your way about?	1	2	3	4	5	6
29. Do you have more difficulty now than you used to in calculating or working with numbers (including managing finances, paying bills, etc.)?	1	2	3	4	5	6
30. Do you have more difficulty now than you used to in planning or organizing activities (i.e., deciding what to do and how it should be done)?	1	2	3	4	5	6
31. Do you have more difficulty now than you used to in solving problems that come up around the house, at your job, etc.? (in other words, when something new has to be accomplished, or some new difficulty comes up, do you have more trouble figuring out what should be done and how to do it?)	1	2	3	4	5	6
32. Do you have more difficulty than you used to in following directions to get somewhere?	1	2	3	4	5	6

	Almost Always	Very Often	Fairly Often	Once in A While	Very Infrequently	Almost Never
33. Do you have more difficulty than you used to in following instructions concerning how to do things?	1	2	3	4	5	6

34. Do you think you are as "bright" now as you were before your accident or present illness?

Yes 1
No 2
I don't know 3

SCALE VI: WORK

35. Are you presently holding a job?

Yes, Full-time 1
Yes, Part-time 2
No ..... SKIP TO QUESTION 39 3

36. What kind of job do you have, and briefly describe your duties:

_____
_____
_____

37. What is your salary per month: _____

38. On your job how much supervision is being given to you now?

I am closely observed and supervised in almost everything I do. 1
There is a supervisor around most of the time, but supervision is not really constant. 2
I receive only occasional supervision, though there may be more when a new job is given or after a job is completed. 3
I usually receive supervision only when being given a new job to do, or after a job has been completed. 4
I function very much on my own at work. 5
I am self-employed. 6

39. Are you a student?

Yes, Full-time 1
Yes, Part-time 2
No ..... SKIP QUESTIONS 40 & 41 3

40. Are you currently taking regular academic courses or special education courses?

All special education courses 1
Mostly special education courses 2
About an equal number of each type of course 3
Mostly regular academic courses 4
All regular academic courses 5

41. What is your approximate grade point average in regular academic courses only (i.e., leaving out grades in special education courses)?

Better than 3.7 (A) 1
3.0 to 3.6 (B to A minus) 2
2.0 to 2.9 (C to B minus) 3
1.0 to 1.9 (D to C minus) 4
Less than 1.0 (F) 5

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ACTIVITIES OF DAILY LIVING

INSTRUCTIONS TO PARTICIPANT: We are interested in knowing how well you are able to perform common tasks.

- Please circle the number under the "NOW" column that most accurately indicates your current ability level.
- Then circle the number under the "BEST" column that most accurately indicates your highest ability level (this would be the time in your life when you were functioning at your best).

Please add any comments that you feel will help clarify your responses (e.g., when you started having difficulties and what you think are the causes of the problem).

	Now	Best
1. Housekeeping		
I maintain my house/apartment by myself or only need occasional help for larger jobs	0	0
I only perform light daily tasks (wash dishes, make bed)	1	1
I perform some light tasks, but have difficulty keeping my place clean	2	2
I need help with all housekeeping tasks	3	3
I am fully able to do housekeeping, but choose not to do so	8	8

Comments _____

	Now	Best
2. Managing finances		
I manage all of my finances (check cashing, banking, handling money) by myself	0	0
I manage routine small purchases, but need help with banking, checking and balancing accounts	1	1
I am not able to handle money accurately	2	2
I am able to handle my own finances, but someone else does them for me	8	8

Comments _____

	Now	Best
3. Buying Groceries		
I create my own grocery list and do my own shopping	0	0
I need occasional assistance in buying groceries	1	1
I need someone else to do my grocery shopping for me	2	2
I am able to create my own grocery list and do my own shopping, but someone else does it for me	8	8

Comments _____

	Now	Best
4. Cooking		
I plan, prepare, and serve many of my own meals	0	0
I prepare meals if someone else provides me with the right ingredients	1	1
I heat and serve meals provided by others	2	2
I need to have meals prepared and served to me	3	3
I am able to plan, prepare, and serve my own meals but someone else does it for me	8	8

Comments _____

5. Planning social activities	Now	Best
I frequently initiate and plan social activities (e.g., going out, having a party)	1	1
I rarely initiate and plan social activities	2	2
I do not plan and initiate social activities	3	3

Comments _____

_____

6. Understanding reading materials/TV	Now	Best
I understand reading materials (e.g., novels, newspaper) and TV (plots, etc.) without difficulty	0	0
I have occasional difficulty understanding reading materials or TV	1	1
I have frequent difficulty understanding reading materials or TV	2	2
I am unable to understand reading materials or TV	3	3

Comments _____

_____

7. Transportation	Now	Best
I drive my own car or take public transportation on my own (if you do not own a car)	0	0
I arrange my own travel using taxis, but do not drive or use public transportation	1	1
I can travel on public transportation or use taxis if I am assisted by another	2	2
I do not travel at all	3	3

Comments _____

_____

8. Using the telephone	Now	Best
I handle using the telephone without difficulty (looking up and dialing new numbers, etc.)	0	0
I only dial a few well-known numbers	1	1
I answer the telephone, but do not dial	2	2
I do not use the telephone at all	3	3
I do not have access to a telephone	8	8

9. Home repairs	Now	Best
I handle most minor home repairs (plumbing, gardening)	0	0
I need assistance with most minor home repairs	1	1
I am unable to do most repairs by myself	2	2
I am capable of making minor repairs but choose not to	8	8

Comments _____

_____

10. Bathing	Now	Best
I handle all of my bathing needs by myself	0	0
I need occasional assistance with bathing (getting in and out of the tub/shower, etc.)	1	1
I always need help from others when bathing	2	2

Comments _____

_____

11. Dressing	Now	Best
I am able to dress myself and pick out my own clothes	0	0
I dress myself, but someone else must pick out my clothes for me	1	1
I need occasional assistance getting dressed or frequently make mistakes in choosing clothes	2	2
I need frequent assistance in getting dressed	3	3

Comments _____

_____

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	Now	Best
12. Shopping (e.g., clothes, other non-food goods)		
I take care of all of my shopping needs	0	0
I only make small purchases	1	1
I need someone to go with me on any shopping trip	2	2
I am unable to shop	3	3
I am able to shop, but choose to have someone else do my shopping for me	8	8

Comments _____

_____

	Now	Best
13. Laundry		
I do all of my own laundry	0	0
I need occasional help in doing the laundry	1	1
I launder only small items (e.g., rinse socks, stockings, etc.)	2	2
All laundry must be done by others	3	3
I am able to do my own laundry, but choose to have others do it for me	8	8

Comments _____

_____

	Now	Best
14. Taking/keeping track of medication		
I take sole responsibility for taking medications in correct dosages at the correct time	0	0
I take medications that are prepared in individual doses by someone else	1	1
I am unable to track my own medications	2	2
I am able to take care of my own medications, but choose to have someone else do it for me	8	8

Comments _____

_____

	Now	Best
15. Child Care		
I am fully able to handle child care	0	0
I need occasional assistance in caring for my children	1	1
I need constant assistance in caring for my children	2	2
I do not have children	8	8

Comments _____

_____

	Now	Best
16. Work		
I am efficient at work	0	0
I am not very efficient at work and have difficulty maintaining attention or finishing tasks	1	1
I am having a great deal of difficulty in maintaining attention or finishing tasks at work	2	2
I am no longer able to work	8	8

Comments _____

_____

17. Please tell us of any other areas in which you are having difficulty:

_____

_____

_____

18. **What do you think are your major areas of difficulty at this time?**

_____

_____

_____

19. **I feel that the difficulties that I am having on the above tasks, if any, are due to:** **Now**

Primarily cognitive problems (e.g., thinking, memory, paying attention) 1
Primarily physical problems (e.g., fatigue, feeling sick) 2
Equally cognitive and physical problems 3
I am not having any difficulties on the previous tasks 8

Comments_____

_____

20. **If you are having more difficulty than you used to with the above tasks, approximately when did the difficulties begin?**

Within the last month 1
1 to 6 months ago 2
6 months to 2 years ago 3
2 to 5 years ago 4
More than 5 years ago 5
I am not having any difficulties 8

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SUBSTANCE USE

INSTRUCTIONS TO CLINICIAN: Ask the participant if he/she has used or even tried any substances from the following categories listed below EVER (if Cross-Sectional visit) or SINCE THE LAST VISIT (if longitudinal visit). Provide examples of substances from each substance category. (This list does not encompass all illicit substances; these are just a few examples. Refer to your reference manual for a longer list.) Circle the number that corresponds best to the participant's response.

Code "1" if the participant has used the substance 5 or more times in the period of interest.
Code "2" if the participant has used the substance 4 or less times in the period of interest.

For each substance coded "1," complete the Substance Use History (CH13B or ND25) for that substance.

	NO	YES ≥5X	YES ≥4X
1. Alcohol	0	1	2
2. Tobacco (e.g., cigarettes, cigars, chew, snuff)	0	1	2
3. Marijuana	0	1	2
4. Cocaine / Crack	0	1	2
5. Methamphetamine (i.e., Crystal Meth, Ice, Glass)	0	1	2
6. Other Stimulants (e.g., amphetamines, Ritalin)	0	1	2
7. Heroin	0	1	2
8. Other Opioids (e.g., Vicodin, Oxycontin)	0	1	2
9. Sedatives (e.g., Rohypnol, GHB, Quaaludes, etc.)	0	1	2
10. Antianxiety Drugs (e.g.,Valium, Xanax, Ativan)	0	1	2
11. Hallucinogens (e.g., LSD, mushrooms, Acid, etc.)	0	1	2
12. Dissociative Drugs (e.g., PCP, Angel Dust, Ketamine)	0	1	2
13. Inhalants (e.g., Nitrous Oxide, gasoline, glue, Whippits, etc.)	0	1	2
14. Poppers (e.g., Amyl Nitrate, Butyl Nitrate)	0	1	2
15. Ecstasy (i.e., MDMA, E, X)	0	1	2
16. Other: _____	0	1	2

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CHQUSUB CH13D

Study No. | Visit No. | Date | Staff I.D.

CHINESE SUBSTANCE USE HISTORY

INSTRUCTIONS TO CLINICIAN: Refer to detailed instructions on substance categories.

1. Substance: _____

2. Last Use: ☐☐

Hours ago 1
Days ago 2
Weeks ago 3
Months ago 4
Years ago 5

3. Current Age: ☐☐

4. Age Of 1st Use: ☐☐

AGE AT ONSET OF EPOCH	DURATION (NUMBER)	PERIOD OF DURATION				DAILY QUANTITY USED	QUANTITY UNIT			FREQUENCY AMOUNT (NUMBER)	FREQUENCY PERIOD				PRIMARY ROUTE						IV USE DURING EPOCH	
		Day(s)	Week(s)	Month(s)	Year(s)		Units	Grams	Other		Day	Week	Month	Year	Smoking	Ingesting	Intranasal	Injection	Rectal	Mucosal	No	Yes
Last 7 days		1					1	2	3		1				1	2	3	4	5	6	0	1
Last 8-30 days		1	2	3			1	2	3		1	2	3		1	2	3	4	5	6	0	1
2-12 months ago		1	2	3	4		1	2	3		1	2	3	4	1	2	3	4	5	6	0	1
Peak Use: _____		1	2	3	4		1	2	3		1	2	3	4	1	2	3	4	5	6	0	1

1 unit = 1 drink = 1 cigarette = 1 pill = 1 tab = 1 dose

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Data Entry Only

USE OF ACADEMIC SKILLS QUESTIONNAIRE

1. **How often do you read in your everyday life:**

Never.....SKIP TO QUESTION 7.....1
Rarely (less than once per day).....2
Sometimes (at least once per day, but less than 3 times/day).....3
Often (3 times per day or more).....4

If participants reads in everyday life, does he/she always or almost always understand (for each item code "yes", "no" or "not applicable/ does not attempt to read).

	NO	YES	N/A
2. Signs and product names	0	1	8
3. Instructions (how to use products, or go places, etc.)	0	1	8
4. Mail, or written messages on mobile phone	0	1	8
5. Newspapers, magazine articles or subtitles on foreign TV/movies	0	1	8
6. Books	0	1	8

7. **How often do you write in your everyday life?**

Never.....1
Rarely (less than once per day).....2
Sometimes (at least once per day, but less than 3 times/day).....3
Often (3 times per day or more).....4

8. **How often do you use addition or subtraction?**

Never.....1
Rarely (less than once per day).....2
Sometimes (at least once per day, but less than 3 times/day).....3
Often (3 times per day or more).....4

9. **During a typical day, how many non-family people do you talk with?** ☐☐ Number of people

10. **During all years you attended school, how often did you skip or miss classes except for sick time or sick leave?**

Never missed classes except sick leave.....1
On average, missed less than one week per year.....2
On average, missed one week or more, but less than one month per year.....3
On average, missed on month or more, but less than 3 months per year.....4
On average, missed three months or more, but less than 6 months per year.....5
On average, missed 6 months or more per year (missed more than half of the classes).....6

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NEUROBEHAVIORAL MEDICAL SCREEN

Date of Birth: _____ MM/DD/YY Age: _____

INSTRUCTIONS TO EXAMINER: Ask the subject the following questions. If "Yes" is circled for any of the items below, write a summary of the incident in the space provided. Also, list any aftereffects (e.g., changes in vision, headaches, nausea, vomiting, amnesia, dizziness) or related events (e.g., artificial resuscitation, hospitalization).

1. In your lifetime, have you ever...
   a. Had an open or closed head injury? Yes / No
   b. Had a CHI with a loss of consciousness? Yes / No
   c. Been in a coma? Yes / No
   d. Had a blackout from alcohol and/or drugs? Yes / No
   e. Passed out from alcohol and/or drugs? Yes / No
   f. Been unconscious for any other reason (exclude surgery)? Yes / No
   g. Had a seizure? Yes / No
   h. Had a heart attack? Yes / No
   i. Had a stroke? Yes / No
   j. Fainted for any reason? Yes / No
   k. Overdosed on alcohol, drugs or medication? Yes / No

2. Is there a history of neurologic illness in your family such as Parkinson's Disease, Alzheimer's Disease, Huntington's Chorea, Multiple Sclerosis, Epilepsy, etc.? If so, who and was this from maternal or paternal side of the family?

3. Did you ever have any difficulty in school learning basic academic skills (i.e., problems in math or problems with reading). If so, were you in special classes or require tutoring?

4. Were you ever diagnosed as having a learning disability, dyslexia, attention deficit disorder or attention-deficit hyperactivity disorder? Who diagnosed you? How old were you when diagnosed?

5. Were you ever held back or skipped a grade in school? Why?

6. How many years of education have you completed? (Tester: List specific degrees or units/semesters completed and <u>when</u> and <u>where</u>.)

   High school diploma or GED?_____ If GED, what was the last grade completed? _____

   If degree(s) earned, please list college and degree obtained _____

   _____

   If no college degree, college and number of classes/units completed _____

   _____

   Total years of education: ☐☐

7. How much sleep did you get last night? Is this more or less sleep than usual? Was it restless or restful?

8. Are you currently employed? If so, what is your occupation? If not, how long has it been since you last worked? What was highest position you ever held? How long did you have this position? (Indicate dates)

9. What medications are you currently taking? When did you last take them? (Tester: only list non-HIV medications.)

Name of Medication	When did you last take it?	What is it for?

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Data Entry Only

BEHAVIORAL NOTES

EDUCATION: ☐ AGE: ☐

1. **Confounds:** (LIST REASON(S) FOR CONFOUND(S) IN ITEM #28)

	NO	YES
Alcohol	0	1
Drug	0	1
Language	0	1
Education	0	1
CHI with LOC	0	1
Medical	0	1
Psychiatric	0	1

2. **Gender at Birth:** ☐ SEE ITEM #28
   - Male 1
   - Female 2

3. **Handedness:** ☐ SEE ITEM #28
   - Right 1
   - Left 2

4. **Ethnicity and Code:** ☐ SEE ITEM #28
   _____ ☐☐

5. **Language Tested: Spanish / English** (CIRCLE ONE)

6. **First Language:** _____

7. **Transportation:** _____

8. **Employment:** _____

9. **Affect:** ☐ SEE ITEM #28
   - Euthymic 1
   - Dysthymic 2
   - Dysphoric 3

10. **Appropriateness**
    - Appropriate 1
    - Inappropriate 2

11. **Demeanor:** ☐ SEE ITEM #28

	NO	YES
Friendly	0	1
Cheerful	0	1
Anxious	0	1
Humorous	0	1
Defensive	0	1

12. **Rapport:** ☐ SEE ITEM #28
    - Good 1
    - Fair 2
    - Poor 3

13. **Cooperation:** ☐ SEE ITEM #28
    - Excellent 1
    - Good 2
    - Adequate 3
    - Fair 4
    - Poor 5

14. **Effort:** ☐ SEE ITEM #28
    - Excellent 1
    - Good 2
    - Adequate 3
    - Fair 4
    - Poor 5

15. **Gait Disturbance:** ☐ SEE ITEM #28
    - Severe 1
    - Moderate 2
    - Moderate/Mild 3
    - Mild 4
    - None 5

16. **Impaired Use of Hands:** ☐ SEE ITEM #28
    - Severe 1
    - Moderate 2
    - Moderate/Mild 3
    - Mild 4
    - None 5

17. **Speech:** ☐ SEE ITEM #28

	NO	YES
Rapid	0	1
Average	0	1
Slow	0	1
Slurred	0	1
Pressured	0	1
Stuttering	0	1

18. **Sensory - Auditory:** ☐ SEE ITEM #28
    - Adequate 1
    - Poor 2

19. Sensory - Visual: ☐ SEE ITEM #28

Adequate 1
Poor 2

20. Attention Concentration: ☐ SEE ITEM #28

Good 1
Fair 2
Poor 3

21. Distractibility: ☐ SEE ITEM #28

Low 1
Moderate 2
High 3

22. Understanding of Instructions: ☐ SEE ITEM #28

Very Good 1
Good 2
Adequate 3
Fair 4
Poor 5

23. Memory: ☐ SEE ITEM #28

	NO	YES
Intact	0	1
Impaired: Poor - Recent	0	1
Impaired: Poor - Remote	0	1

24. Frustration Tolerance: ☐ SEE ITEM #28

Very Good 1
Good 2
Adequate 3
Fair 4
Poor 5

25. Nonstandard or Invalid Test: ☐ SEE ITEM #28

None 1
Yes - See Comments Below 2

26. Step Down:

No 1
Yes - Explain Below 2

27. Reliability: ☐ SEE ITEM #28

28. Examiner's Observations:

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Data Entry Only

HISCOCK DIGIT MEMORY TEST

TOTAL:

	BLOCK A (5" Delay)		BLOCK B (10" Delay)		BLOCK C (15" Delay)	
	TARGET	RESPONSE	TARGET	RESPONSE	TARGET	RESPONSE
1.	81359		61827		18475	
2.	92785		18475		85321	
3.	80623		29381		20317	
4.	95321		95321		52187	
5.	75142		48970		76123	
6.	53619		31027		61827	
7.	61827		18475		81359	
8.	18475		85321		92785	
9.	29381		20317		80623	
10.	95321		52187		95321	
11.	48970		76123		75142	
12.	31027		61827		53619	
	CORRECT:		CORRECT:		CORRECT:	

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Data Entry Only

HOPKINS VERBAL LEARNING TEST REVISED - RECORD FORM Z

Time Trial 3 Completed: _____ Time Delay Recall Complete: _____ Delay Interval (20 min.): _____

TRIALS 1-3 & DELAY:

PROBLEM	TRIAL 1	TRIAL 2	TRIAL 3	DELAY
1. Lion				
2. Copper				
3. Horse				
4. Tent				
5. Iron				
6. Hotel				
7. Cave				
8. Lead				
9. Tiger				
10. Zinc				
11. Cow				
12. Hut				

Trial 1 Total: | Trial 2 Total: | Trial 3 Total: | Delay Total:

True Positives:

False Positives:

TRIAL RECOGNITION:

PROBLEM	YES/ NO	
1. Horse	**Y**	N
2. House*	Y	**N**
3. Hut	**Y**	N
4. Tent	**Y**	N
5. Steel*	Y	**N**
6. Copper	**Y**	N
7. Lead	**Y**	N
8. Mountain	Y	**N**
9. Cave	**Y**	N
10. Tiger	**Y**	N
11. Iron	**Y**	N
12. Cat*	Y	**N**
13. Balloon	Y	**N**
14. Boat	Y	**N**
15. Dog*	Y	**N**
16. Hotel	**Y**	N
17. Coffee	Y	**N**
18. Scarf	Y	**N**
19. Apartment*	Y	**N**
20. Cow	**Y**	N
21. Lion	**Y**	N
22. Zinc	**Y**	N
23. Kwacha	Y	**N**
24. Bronze*	Y	**N**

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Data Entry Only

BRIEF VISUOSPATIAL MEMORY TEST - REVISED

Time Trial 3 Completed: _____ Time Delay Recall Completed: _____ Delay Interval (25 min.): _____

Form Administered: 1 2 3 4 5 6 (circle one)

	Raw Score	T Score	Percentile
Trial 1			
Trial 2			
Trial 3			
Total Recall[1]			
Delayed Recall			
Percent Retained[2]			
Recognition Hits (True Positives)			
Recognition False Alarms			
Recognition Discrimination Index[3]			
Reconition Response Bias			
Copy (optional)			

Normative table/comparison group_____

[1]Total Recall = (Trial 1 raw score + Trial 2 raw score + Trial 3 raw score).
[2]Percent Retained = [Delayed recall raw score/(higher value of Trial 2 raw score or Trial 3 raw score)] x 100.
[3]Recognition Discrimination Index = Recognition Hits raw score - Recognition False Alarms raw score.

Recognition Trial Scoring Worksheet

Item	Response	
	Hits	False Alarms
1.	**YES** no	
2.		yes **NO**
3.	**YES** no	
4.		yes **NO**
5.		yes **NO**
6.	**YES** no	
7.	**YES** no	
8.		yes **NO**
9.	**YES** no	
10.		yes **NO**
11.		yes **NO**
12.	**YES** no	
Total raw score		
Discrimination Index (Hits minus False Alarms)		
Response Bias (Find the cell corresponding to Total Hits and False Alarms raw scores in look-up table below.)		

Response Bias Look-up Table

	False Alarms						
Hits	0	1	2	3	4	5	6
0	.07	.19	.28	.35	.41	.46	.50
1	.08	.21	.31	.39	.45	.50	.54
2	.10	.25	.36	.44	.50	.55	.59
3	.13	.30	.42	.50	.56	.61	.65
4	.17	.38	.50	.58	.64	.69	.72
5	.25	.50	.63	.70	.75	.79	.81
6	.50	.75	.83	.88	.90	.92	.93

NPDYLW3 ND16

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Data Entry Only

WAIS-III DIGIT SYMBOL

TOTAL: (Maximum Score is 133)

1	2	3	4	5	6	7	8	9
—	⊥	⊐	L	⊔	○	∧	×	=

SAMPLES

2	1	3	7	2	4	8	2	1	3	2	1	4	2	3	5	2	3	1	4

5	6	3	1	4	1	5	4	2	7	6	3	5	7	2	8	5	4	6	3

7	2	8	1	9	5	8	4	7	3	6	2	5	1	9	2	8	3	7	4

6	5	9	4	8	3	7	2	6	1	5	4	6	3	7	9	2	8	1	7

9	4	6	8	5	9	7	1	8	5	2	9	4	8	6	3	7	9	8	6

2	7	3	6	5	1	9	8	4	5	7	3	1	4	8	7	9	1	4	5

7	1	8	2	9	3	6	7	2	8	5	2	3	1	4	8	4	2	7	6

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Data Entry Only

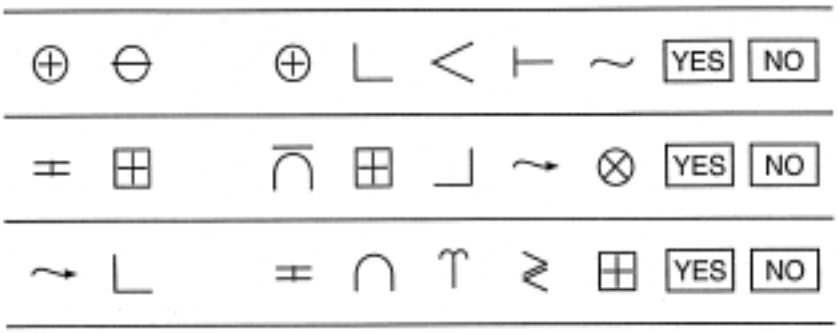
WAIS-III SYMBOL SEARCH

TOTAL: (Maximum 60)

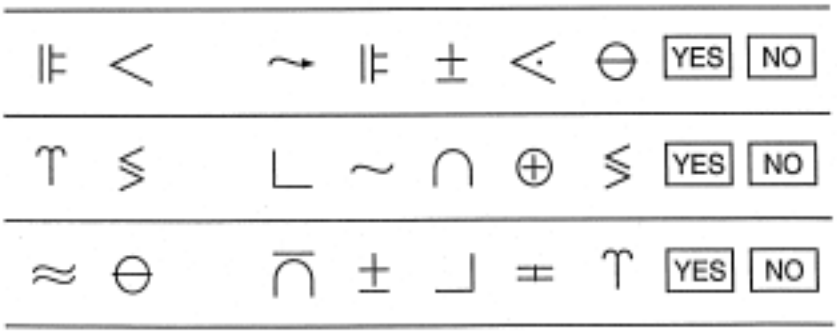
INSTRUCTIONS TO EXAMINER: Discontinue after 120 seconds.

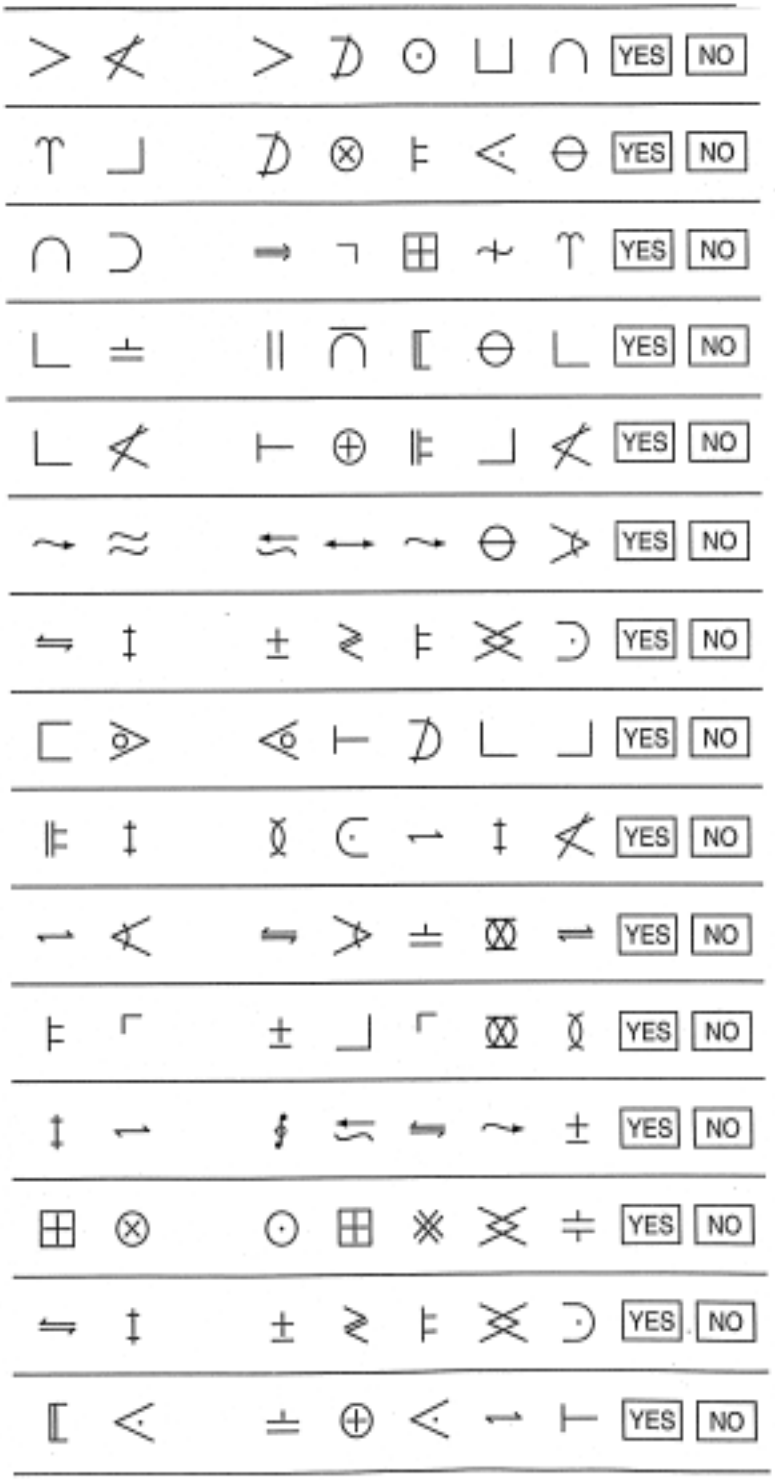
TIME LIMIT	COMPLETION TIME (Seconds)	NUMBER CORRECT	NUMBER INCORRECT
120"			

Sample Items



Practice Items

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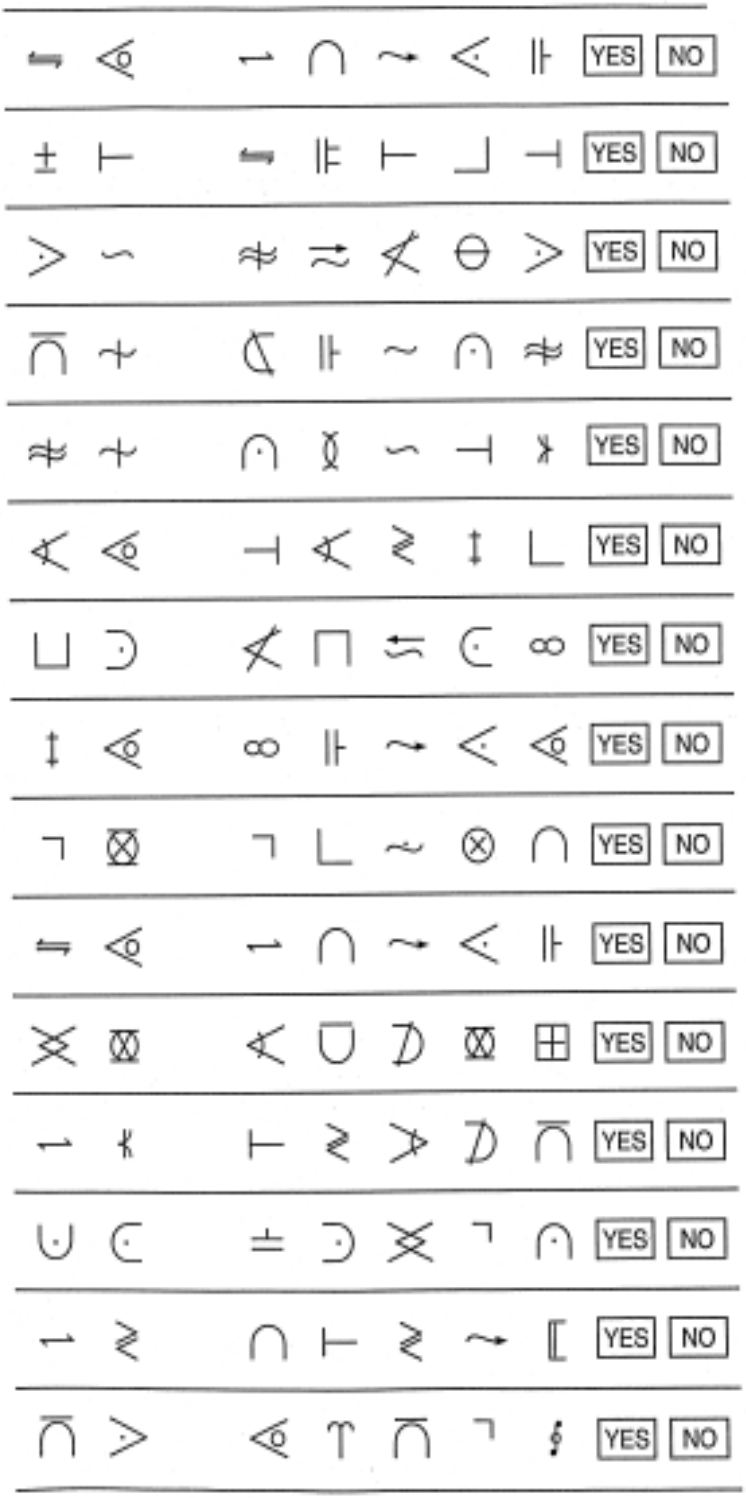
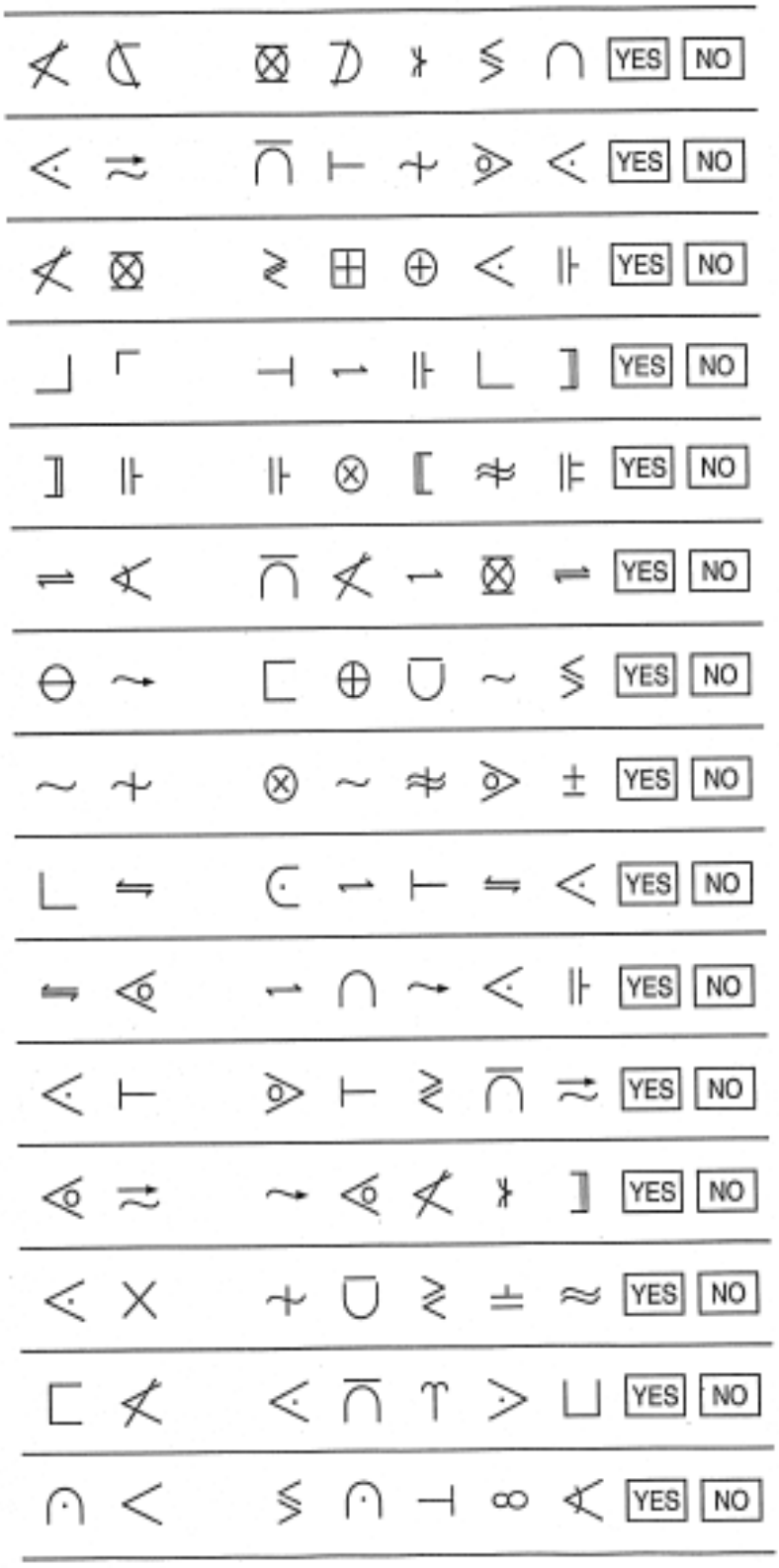
Study No. | Visit No. | Data Entry Only

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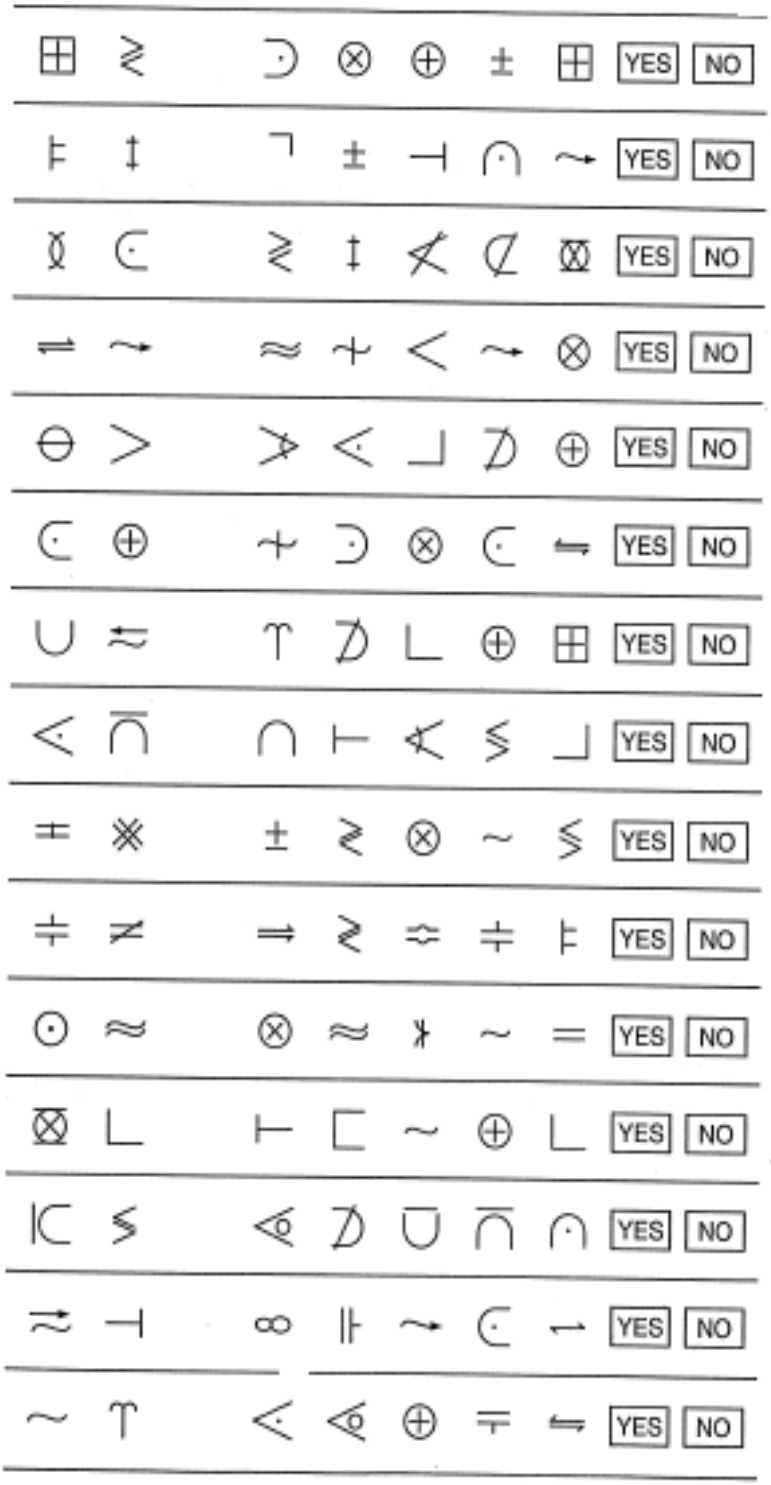

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Data Entry Only

GROOVED PEGBOARD TEST SUMMARY SHEET

DOMINANT TRIAL

Handedness (CIRCLED): LEFT RIGHT

Time: ___ SECONDS

No. In: ___ PEGS

Dropped: ___ PEGS

NON-DOMINANT TRIAL

Handedness (CIRCLED): LEFT RIGHT

Time: ___ SECONDS

No. In: ___ PEGS

Dropped: ___ PEGS

NOTES:

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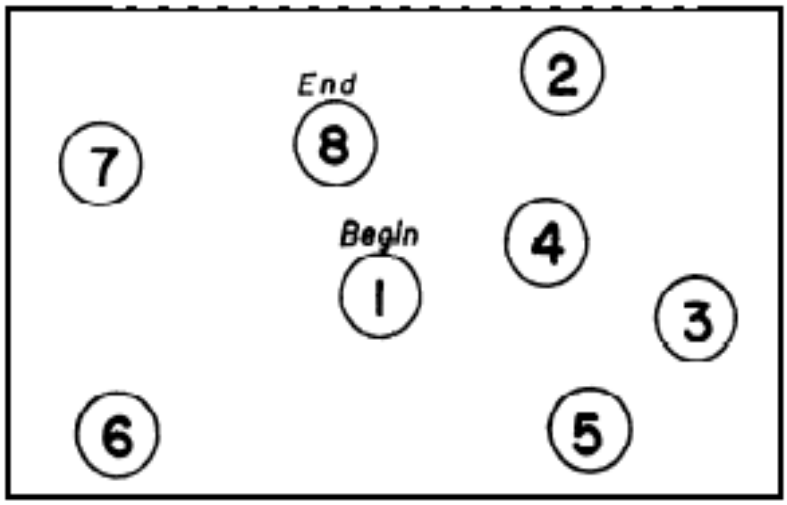
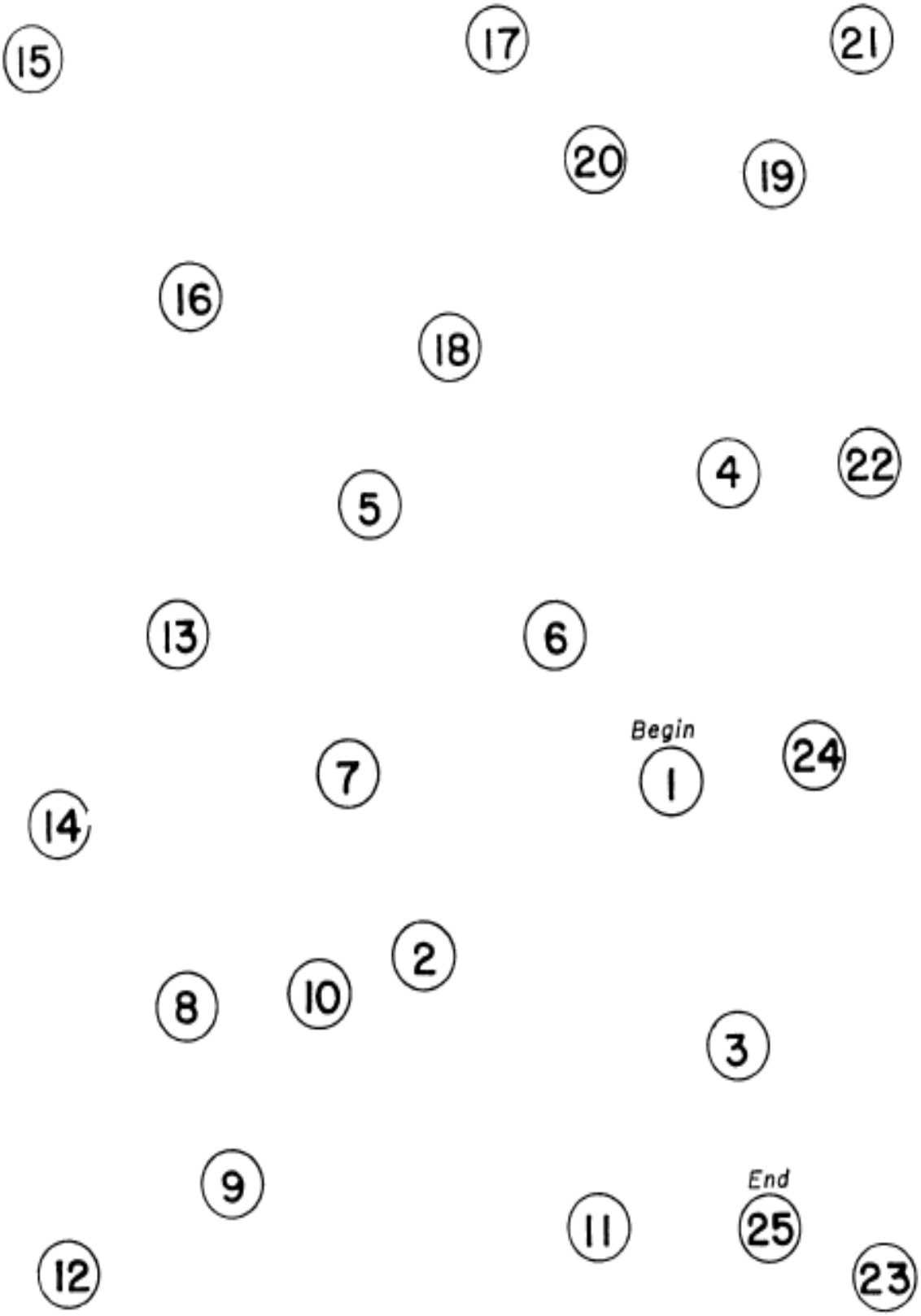
TRAIL MAKING TEST - PART A

SAMPLE TIME: | PART-A TIME: | PART-A ERRORS:

SAMPLE

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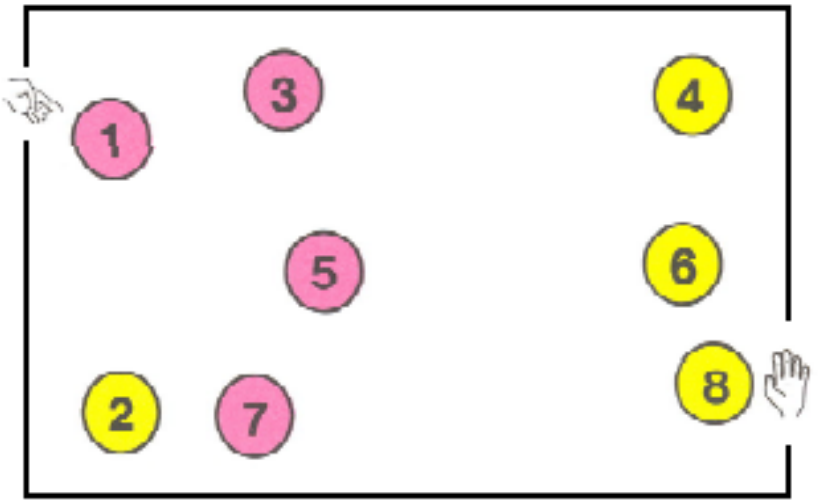
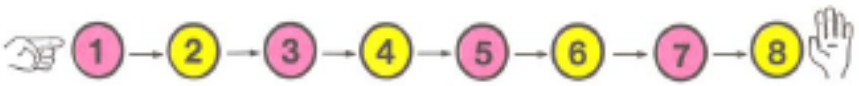
Data Entry Only

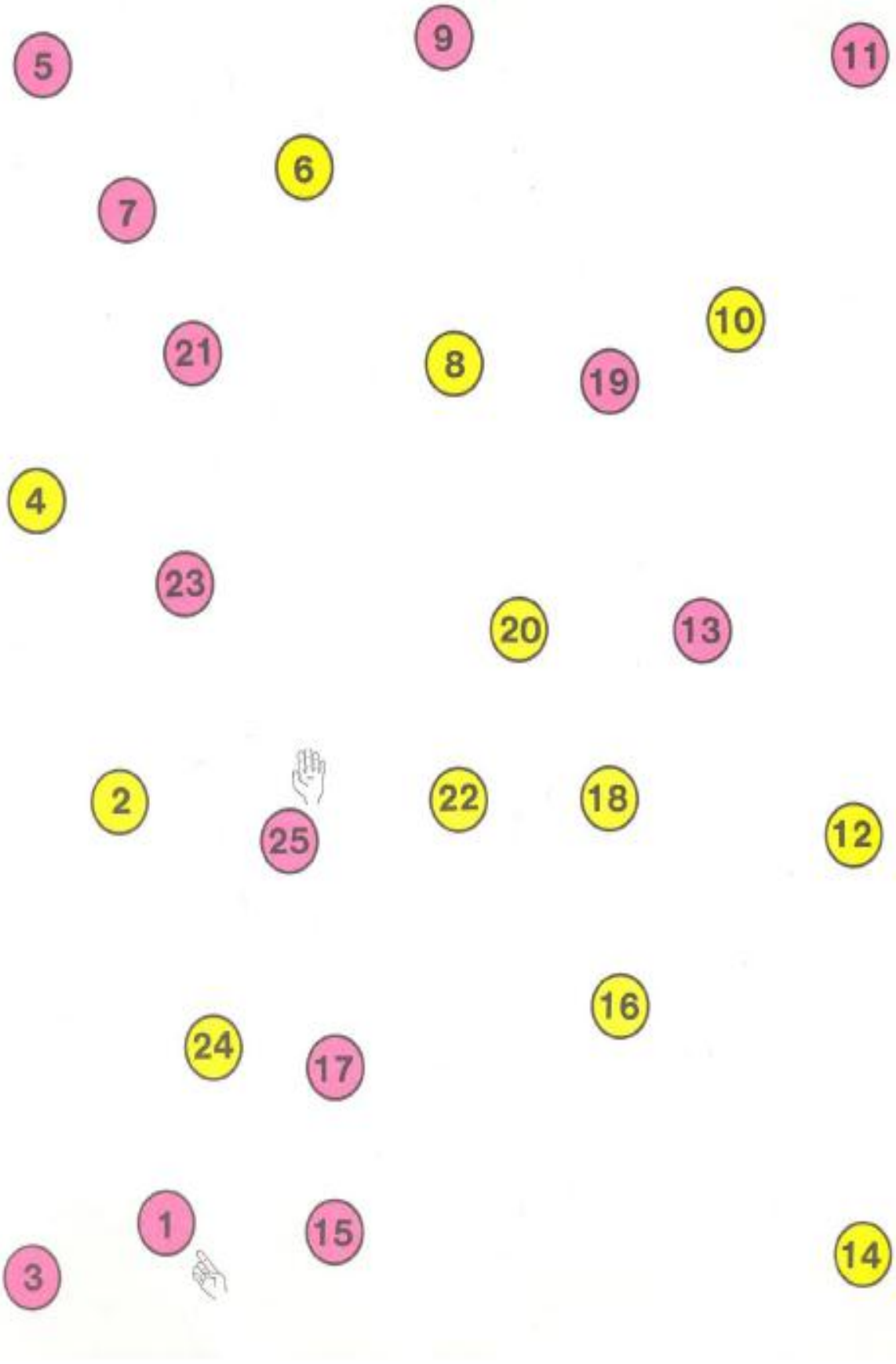
COLOR TRAILS 1 - FORM A

SAMPLE TIME: TRAILS 1 TIME: TRAILS 1 ERRORS:

Louis F. D'Elia, PhD and Paul Satz, PhD



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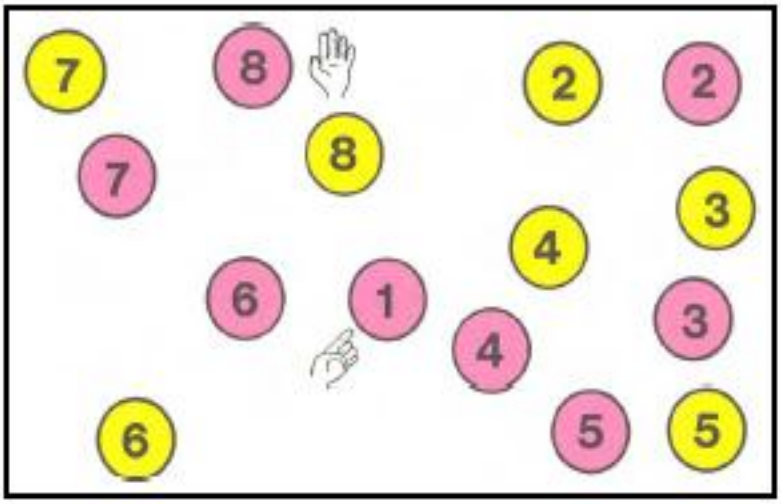
NPTRLS2 NP41B

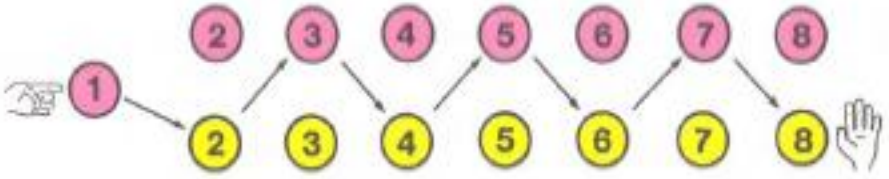
Study No. | Visit No. | Date | Staff I.D. | Data Entry Only

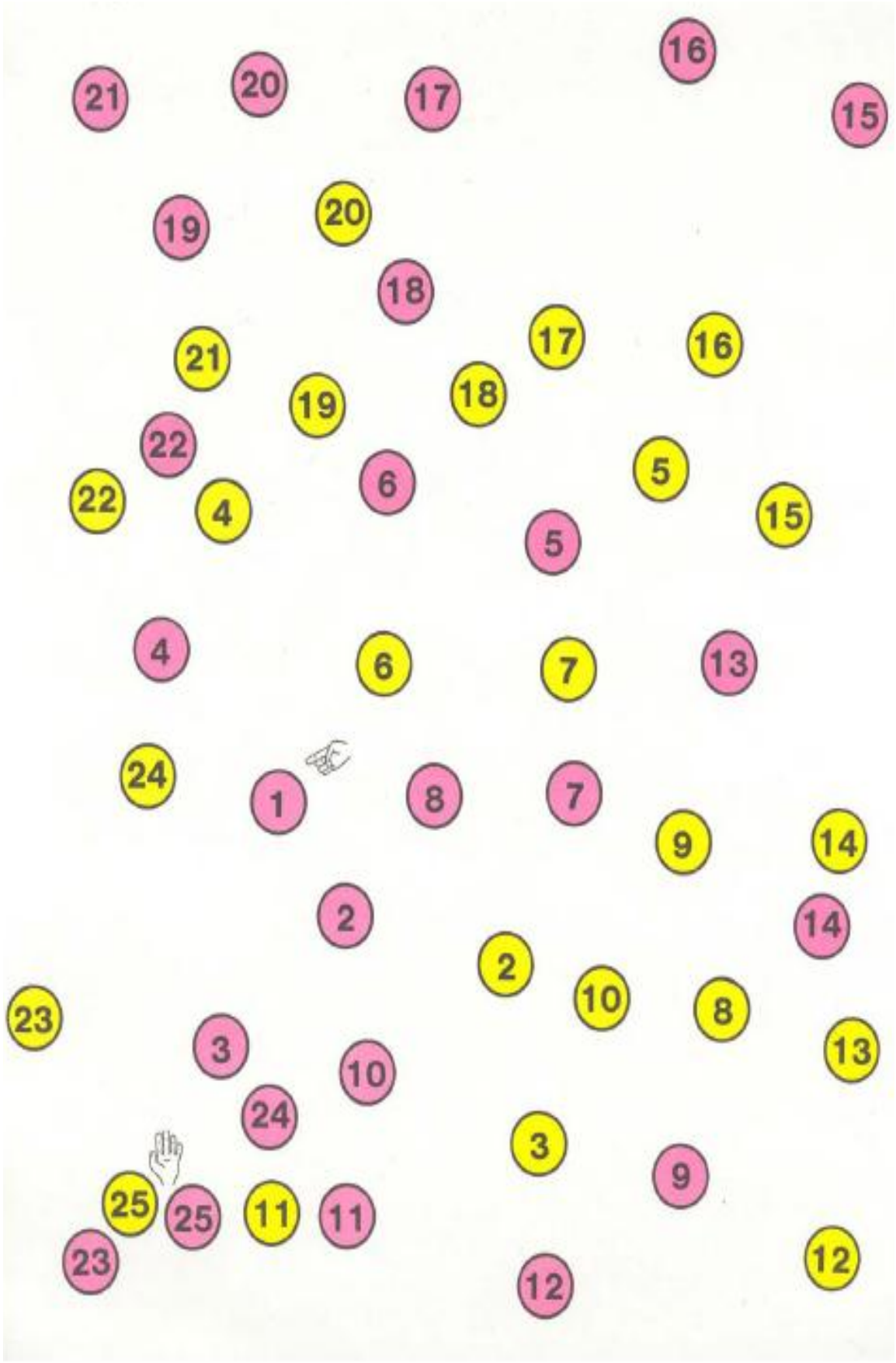
COLOR TRAILS 2 - FORM A

SAMPLE TIME: | TRAILS 2 TIME: | TRAILS 2 ERRORS:

Louis F. D'Elia, PhD and Paul Satz, PhD



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Data Entry Only

WMS-III SPATIAL SPAN

TOTAL SCORE:

INSTRUCTIONS TO EXAMINER: Administer both trials of each item, even if examinee passes first trial. Discontinue after failure on both trials of any item. Maximum score for both trials is 32.

SPATIAL SPAN FORWARD

ITEM	TRIAL	RESPONSE	SCORE
1.	Trial 1	3 - 10	0 1
	Trial 2	7 - 4	0 1
2.	Trial 1	1 - 9 - 3	0 1
	Trial 2	8 - 2 - 7	0 1
3.	Trial 1	4 - 9 - 1 - 6	0 1
	Trial 2	10 - 6 - 2 - 7	0 1
4.	Trial 1	6 - 5 - 1 - 4 - 8	0 1
	Trial 2	5- 7- 9- 8 - 2	0 1
5.	Trial 1	4 - 1 - 9 - 3 - 8 - 10	0 1
	Trial 2	9 - 2 - 6 - 7 - 3 - 5	0 1
6.	Trial 1	10 - 1 - 6 - 4 - 8 - 5 - 7	0 1
	Trial 2	2 - 6 - 3 - 8 - 2 - 10 - 1	0 1
7.	Trial 1	7 - 3 - 10 - 5 - 7 - 8 - 4 - 9	0 1
	Trial 2	6 - 9 - 3 - 2 - 1 - 7 - 10 - 5	0 1
8.	Trial 1	5 - 8 - 4 - 10 - 7 - 3 - 1 - 9 - 6	0 1
	Trial 2	8 - 2 - 6 - 1 - 10 - 3 - 7 - 4 - 9	0 1

Forward Total Score

SPATIAL SPAN BACKWARD

ITEM	TRIAL	RESPONSE	SCORE
1.	Trial 1	7 - 4 (4 - 7)	0 1
	Trial 2	3 - 10 (10 - 3)	0 1
2.	Trial 1	8 - 2 - 7 (7 - 2 - 8)	0 1
	Trial 2	1 - 9 - 3 (3 - 9 - 1)	0 1
3.	Trial 1	10 - 6 - 2 - 7 (7 - 2 - 6 - 10)	0 1
	Trial 2	4 - 9 - 1 - 6 (6 - 1 - 9 - 4)	0 1
4.	Trial 1	5 - 7 - 9 - 8 - 2 (2 - 8 - 9 - 7 - 5)	0 1
	Trial 2	6 - 5 - 1 - 4 - 8 (8 - 4 - 1 - 5 - 6)	0 1
5.	Trial 1	9 - 2 - 6 - 7 - 3 - 5 (5 - 3 - 7 - 6 - 2 - 9)	0 1
	Trial 2	4 - 1 - 9 - 3 - 8 - 10 (10 - 8 - 3 - 9 - 1 - 4)	0 1
6.	Trial 1	2 - 6 - 3 - 8 - 2 - 10 - 1 (1 - 10 - 2 - 8 - 3 - 6 - 2)	0 1
	Trial 2	10 - 1 - 6 - 4 - 8 - 5 - 7 (7 - 5 - 8 - 4 - 6 - 1 - 10)	0 1
7.	Trial 1	6 - 9 - 3 - 2 - 1 - 7 - 10 - 5 (5 - 10 - 7 - 1 - 2 - 3 - 9 - 6)	0 1
	Trial 2	7 - 3 - 10 - 5 - 7 - 8 - 4 - 9 (9 - 4 - 8 - 7 - 5 - 10 - 3 - 7)	0 1
8.	Trial 1	8 - 2 - 6 - 1 - 10 - 3 - 7 - 4 - 9 (9 - 4 - 7 - 3 - 10 - 1 - 6 - 2 - 8)	0 1
	Trial 2	5 - 8 - 4 - 10 - 7 - 3 - 1 - 9 - 6 (6 - 9 - 1 - 3 - 7 - 10 - 4 - 8 - 5)	0 1

BACKWARD TOTAL SCORE: ☐

Study No. | Visit No. | Date | Staff I.D.

Data Entry Only

CONTROLLED ORAL WORD ASSOCIATION TEST - FAS

SECONDS	TRIAL 1 Letter "F"	TRIAL 2 Letter "A"	TRIAL 3 Letter "S"
0 - 15			
16 - 30			
31 - 45			
46 - 60			

	"F" Trial	"A" Trial	"S" Trial
Correct Words:			
Perseverations:			
Intrusions:			
Variants:			

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Study No. | Visit No. | Date | Staff I.D.

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CATEGORY FLUENCY TEST

SECONDS	TRIAL 1 "Animals"	TRIAL 2 "Actions"
0 - 15		
16 - 30		
31 - 45		
46 - 60		

	"Animals" Trial	"Actions Trial"
Correct Words:		
Perseverations:		
Intrusions:		

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PACED AUDITORY SERIAL ADDITION TASK - 1 CHANNEL

Channel 1

	Correct	Response
1.	9....11	____
2.	1....10	____
3.	4....5	____
4.	2....6	____
5.	8....10	____
6.	6....14	____
7.	5....11	____
8.	3....8	____
9.	4....7	____
10	9....13	____
11.	1....10	____
12.	3....4	____
13.	6....9	____
14.	8....14	____
15.	2....10	____
16.	5....7	____
17.	1....6	____
18.	8....9	____
19.	6....14	____
20.	9....15	____
21.	2....11	____
22.	4....6	____
23.	3....7	____
24.	5....8	____
25.	6....11	____
26.	5....11	____
27.	8....13	____
28.	9....17	____
29.	4....13	____
30.	3....7	____
31.	1....4	____
32.	2....3	____
33.	6....8	____
34.	3....9	____
35.	4....7	____
36.	8....12	____
37.	9....17	____
38.	5....14	____
39.	1....6	____
40.	2....3	____
41.	8....10	____
42.	1....9	____
43.	2....3	____
44.	5....7	____
45.	3....8	____
46.	9....12	____
47.	6....15	____
48.	4....10	____
49.	3....7	____
50.	6....9	____

#Attempted:

#Correct:

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Study No. | Visit No. | Date | Staff I.D.

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STROOP TEST

INSTRUCTIONS TO THE EXAMINER: Begin by instructing the participant: (Page with word in black ink.) *"This is a test of how fast you can read the words on this page. After I say "BEGIN", read down the columns starting with the first one (point to the leftmost column) until you complete it (run hand down the leftmost column) and then continue without stopping down the remaining columns in order (run your hand down the second column, then third, etc.). If you finish all the columns before I say "STOP", then return to the first column and begin again (point to the first column). Remember, do not stop reading until I say "STOP" and read out loud as quickly as you can. If you make a mistake, I will say, "NO" to you. Correct your error and continue without stopping. Are there any questions?"* Instructions may be repeated or paraphrased as often as necessary until the subject understands what is to be done. *"Ready?....Then begin."* As the subject starts, begin timing. After 45 seconds, say: "STOP". Circle the item they are on.

WORDS:

1.	RED	21.	BLUE	41.	GREEN	61.	RED	81.	BLUE
2.	GREEN	22.	GREEN	42.	RED	62.	BLUE	82.	GREEN
3.	BLUE	23.	RED	43.	BLUE	63.	GREEN	83.	RED
4.	GREEN	24.	BLUE	44.	RED	64.	RED	84.	BLUE
5.	RED	25.	RED	45.	GREEN	65.	BLUE	85.	GREEN
6.	BLUE	26.	GREEN	46.	BLUE	66.	GREEN	86.	RED
7.	RED	27.	BLUE	47.	GREEN	67.	BLUE	87.	GREEN
8.	BLUE	28.	GREEN	48.	RED	68.	GREEN	88.	RED
9.	GREEN	29.	RED	49.	BLUE	69.	RED	89.	BLUE
10.	BLUE	30.	GREEN	50.	GREEN	70.	BLUE	90.	GREEN
11.	GREEN	31.	RED	51.	BLUE	71.	RED	91.	RED
12.	RED	32.	BLUE	52.	RED	72.	GREEN	92.	BLUE
13.	GREEN	33.	RED	53.	BLUE	73.	RED	93.	GREEN
14.	BLUE	34.	BLUE	54.	RED	74.	GREEN	94.	RED
15.	RED	35.	GREEN	55.	GREEN	75.	BLUE	95.	BLUE
16.	BLUE	36.	BLUE	56.	RED	76.	GREEN	96.	RED
17.	RED	37.	GREEN	57.	BLUE	77.	RED	97.	GREEN
18.	GREEN	38.	RED	58.	GREEN	78.	BLUE	98.	BLUE
19.	RED	39.	BLUE	59.	RED	79.	GREEN	99.	RED
20.	GREEN	40.	RED	60.	GREEN	80.	BLUE	100.	GREEN

Word Total: | | | |

INSTRUCTIONS TO THE EXAMINER: (Page with colored X's.) *"This is a test of how fast you can name the colors on this page. You will complete this page just as you did the previous page, starting with this first column. Remember to name the colors out loud as quickly as you can. Are there any questions?"* If the subject has had any trouble following the instructions, they should be repeated in their entirety. As with Page 1, the subject should be allowed 45 seconds.

COLORS:

1.	BLUE	21.	RED	41.	BLUE	61.	GREEN	81.	RED
2.	RED	22.	BLUE	42.	GREEN	62.	RED	82.	BLUE
3.	GREEN	23.	GREEN	43.	RED	63.	BLUE	83.	GREEN
4.	BLUE	24.	RED	44.	BLUE	64.	GREEN	84.	RED
5.	GREEN	25.	GREEN	45.	RED	65.	RED	85.	BLUE
6.	RED	26.	BLUE	46.	GREEN	66.	BLUE	86.	GREEN
7.	GREEN	27.	GREEN	47.	RED	67.	GREEN	87.	RED
8.	RED	28.	RED	48.	BLUE	68.	RED	88.	BLUE
9.	BLUE	29.	BLUE	49.	GREEN	69.	BLUE	89.	GREEN
10.	RED	30.	RED	50.	RED	70.	GREEN	90.	BLUE
11.	BLUE	31.	BLUE	51.	GREEN	71.	BLUE	91.	GREEN
12.	GREEN	32.	GREEN	52.	BLUE	72.	RED	92.	RED
13.	RED	33.	BLUE	53.	RED	73.	BLUE	93.	BLUE
14.	GREEN	34.	GREEN	54.	GREEN	74.	RED	94.	GREEN
15.	BLUE	35.	RED	55.	BLUE	75.	GREEN	95.	RED
16.	GREEN	36.	GREEN	56.	GREEN	76.	BLUE	96.	BLUE
17.	BLUE	37.	RED	57.	RED	77.	GREEN	97.	RED
18.	RED	38.	BLUE	58.	BLUE	78.	RED	98.	GREEN
19.	GREEN	39.	RED	59.	GREEN	79.	BLUE	99.	BLUE
20.	BLUE	40.	GREEN	60.	BLUE	80.	RED	100.	RED

Color Total: | | | |

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INSTRUCTIONS TO THE EXAMINER: (Page with colors and words.) *"This page is like the page you just finished. I want you to name the color of the ink the words are printed in, ignoring the word that is printed in each item. For example, (point to the first item of the first column), this is the first item: what would you say?"* If the subject is correct, go on with the instructions. If incorrect, say: *"No, that is the word that is spelled there. I want you to say the color of the ink the word is printed in. Now (pointing to the same item) what would you say to this item? That's correct (point to the second item), what would the response be to this item?"* If correct, proceed; if incorrect, repeat above as many items as necessary until the subject understand or it becomes clear that it is impossible to go on. *"Good. You will do this page just like the others, starting with the first column (pointing) and then going on to as many columns as you can. Remember, if you make a mistake, just correct it and go on. Are there any questions?"* (As with the other two pages, the instructions can be repeated or paraphrased as often as necessary.) "Ready? ...Begin!" After 45 seconds, say: Stop; Record on the form how many correct responses

COLORS - WORDS:

1.	BLUE	21.	RED	41.	BLUE	61.	GREEN	81.	RED
2.	RED	22.	BLUE	42.	GREEN	62.	RED	82.	BLUE
3.	GREEN	23.	GREEN	43.	RED	63.	BLUE	83.	GREEN
4.	BLUE	24.	RED	44.	BLUE	64.	GREEN	84.	RED
5.	GREEN	25.	GREEN	45.	RED	65.	RED	85.	BLUE
6.	RED	26.	BLUE	46.	GREEN	66.	BLUE	86.	GREEN
7.	GREEN	27.	GREEN	47.	RED	67.	GREEN	87.	RED
8.	RED	28.	RED	48.	BLUE	68.	RED	88.	BLUE
9.	BLUE	29.	BLUE	49.	GREEN	69.	BLUE	89.	GREEN
10.	RED	30.	RED	50.	RED	70.	GREEN	90.	BLUE
11.	BLUE	31.	BLUE	51.	GREEN	71.	BLUE	91.	GREEN
12.	GREEN	32.	GREEN	52.	BLUE	72.	RED	92.	RED
13.	RED	33.	BLUE	53.	RED	73.	BLUE	93.	BLUE
14.	GREEN	34.	GREEN	54.	GREEN	74.	RED	94.	GREEN
15.	BLUE	35.	RED	55.	BLUE	75.	GREEN	95.	RED
16.	GREEN	36.	GREEN	56.	GREEN	76.	BLUE	96.	BLUE
17.	BLUE	37.	RED	57.	RED	77.	GREEN	97.	RED
18.	RED	38.	BLUE	58.	BLUE	78.	RED	98.	GREEN
19.	GREEN	39.	RED	59.	GREEN	79.	BLUE	99.	BLUE
20.	BLUE	40.	GREEN	60.	BLUE	80.	RED	100.	RED

Color/Word Total: | | | |

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NPHCATG NP12

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HALSTEAD CATEGORY TEST RECORD FORM

ERRORS TOTAL:

INSTRUCTIONS TO EXAMINER: The right-hand column is used to check correct responses and the left-hand incorrect.

	SUBTEST I	SUBTEST II	SUBTEST III	SUBTEST IV	SUBTEST V	SUBTEST VI	SUBTEST VII
1.	1	1	1	1	1	1	1
2.	3	3	3	3	3	3	3
3.	1	1	1	1	1	1	1
4.	4	4	4	4	4	4	4
5.	2	2	2	2	2	2	2
6.	4	4	4	4	4	4	4
7.	1	1	1	X 1	1	1	1
8.	2	2	2	2	2	2	2
9.		X 3	3	3	3	3	3
10.		2	2	2	2	2	2
11.		3	3	3	3	3	3
12.		1	1	1	1	1	1
13.		4	4	4	4	4	4
14.		3	3	3	3	3	3
15.		4	4	4	4	4	4
16.		2	2	2	2	2	2
17.		1	1	1	1	1	1
18.		4	4	4	4	4	4
19.		1	1	1	1	1	1
20.		3	3	3	3	3	3
21.			2	2	2	2	
22.			1	1	1	1	
23.			2	2	2	2	
24.			4	4	4	4	
25.			3	3	3	3	
26.			2	2	2	2	
27.			4	4	4	4	
28.			3	3	3	3	
29.			1	1	1	1	
30.			4	4	4	4	
31.			2	2	2	2	
32.			1	1	1	1	
33.			3	3	3	3	
34.			1	1	1	1	
35.			3	3	3	3	
36.			2	2	2	2	
37.			4	4	4	4	
38.			3	3	3	3	
39.			4	4	4	4	
40.			2	2	2	2	

VERSION: 2.1E