

**THE VALIDATION OF THE NATIONAL INSTITUTE OF HEALTH (NIH) TOOLBOX
FOR THE ASSESSMENT OF NEUROLOGICAL AND BEHAVIORAL FUNCTION
AMONG ZAMBIAN CHILDREN AND ADOLESCENTS IN LUSAKA PROVINCE,
ZAMBIA**

BY

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AND DR. D. BEARDEN.**

**A thesis submitted to the University of Zambia in fulfillment of the requirements for the
award of the Doctor of Philosophy Degree of Education in Educational Psychology**

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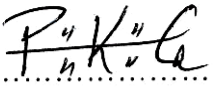
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DECLARATION

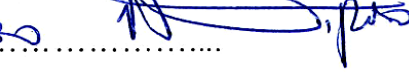
I, **Kabundula Pelekelo. P** do hereby solemnly declare that this piece of work entitled, '*The validation of the NIHTB-CB for the assessment of neurological and behavioral function among Zambian Children and Adolescents in Lusaka Province, Zambia*' is my own, and that all the works of other persons have been duly acknowledged, and that this work has not been previously presented at the University of Zambia and indeed at any other University for similar purposes. This work has been developed and implemented with corporation between the University of Zambia and Rochester University, United States of America.

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CERTIFICATE OF APPROVAL

This thesis of **Kabundula Pelekelo. P** has been approved as a fulfillment of the requirements for the award of Doctor of Philosophy Degree (PhD) of Education in Educational Psychology of the University of Zambia.

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ABSTRACT

The study set out to validate the NIHTB-CB among Zambian Children and Adolescents in Lusaka Province. The objectives of the study were to: evaluate the standardised administration of the NIHTB-CB in assessing cognitive function of children and adolescents aged 8-17 years; identify challenges encountered by children and adolescents aged 8-17 years in the administration of the NIHTB-CB in assessing cognitive function; examine the extent to which the NIHTB-CB is valid based on (face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity) in assessing cognitive function of children and adolescents aged 8-17 years; and compare results from the gold standardised of neuropsychological battery test with a threshold of 0.80-1.00 and the NIHTB-CB in children and adolescents aged 8-17 years in Lusaka Province.

A total of 791 respondents consisting of professional personnel, parents, children and adolescents completed both a gold standard of full neuropsychological testing battery and the NIHTB-CB test battery and were recruited within Lusaka Province. The NIHTB-CB and a gold standard of neuropsychological tool, which was already validated for use in Zambia, was also administered. An explanatory sequential research design also known as instrument validation design was utilised. Data elicited and generated was stored in RedCap. The study elicited both quantitative and qualitative data strands. Quantitative data was analysed using Stata 14.2 (Stata Corp LP, College Station, TX) to perform linear regression using generalised estimating equation, intra-class correlation coefficient (ICC), Pearson correlation for continuous variables and Spearman correlation for categorical variables, a multivariate normative comparison, Receiver Operating Characteristic Curve (ROC) and Confirmatory Factor Analysis were utilised. Qualitative data was analysed thematically.

The results of the study found that the Installation Qualification (IQ) of the NIHTB-CB was done in accordance with the manufacturers' specifications and its Operation Qualification (OQ) operated as expected by the manufacturer as it spelt out considerable details on standardised administration conditions and instructions. The performance qualification (PQ) in terms of psychometric properties of the NIHTB-CB to some extent had appropriate face and construct validity, with the exception of the Picture vocabulary test and Dimensional change card sort test which performed poorly due to requiring high levels of English language skills. Additionally, children and adolescents had limitations in comprehending task instructions, poor literacy and numeracy skills, and were unfamiliar with most of the NIHTB-CB test materials on both List sorting working memory test and Auditory verbal learning test and were later modified in the second phase of the study. In the first phase, correlations with standard neuropsychological tests were moderate (all pairwise correlations $r=0.43$, $p<0.001$) and in the second phase of the study, correlations with standard of full neuropsychological tests were strong to excellent ($r=0.68$; $p<0.001$). Based on the aforementioned findings; the study recommends that the NIHTB-CB should be utilised by the ministry of general education to assess cognitive function of children and adolescents in the Zambian schools for appropriate placement options.

Keywords: *Validation, Psychometric properties, Cognitive function, NIHTB-CB, HIV, HEU, Children and Adolescents.*

DEDICATION

It is rare that an individual finds an opportunity to thank the people that matter the most in life. I, therefore, dedicate this PhD work to my parents Mr. and Mrs. Kabundula (Father; Mr. Moses Kabundula; Mother; Mercy Nawa) for having given life to me and their help as well as support throughout my life as their son and during my studies.

I am indebted to my wonderful family for the moral and financial support they have rendered to me, not only through the completion of this PhD thesis but throughout my life. I also dedicate the thesis to my loving, patient and understanding wife, Exildah Bwalya for her unrelenting support and encouragement even in times when she had enough of her own work but accommodated the pressure for all the years of my study. I further dedicate this work to my lovely and treasurable daughter, Mercy Sitali Kabundula, born during the process of studying for this PhD thesis. I must also thank my caring and terrific sister; Ruth Sitali Kabundula and brothers; Chrispin Kabundula, Festus Mwiya Kabundula; David Kahilu Kabundula, Vincent Kabundula; Misheck Kabundula; Joseph Kabundula²; Alexander Nalishebo Kabundula, and Brian Siyoto Kabundula who helped me so much and gave me their fullest understanding by foregoing the attention and support they needed most from me and believed in diligence and the pursuit of academic excellence. Lastly, I dedicate this PhD to the Almighty Father in heaven for the grace and rare favours He has accorded and bestowed upon me not only in academic excellence but throughout my life.

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ACROYNMS

ANI	Asymptomatic Neurocognitive Impairment
ANOVA	Analysis of Variance
ART	Antiretroviral Therapy
AUC	Area Under Curve
AVLT	Auditory verbal learning Task/Test
AWG	Accessibility Working Group
BENCI	Battery for Neuropsychological Evaluation of Children
BRIEF-2	Behavior Rating Inventory of Executive Function-Second Edition
BSID-II	Bayley Scales of Infant Development, Second Edition
CB	Cognitive Battery
CFR	Centre for Research
CI	Confidence Interval
CI_{NIH}	Crystallized Intelligence
CLIA	Clinical Laboratory Improvement Amendment
COI	Concept of Interest
CTT	Classical Test Theory
CVLT-C	California Verbal Learning Test for Children
CWG	Cultural Working Group
DCCST	Dimensional Change Card Sorting Task/Test
DEBS	District Education Board Secretary
DKEFS-TMT	Delis-Kaplan Executive Function System- Trail Making Test
DS	Digit Span
DSM-IV	Diagnostic and Statistical Manual of Mental Disorder 4th Edition
EF_{NIH}	Executive Function
FSIQ	Full-Scale Intelligence Quotient
GDS	Global Deficit Score
GHQ	General Health Questionnaire
GIS	Geographical Information System

GPS	Geographical Position System
HAD	HIV-Associated Dementia
HAND	HIV-Associated Neurocognitive Dementia
HANDZ	HIV-Associated Neurocognitive Disorders in Zambia
HEU	HIV-Exposed Uninfected
HIV	Human Immune Virus
ICC	Intra Class Correlation Coefficients
IMPAACT	International Maternal Pediatric Adolescent AIDS Clinical Trials Network
IQ	Intelligence Quotient
KABC	Kaufman Assessment Battery for Children
LSWMT	List Sorting Working Memory Task/Test
LR	Likelihood Ratio
MCL	Medial Collateral Ligament
MDAT	Malawi Developmental Assessment Tool
MDI	Mental Developmental Index
MEM	Memory
MND	Minor Neurocognitive Disorder
MOE	Ministry of Education
MOGE	Ministry of General Education
MOH	Ministry of Health
MRI	Mental Resonance Imaging
NIH	National Institute of Health
NIHTB	National Institute of Health Toolbox
NIHTB-CB	National Institutes of Health Toolbox-Cognition Battery
NP	Neuropsychological
NPT	Neuropsychological Testing
NPZ	Composite Z-score
OPRA	Object-based Pattern Reasoning Assessment
OSDMT	Oral Symbol Digit Task/Test
PACRA	Patent Company Registration Agency
PEKA	Pelekelo Kabundula

PCOE	Paediatric Centre of Excellence
PCPST	Pattern Comparison Processing Speed Task/Test
PDI	Psychomotor Developmental Index
PEO	Provincial Education Officer
PHQ-9	Parent Health Questionnaire-9
PMT	Panga Muntu Test
PPVT-4	Peabody Picture Vocabulary Test-Fourth edition
PROs	Patient Reported Outcomes
PSU	Primary Sampling Unit
PVT	Picture Vocabulary Task/Test
QGIS	Quantitative Geographical Information System
RDPDQ	Revised Denver Prescreening Developmental Questionnaire
REDCap	Research Electronic Data Capture
RLC	Resource-Limited Countries
ROC	Receiver Operating Characteristic
SCI	Spinal Cord Injury
SD	Standard Deviation
SDG	Sustainable Development Goal
SES	Socio-Economic Status
SESI	Socioeconomic Status Index
SRQ	Self-Reported Questionnaire
TBI	Traumatic Brain Injury
TO	True Score
TST	True Score Theory
UNIT	Universal Nonverbal Intelligence Test
UNZA	The University of Zambia
URMC	University of Rochester Medical Center
USA	United States of America
UTH	University Teaching Hospital
VABS	Vineland Adaptive Behavior Scales
WCAG	Web Consortium Accessibility Guidelines

WCST	Wisconsin Card Sorting Test
WISC-V	Wechsler Intelligence Scale for Children – Fifth edition
ZamCAT	Zambia Child Assessment Tool

CHAPTER ONE: INTRODUCTION

1.1 Overview

This chapter is segmented into three sections. The first section is the background to the study. It deals with background information on instrument validation across the globe. This shows the trend of instrument validation from the global perspective and exposes the knowledge gap in the information to justify the current study that sought to validate the NIHTB-CB against a gold standard of full neuropsychological testing battery by interrogating their psychometric properties which include Face validity, Content validity, Construct validity, Divergent validity, Convergent validity and Criterion validity. The second section is the contextual background, which highlights different instruments available to aid in the assessment of cognitive function among children and adolescents thereby giving information on instrument validation. Further, the chapter shows both the theoretical and conceptual frameworks that informed and guided the study based on forward mapping technique. The chapter also presents the delimitation of the study and limitations of the study as well as operational definition of terms. The chapter ends with the purpose statement and a summary.

1.2 Background to the Study

The controversy in the application, construction and utilization of assessment instruments is an area of contention in clinical neuropsychology (Russell, Russell and Hill, 2005). The argument often surrounds the interrogation of whether or not most of the alien assessment tools that the resource limited settings use in assessments are valid and reliable (Bauer, 2000; Goldstein, 1997; Incagnoli 1986; Kane, 1991; Mitrushina, Boone, and D'Elia, 1999). It is generally agreed that the acceptance of the standardized or alien instrument is primarily a matter of personal preference and its dependability through a neuropsychological assessment (Lezak, Howieson, and Loring, 2004).

Neuropsychological (NP) testing is one of the most crucial components and valuable psychological and clinical skills that is commonly used and conducted for different purposes including educational assessment, screening for cognitive impairment, differential diagnosis cause, rating of severity of disorders, research, monitoring of disease progression, programme

evaluation and intervention planning (Woodford and George, 2007; Ellingsen, 2016). Neuropsychological testing is vital for human diagnosis of dementias that impair thinking and behavior. It allows for more accurate estimates of functional ability to be made (Burleigh, Reeves and McAlpine, 2002).

A wide range of assessment instruments have been developed to aid psychologists and clinicians in assessing cognitive functions (Woodford and George, 2007). These instruments vary from brief screening tools that take a shorter period of time to formal neuropsychological assessment that takes several hours (Cullen *et al*, 2006). Appropriate choice depends on the time available, truthfulness, dependability and the purpose of assessment (Woodford *et al*, 2007). In this regard, a standardized measure of cognitive functioning is often a primary component of a comprehensive early childhood psychological evaluation (Bartolotta and Shulman, 2009). It is essential to use ecologically validated instruments for the purpose of verisimilitude which is the extent of similarity to relevant environmental behaviors and veridicality, the degree of accuracy in predicting some environmental behaviors in order to obtain reliable, valid and meaningful assessment results and interpret performance appropriately within the context of all other evaluation information (Franzen, 2000; Ringwalt, 2008; Ellingsen, 2016).

For psychologists and clinicians, successfully obtaining reliable, valid and meaningful neuropsychological test results requires considering appropriate selection of validated, normed and psychometric property of instruments (Ballot, 2017; Sabanathan, 2015). Neuropsychological testing is known to be associated with patterns of different measurable constructs (Buch and Chivero, 2016; Antinori *et al* 2006). Although several validated instruments exist and are plentiful in number, “no single instrument for cognitive screening is suitable for global use because some of them are simple, while others are sophisticated and require more complex and systematic testing procedures” (Mitchell and Brown, 1991; Cullen *et al*, 2006; Matafwali and Serpell, 2014).

These instruments are unsuitable for application in most resource-limited settings especially in developing countries (Zuilkowski, McCoy, Serpell, Matafwali and Fink, 2016). In neuropsychological testing, “one size or design of an instrument does not fit all” thereby providing lack of robust evidence to support the validity of many assessment instruments

available (Cullen *et al*, 2006). Most of these assessment instruments were developed, normed and validated from the western countries to measure cognitive function (Bauer *et al* 2013; Hessel *et al* 2016). The application of these assessment instruments whose validation was done elsewhere may fail to identify and tap different constructs especially in most African populations (Phillips and Amos, 2016). This may pose and leave the question of these instrument's suitability and dependability in application to other settings unanswered (Phillips and Amos, 2016; Buch and Chivero, 2016).

A fundamental requirement for neuropsychological assessment instruments is dependability that is realised after a painstaking validation process (Russell *et al*, 2005). This implies that the neuropsychological acquaintance is trustworthy only if it has been authenticated using credible methods and normed against a particular population (Franzen, 2000). Since batteries are used for interpretations of results, the credible and proven methods that are acceptable for individual tests must be applied to batteries to produce trustworthy and reliable evidence (Russell *et al*, 2005; Lezak *et al*, 2004).

In most resource-rich countries, the measuring of cognitive functions has been made a reality due to improved screening and usage of validated assessment instruments (John, Christopher, Corrine and Kali, 2014). For instance, in a case of the United States (U.S.), one such an assessment instrument is the NIHTB-CB designed to briefly and efficiently capture multiple domains of function of cognitive, emotional, sensory and motor skills of people across a broad age spectrum from 3-85 years as presented in a diagrammatical form (Refer to **figure 1 below**). This instrument (NIHTB-CB) was introduced in 2012 and adapted for the cognitive iPad based battery in 2015 in the United States to measure (Bearden *et al* 2017; Bauer, 2013; Baker and Neuhaus, 2011).

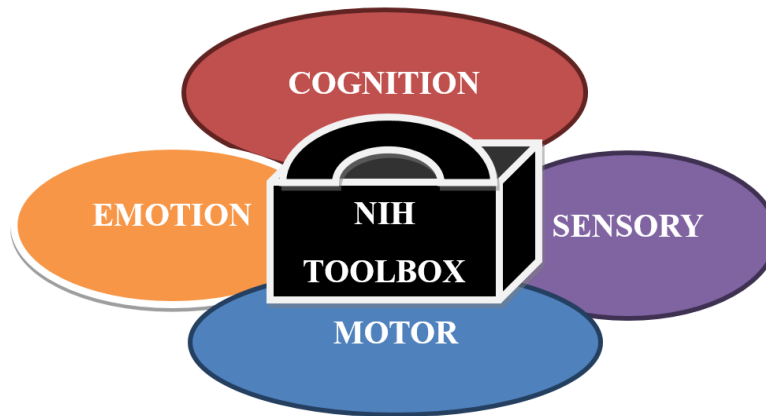


Figure 1.1: A Summary of the NIHTB-CB for Neurological and Behavioral Functions as adapted from Gershon (2013).

Further, the NIHTB-CB measures the subdomains of each of the neurological and behavioral functions as depicted in figure 1.1. For instance, the *subdomain for cognitive function* include; executive function, language, episodic memory, working memory, processing speed and attention, *Emotion function*; include psychological well-being, social relationship, stress and self-efficacy and negative affect. *Motor function skills*; include dexterity, strength, balance, locomotion, endurance, and *Sensory function skills*; include vision, olfaction, vestibular, gustation and audition (Gershon, 2013)

The NIHTB-CB was developed and normed principally for a United States based English and Spanish speaking population using an iPad-based battery of cognitive tests following expert surveys. The panels of research scientists and clinicians conducted these surveys in an iterative manner to rank the domains in isolation of each other in order of their perceived importance for health and evidence of the known biological associations. In this instance, cognitive domain was the top-ranked domain with 95% of neurological and behavioral function as opposed to sensory, emotion and motor (Weintraub, Dikmen, Heaton, Tulskey, Zelazo, Bauer, Carlozzi, Slotkin, Blitz, Wallener-Allen, Fox, nBeaumont, Mungas, Nowinski, Richler, Deocampo, Anderson, Manly, Borosh, Havlik, Conway, Edwards, Freund, King, Moy, Witt and Gershon, 2013). Further, after the status of all the four domains in isolation of each other, ranking information for specific subdomains of cognition on familiarity and importance to make recommendations was submitted

by a number of experts based on the level of priorities in rankings still using the isolation strategy (Refer to **table 1**).

Table 1.1: Cognitive Function Domains Measured by the NIHTB-CB		
Ranks	Names of subdomains	Percentage (%)
1	Executive Function	95
2	Episodic Memory	93
3	Working Memory	57
4	Language	55
5	Processing Speed	52
6	Attention	50

Table 1 shows that the most top-ranked subdomain of cognitive function was executive function (95%), followed by episodic memory (93%), working memory (57%), language (55%), processing speed (52) and attention (50%), while other cognitive subdomains such as spatial cognition were not included in the test battery due to the following reasons among others were because of the lower priorities in the ranking process coupled with time constraints (Weintraub, *et al*, 2013).

The NIHTB-CB-as an iPad based battery of cognitive tests has several advantages which include minimal training requirements, customizability, versatility, easy scalability, applicable across the life span of people from 3-85 years, methodological/psychometrically soundness, brevity and easy to use, enable cross measure comparisons, state-of-the-art design/adaptive to innovation changes in measurement, dynamic, low cost, diversity but available only in English and Spanish for administration (Gershon, Cella, Fox, Havlik, Hendrie and Wagster, 2010; Gershon, 2013; Weintraub, 2013). The entire NIHTB-CB measure is brevity; computer mediated and has an automated scoring, though some components such as sensory and motor employ a more hands-on operation and can only be validated when paired with the measures of the standardized neuropsychological battery testing the same constructs (Gershon *et al*, 2010; John, Christopher, Corrine and Kali, 2014).

While the standardized neuropsychological testing battery has been validated against the urban and rural Zambian population of children and adults and shown consistent results (Jere-Folotiya, 2008; Zuilkowski, McCoy, Serpell, Matafwali and Fink, 2016; Kabuba, Menon, Franklin, Lydersen, Heaton and Hestad, 2018), the NIHTB-CB has not but pilot data from Botswana and Liberia shows it may be successful in paediatric populations (Unpublished data). Due to the probability that some tests may be impaired by chance, the NIHTB-CB may not produce dependable interpretation of results by selecting or combining test results. Therefore, the NIHTB-CB battery test needed to be validated under the light of the Zambian context. The validation process and diagnostic assessment results are obtained by comparisons (Carlozzi, Goodnight, Casaletto, Goldsmith, Heaton, Wong, Baum, Gershon, Heinemann, Tulskey, 2017). Comparisons of the results in the assessments require that the tests in a battery are invariant or have equivalent norms along with a common metric.

While standardized neuropsychological testing battery does meet these criteria among the younger ages under the Zambian context because of its consistent results (Jere-Folotiya, 2008; Kabuba *et al*, 2018), the NIHTB-CB may or may not meet the aforementioned criteria among the younger ages under the Zambian context because its application was marred with a number of assessment result errors which were against the validation principles and ethics as advanced by Clinical Laboratory Improvement Amendment (CLIA-42, 1988).

Clinical Laboratory Improvement Amendment as a Center For Research (CFR) regulatory body emphasises that instrument validation is a crucial undertaking for credible and meaningful assessment as such each and every instrument which has been borrowed and made to move from one cultural locality to another has to undergo validation in order to avoid differences in ecological demands, culture and language (CLIA-42, 1988; Gershon, 2013; Helena-Correia, 2013; Ballot, 2017).

This important validation requirement was ignored not until the NIHTB-CB started presenting assessment errors when it was introduced and used for assessment at the University Teaching Hospital (UTH)-Pediatric Center of Excellence (PCOE) in November 2017 under an Organization called HIV-Associated Neurocognitive Disorders in Zambia (HANDZ) to be used for screening, diagnose and intervention (Bearden, 2017). Although the NIHTB-CB has great

potential as a multimodal assessment because it provides standardized measures of several domains of function and that it has been developed and normed principally for United States – based English and Spanish speaking children of ages 3- 19 years to assess cognitive function (Hessl, 2016; Bearden, 2017;Carlozzi *et al*, 2017), information regarding its validity in Zambia was limited, hence the necessity of the current study to validate the NIHTB-CB and to verify the manufacturers' claims among Zambian Children and adolescents with and without HIV in order to represent a normal population.

1.3 Statement of the problem

The primary and prior value of instrument validation has been widely recognized (CLIA-42, 1988; Straub, 1989; Bauer, 2000; Gershon *et al*, 2010; Gershon, 2013; Helena, 2013; Davison, 2013; Carlozzi *et al*, 2017). This prompts a number of both rich and resource-limited countries to ensure that all the assessment instruments used are normed and ecologically validated in order to obtain valid and meaningful assessment results (Ringwalt, 2008; Ellingsen, 2016) but there are few instruments validated for use especially in resource-limited settings (Bauer *et al*, 2013; Hessl *et al*, 2016; Bearden, 2017 and Zuilkowski *et al*, 2016). Zambia is not an exception to this; for instance, the NIHTB-CB is among other innovative instruments that have been developed and normed principally for a United States (U.S.)-based English and Spanish speaking children of ages 3- 19 years to assess cognitive function. Empirical evidence have demonstrated that the NIHTB-CB also has the capacity to assess the cognitive function of children and adults across a broad age spectrum from 3-85 years and its use ensures that assessment methods and results can be used for comparisons across existing and future studies (Bauer, 2000; Gershon *et al*, 2010; Hessl *et al*, 2016; Bearden, 2017; Carlozzi *et al*, 2017).

The NIHTB-CB is now in Zambia and undergoes validation process for it to be used for the assessment of cognitive function in children and adolescents with and without HIV in order to represent a normal population at the University Teaching Hospital (UTH) - Paediatric Centre of Excellence (PCOE) in Lusaka Province but information about its validity in assessing cognitive function among Zambian children and adolescents appears inadequate. Therefore, going by the principles of instrument adoption and validation, an assessment instrument or tool could only be deemed valid if it has been subjected to the norms and ecological aspects of a specific context

within which it is being applied to avoid ecological differences and assessment errors (CLIA-42, 1988; Ellingsen, 2016; Zuilkowski *et al*, 2016). Based on this principle of adoption and validation, if the NIHTB-CB whose validation was done with the norms and ecological concepts of the United States' population was left invalidated in assessing the cognitive function of children and adolescents in Zambia, it might suffer from differences in ecological demands, culture, language, norms and education thereby compromising the quality of assessment results. This would also lead to relative cost of false negative and positive results, poor interventional programmes such as wrong diagnosis of cognitive impairment and placement of children and adolescents in special schools which can be disastrous for a country. Further, this would also compromise a relevant dimension of Instrument development and validation which is a critical component of policy and clinical practice in Zambia. A compelling knowledge gap that the proposed study was avid to comprehensively address.

1.4 Purpose of the study

The purpose of the study was to validate the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province, Zambia.

1.5 Research objectives

1. To evaluate the standardised administration of the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province.
2. To identify challenges encountered in the administration of the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province.
3. To examine the extent to which the NIHTB-CB is valid based on (face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity) in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province.
4. To compare between the composite Z-score of the standardised neuropsychological battery test across all 8 cognitive domains with the composite

scaled-score of the NIHTB-CB in children and adolescents aged 8-17 years in Lusaka Province.

1.6 Research questions

1. What is the standardised administration of the NIHTB-CB in assessing cognitive function of children and adolescents aged 8-17 years in Lusaka Province?
2. What are the challenges encountered in the administration of the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province?
3. To what extent is the NIHTB-CB valid based on face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province?
4. Is there a difference between the composite Z-score of the standardized neuropsychological battery test across all 8 cognitive domains with the composite scaled-score of the NIHTB-CB in children and adolescents aged 8-17 years in Lusaka Province?

1.7 Significance of the study

It is envisaged that the findings of the study may act as a ground breaking for the validation of the NIHTB-CB in Zambia because greater knowledge on the realities of validity of innovative and gold standard, sensitivity, specificity, positive and negative likelihood ratios and Receiver operating characteristic (ROC) curve when appropriate among Zambian children and adolescents may be made known and contribute to the validation processes of other assessment instruments in the country.

It is also anticipated that the validation of the NIHTB-CB among Zambian children may also increase the precision of intervention processes thereby enabling a more reliable informed diagnosis that would give an appropriate school placement. Further, the use of a NIHTB-CB in light of Zambian educational and research settings may help to address current knowledge gaps and advance understanding of educational psychology development in children and adolescents in schools.

Additionally, it is hoped that the results this study may provide valuable information on the validation of the NIHTB-CB in the pediatric population in Zambia and other similar settings in Africa through the dissemination of the findings to the general populace. In addition, the findings of the study may have the potential to enlighten and provide valuable information to policy makers in the Ministry of General Education, which may be used to improve a wider process of screening, interventional, and evaluation programmes in the education sector. Furthermore, the study may contribute to the overall scientific body of knowledge in understanding the cognitive functioning and set a stage for future research.

1.8 Theoretical and Conceptual frameworks

The study positioned both theoretical and conceptual frameworks before literature review on grounds that these frameworks guided the review of literature process. The assumption was that a researcher continued to read literature while identifying some key concepts to be addressed in the study, a technique known as forward mapping (Msabila and Nalaila, 2013). As opposed to backward mapping technique, which identifies concepts after reading literature and positions both the theoretical and conceptual frameworks after or within literature review, forward mapping proceeds reasoning from theories to specific concepts of literature (Elmore, 1980).

1.8.1 Theoretical framework

Theoretical framework according to Kombo and Tromp (2006) is a collection of interrelated ideas based on theories. It is a reasoned set of prepositions, which are derived from and supported by data (Msabila and Nalaila, 2013). The importance of a theory in any research cannot be over emphasised as Kwame Nkrumah of Ghana correctly observed that ‘theory without practice is hollow; and practice without theory is blind’. It therefore follows that theory illuminates practice and practice illuminates’ theory (Omari, 2011).

The study was anchored and guided by Classical Test Theory (CTT) also known as True Score Theory (TST), which originated from the works of Spearman in 1904 and was propounded by Lord and Novick (1968). Classical Test Theory holds that all psychological testing uses psychometric properties and test score comparison techniques to determine the validity and reliability of instruments to evaluate the quality of measures such as Patient Reported Outcomes (PROs), clinical rating scales, questionnaires, surveys, and achievement tests of constructs that in

principle show a relationship between test scores that must be invariant to each other and are hidden and cannot be measured directly such as cognitive status, pain and depression. The Classical Test Theory assumes that there must be no difference in the test outcome between tool **A** and tool **B**, where tool **A** is a gold standard and **B** is NIHTB-CB, a test tool which was under scrutiny for validation (Adams, Mwanza-Kabaghe, Kabundula, Mbewe and David, 2019; Edelen and Reeve, 2007).

This study validated the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province. Therefore, the selection and relevance of this theory was based on the appreciation that the NIHTB-CB as an iPad battery (Tool **B**) is a computer mediated tool that utilizes several measures in items of development, test construction, and automated scoring enabling it to be compared with other tests. This theory was appropriate for conceptualizing the optimal assessment of cognitive function of children and adolescents as it is able to give a true score as obtained by an individual based on the NIHTB-CB (Tool **B**) scores which are comparable with the scores of other tests such as neuropsychological testing battery which was a gold standard test (Tool **A**) (Gershon, 2013; Spearman, 1904; Kaplan and Saccuzzo, 2005).

Additionally, the study was firmly grounded on the theory of classical test because multiple studies have recognised and appreciated its relevance, meaningfulness, effectiveness and efficiency as a widely used theoretical framework in many faculties both in developed and developing countries that endeavoured to develop and validate instruments with the help of a gold standard and kappa strategy not only in education but also in Psychology, Nursing, Public Health outcomes, Quality-Of-Life Research, and Clinical Research Technology (Hays, Morales, and Reise 2000; Edelen and Reeve 2007; Holman, Glas, and de Haan 2003; Reise and Waller, 2009; Reckarse, 2009 and De Mars, 2010).

1.8.2 Conceptual framework

Kombo and Tromp (2006) define conceptual framework as a research tool intended to assist a researcher to develop awareness and understanding of the situation under scrutiny. This entails that when clearly articulated, conceptual framework has potential usefulness to make meaning of subsequent findings, implying that it forms part of the agenda for negotiation to be scrutinized

and tested, reviewed and reformed as a result of investigation. In this manner, the researcher would be able to organise, think through and complete a task successfully as it explains the possible relationship between variables in the study either theoretically or diagrammatically. Msabila and Nalaila, (2013) further define conceptual framework as a set of coherent ideas or concepts organised in a manner that make them easy to communicate to others by thinking about how and why a project takes place and what it implies when influenced by the ideas and research of others.

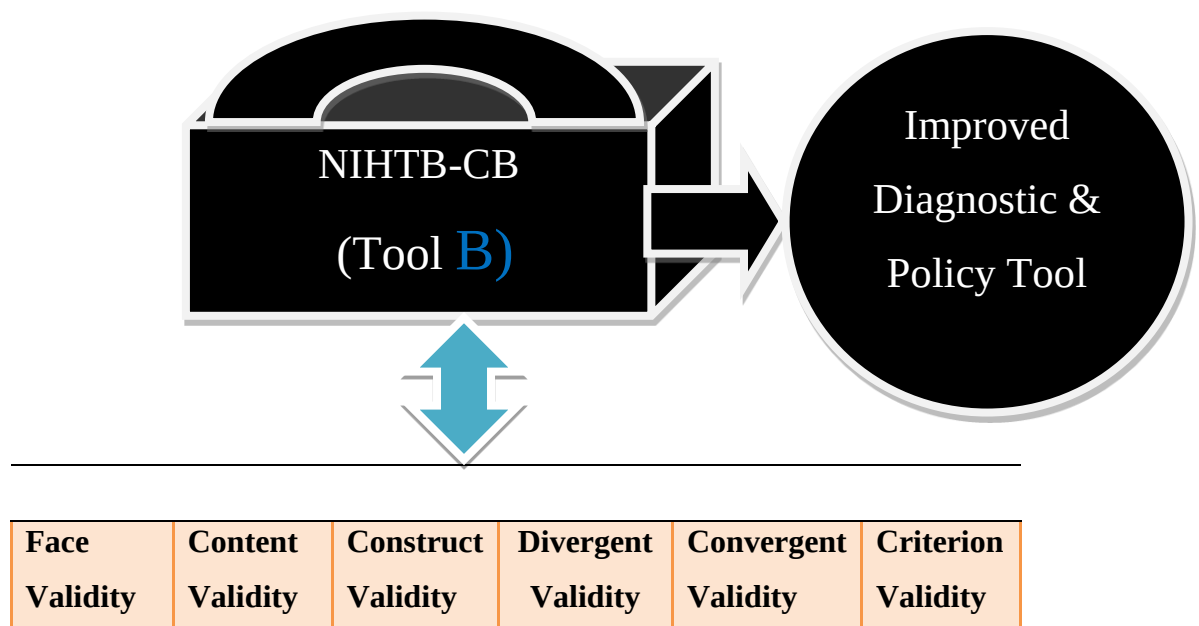
In view of this therefore, the model below was built based on a bottom-up approach which illustrates that the validation of the NIHTB-CB could only be achieved through comparisons between domain-based measures of a gold standard of full neuropsychological test battery with an acceptability measure of precision at 0.80-1.00. This was made possible by a pairwise correlation between the composite Z-score of a gold standard of full neuropsychological test battery and the NIHTB-CB across cognitive domains of Executive function, Episodic memory, Processing speed, Language, Working memory and Attention which were generated to summarize global cognitive test performance. The comparisons of these domain-based measures were done through correlations against each other of the same construct measured by both NIHTB-CB and the gold standard of neuropsychological battery test using face validity, content validity, construct validity, divergent validity, convergent validity and criterion validity in children and adolescents.

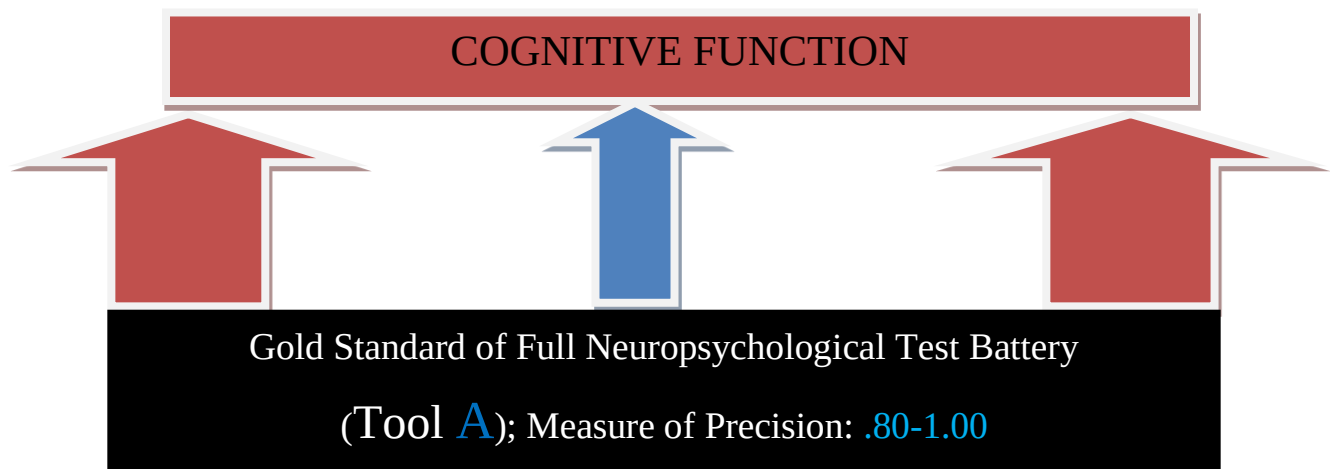
The ultimate goal was to have the NIHTB-CB validated among the Zambian children and adolescents particularly in Lusaka Province. This was so because the NIHTB-CB was earmarked to be used as a screening, diagnostic and intervention tool in the quest to realise the Sustainable Development Goal (SDG) number 4, which reads in part “Quality Education for all”. These aspirations on SDG number 4 could only become a reality with a cognitive functioning citizenry. However, without this, which could only be assessed and identified with the help of a Zambian ecological validated NIHTB-CB, a Zambian population of children and adolescents’ cognitive function would continue to be wrongly diagnosed, leading to poor interventional programmes and placement of children in schools. Poor interventional programmes and placement options in a long run could have severe effects with regard to quality delivery of education services as the

saying goes “Quality education is synonymous with National development”. Below is Figure 1 illustrating a model of the conceptual framework on which the study was anchored.

Figure 1.2: Conceptual framework

A framework of neuropsychological test battery’s psychometric properties in comparison with the NIHTB-CB





Source: Adapted from Gershon (2013); Maina, Abubakar, Miguel, Vijver and Kumar (2019) and Metz (1978).

1.10 Delimitation of the study

The scope of the study was restricted and fell within the realm of social and educational psychology. The study bordered on Classical Test Theory (CTT) for comparison and covered the HIV-infected children and adolescents who were on antiretroviral therapy (ART) from selected community health centers in Lusaka province and receiving their medical attention on referral basis at Pediatric Center of Excellence (PCOE), a major referral center in the country. This also included the sociodemographic-matched sample of siblings for the HIV-infected children and adolescents with the same age and gender, with the intention to control for potential co-occurring risk factors for cognitive impairment, including effects of having an HIV-infected parent and to have a well-represented sample size of the entire population for the validation purposes.

1.11 Limitation of the study

As in every research, limitations should be noted. Limitations of the study included difficulties in examining covariation of variables. It was difficult to identify pediatric samples large enough to allow for systematic control of the confounding factors. For example, the caregivers of children infected with Human Immune Virus (HIV) frequently were not the biological parents, so information on the child's past was often unreliable or unknown. In addition, the study also ignored other potential participants who did not have their biological parents, hence leaving out

essential information that could, in one way or another, influence and contribute positively on their cognitive function.

In Zambia, the official language used is English. At most study visits, the language used generally was Chinyanja out of 73 dialectic languages in Zambia. However, the NIHTB-CB was designed to be administered in English to the child. This is because the NIH Toolbox uses English in testing which requires high-level skills of English language and this could disadvantage some children whose first and familiar language is Chinyanja and other local languages as Zambia is a multilingualistic country (Mwanza-Kabaghe, 2015). Thus, often it was necessary to make use of a translator during testing. The translators ranged from caregiver to grandmother. Sometimes the researcher got the impression that the translators tried to help the children with the tasks. It is well known that when a task is translated, the reliability and validity of the results may be weakened, resulting in different rates of outcomes (Smith, Malee, Leighty, Brouwers, Mellins, Hittelman, Chase and Blasini, 2006). The aforementioned potential limitations may influence the interpretation and generalization of these results. Generalization may be compromised because the circumstances of the children in this study may differ in important ways from the circumstances of other populations of children such as children in western countries.

The NIHTB-CB pretends to be a test that is not culturally bounded. However, in most cases, the children in Lusaka did not have any experience with tests on the NIHTB-CB. That is why the current study did not use norm groups as a frame of reference, but an HIV negative group that was comparable to an HIV positive group on tests of the NIHTB-CB. By using an HIV negative group, influencing factors such as background and environmental factors were taken into consideration. The study also considered participants from urban areas of Lusaka and might have failed to capture other groupings on other parts of the province especially the rural settings. Further, a number of lost to follow up and potential drop out respondents/participants in the study was also a limitation as it was necessitated by the emergency of COVID-19 pandemic. The number affected data analysis process in the study as it exacerbated the rate at which data got missing based on a list-wise deletion technique.

1.12 Operational definition of terms

Validation:	A quality review of the assessment tools, processes, practices and judgments after a thorough interpretation of results.
Neuropsychological (NP) testing:	A systematic process to ascertain how children and adolescents think and feel in their daily lives.
National Institute of Health Toolbox (NIHB-CB):	An iPad-based Battery Test of cognitive, sensory, motor and emotional function that can be administered across diverse study designs and settings.
Validity:	The degree to which a test measures what it claims, or purports to be measuring.
Face validity:	The extent to which raters agree that an item appears to measure what it is intended to measure.
Construct validity:	The quality or degree to which a measurement tool or instrument is able to measure the construct which it is supposed to measure.
Convergent validity:	The degree to which the scores on one measure are related or correlate with the scores of another measure of the same construct.
Concurrent validity:	The type of validity demonstrated when scores obtained from a new measure are directly related to scores obtained from a more established

measure of the same variable against a certain standard.

Divergent validity:

This refers to the degree to which a measure or a tool is able to show differences between dissimilar constructs.

Content validity:

The extent that measurement instrument NIHTB-CB items are relevant and Representative of the target construct.

Predictive validity:

This refers to the extent or degree to which the scores of the current measure can reflect the future traits and behavior of an individual.

Criterion validity:

Criterion validity has two components, reflecting the extent to which an instrument is correlated with or predicts a current (concurrent validity) or future (predictive validity) event

Adolescence:

A state of complete physical, mental and social well-being in all matters relating people between the ages of 10-19 years old.

Executive function:

A set of cognitive abilities that control and regulate behaviours required for learning.

Memory:

A system composed of working and episodic way of storage and retrieval of information.

Language:

A set of mental processes that translate thought into symbols, words and gestures which can be shared among individuals for purposes of communication.

Processing speed:	The amount of time it takes to process information that can be processed within a certain unit of time.
Attention:	Allocation of one's limited capacities to deal with an abundance of environmental stimulation.
Cognition:	Mental processes involved in gaining knowledge and comprehension, such as thinking, knowing, remembering, judging, and problem solving.
Socioeconomic status index:	A composite measure constructed from 15 variables prespecified as of likely importance such as paternal education, maternal education, electricity, running water, presence of a flush toilet, food security, monthly income, Radio, Bicycle, Car, Television, Refrigerator, Gas or electric stove, Mobile phone and Computer.
Composite score:	This is a group of tests that may tap more than one specific ability domain but share certain theoretical and psychometric characteristics across the lifespan.
Perseveration error:	This occurs when a child keeps on mentioning a test item repeatedly due to massive familiarity.
Intrusion error:	Happens when a child mentions a test item, which does not belong to the prescribed items on the list.

Set loss error:

This occurs when a child mentions a test item outside the contextual meaning due to unfamiliarity.

1.13 Purpose statement

The intent of this two-phased, explanatory sequential mixed method was to; evaluate the standardised administration of the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years; identify challenges encountered by children and adolescents aged 8-17 years when tested with the NIHTB-CB; examine the extent to which the NIHTB-CB is valid based on (face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity) in assessing the cognitive function of children and adolescents aged 8-17 years and compare between the composite Z-score of the standardised neuropsychological test battery across all 8 cognitive domains with the composite scaled-score of the NIHTB-CB in children and adolescents aged 8-17 years in Lusaka Province. The first phase was a quantitative inference that transformed verbal information into quantifiable expression for the purpose of meaningful scientific decision. This was used to test the research questions that guided the current study such as to; examine the extent to which the NIHTB-CB was valid based on face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity in assessing the cognitive functions and compared between the composite Z-score of the standardised neuropsychological test battery across all 8 cognitive domains with the composite scaled-score of the NIHTB-CB in children and adolescents aged 8-17 years in Lusaka Province.

A second phase was a qualitative explanation in the identification of challenges encountered by Children and adolescents when tested with the NIHTB-CB in assessing cognitive function in Lusaka Province. The reason for collecting qualitative data was to have an in-depth understanding of the validation process through interviews by explaining all the psychometric properties of the NIHTB-CB. The validation process of the NIHTB-CB as a classical instrument proceeded by explanation phase I, which helped in the identification of challenges encountered by children and adolescents in the study. Quantitative data stand in phase I was followed up by a qualitative data strand in phase II which addressed the challenges through modifications and

differences by examining the psychometric properties (face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity) of the two instruments and comparisons between the standardised neuropsychological test battery across all 8 cognitive domains with the composite scaled-score of the NIHTB-CB in assessing cognitive function of children and adolescents aged 8-17 years in Lusaka Province.

1.14 Summary of the chapter

The goal of this chapter was to provide an overview of the background information based on the validation process of the NIHTB-CB in the Zambian context. This showed the trend of the phenomenon from the global perspective and exposed the knowledge gap in the information to justify the current study. The second section was the contextual background. This highlighted different instruments available and used in the assessment of cognitive functioning thereby giving information on instrument validation. What was not empirically provided for was the validation of the NIHTB-CB in assessing cognitive functioning of children and adolescents aged 8-17 years in Lusaka Province. Lastly, the chapter provided the statement of the problem, purpose of the study, research objective, research questions, significance of the study, both theoretical and conceptual frameworks, delimitation of the study and limitations of the study as well as operational definition of terms and purpose statement of the study. The subsequent chapter presents a comprehensive review of relevant literature related to the phenomenon under scrutiny.

CHAPTER TWO: LITERITURE REVIEW

2.1 Overview

The previous chapter presented the introductory aspects of the study. The introduction had different aspects which ranged from the background information based on the validation process

of the NIHTB-CB in the Zambian context. This showed the trend of instrument validation from the global perspective and exposed the knowledge gap in the information to justify the current study which sought to validate the NIHTB-CB in Zambian children and adolescents. The second section was the contextual background which highlighted the different instruments available used in the assessment of cognitive functioning thereby giving information on instrument validation. What was not empirically provided for was the validation of the NIHTB-CB in assessing cognitive functioning of children and adolescents aged 8-17 years in Lusaka Province. Lastly, the chapter presented the statement of the problem, purpose of the study, research objective, research questions, significance of the study, both the theoretical and conceptual frameworks that informed and guided the study using forward mapping technique. The chapter further presented delimitation of the study and limitations of the study as well as operational definition of terms and ended with the purpose statement.

This chapter presents a review of literature on instrument validation that the study addressed. It begins with evaluating the standardised administration of the NIHTB-CB with regard other studies. It also focuses on identifying challenges encountered by children and adolescents when administered with the NIHTB-CB through the explanation phase. The chapter further examines the extent to which the NIHTB-CB is valid in Zambia compared to the United States based on face validity, content validity, construct validity, divergent, convergent validity and criterion validity as the psychometric properties. The chapter also compares the differences between the composite score of the NIHTB-CB with the composite score of the standardised neuropsychological test battery across all 8 cognitive domains. Thereafter the literature is used by the researcher as a tool to identify knowledge gaps that exist in the studies conducted by other scholars concerning the validation of the NIHTB-CB and other similar assessment instruments.

2.2 Standardised administration of the NIHTB-CB

Most standardised instruments spell out considerable details on how the instrument should be administered (Airasian, 2001). This includes how to set up the testing room, what to do when a client takes on the test, how to distribute the test and answer sheets, and how to time the tests. The physical testing environment should be well lit and well ventilated with adequate working space. The examiner should hang a sign on the door of the test room stating, "Testing in

Progress-Do Not Disturb” (McMillan, 2001). In administering the instrument, the assessor should follow word for word the script that is included in the test manual to ensure that the instrument is being given under standardised conditions. This is because if the script is not precisely followed, comparisons of participants’ performance with the population of people on which the norms for the instrument were established could be invalid (Gay and Airasian, 2000).

As any other instrument used in assessment, the NIHTB-CB has spelt out the aforementioned considerable details that should be adhered to during its administration. However, at the time of this study, the NIHTB-CB was being administered upon children and adolescents with different norms. Thus, it was not known whether adhering to its procedures of administration on Zambian children and adolescents would make it yield the same results and be considered valid as among the U.S population.

The NIHTB-CB’s standardised administration procedures were designed to be a resource to help the NIHTB-CB users understand the basic level of how each of the measures that comprised the NIHTB-CB were administered, as well as the potential uses and meaning of the available measures (Akshoomoof, Newman, Thompson, McCabe, Bloss and Chang, 2014; Weintraub *et al*, 2013). It was not intended to be a highly technical procedure, though some technical details were included as necessary to aid understanding. The goal of this standardised procedure was to provide uniform information on how each measure was administered, even though the available NIHTB-CB software did this measuring automatically so that researchers have an essential and universal understanding of how the NIHTB-CB was administered based on a standardised format (Weintraub, 2013; Gershon, 2014). Hence, reason enough for this study to evaluate the standardised administration of the NIHTB-CB in assessing the cognitive functioning of children and adolescents in Lusaka Province, Zambia.

The NIHTB-CB is an iPad-based battery of cognitive tests which is computer mediated and runs on a dual-screen monitor format (Gershon, 2013). The test administration involves the requirement of touch-screen for responding as it assesses the degree to which individuals can think clearly and make sense of complexity due to its brevity (brief and easy to use). The cognitive portion of the NIHTB-CB takes 30-45 minutes to administer. After the test is completed, scores are automatically generated in form of excel spreadsheet, both raw and

normative scores are produced automatically as data for interpretation (John *et al*, 2014). Although the entire battery is computerised and includes automated scoring, it is necessary for an examiner to present task instructions and monitor compliance in order to ensure valid results. For accessibility, all instructions are administered visually on the screen and also presented orally (Weintraub, 2013). While it is established that other countries such as the U.S have used the NIHTB-CB and reported it as a computerized tool that includes automated scoring, making it necessary for an examiner to present task instructions and monitor compliance in order to ensure valid results, it was not known whether the same trends would be obtained during the NIHTB-CB administration in Zambia, particularly among children and adolescents in Lusaka Province.

Nowinski, Victorson and Debb (2013) carried out a study in the United States of America on the NIHTB-CB for assessment of neurological and behavioral function; input on the NIHTB-CB with inclusion criteria surveying the end-user community. The findings of the study revealed that the NIHTB-CB established a standard approach to assess cognitive, emotional, sensory, and motor function. The study further indicated that there was lack or limited infrastructure for surveillance and this hindered the ability to support, share and interpret research results. Furthermore, it was established that the use of the NIHTB-CB enhanced opportunities for comparison of data across studies and the integration of data from multiple studies. However, one weakness of the aforementioned study is that it ignored to clarify and provide the most cardinal information on specific categories of the participants who were involved in the study but ended with community users. As opposed to the aforementioned study that only mentioned the community as the end-user, the current study provides a clear category of respondents who were involved such as children and adolescents in collecting views and feelings on the standardised administration of the NIHTB-CB under the light of the Zambian context.

Similarly, Shatz, Lemere and Williams (2016) in their study on the NIHTB-CB Screen for Medial Collateral Ligament (MCL) and Dementia: Results of a 90-Day Pilot in Primary Care Practices revealed that the NIHTB-CB created an opportunity for economies of scale in the research enterprise and maximize the yield from diverse clinical studies by allowing a greater number of significant research questions regarding neurologic and behavioral health to be studied. Importantly, the instruments were designed to capture this information with minimal increment in subject burden and cost.

The NIHTB-CB also promised to be an excellent resource for investigators outside the clinical neuroscience arena, for example in cardiovascular or cancer research, who now have a readily available and easy-to-use set of measures to examine the impact of perturbations in non-neural systems on brain function. It also allowed for the adaptation of the measures over time without compromising the continuity of data collection. This dynamic feature guards against the impediments created by more typical “crystallized” measures and tolerates updating in response to advances in science or technology. While the NIHTB-CB when used appropriately following the standardised procedures as reported by Shatz, Lemere and Williams (2016), yielded positive results and allowed for the adaptation of measures over time without compromising the continuity of data collection, it was not known whether children and adolescents who were tested with the NIHTB-CB would encounter some difficulties in understanding the administration of the NIHTB-CB that would necessitate any form of modification or adaptation to some measures without compromising the continuity of data generation in Zambia.

In another study by Purnell, Hendrie, and Havlik (2013) in the United States of America on assessment of neurological and behavioral function of the NIHTB-CB was reported that in order to have the NIHTB-CB administration it was necessary for appropriate training of a test administrator to be flexible enough to accommodate participants who were believed to have differences in their backgrounds. As a cognitive test, for instance, it was believed that the instructions could be too complicated if an administrator was not present. The administrator also ought to ensure the comfort and safety of the participants. A specific example of the latter was the recommendation to use a gait belt to prevent falls in the NIHTB-CB Standing Balance Tests.

The aforementioned study was insightful to the current study in that it demonstrated the necessity for appropriate training of a test administrator to be flexible enough to accommodate participants who were believed to have differences in their backgrounds. Further, the study highlighted some vital information on the importance of providing clear instructions to ensure the comfort and safety of the participants. While the reviewed study was conducted and reported information on resource rich countries, the NIHTB-CB was used in an assessment room that allowed and ensured comfortability and safety of respondents as well as the expected expertise from the administrators to avoid disturbances that could influence the results. The tests were also to be conducted in Zambia which is a resource-limited country.

Another study by Victorson, Manly and Correia (2013) on using the NIHTB-CB among the United States of America Special Populations: Considerations for the Assessment of Padiatric, Geriatric, Culturally Diverse, Non-English Speaking and Disabled Individuals reported that at the normative stage of the NIHTB-CB, forty-seven instruments were administered to a national sample of persons aged 3-85 years in both English and Spanish versions. The 47 instruments were combined into a single test battery that flows from both examiner and examinee perspectives. Instructions were “homogenized” to be presented in a common voice with prompts that were similar across instruments. A single professional voice actor (in separate versions for adults and children, English and Spanish) recorded instruments with audio presentation. Thousands of hours of software developer time were dedicated to ensure that all instruments were available in a common interface. Each subject response along with item level timing was stored automatically. The computer controlled the flow of test administration, automatically presenting the specific tests and test items appropriate for different age, language (English- and Spanish-speaking), or other subgroups. For research purposes the order of major domains was alternated. Similarly, the same procedure and process were adhered to during the administration of the NIHTB-CB in Zambia among children and adolescents. However, Zambia being a multilingual society with diverse languages; it was not known whether English as used by the aforementioned study would be comprehended by children and adolescents who were the main respondents in the validation study of the NIHTB-CB in Lusaka Province, Zambia.

In yet another contention, Purnell, *et al* (2013) in their study on assessment of neurological function of the NIHTB-CB further added that there are a number of considerations to reckon with when dealing with issues of assessment using a foreign instrument. These include the changes associated with aging; for example, relative psychomotor slowing of response, the accumulation of physical and sensory impairments in older adults, and the possible unfamiliarity with recent technology, cultural sensitivity, conceptual appropriate, translation and linguistic consideration including the use of computers in this population. A justification enough to validate the NIHTB-CB among children and adolescents in Zambian population in order to ascertain whether the aforementioned changes associated with aging and the possible

unfamiliarity with recent technology, cultural sensitivity, conceptual appropriate, translation and linguistic consideration were evident and attainable.

American scholars such as Wallner-Allen and Fox (2013) in their study on the NIHTB-CB: Measuring Executive Function and Attention, reported that during the review of potential instruments, potential threats to administration of the NIHTB-CB were noted and suggestions for improvement were made such as providing simple, clear, easy-to-follow instructions, using task materials that were engaging, concrete, and familiar, and structuring the testing environment in a child-friendly way. The study further reported that differences in task performance across different ages would more likely reflect differences in competence on the construct of interest rather than differences in performance factors such as the ability to follow complex instructions. The review indicated that all domains needed to reduce the complexity of the language used for instructions in the way tasks were explained and/or in questionnaire items.

Further, Wallner-Allen and Fox (2013) maintained that in order to guide on how to test children across the 4 domains of the NIHTB-CB, children require special considerations for testing including instructions presented slowly and simply (and orally to children who are not yet able to read), training trials to ensure comprehension, attractive stimuli to keep a child's attention, and response hardware that is appropriate for small hands. As a result of these considerations, a set of pediatric assessment principles were articulated. They addressed such issues as instrument design characteristics, the testing environment, the psychological and physical needs of the child, and the nature and extent of the interactions among the test administrator, the child or adolescent, and the parent. Domain teams were also encouraged to provide task-specific guidelines to standardize the interactions between the examiner and participant. When, what, and how often the examiner can say something during task administration is of particular importance for young children.

The current study has a lot to learn from the aforementioned study in that both studies involve standardised administration instructions such providing simple, clear, easy-to-follow instructions, using task materials that are engaging, concrete, and familiar, and structuring the testing environment in a child-friendly way. Some instructions for the administration of the NIHTB-CB to children are clearly been brought out. This implies that the instructions for

administration of the NIHTB-CB in the previous mentioned study domains of measure may be the same. However, it was not known whether the same suggestions and considerations as provided by the aforementioned study would be evident for the current study which endeavored to validate the NIHTB-CB for use in Zambian children and adolescents particularly in Lusaka Province.

2.3 Challenges encountered in the administration of the NIHTB-CB

Identification of challenges based on instrument's limitations is cardinal in the field of assessment and screening as it makes it possible to be adapted for suitability in application to any population in a particular setting (Victorson *et al.* 2013). For instance, the United States Agency for Healthcare Research Quality National Healthcare Disparities Report (2010) revealed that there was increasing acknowledgment that certain subgroups of the U.S population who were more vulnerable to receiving inequitable health care are achieving inferior health outcomes compared with other groups. Further, Hahn and Cella (2003) suggested that such vulnerability could relate to one's age, race, ethnicity, primary language, economic status, sex, and ability and disability status.

In view of the foregoing, a cornerstone of equitable health care begins with well-developed health outcomes assessment tools. Therefore, it is essential that the design, development, and implementation of an assessment tool, including the interpretation of subsequent findings, consider the challenges, opportunities, and special circumstances of the vulnerable subgroups mentioned previously. This, therefore, may suggest that the NIHTB-CB was designed in such a way that all the challenges, opportunities, and special circumstances of the vulnerable subgroups of the U.S population were taken into consideration. As to whether or not this would apply when assessing the cognitive functioning of Zambian children and adolescents was the intention of this study.

The empirical evidence is spreading as most studies to date of HIV-Associated Neurocognitive Disorders (HAND) in children and adolescents in Zambia and throughout the region have relied upon existing norm-referenced tests, some translated or otherwise adapted for the local population, because of the lack of locally validated measures of cognition. Zambia is among the countries in Sub-Saharan Africa with few tests of cognition ecologically or psychometrically validated for use among children

and adolescents. Notable exceptions include the Zambian Child Assessment Test and the Object-Based Pattern Reasoning Assessment (OPRA) to evaluate development of preschool-age children in Zambia, and the Panga Muthu (“Make a Person”) test, to assess global cognitive ability in children aged 7-15 years old (Matafwali and Serpell, 2014; Zuilkowski, McCoy, Serpell, Matafwali and Fink, 2016). While the OPRA was designed to evaluate the development of preschool-age children in Zambia, the NIHTB-CB was designed to assess the cognitive function of persons across the life span of 3-85 years. What was interesting to note was that the NIHTB-CB had not been used before in the Zambian population to assess cognitive function, hence the current study needed to assess its validity for use in Zambia.

Further, initial and revised versions of the Kaufman Assessment Battery for Children (KABC) (Kaufman and Kaufman, 1983; Kaufman and Kaufman, 2004) and the Universal Nonverbal Intelligence Test (UNIT) (Bracken and McCallum, 1998; Bracken and McCallum, 2016), though not specifically developed for use in the region, have been broadly utilized with appropriate adaptations (for instance, standardized translations, local normative data) established as reliable and valid in African settings. However, there are no locally-developed measures of the component parts of general intellectual ability (For instance, verbal vs nonverbal reasoning, fluid vs. crystallized reasoning) or specific neurocognitive domains impacted by HIV such as, attention, memory, and executive function.

Consequently, neuropsychological assessment batteries initially developed and validated outside of the region have been applied to measure and track HIV-Associated Neurocognitive Disorders (HAND) in HIV-affected children living in Africa (Boivin, Barlow-Mosha, Chernoff *et al*, 2018; Milligan and Cockcroft, 2017). Thus, offering reason enough to undertake this study to determine whether the NIHTB-CB being a neurological and behavioral tool that was developed outside of the region could be applied to measure and track HIV-Associated Neurocognitive Disorders (HAND) in the population of Zambian children and adolescents particularly in Lusaka Province.

An additional limiting factor is a general lack of infrastructure to support the acquisition and maintenance of test materials or professional expertise for neuropsychological test administration and interpretation particularly outside of large urban centers. However, a possible solution is presented by the NIHTB-CB, a brief, repeatable, computerized assessment of cognition that is designed to be

administered by study personnel without specialized neuropsychology training, for instance, study coordinators and research nurses (Weintraub, *et al*, 2013, Weintraub, *et al*, 2013). Additionally, the NIHTB-CB can be delivered via a tablet-based app that runs locally without requirement of an active wi-fi link during administration. This is desirable for field-based assessments in limited resource settings where internet capabilities may be limited, allowing data to be batch uploaded at a later time when capabilities allow. In the current study, the NIHTB-CB was used exactly how it was designed with its characteristics of being a brief, repeatable, computerized assessment of cognition that is designed to be administered by study personnel without specialized neuropsychology training, for instance, study coordinators and research nurses. However, what was not known was whether the infrastructure available in Zambia particularly in Lusaka Province was supportive enough in the acquisition and maintenance of the NIHTB-CB administration purposes.

The NIHTB-CB was developed and normed principally for a US-based English- and Spanish-speaking population. Within this context, it has been validated across gender, race/ethnicity, and socioeconomic status groups and a broad age spectrum from 3-85 years old (Weintraub, *et al*, 2013; Bauer and Zelazo, 2013, Gershon *et al*, 2013). There has been limited uptake of the NIHTB to assess HIV-Associated Neurocognitive Disorder (HAND) in children and adults. However, it has been proposed to assess HIV-Associated Neurocognitive Disorder (HAND) in children because of the ability to assess multiple domains of cognitive function (McHenry, McAteer, Oyungu, *et al*, 2018) and is currently being used to aid in evaluating eligibility for a study of perinatally infected adolescents and young adults in the United States aged 13-24 years participating in the International Maternal Pediatric Adolescent AIDS Clinical Trials Network, “IMPAACT-2015” study (IMPAACT, 2015). Additionally, the NIHTB has been discussed for use in studies of adults with HIV infection (Weintraub, Dikmen, Heaton, *et al*, 2014).

To the researcher’s best of knowledge, there is inadequate empirical evidence outside the US that has employed the NIHTB-CB in evaluating cognitive status among a normal population of persons with and without HIV infection; a component of great value to the current study. Because some task stimuli, for instance, certain vocabulary, and pictures may be US-centric, one concern is whether NIHTB-CB tasks can be reliably utilized in other locations particularly in Zambia. Even for tasks with few unique language demands, local normative data are necessary for test results to be interpreted in the relevant context. Fortunately, the NIHTB-CB development team has made all

materials accessible to the broader research community and have encouraged international uptake, including further translation and validation work for other populations and settings (Hodes, Insel and Landis, 2013). Similarly, the current study put in place and took some alternatives of other variables such as the socioeconomic status of different groups and language that may influence the results. For instance, language; the participants were asked to use the language which they were all comfort and familiar with before the assessment commenced. Translation of instructions were done to cater for such eventualities in order to avoid discomfort on the part of the participants.

A study by Victorson, *et al* (2013) that was conducted in the United States of America on cultural consideration to ascertain the challenges of the NIHTB-CB revealed that given the increasing cultural diversification of the U.S population, it becomes imperative to evaluate and ensure the cultural competency of health outcomes measurement tools with the same fervor that is used to assess a tool's psychometric characteristics (Prince, 2008). As such, an internationally recognized Cultural Working Group (CWG) was assembled to evaluate the extent to which NIHTB-CB measures are culturally sensitive and conceptually appropriate in application across different cultural groups and to make specific recommendations to the NIHTB-CB scientific study team that highlight their strengths, limitations, and strategies for remediation. This too necessitated the undertaking of this study owing to the fact that Zambia is a multilingual society with different cultural aspirations and one wondered how the NIHTB-CB was able to assess the cognitive functioning of children and adolescents all with different cultural backgrounds.

To further support the challenges of the NIHTB-CB, members of the Cultural Working Group convened for a day-long face-to-face meeting to review the NIHTB-CB measurement tools within the context of these cultural competency criteria. This included an examination of both the comprehensive translation methodology that was used and the proposed socio-demographic form, as well as an in-depth review of each of the NIHTB instruments in cognition, sensory, motor, and emotion domains. Each measure was evaluated either through actual administration or through video presentations. In addition to domain-specific recommendations, several suggestions were provided to ensure greater knowledge of the cultural and economic diversity of the sample, including gathering information on race or ethnicity, highest level of education completed, education quality, and location of education, acculturation, immigration experience, and nationality.

Recommendations were considered regarding the NIHTB-CB norming phase as a way to make it applicable. However, of great importance was the topic of bilingual respondents and the need to inquire about the extent of formal education completed in each language spoken. Additional discussion centered on how to best capture racial and ethnic self-identification, nation and state of birth, immigration and acculturation experience, and parental country of origin. For the language spoken at home, members recommended that children be asked what they speak with their caregivers and friends, and that adults also be asked what language is spoken at home and with partners. Several members of the Cultural Working Group believed that income did not sufficiently capture socioeconomic status and that a better measure could be attained if income was combined with additional data on the participant's state and city of birth, current zip code (attainable for both United States and foreign-born, and via the U.S Census for urban or rural based on zip code), and whether the person was born in an urban or rural area.

Similarly, the current study gathered information on variables such as tribe, highest level of education attained and school type acculturation, immigration experience, nationality and language spoken at home during the NIHTB-CB administration process as well as neuropsychological testing. However, this information was only gathered from children and adolescents who were urban based as opposed to members of the Cultural Working Group who convened for a day-long face-to-face meeting to review the NIHTB-CB measurement tools within the context of these cultural competency criteria. It was also not known whether the current study would suggest recommendations such as the ones made by the Cultural Working Group that the language used in the instrument administration NIHTB-CB could be that which children spoke with their caregivers and friends, and that adults also be asked what language was spoken at home and with partners in the case of Zambia.

To further illustrate the challenges of the NIHTB-CB, Altman and Gulley (2009) conducted a study in the United States of America on disability access and applicability of the NIHTB-CB in which the findings revealed that in the United States, approximately 15% of community-dwelling individuals older than 5 years had a disability and the prevalence of disabling conditions increased with age. As such, end users of the NIHTB-CB encompassed people with disabilities as well as people with sensory, motor, and cognitive impairments in their research. To ensure that the NIHTB-CB measures were accessible and applicable to persons with

disabilities, Accessibility Working Group (AWG) was formed composed of individuals who had experience with disability, accessible information technology, and assistive technologies.

The first task of the AWG was to develop guidelines based on Section 508 of the Rehabilitation Act and the Web Consortium Accessibility Guidelines (WCAG) and disseminate them to the motor, cognition, emotion, and sensory project teams. In the latter category, they also differentiated measures that were not accessible but should be and measures that were not accessible and should not be. For example, a measure of working memory probably should be accessible and applicable to people who are blind, but a measure of visual acuity did not need to be altered for people who were blind because it was a measure of vision. The Accessibility Working Group considered a broad range of functional limitations such as vision, hearing, motor, speech, and reading. This brought into contention a question of whether the NIHTB-CB was applicable to the Zambian population but with the intention to assess children and adolescents' cognitive functioning in Lusaka Province.

Another study by Helena-Correia (2013) in the United States of America on the challenges of using the NIH Toolbox to the non-English speakers revealed that the only option was translation and linguistic consideration that could create a new version of the NIHTB-CB to enable assessment of speakers who do not speak English or do not speak it well. However, given the heterogeneity of the Spanish-speaking population in the United States, it was particularly challenging to develop a Spanish version that was suitable for all Spanish-speaking individuals. Depending on country of origin, the names given to certain mundane objects or situations could differ. "Banana," for example, could be plátano, banana, banano, cambur, guineo, inguiri, and platanito depending on whom one conversed with.

The issue of universal wording is especially significant in the context of memory-based and image identification tasks because they involve word retrieval. Relying on a computer-assisted evaluation with an audio component, some of the NIHTB-CB measures pose additional challenges for translation. Translating instruments that were developed in English for a non-English-speaking audience can be challenging because often the wording or the concepts have no equivalent in other languages. Using clear syntax, simple and common language, and avoiding extreme colloquialisms contribute to improving comprehension of the English source and to a

certain extent that of the translated version. However, that is not always enough to enable equivalent translations. Spanish does not have, for example, a term to encompass all the negative emotions contained in the multidimensional but simple English concept of “upset.” In order to translate it, it is necessary to clarify its intended meaning in the particular item.

Consideration of language register also affects the creation of the NIHTB-CB Spanish version in that for some measures, the criteria applied to the development of the English version are not equally applicable to the Spanish version. For example, the words from the Vocabulary list, if simply translated, do not reflect the same level of difficulty in both languages. For instance, “moribund” belongs to a higher register in English whereas “moribundo” is easier to understand in Spanish.

In as much as using English in the administration of most assessment instruments brings about harmony and modernisation, the usage of English in some settings especially in resource-limited countries without translation has raised numerous concerns because English has not been an outright success. This begged the question of whether the NIHTB-CB could require a translated version to assess the cognitive functioning of children and adolescents belonging to Zambia a resource-limited country. This was premised on the justification that despite numerous concerns about English language as having some communication and instruction comprehension barriers, English was being used in the administration of the NIHTB-CB among Zambian children and adolescents in assessing cognitive functioning in Lusaka Province thereby warranting the undertaking of the current study.

A study by Eremenco, Cella and Arnold (2005) in the United States of America on Method for the Translation and Cross-cultural Validation of Health Status Questionnaires contended that the Spanish Language Working Group was formed to identify specific challenges and problems of the NIHTB-CB through a translatability review during instrument development and to offer alternative wording solutions more suitable for a culturally diverse population, for translation, and for the survey's mode of administration. A comprehensive translation methodology was used to produce a universal Spanish version appropriate for the majority of U.S Spanish-speakers. During the translatability and applicability review of individual the NIHTB-CB measures, the primary focus was on the “word-heavy” instruments from Emotion and Cognition. However,

selected measures from Sensory were also assessed. For Motor, an early translation of 2 of the measures revealed no significant translatability issues. Although different approaches were adopted for each of the domains based on the specificity of the measures, the following criteria were used to assess translatability: Universality, cultural relevance, figure of speech/jargon, ambiguity, register, number of words, translation reversal, double-negative, double-barrel, sex and number agreement, parts of speech, oral, written, and mode of administration and technology.

The Eremenco, Cella and Arnold (2005) study was vital to the current undertaking in that it had provided valuable and insightful information on various challenges and problems of the NIHTB-CB. However, one weakness of the aforementioned study was that it only concentrated and considered two languages which were English and Spanish to develop the NIHTB-CB as a universal instrument. In view of this, it is therefore imperative to note that English and Spanish are not the only languages spoken worldwide. This being the case, the challenges and problems reported by the aforementioned study may not represent and reflect the general challenges and problems encountered by the general population world over.

Harniss and Magasi (2013) emphasised that all of the NIHTB-CB measures presented applicability and accessibility challenges for different groups of people. For instance, individuals with vision impairments (blind or low vision) face the greatest accessibility and applicability challenges, and individuals with motor impairments are a close second. Accessibility and applicability challenges fall into 3 broad categories: Some measures are inaccessible because a construct is being measured in a way that requires a specific functional ability such as measure of vocabulary that requires vision or a measure of endurance that requires walking, while others are inaccessible because administration guidelines are narrowly defined and these include a measure of taste that gives directions only verbally and some are inaccessible because of decisions made about technology. For example, a pattern-comparison measure that requires users to make use of a touch screen.

While the aforementioned study brought to light information of accessibility and applicability challenges which were found to fall into three broad categories such as specific functional ability, administration guidelines and decisions about technology, what was not known was

whether the NIHTB-CB had issues in terms of challenges of accessibility and applicability in the administration among Zambian children and adolescents without visual and motor impairments as these characteristics were not part of the inclusion criteria which guided the current study.

Further, Tambulukani and Bus (2011) in their study in Zambia on Linguistic Diversity: A Contribution Factor to Zambia's Reading Problems reported and emphasised the fact that most of the standardized neuropsychological tests were administered in a different language mainly in English from that which was spoken locally. They further emphasised that although English was the official language, Zambia was a country with 73 dialects spoken and this made it not culturally appropriate. Tambulukani and Bus' (2011) argument was that most of the standardized neuropsychological tests were administered in a different language mainly in English from that which was spoken locally thereby prompting the undertaking of the current study to question the validity and cultural appropriateness of the NIHTB-CB based on testing in English rather than in the mother-tongue language which was very relevant in terms of psychometric properties when giving instructions during administration among the Zambian population especially children and adolescents in Lusaka Province.

Paediatric cognitive assessment has been known to be a relatively new concept in Zambia. This reflects the challenge that most African countries face in developing culturally appropriate tools that would help in assessing children in clinical or educational settings (Zuilkowski *et al* 2016). Paediatric cognitive assessment in Zambia mostly relies on the use of diagnostic instruments developed in countries with a very different set of cultural values and behaviours. The use of Western-developed tests is not without problems. These difficulties can be seen as lack of normative data and differences in cultural background, ecological demands, language, and education (Ardila *et al.*, 1995; Grigorenko, 2009, Lezak *et. al.* 2004, Razani *et al.* 2006, Reitan *et al.* 1995, Segall, 1986). In the same vein, the NIHTB-CB was also a Western developed tool which, in one way or another might lack normative data and face differences in cultural background, ecological demands and language in a new setting, particularly Zambia, in assessing cognitive functioning of children and adolescents in Lusaka Province.

Another study by Maryland (2015) in London on Challenges and Opportunities for the Use of the NIH-Supported Patient Reported Outcome (PRO) Tools in Comparative Effectiveness

Research revealed that although standardized, there are differences across therapeutic areas regarding which domains are considered important, uncertainty of how to incorporate Patient Reported Outcome (PRO) scores into clinical decision-making and overall too many different measures being used in the field, including some poor quality instruments. The study further brought out other issues that included cultural/linguistic challenges, and adaptability of measures to support both clinical care and high-quality research endpoints. While these findings in terms of challenges were peculiar and applicable in London as reported by Maryland's study, it was not known whether similar challenges would be encountered by children and adolescents when administered with the NIHTB-CB in the assessment of cognitive functioning in Lusaka Province, Zambia.

A study by Kathleen, Wallner-Allen and Fox (2013) in the United States of America on using the NIHTB-CB in Special Populations revealed that children possessing several challenges, many of which were magnified in longitudinal research because there were few measures that could be used across different age points, making it more difficult to measure or understand change over time and the study reported that during the review of potential instruments, potential threats to validity were noted such as providing of complex instructions, using non- task materials that are not engaging, less concrete, and un-familiar items , and unstructured testing environment or objects which are not child-friendly. While it might be true with children and experts regarding challenges as revealed in the aforementioned study, it was not known whether the same challenges might apply to the administration of the NIHTB-CB in assessing children and adolescents' cognitive functioning in Lusaka Province, Zambia.

2.4 Validation and psychometric properties of assessment instruments

Validation of pediatric assessment instruments is vital as it provides rightful procedures and equips the assessor with proper knowledge and skills to detect the effectiveness of the instrument in tapping the construct appropriately (Zuilkowski, *et al*, 2016). In this regard, there is burgeoning empirical evidence on the validation of Pediatric assessment instruments both internationally and locally based on the standardized measures for easily compared across studies against “gold standard” instruments (Weintraub, 2014; Kelly, Ahonen and Aro, 2001). However, neuropsychological testing in Zambia mostly relies on the use of assessment

instruments developed and validated in countries with a very different set of cultural values and behaviours. For example, the NIHTB-CB measure key constructs of developmental stages across lifespan (John *et al*, 2014; Gershon *et al*, 2013). With a more specific reference to educational setting, Zambia has a number of achievement tests which have been developed. These are based on the academic performance of children and adolescents who have not attended school and are more likely to perform poorly. The current study however, took a different dimension as opposed to the above information as it validated the NIHTB-CB that measured the cognitive function comparing it against the gold standard of traditional neuropsychological battery measuring same constructs with similar psychometric properties through interrogating the face validity, content validity, construct validity, convergent validity, divergent validity and criterion validity among children and adolescents aged 8-17 years in Lusaka Province.

Sabanathan (2015) and Ballot (2017) further argue that developmental assessment tools are generally used for children and adolescents with more detailed cognitive assessments who are of school-going ages. Many of these require training and are extremely expensive to purchase. This poses a great challenge in the identification of neurocognitive developmental difficulties in children and adolescents in education or clinical settings (Gladstone; 2014). However, with the coming of the NIHTB-CB among the Zambian population particularly, children and adolescents, the assessment of cognitive function would be made possible in a simplified and accurate manner when adapted to the Zambian setting through the validation process.

Despite a number of standardized tests which are used in research as well as for clinical practices, there is debate about their validity, sensitivity, specificity or how culturally appropriate these assessment tools are (Gladstone; 2014). This reflects a major challenge that most developing countries face in developing and validating culturally appropriate instruments that would help in assessing children and adolescents in clinical or educational settings (Zuilkowski *et al* 2016). This provides a fertile ground and the much-needed impetus to validate the NIHTB-CB by determining its sensitivity and specificity in assessing the cognitive functioning of children and adolescents in Lusaka Province, Zambia.

Validation studies of the NIHTB-CB were conducted to ensure that the tools met all the rigorous scientific standards (Weintraub, Dikmen, *et al.*, 2013). For instance, in the United States of

America, the validation process of the NIHTB-CB was carried out on 400-450 subjects across the entire age range and were later compared against the ‘‘gold standard’’ measures whenever applicable. The calibration samples for tests used Classical Test Theory Technique to scoring as robust models that involved several thousand participants. Similarly, the current study also was informed and grounded on the Classical Test Theory but the two studies were at variance from each other as the current study was conducted in Lusaka Province on a different sample size drawn from the Zambian population specifically of ages 8-17 years.

Furthermore, Weintraub *et al*, (2013) in their study in the United States of America on Cognition assessment using the NIHTB-CB found that in the field-test validation and calibration activities, data was collected from more than 16,000 subjects. The NIH project team carried out a large national standardised study in both Spanish and English to facilitate normative comparisons on each assessment. A sample comprising of 4,859 subjects of ages 3-85 was administered all the NIHTB-CB measures. The participants chosen from various sites in the country represented different races or ethnicities, genders and socioeconomic status. The normative scores for ages 3-85 are now available enabling accurate comparison of any targeted subject groups against the U.S population. However, in Zambia, neuropsychological testing has been known to be a relatively novel concept, this made the current study inevitable as the Zambian populations’ races, ethnicities, genders, and socioeconomic status might differ from that of U.S population on which the NIHTB-CB was normed and validated.

Neuropsychological instruments are important for identifying psychological factors such as depression and determine levels of cognitive functioning relating to school, work or independent living. They too provide and offer improved clinical screening and treatment recommendation of a variety of neurocognitive disorders, psychological adjustment and facilitate comparison across empirical designs (Cubelli, Marchetti, Boscolo, Sala; 2000). In order to appreciate the aforementioned pertinent attributes of neuropsychological process which could be obtained and recorded only by the use of assessment instruments such as the NIHTB-CB, there was need therefore to validate the NIHTB-CB in assessing the cognitive functioning of children and adolescents ages 8-17 years in Lusaka Province, Zambia.

Further, Grigorenko (2009) in his study conducted in the United States of America on Multicultural Psycho-education Assessment reports that although there are questions surrounding the validity of neuropsychological assessments instruments in Zambia, there have been a lot of efforts to ensure that neuropsychological assessments are conducted with the aid of validated instruments. The use of Western-developed and validated tests is not without problems. These difficulties can be seen as lack of normative data and differences in cultural background, ecological demands, language, and education to which the NIHTB-CB ascribe. However, these tests have been in use for several years and researchers have had to make adjustments in the administration or interpretation of results in order to make some profile of children and adolescents' cognitive functioning valid and reliable. This therefore yielded some questions related to the validity of these tests especially the NIHTB-CB in assessing cognitive functioning of children and adolescents in the Zambian settings.

A study by Russell *et al*, (2005) in the United States of America on the fundamental psychometric status of neuropsychological batteries revealed that a fundamental requirement for neuropsychological assessment is dependability. Neuropsychological knowledge was considered to be dependable only if it was validated using psychometric methods. The psychometric validation methods that are acceptable for individual tests must be applied to batteries to produce dependable information. While the aforementioned study stressed on dependability as a pertinent ingredient concerning the psychometric status of neuropsychological assessment, the current study focused on examining the extent in terms of the appropriateness of the psychometric properties of the NIHTB-CB in measuring the cognitive functioning of children and adolescents among the Zambian population in Lusaka Province.

Another study by Carlozzi *et al*, (2017) in the United States of America on validation of the NIHTB-CB in Individuals with Neurologic Disorders by hypothesizing that: Individuals with spinal cord injury (SCI), traumatic brain injury (TBI) and stroke experience a variety of neurologically related deficits across multiple domains of function. The NIHTB-CB was used to examine motor, sensation, cognition, and emotional functioning. The purpose of this study was to establish the validity of the NIHTB-CB in individuals with neurologic conditions. The study further evoked community-dwelling individuals with SCI (n = 209), TBI (n = 184), or stroke (n

= 211) who completed the NIHTB-CB and relative risks for impaired performance were examined relative to a matched control group.

The findings of the study revealed that the largest group differences were observed on the Motor domain and for the Fluid Cognition measures. All groups were at increased risk for motor impairment relative to normative standards and matched controls. Fluid cognitive abilities varied across groups such that individuals with stroke and traumatic brain injury (TBI) performed more poorly than individuals with spinal cord injury (SCI); increased relative risks for impaired fluid cognition were seen for individuals in the stroke and TBI groups but not for those in the SCI group. All three neurologic groups performed normally on most measures in the Sensation Battery, although TBI participants' evidenced increased risk for impaired odor identification and the stroke group showed more vision difficulties. On the Emotion Battery, participants in all three groups showed comparably poor psychological well-being, social satisfaction, and self-efficacy, whereas the TBI group also evidenced slightly increased negative effect.

The information from the aforementioned study was vital to the current study in the sense that it provided guidance and direction on how the NIHTB-CB was validated among individuals with SCI, TBI and stroke in the United States of America. While so much about the NIHTB-CB validation has been shared and disseminated especially among the US population, there was inadequate information about the its validity among Zambian population especially in children and adolescents in Lusaka Province.

A study by Juneja and Abubakar (2012) in India on Ages and Stages Questionnaire as a Screening Tool for Developmental Delay in Indian Children reported that some of the developmental assessment tools which included the Revised Denver Prescreening Developmental Questionnaire (RDPDQ), the Bayley Scales of Infant Development, Second Edition (BSID-II; Bayley (1993) which is an individually administered assessment of a child's current developmental functioning that requires 45-60 minutes to complete. The Bayley Scales of Infant Development, Second Edition (BSID-II) contains two scales to describe a child's functioning; the Mental Developmental Index (MDI) includes problem solving, language, personal or social and the Psychomotor Developmental Index (PDI) addresses gross or fine motor. It also includes the Griffith's Scales of Mental Development, the Denver Developmental

Screening Tool II, require less training and are more user friendly, the Kilifi Developmental Inventory and the Malawian Developmental Assessment Tool.

Parental report measures such as the ages and stages or the Pediatric Evaluation of Development Status are used to detect developmental delay and are highly predictive of true problems. These tools require reading abilities unless a professional reads out the items to the parent. They have all been used in Africa to assess outcomes of developmental delays. However, the NIH Toolbox had not been previously used in Africa but successfully been utilized in pilot studies with children in Botswana and Liberia (Bearden *et al*, unpublished). However, in Zambia, the NIHTB-CB was novelty and this made the undertaking of the current study inevitable.

Carter (2005) also in his study on the Increased Prevalence of Epilepsy Associated with Severe Falciparum Malaria in Children contended that these different developmental assessment tools are translated into local languages but not adapted or validated for a particular population. It is rare that there are standardized norms for these tools, and they are mainly used for research rather than for clinical purposes. In more recent years, some developmental tools such as the Malawi Developmental Assessment Tool (MDAT) and the Kilifi Developmental Inventory have been created or adapted specifically for African settings and have gone through validation and reliability processes to show good predictive validity. New tools such as the NIHTB-CB are being created that may be used for surveillance with specific messages interlinked to provide parents and caregivers with advice. In as much as the above assessment tools have been adapted and validated to be used in African settings, it was not known whether the NIHTB-CB was sensitive enough to tap or show appropriate validity in the Zambian setting among children and adolescents aged 8-17 years by assessing their cognitive functioning in Lusaka Province.

Further, Boivin *et al* (2011) add that Malawi Developmental Assessment Tool (MDAT) is standardized with culturally appropriate developmental milestones. The Malawian Developmental Assessment Tool is used to gain an understanding about a child's level of development in clinical practice and research. It contains 4 main parts and 136 items which are divided into 34 items in each part. The tool is sensitive enough to pick up children with known neuro-disabilities using the pass or fail scoring system that is implemented. The four parts are the gross motor skills function, fine motor skills function, language milestone and social milestones.

As opposed to the MDAT that has four parts and validated in Malawi whose cultural beliefs and practices may be similar to that of Zambia, the NIHTB-CB is a multidimensional set of brief that measures four domains which include cognition, emotion, sensory and motors skills across lifespan of ages 3-85 years, with an automated scoring and has not been validated in African settings particularly in Zambia for assessing cognitive functions of children and adolescents all of ages 8-17 years in Lusaka Province.

Balla, Cicchetti and Sparrow (2005) report on Vineland Adaptive Behavior Scales (VABS; Sparrow, Balla and Cicchetti, 1984) which is a standardized norm-referenced assessment tool that can be used for measuring an individual's daily functioning, measuring deficits in adaptive behavior, clinical diagnosis of autisms spectrum disorders, genetic disorders, developmental delays, developmental evaluations, program planning and research. The Vineland Adaptive Behavior Scales is updated with new norms, expanded age range, and improved items. It is useful for diagnosis, qualification for special programs, progress reporting, program and treatment planning, and research. The VABS offers both respected semi-structured interview format which focuses discussion and gathers in-depth information and also offers convenient rating forms. The foregoing information was vital and insightful to the current study in that it highlighted the pertinent issues surrounding the standardized norm-referenced assessment tools for measuring individuals' daily functioning activities. However, the Vineland Adaptive Behavior Scale was at valiance with the NIHTB-CB which set a stage for the current study and sought to valid it as a diagnostic tool for cognition, emotion, sensory and motor functioning skills among Zambian children and adolescents in Lusaka Province.

A study by Rindermann, Becker and Coyle (2016) on a Survey of Expert Opinion on Intelligence: Causes of International Differences in Cognitive Ability Tests acknowledged that the lowest ability levels of assessment results were found in Sub-Saharan African which begs a question as to whether the instruments used were valid and culturally appropriate. Odgen *et al* (2003) posits that differences in cultures affect performance on neuropsychological tests when they are administered in cultures different from white English-speaking, European or American educated populations. This is not surprising because most neuropsychological tests are culturally biased since test developers have the tendency to develop tests that evaluate sample activities and behaviours that are valued in their communities. This argument provided the current study with a

fertile ground to question the validity and cultural friendliness of the NIHTB-CB to be used among different populations and to be more specific, Zambian children and adolescents in Lusaka Province.

Furthermore, Lynn and Vanhanen (2012) highlighted on other factors such as language, social class, urban-rural residence, gender and age influence cognitive outcomes, education, modernisation, politics, wealth and evolutionary genetic factors as causes of differences in cognitive abilities. While the aforementioned factors could be true as causes of differences in cognitive abilities as indicated by Odgen *et al* (2003), Lynn, and Vanhanen (2012), it was not known whether language, social class, urban-rural residence, gender, education, modernisation, politics, wealth and evolutionary genetic factor and age might also influence cognitive functioning among Zambian children and adolescents in Lusaka Province.

Serpell (1998) in his study on some language developments in Zambia adds that the most suitable neurocognitive assessment instruments validated and normed is the Serpell's Panga Muntu Test ("Make a Person") which was developed in 1976 with the hope of assessing children on a culturally appropriate basis. Unlike the bell-shaped curve's controversial results which came after comparing populations and made a decision and conclusion that all whites were brighter and intelligent with (IQ: Mean of 100) than blacks with (IQ: Mean 85), without factoring in other cultural demands and meeting the principles of validation process in most of the African settings (Hernstein and Murray, 1994). While the PMT which was locally made provides an opportunity to establish cognitive functioning in children, it is however imperative to still note that the tool does not provide coverage for all age ranges. Thus, the ability to detect subtle neurocognitive function in the wider population is not assured by using the PMT. The NIHTB-CB on the other hand provides coverage across the age spectrum of 3-85 years. However, it was not known whether the NIHTB-CB was valid enough to tap the cognitive functioning of Zambian children and adolescents of ages 8-17 years in Lusaka Province.

In addition to the Panga Muntu Test, another cognitive assessment tool that was recently developed in Zambia is the Zambia Child Assessment Tool (ZamCAT, 2010). The ZamCAT however was meant for children aged between 5 and 6 years and not the adolescent population. Based on the ZamCAT, it was therefore important to validate the NIHTB-CB in the light of

Zambian context that cuts across lifespan of ages from 3-85 years in assessing the cognitive functioning of individuals through the various developmental stages.

A recent study by Hackett, *et al* (2018) on the Utility of the NIHTB-CB for Assessment of Prodromal Alzheimer's Disease and Dementia used the NIHTB-CB as a computer-based protocol not yet validated for clinical assessment. The study administered the NIHTB-CB and traditional neuropsychological tests to 247 Memory Disorders and Alzheimer's Prevention Clinic patients with subjective cognitive decline, mild cognitive impairment, mild dementia due to Alzheimer's disease, and normal cognition. Principal component analysis, partial correlations, and univariate general linear model tests were performed to assess construct validity. Discriminant function analyses compared classification accuracy and found that Principal component analysis identified three conceptually coherent factors: memory (MEM_{NIH}), executive function (EF_{NIH}), and crystallized intelligence (CI_{NIH}). These factors were strongly associated with corresponding traditional tests and differed across diagnostic groups as expected.

The study further established that both NIHTB-CB and traditional batteries yielded strong overall discriminative ability (>80%). The NIHTB-CB was a valid method to assess neurocognitive domains pertinent to aging and dementia and had utility for applications in a memory clinic setting. The current study deviated from the Hackett *et al*, (2018) as its main focus was to interrogate the valid of the NIHTB-CB in assessing the cognitive functioning children and adolescents in Zambia as opposed to an assessment of Prodromal Alzheimer's disease and Dementia using the NIHTB-CB among 247 Memory Disorders and Alzheimer's Prevention Clinic patients with subjective cognitive decline, mild cognitive impairment, mild dementia due to Alzheimer's disease, and normal cognition.

Another study by Hessel *et al*, (2014) on the NIHTB-CB for intellectual disabilities revealed that although domain-specific validation tests were not available in study, correlations with chronological and mental age were performed and correlations with chronological age were weak. In contrast, mental age showed moderate to strong correlations with flanker, oral reading, and list sorting tests. Full-scale IQ (FSIQ) demonstrated consistent moderate to strong correlations with NIHTB-CB tasks, and it correlated strongly with the NIHTB-CB cognitive composite. Adaptive behavior was most strongly correlated with flanker, oral reading, and list sorting, and correlated well with the NIHTB-CB composite. As opposed to the aforementioned

study which dwelled on chronological and mental age against NIHTB-CB cognitive composite in which domain-specific validation tests were not available, the current study uniquely considered validating the NIHTB-CB using its cognitive composite score against the gold standard neuropsychological battery test composite across all 8 cognitive domains of children and adolescents in Lusaka Province, Zambia.

Further, Zelazo *et al* (2013) revealed that validity measure expresses how well the tests in the battery measure the intended constructs (convergent validity) as opposed to different cognitive constructs (discriminant validity). The “gold standard” tests related to the Cognition Battery instruments in the expected ways for participants across a wide age band (ages 8-85 years), demonstrating both convergent and discriminant validity. Evaluating construct validity in young children (ages 3-6 years) was challenging because of the absence of specific gold standard measures of targeted constructs appropriate for these ages. In order to avoid the challenges encountered in the Zelazo (2013) study, the current study considered the construct validity as part of the psychometric properties of the NIHTB-CB by having both a Neuropsychological Test Battery as a gold standard and participants were older with ages of 8-17 as opposed to those who were sampled in aforementioned study whose age group ranged from 3-6 years.

Zelazo *et al* (2013) further revealed that lack of such measures may reflect the fact that different subdomains of cognition become more differentiated with experience and development.⁵⁵ The correlations between the NIHTB-CB measures and general cognitive ability, the index of convergent validity in young children (ages 3-6 years), were high (0.54-0.74), possibly supporting such a notion. The NIHTB-CB was designed as a brief, diverse, accessible, and psychometrically sound set of instruments that will be broadly applicable in research studies of normal and abnormal groups across a wide age range. The current results regarding age effects, test-retest reliability, and construct validity are promising. This information was valuable and insightful to the current study in that it highlighted the pertinent issues concerning the convergent, discriminant and construct validity in both a wide age band of ages 8-85 years and young children of ages 3-6 years. However, the current study considered focusing on face validity, content validity, construct validity, divergent validity, convergent validity and criterion validity of the NIHTB-CB to measure the cognitive functioning in children and adolescents with a narrow age band of only 8-17 years in Lusaka Province, Zambia.

Another study done by Zelazo *et al* (2006) on the validation of the NIHTB-CB in measuring Executive Function and Attention reported that the process of validation involved modifying existing measures in order to satisfy the criteria of the Pediatric, accessibility and cultural working groups. Weintraub *et al* (2014) further added that measures were modified so that the instructions were easy to understand and would translate readily into Spanish, the visual displays were engaging for all participants, and the number of trials in each task was minimized while maximizing test-retest reliability and validity. While the aforementioned study considered Executive function and Attention as subdomains of cognition in validating the NIHTB-CB by modifying the language and instructions for easy understanding of the concepts, the current study validated the NIHTB-CB across all 8 cognitive subdomains in children and adolescents in Zambia by striving to determine whether the NIHTB-CB was valid and needed for specific domain modification and if so, which ones were those domains.

Another study by Weintraub, Dikmen and Heaton (2013) on cognitive assessment using the NIHTB-CB revealed that age associations reflected the validity of the tests for measuring cognitive development during childhood and age-related cognitive decline during adulthood in which Pearson Correlation Coefficients between age and test performance were calculated separately for children and adults. Intra class correlation coefficients were calculated to evaluate test-retest reliability and convergent validity was assessed by correlations between each of the NIHTB-CB measure and a well-established “gold standard” measure of the same construct; evidence of discriminant validity was assessed by correlations with gold standards of a different cognitive construct and the findings revealed that gold standard measures were scarce for 3 to 6 year olds, and were unable to identify well-established measures to test convergent or discriminant validity in this age group for the measures of attention, episodic memory, executive function and processing speed.

Additionally, in children from 3 to 6 years of age, all the NIHTB-CB measures were significantly correlated (ranging from $r = 0.54$ to $r = 0.74$) with our measure of general cognitive ability (“g”), indicating that they were sensitive to a range of different cognitive ability levels within this age cohort. For all the NIHTB-CB instruments, correlations for convergent validity

measures ranged from $r = .5048$ to $r = .5093$ (all $p < .0001$), suggesting that the NIHTB-CB measures were tapping the desired constructs. While the aforementioned study concentrated on cognitive assessment using the NIHTB-CB in children aged 3-6 years in which convergent and discriminant validity were pivotal for the measures of attention, episodic memory, executive function and processing speed, however, the current study involved children and adolescents of different age group (8-17 years). It also considered all 8 cognitive subdomains which included working memory in validating the NIHTB-CB in Lusaka Province an important function of cognition which was not treated in Weintraub et al, (2013)'s study.

Bauer and Zelazo (2013) conducted a study on the NIHTB-CB: Introduction and Pediatric Data trying to determine the reliability and validity of the instruments as measures of the target subdomains. This was a validation study involving a total of 476 participants recruited from multiple sites (Chicago's North Shore University Health Systems, Emory University in Atlanta, New Jersey's Kessler Institute for Rehabilitation, and the University of Minnesota). Eligible participants were 3 to 85 years of age and sample recruitment was distributed across age, gender, race, and education strata. There were a total of 120 3-6 year olds and 88 8-15 year olds.

Bauer and Zelazo (2013) maintained that validation measures were selected by reviewing published tests commonly used in neuropsychological practice to assess the constructs being tapped by the Cognitive Battery tests (The NIHTB-List Sorting Working Memory Test) as an example. The results revealed that Pearson Correlation Coefficients between age and test performance were calculated separately for children and adults to describe the developmental and aging-related associations for each measure. Intraclass correlation coefficients (ICC) were calculated to evaluate test-retest reliability. Across measures, $ICC < .4$ were considered poor, $.4 \leq ICC < .75$ were considered adequate, and $ICC \geq .75$ were considered excellent. Convergent validity was assessed with correlations between each Toolbox measure and a well-established validation measure of the same construct. Across measures, $r < .3$ were considered poor, $.3 \leq r < .6$ were considered adequate, and $r \geq .6$ were considered excellent.

While the aforementioned study validated the instrument as measures of the target subdomains among the 476 participants recruited from multiple sites which included Chicago's North Shore University Health Systems, Emory University in Atlanta, New Jersey's Kessler Institute for

Rehabilitation, and the University of Minnesota. The eligibility of the recruited participants was 3-85 years old and the sample recruited was distributed across age, gender, race and education strata. The current study too validated the NIHTB-CB and applied same data analysis strategy however, it did not dwell more on adults but evoked on children and adolescents of ages 8-17 years who were recruited from one site as opposed to 5 sites reported by Bauer and Zelazo (2013). Furthermore, the current study compared the test scores of the NIHTB-CB and a gold standard of full neuropsychological testing battery as a due process for instrument validation while Bauer and Zelazo (2013)'s study separated performance of children from adults by describing the developmental and aging-related associations for each measure of the NIHTB-CB.

A study by Weintraub *et al* (2013) on the psychometric characteristics of the NIHTB-CB covered such psychometric issues as internal consistency, test-retest reliability, and divergent and convergent validity and the findings revealed that test-retest reliability was found to be strong for the entire sample and also for children ages 3-15 years and adults ages 20-85 years. Intra-class correlation coefficients for the entire sample on the NIHTB measures ranged from 0.78 for the Picture Sequence Memory Test to 0.99 on the Oral Reading Recognition Test, with most other values falling >0.90 . Additionally, the effects of age on the NIHTB were assessed, with all the NIHTB-CB measures showing a robust association between test performance and age in the child group ($r = .58 - .87$), with the scores improving with age in this group. Interestingly, age and test scores ($r = -.46$ to $-.65$) on the remaining NIHTB-CB measures were negatively associated, with lower scores at higher age levels, with the only exception to this being language tests. Convergent and discriminant validity were also assessed.

In children from 3 to 6 years of age, all the NIHTB-CB measures were significantly correlated (ranging from $r = .54$ to $.74$) to a general measure of cognition employed by the researchers. The researchers termed this general measure of cognition “*g*”. This was obtained by averaging *z* scores of the Wechsler Preschool and Primary Scale of Intelligence-3rd edition Block Design subtest and the Peabody Picture Vocabulary Test-4th edition. For all the NIHTB-CB instruments, correlations for convergent validity measures ranged from $r = .48$ to $.93$ (all $p < .0001$), which is very strong. Similarly, correlations for discriminant validity measures ranged from $r = .05$ to $.30$, indicating almost no correlation with other measures which capture different constructs. The aforementioned study's findings were vital to the current study in that it highlighted most the

psychometric issues of the NIHTB-CB by considering the internal consistency, test-retest reliability, divergent and convergent validity. However, the current study deviated from the above study by including other important psychometric properties of the NIHTB-CB such as face validity, content validity, construct validity and criterion validity which were not treated in Weintraub *et al* (2013)'s study in order to have a comprehensive examination of the instrument's validity.

A local study by Chipimo and Kylkesnes (2010) investigated Comparative Validity of Screening Instruments for Mental Distress in Zambia. The study started by stating a brief background that the recognition of mental health as a major contributor to the global burden of disease has led to an increase in the demand for the inclusion of mental health services in primary health care as well as in community-based health surveys in order to improve screening, diagnosis and treatment of mental distress. Many screening instruments are now available. However, the cultural validity of these instruments to detect mental distress has rarely been investigated in developing countries. In these countries, limited trained staff and specialized psychiatric facilities hamper improvement of mental health services. It is therefore imperative to develop a quick, low-cost screening instrument that does not require specialized training. The study validated different well established screening instruments among primary health care clinic attendees in Lusaka, Zambia and also assessed the face, content and criterion validity of the Self-Reported Questionnaire (SRQ)'s and determined the most commonly reported symptoms for mental distress.

The screening instruments, Self-Reported Questionnaire (SRQ-20, SRQ-10) and General Health Questionnaire (GHQ-12) were used as concurrent criteria for each other and compared against a gold standard, Diagnostic and Statistical Manual of Mental Disorder 4th Edition (DSM-IV). Their correlation, sensitivity and specificity were assessed. All instruments were administered to 400 primary health care clinic attendees. In-depth interviews were also conducted with 28 of these clinic attendees. The results of the study demonstrated that both the SRQ-20 and SRQ-10 had high properties for identifying mental distress correctly with an area under the curve (AUC) of 0.96 and 0.95 respectively while the GHQ-12 had modest properties (Area Under Curve (AUC), 0.81).

The optimum cut-off points for this population were 7 and 3 for the SRQ and GHQ-12, respectively. The SRQ was also found to have good face and content validity. The aforementioned study was vital to the current study as it brought out pertinent elements of Sensitivity and specificity which were two components that measure the inherent validity of a diagnostic test for dichotomous outcomes against a gold standard. This was so because the reviewed study had demonstrated in principle how the Receiver Operating Characteristic (ROC) curve is applied as it depicts the trade-off between the sensitivity and (1-specificity) across a series of cut-off points when the diagnostic test is continuous or on ordinal scale (minimum 5 categories).

For instance, the study revealed that both the SRQ-20 and SRQ-10 had high properties for identifying mental distress correctly with an AUC of 0.96 and 0.95 respectively while the GHQ-12 had modest properties (AUC, 0.81). While the Chipimo and Kylkesnes' (2010) study managed to reveal and share robust results after investigating Comparative Validity of Screening Instruments for Mental Distress in Zambia by screening instruments such as SRQ-20, SRQ-10 and GHQ-12 with the help of concurrent criteria for each other and compared against a gold standard, Diagnostic and Statistical Manual of Mental Disorder 4th Edition (DSM-IV) in primary health care clinics, the current study too used similar concepts of sensitivity, specificity, AUC and ROC curve but validated the NIHTB-CB in assessing the cognitive function of children and adolescents at the University Teaching Hospital (UTH)-Paediatric Center of Excellence (PCOC), a major referral center in Zambia by invoking on an explanatory Sequential design compared against a gold standard, neuropsychological testing battery as opposed to Diagnostic and Statistical Manual of Mental Disorder 4th edition (DSM-IV) as the case was in Chipimo and Kylkesnes (2010)'s study.

A study by Maina *et al*, (2019) translated into English, adapted and standardized the Computerized Battery for Neuropsychological Evaluation of Children (BENCI). The Battery for Neuropsychological Evaluation of Children (BENCI) battery was adapted using back-translation design, comprehensive cultural adaptation and standardized in a case control study involving two groups of children: HIV infected and HIV unexposed, uninfected children. The content adaptation was iteratively carried out using knowledge of English and feedback from pilot testing with children. The study recruited 544 children aged 8–11 years with half of them being

HIV+ while the other half were HIV unexposed-uninfected. Test–retest reliability was analyzed using Pearson’s correlation while ANOVA and correlational analyses was used to calculate discriminant, convergent and construct validity.

The study found that the BENCI had the ability to correctly classify those with neurocognitive deficits from those without HIV, with the area under the curve ranging from good to excellent. Although the aforementioned study did not indicate specific threshold level, it was insightful to the current study in that it provided information and guidance on the basis of interrogating similar variables such as discriminant validity, convergent validity and construct validity of the BENCI but compared them with those of the NIHTB-CB. However, the current study used a gold standard of full neuropsychological test battery calibrated with a specific threshold level of 0.80-1.00 for easily comparability purposes.

Another local and recent study was conducted by Nyirenda (2020) on Adherence to Antiretroviral Therapy (ART) and Performance on the Neuropsychological Test Battery to assess the relationship between ART and performance on the neuropsychological test battery. The study found that with regards Neuropsychological test battery, subjects who reported $\geq 95\%$ adherence performed better than those who reported less than 95% adherence. There was no relationship between performance on the Neuropsychological test battery domains and gender with regards ART and also results indicated that adherence to antiretroviral therapy did not predict performance on the Neuropsychological test battery domains with respect to education. There were no differences in Neuropsychological test performance between Adherents and Non-Adherents in terms of age. However, the study found that there was significant difference in adherence to antiretroviral therapy in terms with respect to levels of education. The Global Deficit Score (GDS) impairment found that more females were more impaired than the males. The study also found that education and gender had no effect on performance on a neuropsychological test battery domain with respect to adherence or non-adherence to antiretroviral therapy. Similarly, the current study also evaluated divergent/discriminant validity of both the neuropsychological test battery and the NIHTB-CB to determine the test performance between HIV infected and HIV unexposed, uninfected children as the test batteries were able to discriminate between different groups based on the test performance. Further, the study also used

the global deficit score approach to determine cognitive impairment among children and adolescents. However, the current deviated from Nyirenda (2020)'s study by utilizing the Frascati diagnostic criteria to categorize and classify respondents with respect to Asymptomatic Neurocognitive Impairment, Minor Neurocognitive Disorder and HIV-associated Dementia, a placement strategy which was exploited by the aforementioned study.

2.5 The identified research knowledge gap

Although multiple studies have demonstrated that the NIHTB-CB has been normed and validated to measure the cognitive functioning against the U.S population across a broad age spectrum from 3-85 years, it appeared that there was little documentation of comprehensive literature on the validation of the NIHTB-CB among the Zambian population especially in children and adolescents ages 8-17 years in assessing the cognitive functioning. This compelled a need for rigorous neuropsychological validation of the NIHTB-CB that would be used to accurately measure the cognitive functioning of children and adolescents with typical and atypical developmental milestones in Zambia for education and research purposes. Given the known empirical evidence of methodological challenges that Zambia and other African countries have had using alien assessment instruments in neuropsychological testing, it offered a fertile ground for the current study which aimed at validating the NIHTB-CB in order to make it sensitive and responsive in the light of the Zambian context. The introduction of an innovative, normed and validated NIHTB-CB on a representative paediatric Zambian population could render a solution to the problem that Zambia has grappled with for decades in the education sector in the provision of workable and sustainable interventions. This study thus sought to validity the NIHTB-CB in assessing the cognitive functioning of children and adolescents ages 8-17 years in Lusaka Province, Zambia.

2.6 Summary of the chapter

This chapter presented a review of literature on the issues that the study addressed based on the objectives. It begun with evaluating the standardised administration of the NIHTB-CB with regard to other studies. It also focused on identifying challenges encountered by children and adolescents when tested with the NIHTB-CB by children and adolescents through the exploration phase. Further, it examined the extent to which the NIHTB-CB was valid based on

face validity, content validity, construct validity, divergent validity, convergent validity and criterion validity as the psychometric properties and further compared the differences between the composite scores of the NIHTB-CB with the standardised neuropsychological battery test across all 8 cognitive domains. Thereafter, the literature was used by the researcher as a tool to identify knowledge gaps that existed in the studies conducted by others scholars concerning the validation of the NIHTB-CB and other similar assessment instruments. The subsequent chapter presents the methodological aspects used in the study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Overview

The previous chapter presented a review of literature on the issues that the study addressed based on the objectives. It begun with evaluating the standardised administration of the NIHTB-CB with regard to other studies. It also focused on identifying challenges encountered by children and adolescents when tested with the NIHTB-CB through the exploration phase. Further, it examined the extent to which the NIHTB-CB was valid based on face validity, content validity, construct validity, divergent validity, convergent validity and criterion validity as the psychometric properties and further compared the differences between the composite scores of the NIHTB-CB with the standardised neuropsychological battery test across all 8 cognitive domains. Thereafter the literature was used by the researcher as a tool to identify knowledge gaps that existed in the studies conducted by others scholars concerning the validation of the NIHTB-CB and other similar assessment instruments.

The chapter also underscored the importance of other studies and outlined the methodology that was used to generate data in this study. It comprises a section on the philosophical paradigm, ontological assumption, epistemological assumption, human nature assumption, methodological assumption and research design. The chapter also explains the study's location, target population, inclusion and exclusion criteria, sample size and sampling techniques that was used. Furthermore, the chapter presents the research instruments, data generation procedure and data analysis methods as well as ethical considerations that were undertaken in the study and ends with a summary of the chapter.

3.2 Philosophical paradigm

Methodological and philosophical paradigms are used to anchor and ground studies based on a philosophy, coupled with workable mechanisms that a similar problem related to the identified research knowledge gap could have been comprehensively addressed and resolved (Murphy, 1990; Lincoln and Guba, 2000). The major four (4) methodological and philosophical assumptions according to Creswell (2009); include Advocacy/participatory, Social constructivists, Pragmatic and Post-positivists. In view of this, the methodological and philosophical assumption, which underpinned the current study, was a Pragmatic worldview derived from the work of Peirce *et al*, (2011). The ideas of the recent writers Rorty (1990), Murphy (1990), Patton (1990), and Cherrholmes (1992) were used to compliment the idea of the classical thinkers. According to this philosophy, knowledge claims arise out of actions, situations, and consequences rather than antecedent conditions (as in post positivism). Hence, there is a concern with applications of "what works" to be the truth and solutions to problems because it is based on a duality between reality independent (etic) and the mind (emic) (Patton, 1990).

For pragmatic approach, the problem is more important than the method, hence researchers use all approaches to that are credible, well founded, reliable and relevant to advance and provide them with the best understanding of the problem, (Rossman and Wilson, 1985). In this vein, pragmatists argue that researchers need to stop asking questions about reality and the laws of nature and open the door to multiple methods, different worldviews, and different assumptions, as well as to different forms of data collection and analysis as the exact case for the current study which relied on multiple methods and different forms of data generation and analysis.

Mulphy (1990) states that pragmatism accords individual researchers, freedom of choice to pick the methods, techniques, and procedures of research that best meet their needs and purposes. This study therefore employed a pragmatism paradigm because it provided the researcher with the freedom to use different techniques and methods to investigate the phenomenon under review by providing the best understanding of the research problem. In the study, the research problem or concern was whether or not the NIHTB-CB which was principally normed and validated against the United States (U.S) population (Hessl *et al* 2016), was valid and reliably used to

assess cognitive function among Zambian children and adolescents by depicting the reality of “what works” within the Zambian context.

3.3 Ontological assumptions

In order to explain and understand what reality looks like or what the world is and what it contains irrespective of the precise knowledge of it, the explanation is embedded in ontology (Lowe, 2007; Blaikie, 2000). In this vein, both Realism and Nominalist were the ontological assumptions that informed this study. Realism is an etic view of the world that takes the social world as being prior to individual humans and their appreciation of it. Quine (1948) contends that realism as ontology holds that in order to determine what exists as reality, entities are endorsed universally by scientific theory of the world and that reality is etic or given independent of the observer that exists outside the mind (Goldman, 1989; Brink, 1989 and Pring, 2000; Crotty, 1998). Based on this, the realism ontological of the current study was arrived at through conducting standardised assessments with the help of universally accepted instruments such as the NIHTB-CB and a gold standard of neuropsychological test battery.

On the other hand, Nominalists believe that reality is an emic view or that which is imprinted in the mind of the participant or social actor (Guba and Lincoln, 1994; Smith, 1983). In the current study, the Nominalist ontology was realised through conducting interviews with the participants in which different views and opinions were elicited concerning how the NIHTB-CB as an assessment tool worked in Zambia. This was because the truth or reality about the application of the NIHTB-CB was imprinted in the minds (emic) of the directly involved participants and the only method to gather such facts was through conducting face-to-face interviews.

Therefore, the two ontological assumptions were used and applicable to the current study as it evoked on mixed methodological approaches motleying both quantitative and qualitative techniques of data analysis. This was with the evidence that quantitative studies pursue examination, explanatory, predictive, evaluate and influence assessment purposes whereas qualitative pursue explorative, descriptive and understanding types of purposes (Blaikie, 2000; Quine, 1948; Pring, 2000; Guba and Lincoln, 1994). This was because the current study quantified and qualified certain variables measured by the NIHTB-CB qualitative assessment on

whether or not the NIHTB-CB was valid and participants were able to comprehend its administration instructions through face and construct validity.

3.4 Epistemological assumptions

In trying to justify what type of knowledge is knowledge, it is best to select the theoretical assumptions that make researchers appreciate the type of social reality and through which ways the reality is going to be explained. In essence, these are the ontological questions that inform and precede epistemological considerations (Hay, 2004). In other words, epistemology is that part of philosophy that asks what knowledge is and deals with the theory of knowledge which is concerned with the nature, sources and scope of knowledge (Nutter, 1987). Therefore, both positivists and humanists were employed as epistemological assumptions in this study. Logical positivist epistemology claims that science aims at the explanation and prediction of observable phenomena by presenting these as derivable from general laws and that the truth or falsity of the statements intended to express such laws is determined by their relationship to statements describing empirical observable quantitative data. This study treated the knowledge surrounding the assessments by the NIHTB-CB and a gold standard of full neuropsychological testing battery under a controlled environment with universal and structured instructions as positivist epistemology.

On the other hand, a complement of the humanist as an epistemology under qualitative sphere postulates that humans are mechanistic in nature determined by situations of the external world with experiences as products of their environments. This implies that they are conditioned by external circumstances which are rich with probing the meaning and purpose of life in terms of knowledge (Burrell *et al*, 1991). In this study, the humanist epistemology was the knowledge that surrounded the reactions in terms of experiences, opinions and views of the participants as a result of being exposed to the NIHTB-CB in assessing the cognitive functioning of children and adolescents. This was mainly achieved through a component of qualitative assessment in the NIHTB-CB. The qualitative assessment entailed that parents rated the intelligence and school performance of their children against the NIHTB-CB cognitive battery scores as well as putting forward some suggestions which enforced some modifications to the NIHTB-CB.

3.5 Human nature assumptions

The human nature strand concerns the implicit or explicit model of humans and their relationship with their environment. Burrell *et al*, (1991) characterise the two opposing views of how people view the nature of human beings as either an individual subscribes to deterministic or voluntaristic. This study used both determinism and voluntarism as strands of human nature. Determinism refers to peoples' behaviours being determined for them by some external force in as far as they lack originating powers as actors. Determinism is further used to describe the position that cause and effect are related by laws that exist outside of human subjectivity or action (Morrow and Brown, 1994). This principle of causality is a central concept in natural science and tends to explain that laws or social facts determine all social actions and man has no control for them (Popper, 1982).

Deterministic postulates that humans are mechanistic, determined by situations in the external world, meaning that human beings and their experiences are products of their environment and that they are conditioned by external circumstances. In the current study, determinism as a strand of human nature was achieved by exposing the participants to the already structured questions or made instrument as the case for the NIHTB-CB whose originality was in the United States of America but was being used for cognitive assessment in Zambia among children and adolescents which made it start depicting some challenges and reporting errors on assessment results upon being exposed to it due to the fact that the NIHTB-CB was a foreign instrument.

At the other end of the deterministic view is the voluntaristic, free-will view that individual decision-making is not affected by the external factors (Brown, 1994). In this view, the will, empowerment, morale and culture are cardinal concepts in the current version of voluntarism. The voluntarist approach ascribes as much more creative, free-will approach to humans, treating them as agents able to create their environment by their thoughts and actions (Glor, 1998). The current study appreciated voluntarism as a form of human nature by persuading the participants through a consent form that allowed them to have a free-will of deciding whether to take part in the study or not and made some changes to the instrument, in this case, the NIHTB-CB which was under investigation based on their thoughts and actions as created by the context in which the phenomenon was taking place with respect to different and unique cultural dynamics. The

emphasis was on the concept of voluntary participation without coercing them and that they were free to withdraw their participation in the study anytime they so wished. This was further appreciated when participants used their free-will in making decisions that influenced and enforced some changes to the NIHTB-CB based on what they suggested to have been working realities within the Zambian context without any external force.

3.6 Methodological assumptions

The study employed both the Nomothetic and Idiographic Methodology to explain the methodological assumption. The Nomothetic methodology is meant for quantitative studies and is concerned with causal determination, prediction and generalization of findings (Flood and Jackson, 1991). Nomothetic methodology takes an objective etic view of the world that search for universal laws by a process of identifying tangible concepts and then constructing tests, which allow the concepts to be measured. Nomothetic methodology is characterised by group-centred and controlled environmental context and by quantitatively based indirect measures such as questionnaires and structured interviews (Luthans and Martinko, 1987). In Nomothetic approach, an etic perspective is taken whereby the researcher defines the situation and develops the research question with the focus of making measurement and sophisticated statistical analysis that are testing predetermined hypotheses (Morey and Luthans, 1984). Nomothetic methodology is appropriate to analyse relationships and regularities between the elements of which the world is composed; the concern is the identification and definition of the elements and the way relationships can be expressed (Flood and Jackson, 1991). The current study took into consideration the nomothetic methodology by employing both domains as assessed by the NIHTB-CB and a gold standard of neuropsychological test battery as objective measures.

The idiographic methodology is meant for qualitative research and is concerned with exploring uniqueness by using a realistic method that seeks to comprehend phenomena in context-specific settings (Patton, 2001). The idiographic methodology takes a subjective emic view of the world and regards experiences as a basis for knowledge as researchers seek instead illuminate, understand and extrapolate similar situations (Hoepfl, 1997). The principal concern is to understand the way an individual creates, modifies and interpret the world. This entails that the experiences are seen as unique and particular to the individual and placed on the relativistic

nature of the world rather than general and universal individuals (Flood and Jackson, 1991). The current study sought to invoke the idiographic methodology through accommodating unique experiences that Zambian children and adolescents shared after being exposed to the NIHTB-CB. This entailed that Zambian children and adolescents had a subjective emic view as imprinted in their minds on how and what the NIHTB-CB ought to be and what it ought to consider when assessing cognitive function in the light of the Zambian context.

Table 3.2: A summary of the two axes at the core of a mixed approach as adopted by the current study.

Mixed method study		
Etic view: Objective	Two Axes	Emic view: Subjective
Realist	Ontology	Nominalist
Positivist	Epistemology	Humanist
Determinist	Human nature	Voluntarist
Nomothetic	Methodological	Ideographic

Source: Adapted from Burrell and Morgan (1991)

3.7 Research design

A research design is a framework of a research study (Kasonde-Ng'andu, 2013). It is a plan that is used to structure and hold the research and to show how all the elements of the study work together in an attempt to deal with the fundamental research questions (Kombo and Tromp, 2006). Orodho (2003) defines a research design as the scheme, outline or plan that is used to generate answers to the research problem. Yin (1994) describes it as “an action plan for getting from here to there.” He further defines a research design as a “blueprint” of the research, which deals with four problems; (1) what question to study, (2) what data is relevant, (3) what data to collect, and (4) how to analyse the results. Therefore, this study adopted a mixed research

method by focusing on collecting and analyzing both quantitative and qualitative data strand in a single inquiry (Ponce and Maldonado, 2014).

In mixed studies, Creswell (2009) proposed five (5) major designs namely; convergent parallel design, explanatory sequential design, exploratory sequential design, embedded design and transformative design. On the other hand, Cohen, Manion and Morrison (2018) proposed eight (8) major designs which included parallel convergent design, multi-level design, combined sequential design, explanatory sequential design, exploratory sequential design, embedded design, convergent design and transformative design. This study specifically utilised an explanatory sequential design also referred to as instrument validation or development design. This design is a two-phased model with qualitative data strand, which helps explain or build upon the initial quantitative results, and is purely known as instrument design that is explanatory in nature (DeVellis, 2003). The design has two prominent phases; namely phase I which begins with the collection and analysis of pure quantitative data strand, followed by the subsequent collection and analysis of qualitative data in phase II also known as originality phase which comes as a result of redesigning or modification to the classical instrument. This was designed so that it follows (or connects to) the results of the first quantitative phase (Cohen *et al*, 2018).

Explanatory sequential design best suited this study as it had been used in developing or validating assessment instruments and scales based on the following steps; needs qualitative data to explain significant (or nonsignificant) results, outlier results, or surprising results, also when determining what one wants to measure, generating an item pool, determining the format for items, expert review of initial item pool, adding social desirability items, pilot testing and item analysis, administering instrument to a larger sample, evaluating the items and revising the instrument based on that which works from that which does not work (Creswell, 2013; De Vellis, 2003; Fishman and Galguera, 2003; Pett, Lackey, and Sullivan, 2003). The process of instrument validation in this study was strengthened by a modified Delphi's technique of instrument validation which also emphasised on two-phased design of explanatory and redesigning to justify the originality of knowledge (Akins, Tolson and Cole, 2005; Davidson, 2013). Below is a sketch of figure 3 depicting an explanatory sequential design for the study;

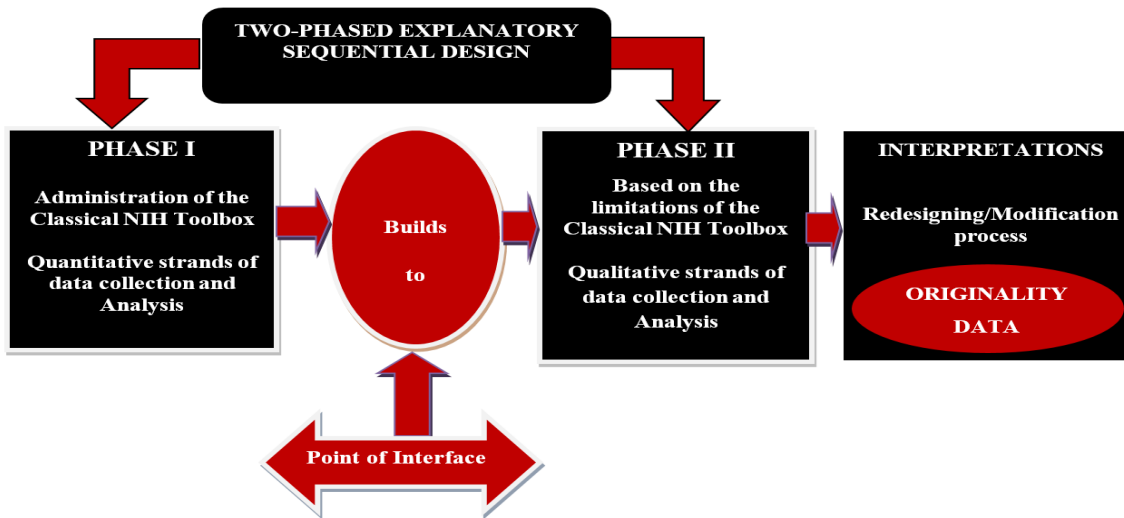


Figure 3.3: A diagrammatically presentation of explanatory sequential design: Source:
Adapted from Delphi's Technique of Instrument Validation by Akins et al (2005)

3.8 Location of the study

Msabila and Nalaila (2013) contend that there are various factors that can influence the researcher's choice of the study area; among them are the nature and incidence of the problem, research time frame, data accessibility, clients' interest, instructions, resource availability, goals and objectives of the study. As such, this study was conducted from the Pediatric Center of Excellence (PCOE), a major Human Immune Virus (HIV) referral center in Lusaka, Zambia, the capital city at University Teaching Hospital (first level hospital) where there were people from all the provinces and different socio-economic status (SES) in the country. The researcher chose this location because it was the most central, apart from being a major referral center; it has advanced facilities, comparable instruments and the required expertise from medical personnel. The choice of the location also hinged on issues of positionality and reflexivity which are very important in research for the avoidance of fieldwork dilemmas especially when an inquiry undertaken requires a crossover from the researcher's field of specialisation to another due to various areas of interests (Sultana, 2017). It was a cost- effective measure as it was near the University of Zambia (UNZA).

3.9 Research target population

Msabila and Nalaila (2013) define research target population as a complete or universal set of elements or units that possess some common characteristics of great and potential interest to the researcher from which results will be inferred. Kasonde-Ng'andu (2013) further defines it as a group of individuals and objects from which samples are taken for measurement. Bryman (2004) adds that a research or target population is the universal or entire group of persons or elements that have at least one or more similar characteristics from which samples are drawn for measurement. Achola and Bless (1988) describe it, as “the set of elements or parameters that the researcher focuses upon and to which results obtained testing the identified sample should be generalized”. Equally, Fraenkel and Wallen (1993) perceive research target population as the group of interest to the researcher, the group to whom the researcher would like to identify a sample and generalise the results of the study. Msabila and Nalaila (2013) define research target population as a set of individuals that possess some common, similar and binding characteristics or traits defined by the sampling criteria established by the researcher for whom the findings may be desired and generalised. In this case, the target population for this study consisted of all parents or caretakers, children and adolescents in Lusaka Province, Zambia.

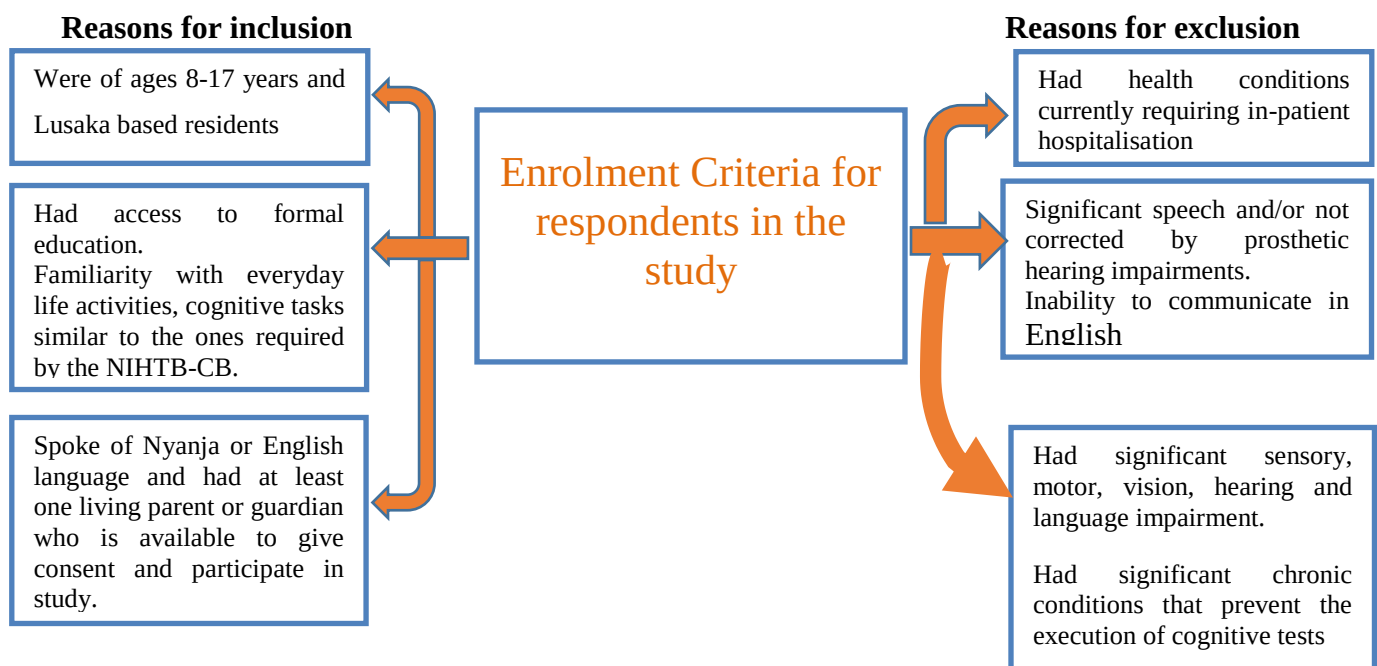


Figure 3.4: Flow chart for inclusion and exclusion criteria used in the study.

3.10 Sample size and sampling estimation power

The sample size of the study refers to the number of items to be selected from the universe to constitute a sample (Msabila and Nalaila, 2013). Hence, the size of sample should neither be excessively large nor too small. However, it should be optimum meaning that it should fulfill the requirements of efficiency, representativeness, reliability and flexibility. Therefore, while deciding the size of sample, the researcher must determine the desired precision and also an acceptable confidence level for the estimate (Kothari, 2004).

A total sample size of 800 respondents were recruited in the study consisting of 400 children and adolescents and 400 parents or care-takers who rated the intelligence of their children using a 5-point Likert scale. The selection of children and adolescents in the study automatically selected their parents or caretakers. A sample size of children and adolescents was calculated for this study and determined based on a statistical formula given by Yamane (1967) as follows;

$$n = \frac{N}{1 + N (e)^2},$$

Where **n** =sample size, **N** =target population, **e** = level of precision (±5%) and **1**= constant. Based on this formula, the sample size for the study consisted respondents who included children and adolescents. As part of the Human Immune Virus (HIV)-Associated Neurocognitive Disorders in Zambia (HANDZ). All the 400 children and adolescents were scheduled to complete the baseline of the NIHTB-CB and neuropsychological assessments for data analysis in the study. However, an estimated level of precision at +5% to account for issues of attrition and 17 were excluded due to missing data as a result of invalid neuropsychological test, lost to follow-up, potential drop-out and death, leaving 389 complete and analysable data on respondents. Of these, n = 206 were respondents with Human Immune Virus (HIV) infection and n = 183 were Human Immune Virus (HIV)-exposed but uninfected as demonstrated in an organogram flow chart and table below.

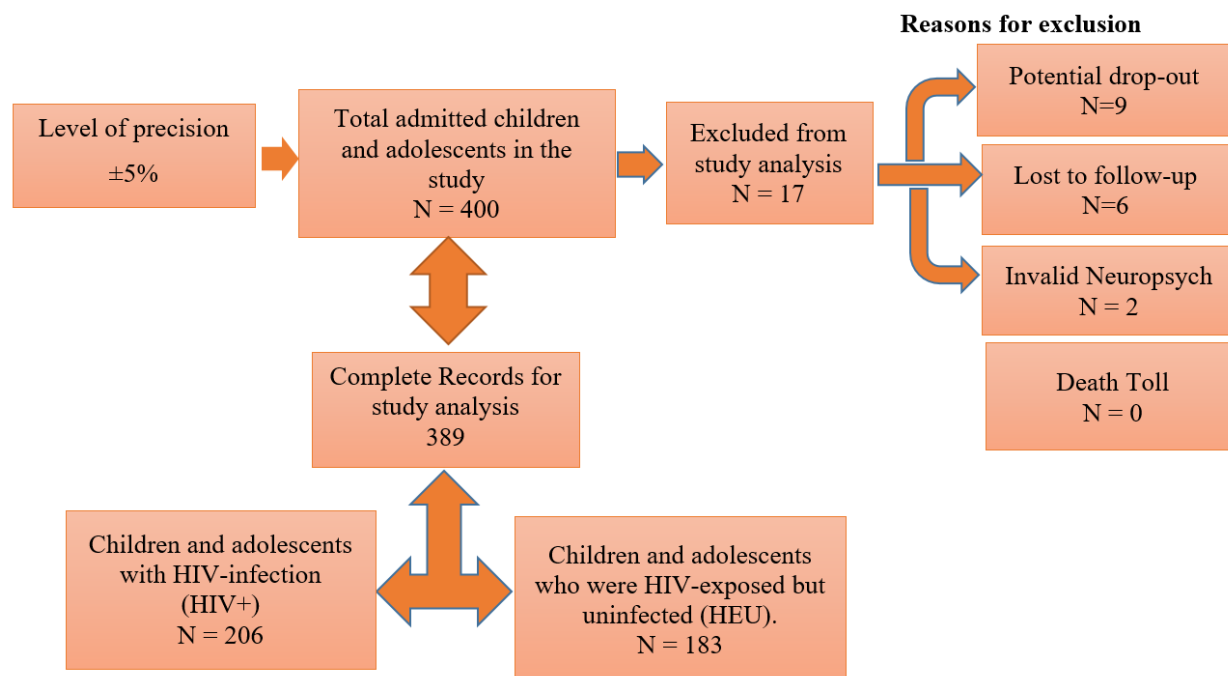


Figure 3.5: Organogram flow chart: Respondents who completed the study's neuropsychological visits. Source: Fieldwork (2021).

Table 3.3: Demographic characteristics of respondents

Variables	Frequency (%)
Age (Mean (SD))	12.5 (2.8)
Sex (Boys)	201 (52)
(girls)	188 (48)
Ses (mean (SD))	4.8 (2.0)
Years of Maternal Education (Mean/SD)	6.2 (3.5)
Years of Paternal Education (Mean/SD)	9.6 (2.6)
Primary language (%)	
1. Nyanja	380 (98)
2. English	8 (2)
School type (%)	
1. Public	189 (52)
2. Private	158 (43)
3. Other	4 (5)
School Attendance (%)	
Yes, attends school	316 (91)
No, not in school	31 (9)
Grade level	5 (2.6)
* SESI : A composite measure constructed from 15 variables prespecified as of likely importance based on principal component analysis.	
* TRIAD SCALE : Score below 5= Low SES ; Score of 7.5= Middle SES ; Score above 8= High SES .	

Table 3 shows that the average age of the respondents in the study was 13 years. Furthermore, there were more boys (201) than girls (188) who participated in the study. Based on principal component analysis, the average socioeconomic status of the respondents was at (4.8) out of 15 items on socioeconomic status index, implying that most of the respondents were coming from low socioeconomic status while the average of maternal education was at (6.2) implying that most of the mothers for the children and adolescents in the study had spent only 6 years in school mainly at primary school level. Further, the average paternal education of the respondents was (9.6), implying that most of the fathers for the children and adolescents in the study had spent 9-10 years in school equivalent to junior secondary school level.

Regarding the primary language used at home by the respondents/participants, the majority used Chinyanja (98%), followed by English, which was rare (less than 5%). In terms of school type, 189 (54%) attended public schools and 158 (46%) attended private

schools and the average grade level for the respondents was grade 5 (five), implying that most of the children were doing grade 5 at school.

3.11 Sampling techniques

According to Kothari (2004), the term sampling has been defined as a precise course of action or procedure that can be followed when selecting a portion or segment that is representative of a whole. Msabila and Nalaila (2013) put it that sampling techniques are classified into non-probability and probability sampling. For the sake and purpose of the current study, both probability sampling and non-probability techniques were used. Probability sampling was utilised in which selection of individual respondents for the study in the population were provided with equal chances of being selected at random while non-probability sampling technique did not ascribe to equal chances but expertise defined within a certain profession.

3.11.1 Multi-stage random sampling technique

Multi-stage random also known as multi-stage cluster sampling technique was utilized among other techniques under probability sampling. This was because multi-stage cluster sampling contains two or more stages in sample selection (Cohen *et al*, 2018). In simple terms, multi-stage sampling large clusters of population were divided into smaller clusters in several stages in order to make primary data generation more manageable. This sampling technique considers the following factors; selection of relevant discrete groups and choosing the members of the sample group from the sub-groups using some variation of probability sampling. Multi-stage cluster random sampling has been reported to be effective in primary data collection from geographically dispersed, population when face-to-face contact is required, cost-effectiveness, time-effectiveness and high level of flexibility (Kasonde-Ng'andu, 2013; Cohen *et al*, 2018).

In the current study, multi-stage cluster random sampling was utilised by dividing the country into (10) provinces and among the provinces Lusaka province was sampled and clustered into constituencies and specific community health centres within which, a proportionate sampling technique was applied to the sociodemographic matched sample of HIV-infected children and adolescents to further increase precision levels based on different cases referred to the University Teaching Hospital (UTH)/Pediatric Centre of Excellence (PCOE), as a major referral centre in

the country which was a primary sampling unit (PSU) for the administration of NIHTB-CB and a Standardised Neuropsychological Test Battery as illustrated below in figure 5;

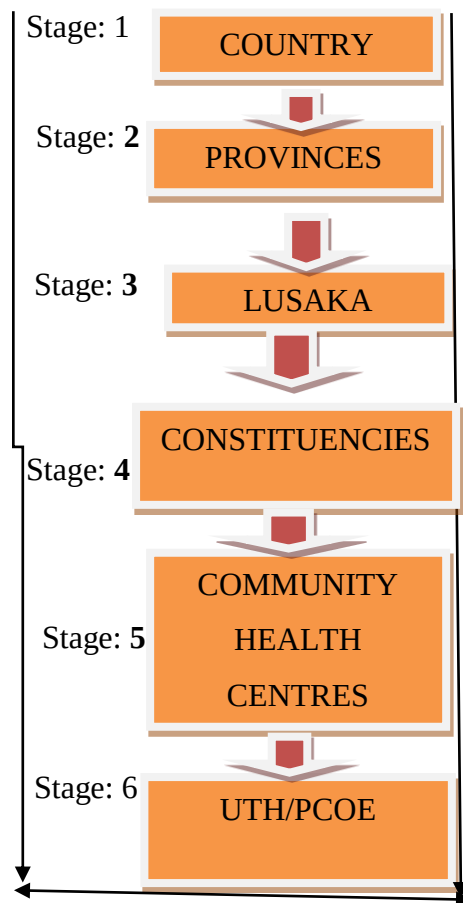


Figure 5: Multi-stage random sampling technique; Source: Adapted from Cohen *et al* (2018).

In conjunction with multi-stage sampling technique, Geographic Information Systems (GIS), and Geographical Position System (GPS) were conducted on the participants from the HANDZ study. From the participant demographic forms, GPS data of the participants' addresses was approximated using Google Maps and OpenStreetMap. Maps were generated by importing the dataset from the HANDZ study with GPS coordinates and shapefiles of Zambian maps into QGIS 3.2.0 (QGIS Development Team, 2018. QGIS Geographic Information System. Open-Source Geospatial Foundation. <https://www.qgis.org/en/site/>). A specific shapefile map of the Lusaka constituencies was created and saved as the base layer. The dataset was merged with the GPS points using the 'Join' tool in QGIS. With this tracking system, the goal was to locate and

describe the geographical distribution of children with HIV and matched controls around Lusaka to visualize the geographic distribution of participants in the study (Refer to **figure 6**);

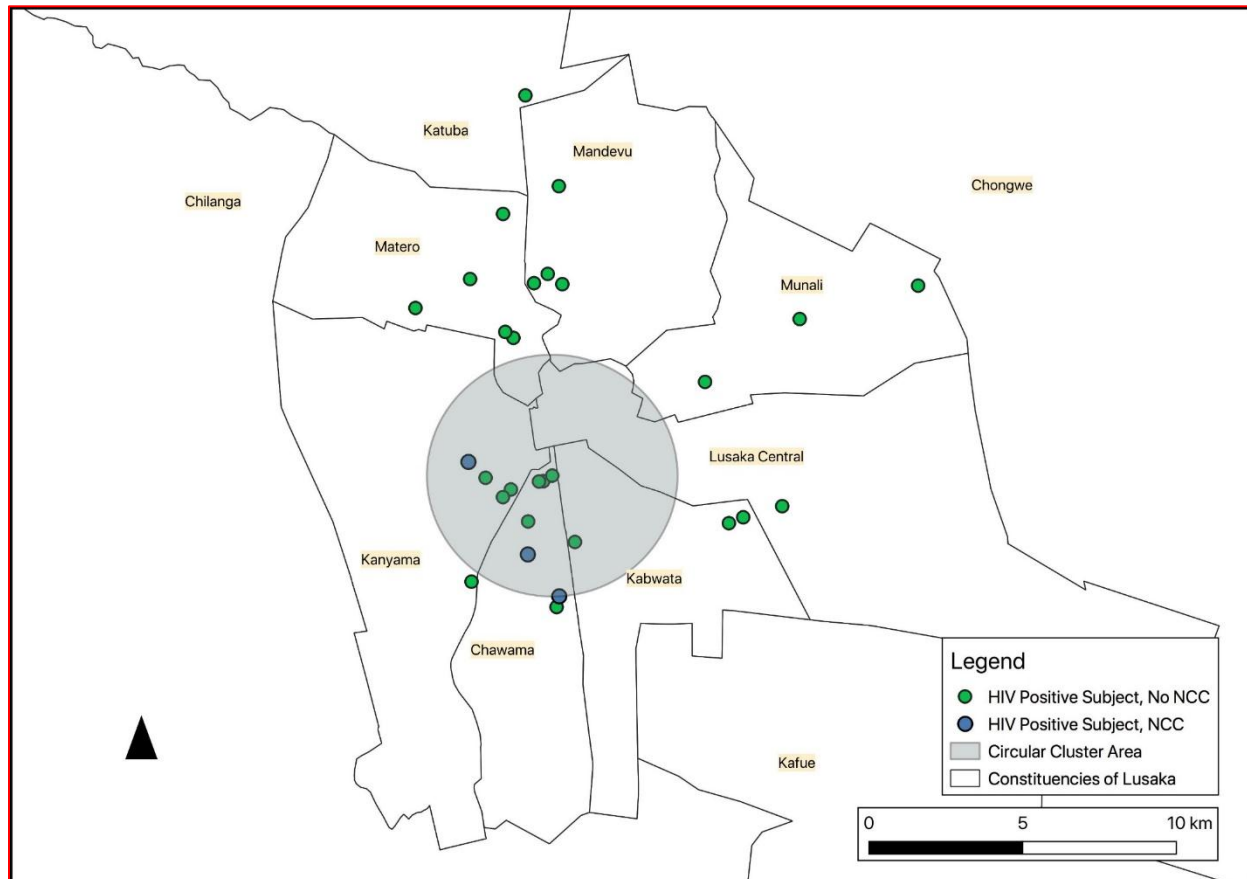


Figure 6: Geographic information systems (GIS) and Geographical positioning system (GPS) for tracking participants in the study.

3.11.2 Stratified sampling technique

Stratified sampling technique divides the population into subgroups or strata by employing a sampling fraction that is similar for all strata (Msabila and Nalaila, 2013). The current study employed stratified sampling technique by identifying and recruiting all HIV-infected children and adolescents in Lusaka province from various community health centres based on the files of medical Antiretroviral Therapy (ART), with referral letters indicating that their ART medical routine was received from University Teaching Hospital (UTH)-Pediatric Centre of Excellence

(PCOE) as a major referral center in the country. The identified and recruited HIV-infected children and adolescents were later sociodemographically matched with a control respondent (HEU) of the same age, and sex from the siblings to the same HIV-infected children and adolescents followed at the Pediatric Centre of Excellence (PCOE) through engagement and consent of parents. Sociodemographic matched sample of children and adolescents in the sense to increase the precision benefits and to be more precise on the standard error estimates at every level within each health centre in the study. Similar technique was repeated severally until all the target number of children and adolescents in the study was obtained from the sampled community health centres respectively with the help of community health workers in Lusaka province.

3.11.3 Purposive sampling technique-Expert sampling

Expert sampling is a type of purposive sampling technique that is used when the study seeks to glean knowledge from individuals that have particular expertise (Kothari, 2004). This expertise may be required during the explanatory phase of qualitative data strand. Expert sampling is particularly useful where there is a lack of empirical evidence in an area of time and high level of uncertainty, as well as situations where it may take a long period of time (Lawshe, 1975; Choudrie and Dwivedi, 2005). The rationality and supremacy of expert sampling lie in choosing people to study who are potentially knowledgeable about a topic under investigation and are eager to share their knowledge. Expert sampling involves identifying key respondents who can enlighten an investigation through their knowledge, experience, and expertise. Therefore, a cautiously selected group of logically critical witnesses and knowledgeable persons using a multifaceted approach who in this study included psychologists, counsellors, teachers, linguists, neurologists, medical doctors, parents and nurses to serve as a panel of experts in the validation process of the NIHTB-CB in Zambia.

3.12 Instruments for data generation and measures

Kombo and Tromp (2006) identify the following as some of the research instruments that researchers use to collect data from the respondents. These research instruments include questionnaires, interviews schedules, checklists, participants and non-participant observations and focused group discussions. In this study however, the NIHTB=CB Ipad-based Cognitive test

battery, Research electronic data capture (REDCap), the NIHTB-CB-Qualitative interviews and a full gold standard of neuropsychological test battery were used as instruments to elicit data from the participants in the validation process of the NIHTB-CB in Lusaka Province.

3.12.1 The NIHTB-CB

The NIHT-CB for Assessment of Neurologic and Behavioral Function as a tablet computer-based battery of open-access tests of cognitive function was used to generate data from the respondents. The following were the subtests of the NIHTB-CB assessed in children and adolescents in Lusaka Province, Zambia;

3.12.1.1 Flanker inhibitory control and attention task

Executive Function – Response Inhibition:

The NIHTB-CB measure: This is a test of attention and inhibitory control. On this test, respondents focused on a given stimulus shown on the screen while inhibiting attention to stimuli flanking it (Delis, Kaplan and Kramer, 2001). For example, an arrow appeared on the left side of the screen but pointing toward the right. Respondents pressed a button on a keypad to correctly select the target or focus stimuli. Further, respondents were instructed to choose the button to indicate “left” because of the arrow’s position on the screen rather than the “right” button because of the direction the arrow was facing.

3.12.1.2 Dimensional change card sorting task (DCCST)

Executive Function – Set Shifting / Cognitive Flexibility:

The NIHTB-CB Measures: Dimensional change card sort test (DCCS): This is a test of cognitive flexibility and attention. Respondents were presented with pictures with varying along two dimensions of shape and color. The dimension for sorting was indicated by a cue word on the screen through which respondents made their choices quickly and accurately (Gershon *et al*, 2010). The dependent variable was based upon the response given.

3.12.1.3 Oral symbol digit modalities task (OSDT)

Processing Speed:

The NIHTB-CB measures: For the Oral symbol digits task, respondents were required to match numbers to symbols using a key; the dependent variable was the number of correct matches within

120 seconds. This test was designed to serve as a supplemental measure of processing speed within the NIHTB-CB and correlated well with the Pattern comparison processing speed test (Carlozzi, Beaumont, Tulsy, Gershon, 2015).

Table 3.4: Showing an example of the NIHTB-CB Oral symbol digit 8+ administration key

–	□	□	L	U	O	^	X	=	
1	2	3	4	5	6	7	8	9	
O	X	□	=	U	L	–	^	□	U
X	^	□	U	O	L	^	□	□	□
U	X	O	L	□	–	^	X	□	–

3.12.1.4 List sorting working memory task (LSWMT)

Attention / Working Memory:

The NIHTB-CB Measure: List sorting working memory test evaluated attention and working memory (Milligan and Cockcroft, 2017). Respondents were shown a series of pictures on the iPad screen accompanied by a voice-over stating the name of the item. They were then asked to verbally re-sequence the pictures according to a pre-specified rule, for instance, in order from smallest to largest item. The sequences became longer as the test progressed and the dependent variable was the total number of items passed (for instance, accuracy).

3.12.1.5 Pattern comparison processing speed task (PCPST)

Processing Speed:

The NIHTB-CB measures: Pattern comparison processing speed test (PCPST); Oral symbol digit span test. On the PCPS task, respondents were asked to make rapid, accurate judgments regarding whether two stimuli were the same or different. The dependent variable was the number of correct responses provided within 90 seconds. PCPS test scores correlate in the

expected manner with traditional measures of response time and processing speed (Carlozzi, Tulskey, Chiaravalloti, *et al*, 2014; Carlozzi, Tulskey, Kail and Beaumont, 2013).

3.12.1.6 Auditory verbal learning task (Rey) (AVLT)

Learning and Immediate Recall:

The NIHTB-CB measure: Auditory verbal learning test. The NIHTB-CB Auditory verbal learning test (AVLT) is a 3-trial version of the traditional Rey auditory verbal learning test (Strauss, Sherman and Spreen, 2006; Slotkin, Kallen, Griffith *et al*, 2012). The auditory verbal learning test was used as the external convergent validation measure for the NIHTB-CB-Picture sequence memory test, pediatric sample, and was itself a supplemental measure within the NIHTB-CB (Weintraub, *et al*, 2013). In the NIHTB-CB version of this task, respondents were asked to recall a list of 15 words that were presented on the iPad via audio recording. The list was presented three times and participants' recall was evaluated after each of these learning trials. The dependent variable was the total number of correctly recalled words across all three trials.

3.12.1.7 Motor speed

The NIHTB-CB measure: The Nine-hole pegboard dexterity test evaluates motor dexterity and speed in dominant and non-dominant hands; the dependent variable was the time required for subjects to rapidly place into, and then remove 9 pegs from a grid. The test correlates well with other measures of fine motor dexterity and speed (Reuben, *et al*, 2013).

3.12.1.8 Picture vocabulary test 4th edition (PVT-IV)

Receptive Vocabulary:

The NIHTB-CB measure: This is a test of receptive vocabulary similar to the Peabody picture vocabulary test. In this test, respondents were shown four pictures and a word stating to match one of the pictures. The test helped to generate a raw score and age adjusted T-score with a mean of 50 and a standard deviation of 10.

Table 3.5: A summary of the NIHTB-CB measures of cognitive domains

Cognitive domains	NIHTB-CB measures
Executive Function	Flanker Inhibitory Control and Attention Test Dimensional Change Card Sort Test
Attention	Flanker Inhibitory Control and Attention Test
Processing Speed	Pattern Comparison Processing Speed Test
Working Memory	List Sorting Working Memory Test
Learning and immediate recall	Auditory Verbal Learning Task
Motor Speed	Nine-Hole Pegboard Dexterity test
Receptive Vocabulary (Language)	Picture Vocabulary Test

3.12.2 Research electronic data capture (REDCap)

All local data in this study were collected and entered into a unique password-protected Research electronic data capture (REDCap) database installed on portable tablet computers (Gershon *et al*, 2013). Research electronic data capture (REDCap) maintains regulatory compliance for data protection, generates complete audit trail of user activity, provides reporting, and has an automated export mechanism to common statistical packages. Data was collected offline in Research electronic data capture (REDCap) and then uploaded at least daily to the University of Rochester Medical Center (URMC)-based server, permitting the Principal Investigator and the entire study team members to have access and review data irrespective of location. The Research electronic data capture (REDCap) database was backed up daily and transferred to a secure file server accessible only to designated personnel; the server was also backed-up on a daily basis. The Research electronic data capture (REDCap) as instrument for data collection captures data from the respondents upon signing the consent form.

This makes the Research electronic data capture (REDCap) a browser-based workflow methodology for designing clinical and translational research databases (Weintraub, 2013). Each respondent was assigned a unique study number and personal identifying information which was kept separately from data accrued during the study, that was the participants name, date of birth, and medical record number, linked to study number, and was kept on a separate master list in a password protected Excel file. This file was kept on a password protected computer on which

data was managed, stored and be accessible only to study staff (Weintraub, 2013; Akshoomoff, Newman and Thompson, 2014). This file was only destroyed after publication of study results thereby rendering the remaining data de-identified.

3.12.3 A gold standard of full neuropsychological test battery-Precision level of 0.80-1.00 (Refer to Appendix 12)

A gold standard of traditional neuropsychological test battery providing quantification of cognition was used clinically to diagnose impairment and inform medical and behavioral treatment decisions and convey the idea that the psychometric test results were relevant and comparison for conclusion pertaining to cognitive functioning (Benedict *et al*, 2012). A full standardised of neuropsychological test battery which was used as a gold standard in this study has not been formally validated in Zambia but widely accepted and used in the U.S population. However, the two instruments (the NIHTB-CB and Neuropsychological test battery) were comparable because they were measuring same constructs with similar psychometric properties of face validity, content validity, construct validity, convergent validity, divergent validity and criterion validity. Further, the neuropsychological test battery has been previously and widely used in several studies in Zambia and been able to show consistent, reliable and valid results in identifying cognitive function and establishing levels of intelligence among children in both urban and rural Zambia with other tests (Nyirenda, 2020; Maina *et al*, 2019; Kabuba *et al*, 2018; Zuilkowski *et al* 2016; Mwanza-Kabaghe, 2015; Chirwa, 2012; Walubita, 2011; Serpell and Jere-Folotiya, 2008; Metz, 1978). This study considered the principles of consistent, reliable and valid results as evidence enough to warrant it be used as a gold standard with the precision level of 0.80-1.00. The following were the different subtests that the standardised neuropsychological testing battery measures with a threshold of 0.80-1.00 precision level considered in the current study;

3.12.3.1 California verbal learning test for children (CVLT-C)

Traditional neuropsychological measures: California verbal learning test for children (CVLT-C) (Delis, Kramer, Kaplan and Ober, 1994), List A Total Trials 1-5. Like the NIHTB-CB AVLT, the CVLT-C is a task of rote verbal learning and recall (Bracken and McCallum, 2016). The stimuli (list of words) are different than those in the NIHTB-CB, but the core task was

effectively the same. The CVLT-C consisted of five individual learning trials and the dependent variable was based upon the total number of correct words recalled across all five trials.

3.12.3.2 Universal nonverbal intelligence test (UNIT-2)

Traditional neuropsychological measures; The Universal nonverbal intelligence test (UNIT-2) is set of intelligence test that is meant to measure the cognitive abilities of children between the ages of 5 and 17 (Fives and Flanagan, 2003). The test is ideal for children across different cultures and for children who may not have an inclination to traditional intelligence tests. The test primarily measures two forms of intelligence which include memory and reasoning. The Universal nonverbal intelligence test (UNIT) comprises six subtests that are not limited to symbolic memory, non-symbolic quantity, analogic reasoning, spatial memory, numeric series and cube design but in the current study, only three Universal non-verbal intelligence tests were considered and used which included non-symbolic memory, spatial memory and analogic reasoning with wider empirical evidence to measure memory and reasoning of children.

Traditional neuropsychological measures: Universal nonverbal intelligence test, second edition (UNIT-2), non-symbolic quantity subtest evaluates numerical value responses best fits the incomplete conceptual or numerical analogy, sequence, or problem. Respondents are presented with an array of white and/or black domino-like objects of various numerical values that create a numerical sequence, equation, analogy, or mathematical problem with a red question mark. Respondents completed the item by pointing to one of the response options provided on the stimulus page. Performance on the non-symbolic quantity subtest predicted such future behaviors as the examinee's ability to understand and solve abstract problems using symbols; determine the interrelationships between and among numbers; understand the relations represented by numbers; value classifications of symbolic systems; generalize learned principles to solve new problems, applying numerical rubrics learned in one context to a new but similar context and used rules in a systematic fashion. The primary dependent variable was the total number of responses correctly passed.

Traditional neuropsychological measures: Universal nonverbal intelligence test, second edition (UNIT-2), The Analogic reasoning subtest evaluates symbolic reasoning. Respondents were presented with incomplete conceptual or geometric analogies in a matrix format that required

only a pointing response. The respondent completed the matrix analogies by selecting from four response options. Performance on the analogic reasoning subtest predicts such future behaviors as the examinee's ability to understand and solve conceptual problems; determine the interrelationships between objects and actions, understand cause-and-effect relationships, produce rational arguments, based on sequential logic, generalize learned principles to solve new problems, apply centrifugal force to cause sediments to settle in a vial and acquire and use rules in a systematic fashion. The dependent variable was the number of correct responses given.

Traditional Neuropsychological Measures: Universal nonverbal intelligence test, second edition (UNIT-2), Spatial Memory Subtest evaluates immediate recall of visual information. The UNIT-2 Spatial Memory Subtest respondents of ages 8-21 years view a random pattern of green, black, or green and black dots presented on a 1 X 2, 2 X 2, 3 X 3, or 4 X 4 grid for a period of 5 seconds. Respondents were asked to reproduce a visual design from memory after an initial brief exposure. The dependent variable was the total number of items correctly passed (i.e., accuracy). The Universal Nonverbal Intelligence Test, Second Edition (UNIT-2) and its predecessor, the Universal Nonverbal Intelligence Test (UNIT), have been previously established for use in evaluating cognitive abilities in Zambian children (Hein *et al*, 2014; Stemler, *et al*, 2009).

3.12.3.3 Delis Kaplan for executive function system- Trail making test (DKEFS-TMT)

Traditional Neuropsychological Measures: Delis-Kaplan executive function system Trail Making Test (DKEFS TMT), three conditions of Delis-Kaplan executive function system (DKEFS) were considered, namely Condition 1, condition 4 and condition 5. Delis-Kaplan executive function system (DKEFS) Trail making test (TMT), Condition1 – Visual scanning (Delis, Kaplan and Kramer, 2001). Respondents were required to rapidly search and find specific targets on a worksheet while ignoring non-target items; the primary dependent variable was the time (in seconds) required to complete the task.

Delis-Kaplan executive function system (DKEFS) Trail making test (TMT), Condition 4: This is a test of fine motor speed, attention, rapid sequencing, and cognitive flexibility. Respondents were required to complete various connect-the-dots style activities of number-letter switching. The dependent variable was based upon the time required to complete the task and Delis-Kaplan executive function system (DKEFS) Trail making test (TMT), Trial 5 – Motor speed (Delis,

Kaplan and Kramer, 2001). Respondents were required to trace a line as quickly as possible in a connect-the-dots task. The dependent variable was based upon the time required to complete the task.

3.12.3.4 NEPSY-2: Word generation test

Traditional Neuropsychological Measure: This subtest is designed to assess verbal productivity through the ability to generate words within specific semantic and initial letter categories. Respondents were given a semantic or initial letter category and asked to produce as many words as possible in 60 seconds based on different names of animals and things to eat or drink while the examiner noted down words as produced by the examinee. The primary dependent variable was the time (in seconds) required to produce words.

3.12.3.5 NEPSY-2: Affect recognition

Traditional Neuropsychological Measure: This subtest evaluates social perception and specifically the ability to recognize and match emotional expressions on faces. Respondents were made to look at pictures of children's faces and asked to choose the faces that matched the child's emotional expression. The dependent variable was correct responses given as well as time taken as some of the tasks in this test were timed, requiring exposure of the stimulus item for 5 seconds, followed by the test item.

3.12.3.6 WISC-V: Digit span test

Traditional Neuropsychological Measures: Wechsler intelligence scale for children – fifth edition (WISC-V) (Wechsler, 2014), Digit Span (DS) total score. The WISC-V digit span task comprised of three parts, each of which involved repeating number sequences in a pre-specified order after hearing them presented by the examiner: verbatim repetition (DS Forward); repetition of the sequences in reverse order (DS Backward); repetition in order from smallest to largest (DS Sequencing). The dependent variable was the total number of items passed (for instance, accuracy).

3.12.3.7 Wisconsin card sorting test (WCST)

Traditional Neuropsychological Measures: Wisconsin card sorting test (WCST), Perseverative Errors; The WCST-64 is a test of a cognitive flexibility. Respondents were required to sort cards

according to pre-determined sorting rules (for instance, color). The dependent variable was based upon the sorting rules which periodically change during the test, without warning.

3.12.3.8 Pencil tapping test

Traditional Neuropsychological Measures: Pencil tapping test: This test (opposite taping) measures inhibition. The test was a simple assessment that took the form of a game played between the assessor and the child with a pencil. The dependent variable was based upon the subject inhibiting his/her natural response to mimic the assessor's behavior.

3.12.3.9 Behavior rating inventory of executive function-second edition (BRIEF-2)

Traditional Neuropsychological Measures: The behavior rating inventory of executive function (BRIEF-2 Shift Scale) has 63 items, which generates information about everyday behavior associated with specific domains of executive functions in respondents from parents/ proxy. This test rated executive skills in everyday settings. The dependent variable was based upon the responses from parents/ proxy of whether the behavior inhibited by a participant was not a problem (**N**), sometimes a problem (**S**) and often a problem (**O**) in the past 6 months.

Table 3.6: Summary of the neuropsychological testing battery elements and comparison measures for each NIHTB-CB;

Construct /domain	NIHTB-CB measure	Comparison measures
Overall Cognitive Function	Cognitive Function Composite Score	Summary NPZ Score Unit 2 IQ
Executive Function/Inhibit	Flanker Inhibitory Control and Attention Test	Pencil Tapping Test Inhibit subscale of the Behavior Rating Inventory of Executive Function (BRIEF).
Executive Function/Shift	Dimensional Change Card Sort Test.	Wisconsin Card Sorting Test Shift subscale of the BRIEF.
Processing Speed	Pattern Comparison Processing Speed Test Oral Symbol Digit.	Trail Making Test (condition 1; condition 4)
Working Memory	List Sorting Working Memory Test.	Digit Sequencing CVLT Trial 1.
Receptive Language	Picture Vocabulary Test	NEPSY II (Word Generation).
Motor Speed	Nine Hole Pegboard Dexterity Test	DKEFS TMT, Condition 5.

Verbal Learning	Auditory Verbal Learning Test	California Rey Auditory Verbal Learning Test.
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3.12.4 NIHTB-CB-Qualitative interviews

On the interview guide, questions are asked orally (Kombo and Tromp, 2006). One to one interviews were used to generate data from participants who included children, adolescents and parents on the basis that qualitative inquiry usually produces in-depth data. It was from this description that the researcher was able to explore and understand children's, adolescents' and parents' views and feelings about the NIHTB-CB. Kombo and Tromp (2006) state that semi-structured interview guides are based on the use of an interview guide which is a list of questions or topics to be covered by the interview. Semi-structured interviews are flexible because they consist of both open and closed-ended questions. They are important because they gather in-depth information which gives the researcher a complete and detailed understanding from open ended questions (Creswell, 2009). Therefore, using semi-structured interviews under the NIHTB-CB's qualitative assessment enabled the researcher to get first-hand information on the views and feelings of children, adolescents and parents about the administration of the NIHTB-CB in assessing cognitive function on the comprehension of its administration instructions, perceived scores and whether or not its constructs are valid holistically.

3.13 Data generation procedure

Bloomberg and Volpe (2008) point out that the data collection section in research is the section that describes and justifies all data collection methods, tools, instruments, and procedures, including how, when, where, and by whom data will be collected. After consent with the respondents/participants, an enrollment questionnaire was completed, and both children and parents' interviews were conducted. The NIHTB-CB assessment was completed on the day of enrollment when time permitted or was rescheduled for a separate day. Each respondent/participant was scheduled to return for neuropsychological testing and qualitative interviews on a separate day which was scheduled at least one week after NIHTB-CB testing to minimize interference and testing fatigue. Details of Neuropsychological Testing followed a complete description and were performed by the study Principal Investigator or a PhD Fellow

under her supervision with the exception of NIHTB-CB measures which were administered by the study research nurse.

Briefly, the neuropsychological testing consisted of a custom cognitive battery conducted on the NIHTB-CB, the Universal Nonverbal Intelligence Test, a supplemental battery assessing language and executive function. All testing took place in a quiet, private room either in the paediatric centre of excellence (PCOE) or the study office. Testing was conducted and took place in the morning and took approximately 1 hour 30 minutes to complete by following the scripted administration steps which included; how to set up the testing room, what to do to provide clear, simple, concise and easy to follow administration instructions. A hanging sign was put on the door to the room stating “Testing in Progress-Do Not Disturb”. The instructions also stated how to distribute the test and timing. The physical environment was well lit and ventilated with adequate working space, comfortable chairs, structured in a child-friendly way. The examiners also followed word for word when giving instructions as scripted in the manual to maintain uniformity. All respondents/participants were offered a snack to ensure that hunger did not interfere with testing protocol.

3.14 Instrument translation (Refer to Appendix 13)

All the instruments (NIHTB-CB and Neuropsychological battery) were translated into Chinyanja as the most predominantly spoken language in Lusaka. The results from the first year or phase I of the study confirmed that most participants did not understand the English that the NIHTB-CB was using and this prompted translation to the administration instructions and actual constructs. Thus, in the second year or phase II of the study participants opted to be interviewed in translated Chinyanja based on the following steps; translation process, synthesis and resolution of discrepancies, back translation, review, revision and iterative development, consolidation, expert committee review and revision, preparation of pre-final instrument, external review, making the instrument available to others. Thus, in the second year or phase II of the study participants opted to be interviewed in Chinyanja based on the following steps; pre-test and review, field test, instrument revision, formal instrument assessment, standard scores across cultures, validation research and instrument documentation. Bilingual linguists then translated the instructions embedded in the NIHTB-CB to English from the linguistics department of the University of

Zambia. The study members that included the principal investigator, psychologists, translators, nurses and a medical doctor from the neurology hospital discussed inconsistencies that were found in the study. This was done in order to ensure that all the psychometric properties of the NIHTB-CB were appropriate and final changes were infected during phase II in the administration of the NIHTB-CB in the study.

3.15 Training of study staff

A team of two male psychologists under the supervision of the principal investigator, who had massive experience in neuropsychological assessments, were complemented by another enrolment team of four female interviewers to administer the NIHTB-CB. They all had previous experience administering questionnaires in other epidemiological studies. Three (3) weeks training sessions were conducted in administering the NIHTB-CB. This involved explanations and discussions of conceptual definitions of each item in the instruments and role-playing sessions. This was followed by a series of non-participant observations of actual testing by the facilitators on a few sampled respondents/participants. After demonstrating the required levels of assessment competence from the team members, they were declared ready and competent enough to start performing the assessments on the sampled respondents in the study.

3.16 Methods of validation for the NIHTB-CB

During the administration of the NIHTB-CB to respondent, the study conducted an initial qualitative phase which explained the relevance and validity of the NIHTB-CB in the Zambian population. This phase was coordinated by an expert panel (consisting of all study investigators as well as Zambian psychologists) who reviewed criteria for the applicability of the NIHTB-CB among Zambian children and adolescents; and rated items assessing cognition for face validity, content validity and construct relevance through a cognitive interview. Cognitive interviewing evaluated how a participant constructed his or her answers; what the respondents interpreted the questions to mean; any difficulties the participant had in answering the questions; and any other circumstances to the participant's answers. Respondents and caregivers (parents) informed the researcher in their own words what they thought each item was asking in order to determine whether the questions were translated appropriately and well understood.

The researcher also asked whether the content of the NIHTB-CB was objectionable and whether the length was acceptable. This was realized through the qualitative phase which was used to generate a list of items which could be included or removed in the interview to increase cultural appropriateness. All the participants completed qualitative cognitive interviews regarding understanding and relevance of each item. Based on the results of the cognitive interview, the NIHTB-CB was adapted or modified (Davidson, 2013; De Vellis, 2003). The following were the types of translational validity that were interrogated in the study in order to help validate the NIHTB-CB in the Zambian setting.

3.16.1 Face (expert) validity

In order to examine the face validity of the NIHTB-CB, members of the panel were asked to rate the face validity of each item based on a dichotomous scale with categorical option of “Valid” and “Not valid” item, respectively; where valid item meant that the item was objectively structured and could be positively classified under the thematic category. Face validity is the extent to which raters agree that an item appears to measure what it is intended to measure or the extent to which a test is deemed (at face value) to be representative of the concepts of interest (Trochim 2001). This implies that face validity indicates how the questionnaire appears to be appropriate to the study purpose and content area on face value. Further, face validity is the easiest validation process to undertake but it is the weakest form of validity. This is because it evaluates the appearance of the questionnaire in terms of feasibility, readability, consistency of style and formatting, and the clarity of the language used (Haladyna 1999; De Von, Block, Moyle-Wright, Ernst, Hayden, Lazzara *et al* 2007). Thus, face validity is a form of usability rather than reliability. In this study, face or expert validity of the NIHTB-CB was evaluated based on Cohen’s Kappa Index (CKI) (1960)’s six-point scale of ≤ 0 No Agreement; 0.01-0.20 None to Slight; 0.21-0.40 Moderate; 0.61-0.80 Substantial; 0.81-1.00 Almost perfect agreement.

3.16.2 Content (logical) validity

Each panel member from a list of psychologists, counselling teachers, linguists, neurologists, psychiatrists, nurses and medical doctors commented on and rated the content validity of each item. Content validity refers to a logical structure that maps the items on the test to the content domain or the extent to which the measurement device provides adequate coverage of the

investigative questions (Msabila and Nalaila, 2013). There are two forms of content validity; face validity and sampling validity. Sampling validity is simply called content validity which refers to the representative character of the content of the instrument. This can be determined by comparing the instrument items with the universe of items such as statements, names, questions, and indicators that could theoretically be included (Trochim 2001; Nasrin and Trisha, 2009).

In the current study, content validity was ensured by examining the distribution of the final item pool and adjusting item distribution accordingly. Items, which were not applicable, were removed, those with substantial agreement were retained and those with substantial disagreement were discussed and re-worded, where indicated. The researcher then repeated this process until members of the panel reached agreement on all items based on content validity ratio scale using Lawshe (1975)'s method on a three-point scale of not applicable, useful but not applicable and useful and applicable. In this case, items that were not significant at the critical level were eliminated as demonstrated following the critical level of Lawshe method of content validity below.

3.16.2.1. Content validity ratio (CVR); Lawshe (1975)'s method of content validity

The CVR (content validity ratio) proposed by Lawshe (1975) is a linear transformation of a proportional level of agreement on how many “experts” within a panel rate an item “not applicable=0; useful but not applicable=1 and applicable=2”, which was calculated, based on the majoritarian following this formula;

$$\mathbf{CVR} = \frac{n_e - (N/2)}{N/2},$$

Where **CVR** is the content validity ratio, n_e is the number of panel members who indicated either “not applicable; useful but not applicable or applicable,” and **N** is the total number of panel members. The final evaluation to retain the item based on the **CVR** was dependent on the number of panels who indicated an item to be applicable as opposed to either being useful but not applicable or not applicable. **CVR** values range between –1 (to mean perfect disagreement) and +1 (to mean perfect agreement) with **CVR** values above zero indicating that over half of the panel members agreed on an item to be applicable.

3.16.3 Construct validity

This refers to quality or degree to which a measurement tool or instrument is able to measure the construct or variable which it is supposed to measure rather than irrelevant constructs that can lead to measurement error (Msabila and Nalaila, 2013). Convergent validity and divergent validity are two types of construct validation. Convergent validity examines the extent to which two instruments that claim to analyze the same subject or content are similar to each other, while divergent validity assesses the extent to which an instrument is able to distinguish between groups who are expected to obtain different results (Engellant, Holland and Piper, 2016; Elliott *et al*, 2001). In this study, the construct under measurement was cognitive function which was determined by convergent validity, through a correlation between the NIHTB-CB scores and the non-NIHTB-CB scores and discriminant validity was evaluated considering differences between individual groups especially those with Human Immune Virus (HIV+) infection from those HIV-exposed uninfected (HEU) based on the NIHTB-CB test scores.

3.16.4 Concurrent validity

This is defined as a type of validity demonstrated when scores obtained from a new measure are directly related to scores obtained from a more established measure of the same variable against a certain standard (Msabila and Nalaila, 2013; Elliott *et al*, 2001). In this study, concurrent validity was determined by comparing the NIHTB-CB composite score abbreviated as “NP4” and a gold standard called standardised neuropsychological composite score abbreviated as “NPZ8” which was generated to summarize global cognitive test performance across all 8 cognitive domains.

3.16.5 Criterion validity

Criterion validity has two components reflecting the extent to which an instrument is correlated with or predicts a current (concurrent validity) or future (predictive validity) event (Oluwatayo, 2012). In the current study, criterion validity was demonstrated by the application of the Receiver Operating Characteristics (ROC) Curve, a procedure used in assessing diagnostic properties of tests, comparing the diagnostic performance of two or more tests and in determining the optimal cut-off point of a test to ascertain if a person with a certain score or condition belongs to one or another category (Westin, 2001). The optimal cut-off point is the one

which either maximizes or minimizes sensitivity and specificity (Streiner and Cairney, 2007). Sensitivity, also referred to as the true positive rate (when expressed as a percentage) is defined as the probability that a test result is positive when the disease is present and specificity also referred to as the true negative rate (when expressed as a percentage), represents the probability that a test is negative when the disease is not present (Jokinen, Nordstrom and Nordstrom, 2008) also by demonstrating the area under the curve (AUC) which is a measure of accuracy or precision of the instrument or test based on Sackett, Richardson, Rosenberg and Haynes (1997) and Metz (1978)'s Five Diagnostic Accuracy Scale: 0.90-1.00= Excellent; 0.80-0.90=Good; .70-.80=Fair; .60-.70=Poor; .50-.60=Fail.

3.17 Reliability

Once the validity procedures were completed, the final version of the NIHTB-CB was examined to assess its reliability. Reliability refers to the ability of a questionnaire to consistently measure an attribute and how well the items fit together, conceptually (Haladyna 1999; DeVon *et al* 2007). Although reliability was necessary, it is not sufficient to validate an instrument, because an instrument may be reliable but not valid (Msabila and Nalaila, 2013; Beanland *et al* 1999; Pilot and Hunger 1999, DeVon *et al* 2007). Cronbach and Shavelson (2004) suggested some necessary conditions to researchers that are key which this study up-held and considered when determining the reliability of the NIHTB-CB were:

- Standard error of the instrument, which is the most important reliability information to report.
- Independence of sampling.
- Heterogeneity of content.
- How the instrument was used.
- Participants reliability.
- Observer reliability.
- Situational reliability.
- Data processing reliability.

Nasrin and Trisha (2009) opine that the two estimators of reliability, which are commonly used are; internal consistency reliability and test-retest reliability: In this study, only test-retest was used to examine the reliability of the NIHTB-CB.

3.17.1 Test-retest reliability

Test-retest reliability was estimated by administering the same tool which was NIHTB-CB with the Cronbach Alpha scores ranging from acceptance level of ($\alpha \geq .7$) to excellent ($\alpha \geq .9$) to the same stable sample or group of people on two different occasions on the assumption that there would be no substantial change in the construct under study between the two sampling time points (Msabila and Nalaila, 2013; Trochim 2001; DeVon *et al* 2007). A high correlation between the scores at the two time points indicates that the instrument is stable over time (Haladyna 1999; DeVon *et al* 2007). The duration of time between the two tests is critical and the trick with test-retest reliability is to determine how long to wait between the two administration points. Currently, there is no definite evidence about the best time interval to allow between the test and the retest (Nasrin and Trisha, 2009). However, this study took three (3) months for the test-retest reliability using operational equivalence technique, an assumption that has been accepted and supported by Msabila and Nalaila (2013); Nasrin and Trisha (2009) who revealed that test-retest statistic examination has stability of the responses at two time points approximately 12 weeks or a couple of months apart. This implies that the shorter the interval, the higher the correlation between the two tests, the longer the interval, the lower the correlation and this can affect the results because of changes in participants or their environment (Linn and Gronlund 2000; Trochim 2001; De Von *et al* 2007).

Table 3.7: Summary of validation methods for NIHTB-CB

Types of validity (domains)	Methods of validation
✓ Face validity	Qualitative evaluation and expert interviews based on face value.
✓ Content Validity	Cultural appropriateness, relevance and representative of the testing materials of the NIHTB-CB of the target construct.
✓ Construct Validity	Correlation with age; subdomain of cognitive scores.
✓ Divergent Validity	Correlation differences between groups.

✓ Convergent Validity	Comparison between the NIHTB-CB with Standardized NP Tests.
✓ Concurrent Validity	Correlation between the NIHTB-CB with a measure that has previously been validated (e.g. NP Tests).
✓ Criterion Validity	Application and examination of Receiver Operating Characteristic curve (ROC), Sensitive and Specificity of the NIHTB-CB.
✓ Reliability-Test-retest reliability	Repeat testing after 3 months in a stable participant

3.18 Technique used to account for missing data in the study.

The researcher was aware of the probability of missing data due to the longitudinal nature of the study and attritions which could be necessitated by potential drop out, death, lost to follow up, withdraws and invalid assessment results due to absences of respondents/participants and unexpected interruptions. First and foremost, the researcher made sure to know that data was missing, how much data was missing and traced some pattern of the missing data. After this was determined, the researcher vested himself with the different levels of the missing data. For instance, data could be missing completely at random when the data was not entered by the researcher, missing at random when the respondents had not answered certain questions or when they were not willing to provide answers for certain questions, and missing not at random when the respondent was too impaired to take on a test.

However, if data was missing not at random, there was no statistical technique that could be used because it was not possible to take care of the data that was non-existence but data missing at random and completely at random, there are some statistical techniques that have been recommended to use and these include; case-wise deletion, list-wise deletion and imputation. In this vein, the current study used listwise deletion to account for missing data which is a statistical technique used to remove the entire subject or respondent from the analysis (Peugh and Enders, 2004). In other words, listwise was used to delete cases where complete data were not collected. Listwise deletion involved the removal of cases with missing values and excludes them from the subsequent analysis (Ender, 2006). Further, the reasons for missing data in the current study

included absences of respondents, unexpected interruptions/invalid neuropsychological assessment, potential dropout and lost to follow up. After the missing data were removed, the final analysed sample size was 389 children and adolescents.

3.19 Data management and analysis

After the data were collected, entered and managed into a unique password-protected Research electronic data capture (REDCap) database installed on portable tablet computers, there was need to manipulate it and make meaning through a data technique known as data analysis. Signh (2006) describes data analysis as a process of studying the tabulated materials so as to determine inherent or meaning. Therefore, it involves breaking down complex factors into simpler ones and parking the parts together in new arrangement for the purpose of interpretation. Since the study adopted a mixed methods approach, both qualitative and quantitative methods were employed to analyse data. Qualitative data was analysed using emerging issues forming themes.

Since the qualitative data is characterized by its subjectivity or emic, richness, and comprehensive text-based information, the corner stone of analyzing this data is the coding process. Codes according to Bazeley (2007) are tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study. Codes often adhere to chunks of words, phrases, sentences or the entire paragraph. Coding involves pursuing related words or phrases mentioned by the interviewees or in the documents. These words or phrases are then combined in order to realise the connection between them (Drijvers, 2012). The qualitative analysis in this study gave a detailed account of what the interviewees stated through verbatim reporting about the administration of the NIHTB-CB in assessing the cognitive functioning of children and adolescents.

Face validity was also analysed qualitatively by asking members of the panel based on participants' answers to rate test items by agreeing on how an item appeared to measure the concept of interest (COI), participants' comprehension of the NIHTB-CB' administration instructions and expert's perceptions towards the validity of the NIHTB-CB also based on Zambian children and adolescents' responses on the NIHTB-CB test items.

With regard to quantitative data, all statistical analyses were executed using Stata (StataCorp

2018, Stata Statistical Software: Release 14.2. Pairwise correlations (Pearson for continuous variables and Spearman for categorical variables) were utilised to compare individual domain scores and NPZ scores between a gold standard of neuropsychological test battery and the NIHTB-CB. To establish validity of the cognition measures of the NIHTB-CB, the study examined intra-class correlation coefficients (ICC) between the overall NIHTB cognition score and the Universal Nonverbal Intelligence Test (UNIT) Full Scale Score, as well as correlations between subdomain scores and each comparison measure. In addition, a multivariate normative comparison using the full neuropsychological test battery as a gold standard was used and then Receiver Operating Characteristic (ROC) curves were used to identify optimal cutoff points as a threshold on the NIHTB-CB. Confirmatory factor analysis was utilized to examine the psychometric properties of the NIHTB-CB compared to expected properties. Further, the study used two-sided tests and a p-value <0.05 (adjusted for multiple comparisons when appropriate) as the criteria for statistical significance.

3.20 Ethical considerations

Cohen *et al* (2000) explained that ethical issues are matters which are highly sensitive to the rights of others. In this regard, ethical issues were highly upheld in the study. The study was part of the larger study called HIV-Associated Neurocognitive Disorders in Zambia (HANDZ). As such Institutional Review Boards of the University of Rochester (Protocol #:00068985) was obtained both in the United States of America and the University of Zambia (UNZA; Reference #:004-08-17) and the National Health Research Authority of Zambia. Informed consent, parental permission, and child assent were obtained in accordance with UR and UNZA requirements (Refer to **Appendix 14**). This was conducted in accordance with the good clinical practice guidelines promulgated by the international conference on harmonization as well as any applicable national and local regulations. This was done in full accordance with all University of Zambia (UNZA) rules and regulation. First, a clearance letter was obtained from the Directorate of Postgraduate Studies then the researcher sought consent from the Biological Sciences Ethical Committee at Ridgeway Campus coupled with biological courses which the researcher and others did from Rochester University in which the researcher was certified upon demonstrating competence (Refer to **Appendix 15**).

To ensure that participation by children, adolescents and parents was voluntary; the researcher explained and notified them about the benefits and risks attached to the study in terms of the procedure, relevance and purpose. Respondents were also assured that the data generated was to be kept confidential in a device known as Research electronic data capture (REDCap) and would only be used for research purposes. During and after signing the consent form, each participant was given a unique identifying number for the study which was used for all data forms. Data was originally captured on paper-based forms or entered directly into Research electronic data capture (REDCap) via double password protected iPads.

Furthermore, the researcher assured the respondents that names and personal details were not going to be revealed or published in order to ensure anonymity and that respondents were free to withdraw from the study at any time they so wished and if they could not wish to respond to any question, they were also free to remain silent. Ultimately, the researcher took full responsibility for the study and any unforeseen consequences it attracted. To achieve this, the researcher applied a strategy of positionality and reflexivity by fronting the medical personnel to help in data generation due to their expertise as required by the nature of the study (Sultana, 2017). All the mentioned activities were done in order to ensure that the rights of the respondents were respected and their dignity as human beings was safeguarded based on mutual respect as an ethical principle.

On the part of respondents' risks, the researcher employed a principle of justice by attempting to minimize risks through multiple steps including training of study personnel on best practices for conducting research on sensitive participants. There were some questions included in this study that probed some sensitive information related to mental health. While respondents were informed that they could refuse to answer any questions at any time, responses or reactions to certain questions could indicate potential distress on the part of the participants. If a respondent appeared to be experiencing undue stress which did not happen in the study as a result of questions asked during the study, the examiner could terminate that portion of the questionnaire.

At the examiner's discretion, respondents with stress or anxiety related to testing were referred for further counseling. If at any time during the assessment or completion of the questionnaires, a respondent divulged to any study staff that he or she was at risk for harm, including but not

limited to suicidality, the respondent's parent and primary care provider would be notified and an appropriate referral made for instance to a psychiatrist if there was severe depression with suicidality. The primary care provider determined clinical risk and followed up. On the other hand, the study also exercised a principle of beneficence in which some benefits to participants were fairly distributed in that respondents had neuropsychological testing performed which would not otherwise be available to them. Some participants had mental resonance imaging (MRI) scan performed but the results were not part of this study. Results were made available to the care provider if participants consented, which allowed for appropriate referral and treatment if necessary. In addition, participants indirectly benefited from the improved scientific knowledge that was generated during the undertaking of this study.

3.20 Summary of the chapter

This chapter outlined the methodological techniques/methods that was used to collect data in this study. The chapter comprised a section on the philosophical paradigm, ontological assumption, epistemological assumption, human nature assumption, methodological assumption and research design. The chapter also explained the study's location, target population, inclusion and exclusion criteria, sample size and sampling techniques that were used. The chapter further presented the research instruments, data generation procedure, instrument translation, training of study staff, methods of validation for the NIHTB-CB (face validity, content validity, construct validity, concurrent validity and criterion validity), reliability of the NIHTB-CB (test-retest reliability), technique for missing data and data analysis methods as well as ethical considerations that were undertaken in the study. The subsequent chapter presents the research findings.

CHAPTER FOUR: PRESENTATION OF RESEARCH FINDINGS

4.1 Overview

The previous chapter presented the methodological aspect of the study which covered the following sub-themes; philosophical paradigm, ontological assumption, epistemological assumption, human nature assumption, methodological assumption and research design. The chapter also explained the study's location, target population, inclusion and exclusion criteria, sample size and sampling techniques that was used. Furthermore, the chapter presented the research instruments, data generation procedure, methods of validation and data analysis as well as ethical considerations that were undertaken in the study and ended with a summary of the chapter. This chapter presents the findings of the study. It starts with information on associations between the demographic characteristics and the HIV status of the participants on various background variables to ascertain how each of these variables influenced cognitive function based on their contributions. The presentation is done in tandem with the research questions which were;

1. What is the standardised administration of the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province?
2. What are the challenges encountered by children and adolescents when administered with the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province?

3. To what extent is the NIHTB-CB valid based on face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity in assessing the

Variables	HIV-Negative (n=183)	HIV-Positive (n=206)	P-Value
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cognitive function of children and adolescents aged 8-17 years in Lusaka Province?

4. Is there a difference between the composite Z-score of the standardized neuropsychological battery test across all 8 cognitive domains with the composite scaled-score of the NIHTB-CB test battery in children and adolescents aged 8-17 years in Lusaka Province?

Table 4.8: Bivariate analysis on the associations between demographics characteristics and HIV Status of respondents

Age (Mean (SD))	12.5 (2.8)	12.2 (2.3)	0.29
Sex (Male %)	87 (43)	114 (57)	0.15
Sesi (mean (SD))	4.8 (2.0)	6.0 (2.7)	<0.001
Years of Maternal Education (Mean/SD)	6.2 (3.5)	7.6 (3.4)	0.0006
Years of Paternal Education (Mean/SD)	9.6 (2.6)	10.3 (2.6)	0.005
Primary language (%)			0.31
3. Nyanja	124 (68)	135 (66)	
4. Bemba	42 (23)	45 (22)	
5. Tonga	5 (3)	9 (4)	
6. English	1 (1)	7(3)	
7. Other	10 (5)	10 (5)	
School type (%)			0.01
4. Public	97 (52)	88 (48)	
5. Private	58 (37)	100 (53)	
6. Other	2 (50)	2 (50)	
School Attendance (%)			0.025
Yes, attends school	151 (83)	187 (91)	
No, not in school	31 (17)	18 (9)	
Grade level	5.1 (2.6)	5.1 (2.4)	0.61

Table 8 shows full demographic characteristics of the entire sample of respondents against the HIV Status. Briefly, the groups in the sample were sociodemographic matched with respect to average age, sex, primary language, grade level, and school type and attendance. In this regard, there were no statistical significant differences in the respondents' mean age ($p=0.332$), primary language ($p=0.314$) and grade level ($p=0.957$). In terms of their gender, there were more males (52%) than females (48%) but the difference in gender was not significant ($p=0.124$) from each group in the study. The average years of maternal education (<0.001) and paternal education (0.005), the level of family socioeconomic status (<0.001), school type (0.007) and attendance (0.015), was statistically significant higher in the Human Immune Virus (HIV)-infected cohort as compared to the HIV-exposed but uninfected (HEU) group. In terms of race, all the participants were of Zambian descent.

4.3 What is the standardised administration of the NIHTB-CB in assessing cognitive function of children and adolescents aged 8-17 years in Lusaka Province?

4.3.1 Standardised administration of the NIHTB-CB

Evaluating an instrument based on its standardised administration requires an initial validation stage which is anchored on delphil's three key principles of instruments validation namely, installation qualification (IQ), operation qualification (OQ) and performance qualification (PQ).

4.3.1.1 Installation qualification of the NIHTB-CB in Zambia

On the installation qualification, the study found that the NIHTB-CB and its subsystems were installed in accordance to manufacturer's specifications. These specifications verified that; all components and parts of the NIHTB-CB were functional, the local supply voltages conformed to the instrument, the ambient conditions existed for optimal instrument performance, correct versions of software were issued with the instrument and setting up of instrument parameters such as date, time, language, test protocol were done correctly and that there was supportive infrastructure for assessment and surveillance. On the contrary, the study found that in Zambia as in many resource-limited countries (RLC), there was limited infrastructure for surveillance and support the NIHTB-CB for the assessment of cognitive function in children and adolescents living with and without HIV.

4.3.1.2 Operational qualification of the NIHTB-CB in Zambia

Regarding operational qualification of the NIHTB-CB, the study found that the NIHTB-CB operated as expected by the manufacturer as it spelt out considerable details on standardised administration conditions and instructions to the examiners and researcher in the study. The administration steps included how to set up the testing room and what to do to provide clear, simple, concise and easy-to-follow administration instructions when a participant takes on the test. A hanging sign was put on the door to the room stating "Testing in Progress-Do Not Disturb". The instructions also stated how to distribute the test and timing. The physical testing environment was well lit and ventilated with adequate working space, comfortable chairs, structured in a child-friendly way.

4.3.1.3 Performance qualification of the NIHTB-CB in Zambia

On the performance qualification, based on NIHTB-CB's psychometric properties for previous scores among the US population, the performance ranged from good to excellent (approximately with a sensitivity of .90; specificity of .85 and the area under the curve was at .95) respectively. However, when the NIHTB-CB was tested on the Zambian population of children and adolescents, the study demonstrated that the psychometric properties of the NIHTB-CB to some extent were not good and appropriate. This was because certain tests were not culturally appropriate and applicable because the NIHTB-CB tasks used vocabulary and concepts were U.S.-centric and familiar to Western audiences but not encountered in everyday life by children in Zambia and this required translations when administered to the Zambian children and adolescents. This made the sensitivity (ability of the test to detect true positive), specific (ability of the test to exclude true negatives) and area under the curve (a measure of precision/accuracy) of the NIHTB-CB under the Zambian context to some extent were poor to moderate (approximately with a sensitivity of .65; specificity of .60 and the area under the curve at .55) respectively, all these concepts of diagnostic tests were rated poor to moderate because they were slightly far below the acceptable threshold of a standardised instrument which ranged from .80-1.00.

Further, correlations with standard neuropsychological tests were also low to moderate (all pairwise correlations $r=0.4$, $p<0.001$). This made the NIHTB-CB to be questionable for use without being validated in screening, diagnosing and suggesting interventional programmes as it purported to assess cognitive function in Zambian children and adolescents. Additionally, the NIHTB-CB had tests which posed difficulties to children and adolescents to comprehend during administration thereby making them exhibit poor performance. In order to demonstrate tests in the NIHTB-CB which were difficult to comprehend resulting into exhibiting poor performance by children and adolescents, the following were presented in a figure below;

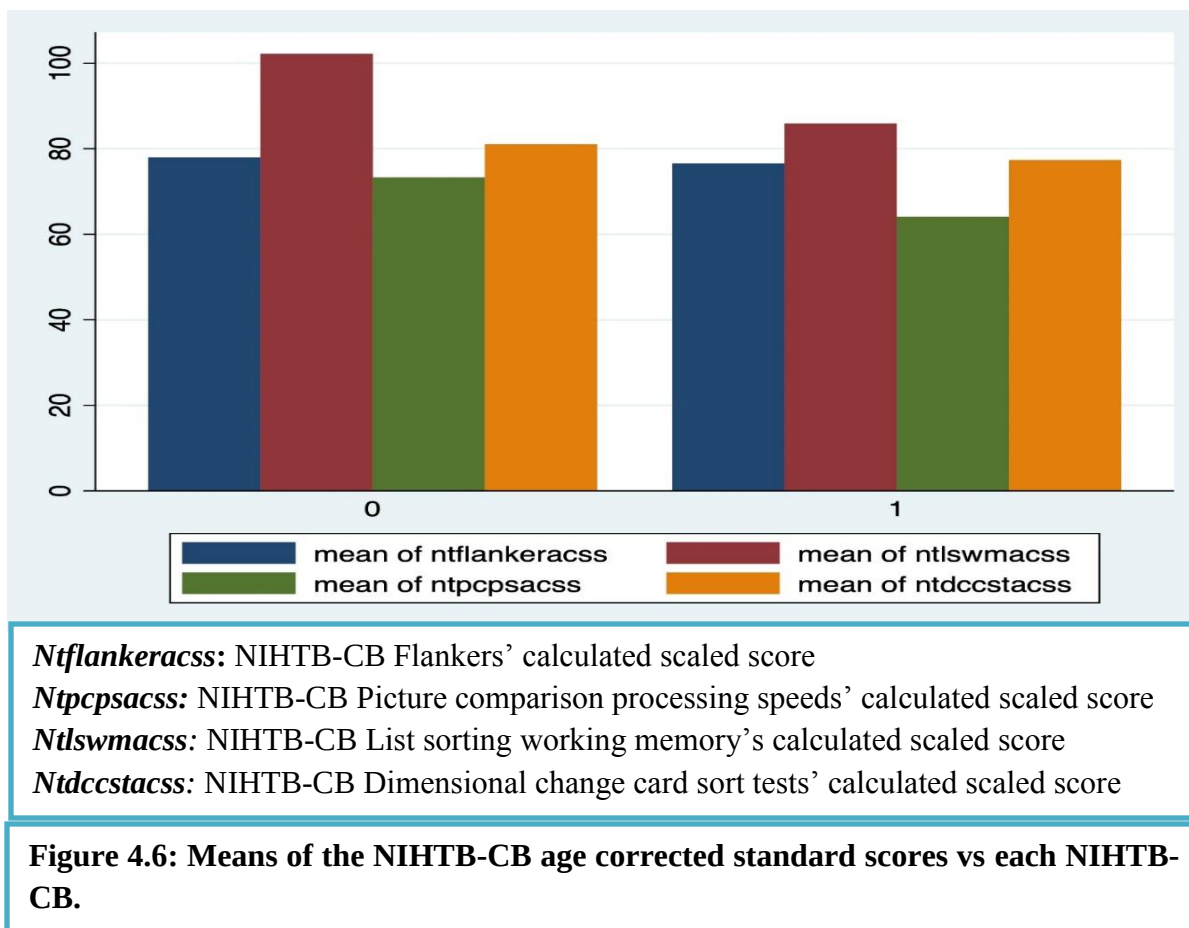


Figure 6 demonstrates that generally, children and adolescents performed well on the means of the NIHTB-CB age corrected scores of each test. The highest mean score was recorded on List sorting working memory test with about 82-100% followed by Dimensional change card sort test with about 78-80%, then Flanker Test with 76-79% and the least was Pattern comparison processing speed test with about 62-75%. This entails that the overall performance of children and adolescents on the NIHTB-CB tasks was good with the lowest scoring 62% and the highest scoring between 75 and 100%. This was because technical administration of the NIHTB-CB was feasible and children easily understood how to use the tablet touch screen, and the tablets were, as expected, durable and readily portable for use in the field setting. Nonetheless, children and adolescents encountered some challenges in the administration of the NIHTB-CB associated with language, culture, and setting. The NIHTB-CB associated challenges were encountered on Picture vocabulary test, Dimensional change card sort test, Auditory verbal learning test and List sorting working memory test, which were adequately addressed in the second objective of the study.

4.4 Challenges encountered in the administration of the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province.

4.4.1 Challenges encountered by Zambian children and adolescents when tested with the NIHTB-CB

Challenges were expected to be encountered by Zambian children and adolescents when tested with the NIHTB-CB in assessing cognitive function which was validated and normed principally for a United States (U.S.)-based English and Spanish-speaking population. Among other challenges that Zambian children and adolescents encountered were as follows;

4.4.1.1 Poor comprehension of English language skills by Zambian children and adolescents when tested with the NIHTB-CB

Lack of English language skills and actual constructs; the study found that Zambian children and adolescents performed poorly on the NIHTB-CB tests such as Picture vocabulary test 4th edition (PVT-IV) which required high levels of English language skills. The poor performance on PVT-IV was because several NIHTB-CB tasks, which were selected for apparent minimal cultural influences, were found not to be culturally relevant for children and adolescents in Zambia due to inclusion of unfamiliar vocabulary. For instance, matching words, which were characterised by a number of set loss errors such as Trench, Cotati, Ripple, Port, Absorb, Fabricate, Residential, Judiciary, Orchard, Figuring and Decadent to the target, and correct images/pictures that were displayed on the screen for Zambian children was difficult as this required exposure and high level of English language skills. In particular, the study had selected a simple test of receptive vocabulary within the neuropsychological assessment battery to aid in validation of an analog measure from the NIHTB-CB was PVT-IV, and discovered that there were more items than expected and that participants reported lack of familiarity with, even when translated terms were provided informally Chinyanja by study staff such as nurses and psychologists, to assess whether the difficulties were due to a language barrier or unfamiliarity with the underlying concepts.

Further, the study found that with the PVT-IV, it was not only the vocabulary that presented the challenge of cultural differences between English usage in United States of America and Zambia, but also the images / pictures used in the PVT-IV, and also possible mis-match between pictures

and words, within the local context. The PVT-IV showed four pictures, and the child was asked to point to the picture that matched the picture. For instance, a problem was encountered when the target picture was “maize” but the vocabulary word was “corn”. Here, the image was appropriate but the matching vocabulary was not for the context of use (Zambian English). There were other problems that occurred when the picture itself was unfamiliar to the child (perhaps an animal or a food item that did not occur, or was uncommon in Zambia).

In the second year or phase II of the study: The aforementioned challenge was resolved by removing the NIHTB-CB’s PVT-IV from their respective test batteries soon after the study was initiated and realized that the test had challenges of cultural boundedness. In the light of this, a Zambia-adapted version was proposed and put in the local administration manual but it also was not deemed suitable for the main sample of children ≥ 8 years old, as it was developed with item content only suitable for younger children ≤ 6 years old. This would have led to ceiling effects with the sample which enrolled adolescents as old as 19 years of age. Administration instructions and task stimuli were re-stated by the examiner using Zambian-accent English and also presented in Chinyanja when necessary.

Further, the study demonstrated that lack of English language skills by children and adolescents did not only apply to the NIHTB-CB’s–PVT-IV but even on NIHTB-CB tests. This was because the NIHTB-CB uses U.S-based English in administration to the participants hence, all the NIHTB-CB subtests required the use of high English language skills which made the children and adolescents exhibit poor performance on most of the NIHTB-CB especially on list sorting working memory and auditory verbal learning. This was contended on the premise that all children attending school receive instructions in English, and academic contents in textbooks are provided in English. Further, the study expected some participants initially enrolled in the study (ages 10 years and older) to have had at least several years of English language exposure in school and to use English in performing everyday activities and transactions in the community. However, the study established soon after beginning enrollment that some children and adolescents with regular school attendance still struggled to understand cognitive test instructions in English. In order to provide solutions to these challenges, the study suggested some solutions through modifications as stipulated in a local administration manual yet to be

implemented in the NIHTB-CB when permission is granted by the NIHTB-CB developers (Refer to **Appendix 12**).

In the second year or phase II of the study: The aforementioned challenge was addressed in the second phase or year 2 of the study by instituting several solutions through modifications. First, test instructions for all NIHTB-CB and neuropsychological assessments were translated/back-translated by local staff into Chinyanja, the vernacular language throughout the Lusaka community. Test stimuli were not translated as this would have necessitated re-validation of the measures and establishment of vocabulary (in Chinyanja) of similar frequency and difficulty level as in English. When participants reported for study visits, local study staff ascertained their ability to converse and understand task instructions in English vs. Chinyanja, and proceed accordingly with the cognitive assessments NIHTB-CB and neuropsychological battery. The study added a field to the data collection forms to indicate whether task instructions were presented in English or in Chinyanja.

Another related, unexpected challenge that the study found was that children also had difficulty understanding some instructions (and verbal stimuli) presented on the NIHTB-CB because of the American-accent recorded voice which came with the test. Children and adolescents demonstrated lack of clear understanding of the voice intonation of an American-accent voice giving instructions. The voice intonation in the NIHTB-CB was not culturally appropriate and context bound as such it sounded strange while posing difficulties in comprehension. The voice intonation (American accent) that the NIHTB-CB was using was meant for the U.S population as opposed to the Zambian population more especially children and adolescents aged 8-17 years enrolled as participants in the study. This challenge however, was not left unattended. It was addressed through suggested solutions that led to some modifications to be made to the NIHTB-CB after permission from the NIHTB-CB developers is granted.

In the second or phase II of the study: This challenge was addressed in the second year or phase II of the study by re-stating the examiner to be presenting instructions in Zambian-accent English and Chinyanja when necessary, depending on the participants' language of preference. When the Zambian-accent English and Chinyanja were used during the NIHTB-CB administration, participants proved to have understood the instructions clearly as they could

express themselves freely in the language, they were familiar and comfortable with for the tests to be valid.

4.2.1.2 Poor literacy skills by Zambian children and adolescents when tested with the NIHTB-CB

Furthermore, the study found that children and adolescents demonstrated poor literacy especially on Dimensional change card sort test (DCCST) and Oral symbol digit test (OSDT) as they were unable to read and understand instructions during the administration of the NIHTB-CB. Dimensional change card sort test was about popping either colour or shape on the middle of the screen and giving corrective feedback to the participant to point on either colour or shape if one of them appeared on the middle of the screen. Initially, the older participants of ages 12 and above were not given corrective feedback only to younger children of ages 8-11 years. Lack of corrective feedback on the Dimensional change card sort test during the administration to 12 years and above contributed to poor performance on the test. This was because most of the participants were unable to read and understand instructions without any corrective feedback provided.

Another test that was affected by low literacy levels was the Delis-Kaplan executive function system (DKEFS)-Trail making test (TMT). This is because children needed to read and write (to dictation) letters and numbers in English, and recite the English alphabet and numbers in order. The tasks were presented in the same way for each participant and responses were recorded on a standard data collection sheet. Finally, the study removed a planned task, the “First Letter” task of the NEPSY Verbal Fluency test; this test involves rapid naming of words beginning with a specific first letter of the English alphabet and depends on mastery of basic phonemic awareness (understanding of letter-sound correspondences).

In the second year or phase II of the study; to address this, the study added a brief screening at the beginning of the neuropsychological assessment battery, to guide interpretation of the DKEFS-TMT results. In particular, the researcher now asks all participants.

4.2.1.3 Poor numeracy skills by Zambian children and adolescents when tested with the NIHTB-CB

Further, the study found that poor numeracy was also a challenge among children and adolescents as this was evident on the DKEFS-TMT for which two sub-tasks required rapid, accurate sequencing of numbers (from 1-16) and the alphabet (letters A-P) in order, respectively, and a third sub-task (Number-Letter Switching) required rapid alternation in the sequencing of numbers and letters (1-A, 2-B,) and so on in order respectively. The study also indicated that children and adolescents demonstrated poor numeracy skills on Oral symbol digit test.

In the second year or phase II of the study: As a way of providing a solution to the aforementioned challenge in the second phase or year 2, the study has suggested to modify the NIHTB-CB iPad battery to start providing instructions in Chinyanja to each and every participant with corrective feedback regardless of their age and this has since been put in a local administration manual, awaiting an approval for implementation from the NIHTB-CB-developers. This was done in order to help these children and adolescents in reading and understanding the Dimensional change card sort test (DCCST).

4.5 Validity of the NIHTB-CB

4.5.1 Face (expert) validity

4.5.1.1 Participants' comprehension of the NIHTB-CB's tasks (Concepts of interest)

The NIHTB-CB qualitative assessment was conducted in which participants were asked to note any difficulties they had in understanding how to complete each task, to describe, in their own words, the purpose of each test and whether the test appeared to measure the intended construct (for instance, sustained attention, or processing speed). Similarly, the examiners also were provided with a platform to rate their impression of the participant's comprehension of the NIHTB-CB task instructions based on face validity. Face validity is the extent to which a test is deemed (at face value) to be representative of the concepts of interest, for instance, *does the test appear to measure what it is supposed to measure?* Tests in which the purpose is relatively clear to both test administrators and participants and in which participants have relatively little

difficulty understanding test instructions have some evidence of face validity. Preliminary evidence of face validity was sought through discussion with local experts and study staff and evaluated through a qualitative assessment with participants and the study personnel who conducted the NIHTB-CB evaluation.

For each individual NIHTB-CB task, participants were asked to explain what skill or ability they thought each instrument was intended to measure, and their comprehension of task instruction. The researcher (Principal investigator) reviewed participants' descriptions of task content to determine if these were reasonably related to the concept of interest (COI). These descriptions were classified as "on target" (good correspondence with the COI), "partially on target" (partial correspondence with the COI), or off target (not related to COI). For example, to assess the COI (memory) for the Auditory verbal learning test, a participant response of "my memory" would be deemed "on target", a response of "my thinking" would be deemed "partially on target", and a response of "my hearing" would be deemed "off target". This distinction was guided by a concern that some NIHTB-CB instructions might use unfamiliar vocabulary or because the American-accent English of tasks using pre-recorded instructions might limit comprehension.

Table 4.9: Face validity of the NIHTB-CB: Examiner rating of child's accuracy in describing cognitive concept of interest (COI).

NIHTB-CB measures	COI accuracy: N (%) [N=389]				
Examiner's rating	On target	Partially on target	Off target	"I don't know" ²	Difficult to interpret
Pattern Comparison Processing Speed Test	37 (9)	139 (38)	77 (19)	56 (13)	80 (19)
Flanker	15 (3)	153 (41)	87 (21)	53 (13)	81 (20)
Dimensional Change Card Sort Test	24 (5)	169 (45)	60 (1)	55 (13)	81 (20)
List Sorting Working Memory Test	75 (18)	113 (31)	70 (17)	52 (12)	79 (19)
Auditory Verbal Learning Test	179 (47)	74 (18)	40 (10)	40 (10)	56 (14)
Oral Symbol Digit Span Test	60 (14)	131 (36)	77 (18)	47 (11)	74 (18)

Table 9 shows participants' ability to describe what they thought each test was measuring was somewhat limited. Approximately half of the ratings for each test were considered fully or

partially on target, but the remainder of participants' responses reflected poor understanding of test Concept of Interests (COIs). Additionally, if a child's description of a task lacked sufficient information to classify, it was labeled by the investigators (researcher) as "difficult to interpret". Finally, participants had the option to state they "did not know" what a test was intended to measure. At the end of each NIHTB-CB assessment, the examiner rated whether the target Concept of Interest (COI) for each NIHTB-CB task was adequately measured (for each child).

4.5.1.2 Participants' comprehension of the NIHTB-CB's task instructions

Further, the researcher (Principal investigator) reviewed participants' descriptions of task content to determine if the tasks were reasonably easier to comprehend. These descriptions were classified as "No difficulties" (Comprehension of the task instructions without difficulties), "minor difficulties" (Comprehension of the tasks with minor difficulties), or "moderate difficulties" (Comprehension of the task instructions with moderate difficulties), "can complete if instructions are simplified" (Comprehension of the task if instruction were simplified) and "comprehension poor, even when instructions are simplified" (Poor comprehension of the task even when instructions were simplified). For example, to assess the COI (food) for the List sorting working memory test, the NIHTB-CB's instruction of "Corn" would be deemed "poor comprehension even when simplified", an instruction of "Maize" would be deemed "minor difficulties", and instruction of "*Milisi*" would be deemed "No difficulties". This distinction was guided by a concern that some NIHTB-CB instructions might use unfamiliar vocabulary or because the American-accent English of tasks using pre-recorded instructions might limit comprehension.

Table 4.10: Face validity of the NIHTB-CB: Examiner rating of child's comprehension of task instructions.

NIHTB-CB measures	Task comprehension: N (%) [N=389]				
Examiner's rating	No difficulties	Minor difficulties	Moderate difficulties	Can complete if simplified	Comprehension poor, even when simplified
Pattern Comparison Processing Speed Test	321 (83)	48 (11)	18 (4)	1 (0)	1 (0)
Flanker	316 (82)	56 (13)	12 (2)	0 (0)	5 (1)
Dimensional Change	277 (72)	72 (17)	34 (8)	0 (0)	6 (1)

Card Sort Test					
List Sorting Working Memory Test	219 (58)	123 (30)	40 (9)	3 (0)	4 (0)
Auditory Verbal Learning Test	355 (91)	21 (5)	13 (3)	0 (0)	0 (0)
Oral Symbol Digit Span Test	346 (89)	18 (4)	18 (4)	2 (0)	5 (1)

Table 10 demonstrates that the most participants (80%-90%) experienced little to no difficulty understanding how to complete most NIHTB-CB tasks. Of note, approximately 10% of participants were rated to have moderate difficulties understanding the List sorting working memory task, and a small number (approximately 1%) were deemed unable to understand the task at all, even if instructions were simplified. At the conclusion of each NIHTB-CB assessment, the examiner rated whether the target COI for each NIHTB-CB task was adequately measured (for each child), and also whether the child appeared to understand how to complete the task, or if not, whether comprehension would improve if instructions were simplified.

4.5.1.3 Examiner/Experts' perception towards face validity of the NIHTB-CB

The study participants were also asked to describe, in their own words, the purpose of each test and whether the test appeared to measure the intended construct. In this vein, the study evaluated the face validity of the NIHTB-CB based on a dichotomous scale with categorical options of “*Valid and not Valid*” by asking examiners to rate their perceptions towards participants’ description, in their own words, the purpose of each test and whether the test appeared to measure the intended construct (COI) as depicted in table 5;

Table 4.11: Face validity of the NIHTB-CB: Examiners’ perception towards the validity of NIHTB-CB based on Cohen’s kappa index (1960).

NIHTB-CB measures	COI accuracy: N (%) [N=389]	
Examiner’s rating	“Valid”	“Not Valid”
Pattern Comparison Processing Speed Test (PCPST), N=389	387 (99)	2 (0.5)
Flanker, N=389	386 (99)	3 (0.7)
Dimensional Change Card Sort Test (DCCST), N=389	386 (99)	3 (0.7)
List Sorting Working Memory Test (LSWMT), N=389	388 (99)	1 (0.3)
Auditory Verbal Learning Test (AVLT),	385 (99)	4 (0.9)

N=389		
Oral Symbol Digit Span Test (OSDT), N=389	384 (98)	5 (1.2)
Cohen's kappa index (CKI) based on a six-point scale; ≤ 0 No Agreement; 0.01-0.20 None to Slight; 0.21-0.40 Fair; 0.41-0.60 Moderate; 0.61-0.80 Substantial; 0.81-1.00 Almost Perfect Agreement		

Table 11 shows a dichotomous scale with categorical options of valid and not valid based on face or expert validity of NIHTB-CB based on Cohen's kappa index. The table demonstrates that most examiner/experts (99-100%) rated all of the NIHTB-CB tasks as valid. These included the Pattern comparison processing speed test, Flanker test, Dimensional change card sort test, List sorting working memory test, and Auditory verbal learning test and Oral symbol digit span test. Of note, a small number (approximately 1%) rated the NIHTB-CB tasks as not being valid. This entails that after the NIHTB-CB underwent modifications; its psychometric properties of face validity were good and appropriate.

4.5.2 Content (logical) validity

In the quest to examine the NIHTB-CB's validity based on content validity, the study found that the content validity of the NIHTB-CB was not representative enough to provide an adequate coverage of the investigative items to the Zambian children and adolescents. Most of the children and adolescents were unfamiliar with the vocabulary of some names of test materials used in the administration of the NIHTB-CB. The test materials were specifically embedded in two NIHTB-CB tasks namely; the NIHTB-CB; List sorting working memory and Auditory verbal learning test were examined by isolating each of the following types of assessment errors namely; perseveration; intrusion and set loss error.

5.4.2.1 The NIHTB-CB; List sorting working memory test

The NIHTB-CB-List sorting working memory test had both foodstuffs and animals as test items. On the part of the NIHTB-CB; List sorting working memory foodstuffs, the test items had Blueberry, Cherry, Strawberry, Lemon, Pineapple, Pumpkin, Banana, Watermelon, Apple, Pear, Humberger, Popcorn, Peach, Corn, Egg and Orange. These foodstuffs as cited by the NIHTB-CB; List sorting working memory tests such as corn and pear were not common and culturally friendly to the participants in the study as they were characterised by a number of set loss errors.

The NIHT-CB; List sorting working memory test also had some names of animals which included the Bear, Frog, Tiger, Cow, Elephant, Duck (Duckies), Dog, Turtle, Rabbit, Monkey, Butterfly, Cat, Pig, Lion, Bird, Mouse, Horse, Sheep, Camel and Bee. Most of the names of animals such as Camel, Humberger and Turtle which were used by the NIHTB-CB were not common and familiar to Zambian children and adolescents thereby presenting children and adolescents with some difficulties to identify them as they were not part of their vocabulary. In order to ensure familiarity and easy understanding of different foodstuffs as well as names of animals in the NIHTB-CB, the study suggested some modifications through calibration to be instituted to the NIHTB-CB and the detail of this has been demonstrated in the local administration manual of the study.

In the second year or phase II of the study: As a way of providing a solution to the aforementioned challenge on the NIHTB-CB; List sorting working memory test, the study suggested to remove some names of foodstuffs and animals and have them replaced with the local and familiar names of foodstuffs based on Lawshe's (1975) content validity method in which some test items were retained and others especially those that were not significant at the critical level (*applicability level=2*) were eliminated completely. Some of the test items that were suggested by the study and approved through rating as useful and essential by panel members were *Maize (Milisi), Mango, Orange, Bananas, Guavas, Watermelon, Lemon, Rice, Nshima, Pawpaw, Drink, Chips, and Hungry-lion*. Animals' names that were suggested and implemented in a local administration manual included *Dog (Galu), Cat (Pusi), Goat (Mbuzi), Bee (Nzimu), Camel (Gamila), Frog (Chule), Pig (Nkumba), Lion (Mukango), Bird (Kanyoni), Monkey (Kolwe), Cow (Ng'ombe), Elephant (Njobvu), Tortoise (Fulu), Rat (Koswe), Rabbit (Kalulu), Horse (Hachi) and Sheep (Mbelele)*. The local names of both foodstuff and animals are yet to be implemented in a modified NIHTB-CB as they form part of participants' culture after permission would be granted by the NIHTB-CB developers. By so doing, children and adolescents would be participating freely as they would be relating the names of either Zambian foods or animals without difficulties thereby making the assessment tests context bound as illustrated in a summary table below regarding the NIHTB-CB's List sorting working memory

test. Items that were difficult in the study were determined by set loss and intrusion errors based on both item-difficulty and item discrimination analyses.

Table 4.12: A summary of the NIHTB-CB's list sorting working memory test; Lawshe's (1975) method of content validity based on a three-point scale; Not applicable=0; Useful but not applicable=1 and Applicable=2

Names of foodstuffs		Names of animals	
PHASE I	PHASE II: <i>Suggested test items in a local administration manual for implementation in the NIHTB-CB.</i>	PHASE I	PHASE II: <i>Suggested test items in a local administration manual for implementation in the NIHTB-CB.</i>
Blueberry	<i>Banana</i>	Bear	<i>Lion</i>
Cherry	<i>Watermelon</i>	Frog	<i>Frog</i>
Strawberry	<i>Mango</i>	Cow	<i>Cow</i>
Pineapple	<i>Orange</i>	Turtle	<i>Tortoise</i>
Apple	<i>Lemon</i>	Rabbit	<i>Kalulu</i>
Humberger	<i>Pawpaw</i>	Butterfly	<i>Elephant</i>
Popcorn	<i>Chips</i>	Mouse	<i>Rat</i>
Peach	<i>Rice</i>	Horse	<i>Horse</i>
Corn	<i>Nshima</i>	Sheep	<i>Cat</i>
Pears	<i>Guava</i>	Bee	<i>Dog</i>
Corn	<i>Maize (Milisi)</i>	Camel	<i>Pig</i>
Pumpkin	<i>Drink</i>	Tiger	<i>Bird</i>

5.4.2.2 The NIHT-CB; Auditory verbal learning test

Similarly, Lawshe's (1975) content validity method was also used on the NIHTB-CB's auditory verbal learning test on which different test items were mentioned by the NIHTB-CB-iPad and required that children and adolescents could remember and recite them in any order to the examiner. These test items included the River, Drum, Curtain, Bell, Moon, Garden, School, Colour, Hat, Parent, Turkey, Nose, Farmer, Coffee and House. Therefore, certain foods and

animals as well as some English words for memory on Auditory verbal learning test were found to be not culturally relevant and essential for children and adolescents in Zambia due to a number of set loss errors. This prompted some suggested modifications through calibration to be instituted to the NIHTB-CB in terms of the replacing and eliminating some of the test items/materials and this was implemented in the local administration manual yet to be instituted to the NIHTB-CB after permission would be granted by the NIHTB-CB developers.

In the second year or phase II of the Study: As a way of providing a solution to the aforementioned challenge on auditory verbal learning test, the study retained and replaced some of the English words for memory with the use of local and familiar English words and names in the local administration manual yet to be implemented in the NIHTB-CB with the permission from the NIHTB-CB developers. The names of local words were; *River (Mumana), Ngoma (Dramu), Ma-curtain (Ketani), Bello (Ngilingili), Mwezi, Garden (Munda), Sukulu, Colour (Khala), Kasote, Kolo, Kalukuluku, Mphuno, Mulimi, Coffee (Kofi) and Nyumba*. A further illustration of items in phase I and phase II with regard to Auditory verbal learning test are shown in a summary table below;

Table 4.13: A summary of the NIHTB-CB’s auditory verbal learning test; Lawshe’s (1975) method of content validity based on a three-point scale; Not applicable=0; Useful but not applicable=1 and Applicable=2

NIH Toolbox’s Auditory Verbal Learning Test	Memory for English words	
	PHASE I	PHASE II: Suggested familiar words in the local administration manual for implementation in the NIHTB-CB.
	River	<i>River (Mumana)</i>
	Drum	<i>Ngoma (Dramu)</i>
	Curtain	<i>Ketani (Ma-curtain)</i>
	Bell	<i>Bello (Ngilingili)</i>
	Moon	<i>Mwezi</i>
	Garden	<i>Garden (Munda)</i>
	School	<i>Sukulu</i>
	Colour	<i>Colour (Khala)</i>
	Hat	<i>Kasote</i>
	Parent	<i>Kolo</i>
	Turkey	<i>Kalukuluku</i>
	Nose	<i>Mphuno</i>
	Farmer	<i>Mulimi</i>

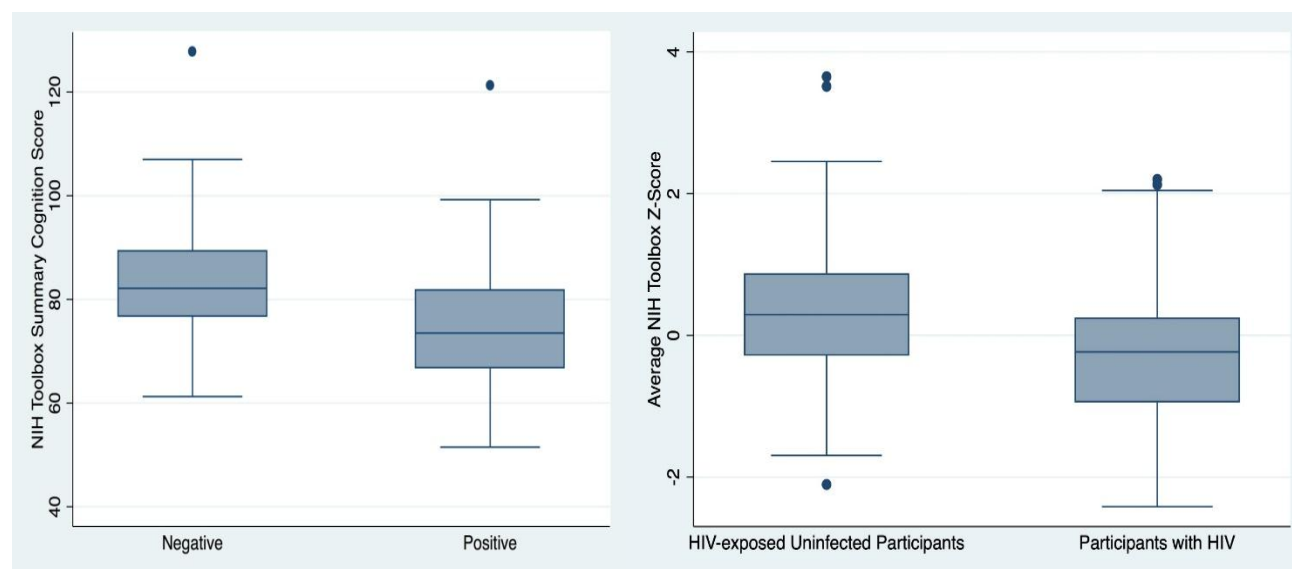
	Coffee	<i>Kofi (Masamba)</i>
	House	<i>Nyumba</i>

4.5.3 Construct validity

Construct validity is a quantitative value rather than a qualitative distinction between ‘valid’ and ‘invalid’. It refers to the degree to which the intended independent variable (construct) relates to the proxy independent variable (indicator) (Hunter and Schmidt 1990). Construct validity has two components: convergent and divergent validity (Engellant, Holland and Piper, 2016).

4.5.3.1 Divergent validity

In this study, the construct validity was cognitive function which was determined by divergent validity (Refer to **figure 7**), by evaluating differences between individual groups based on Spearman’s correlation in terms of performance on the NIHTB-CB Tasks as demonstrated in figure 10 below.



*Group 0=HIV-exposed, uninfected Group 1=HIV-infected;

Figure 4.7: Construct (Divergent) validity: NIHTB-CB Total Z score by HIV-infection status.

Figure 7 shows the NIHTB-CB’s summary cognitive score by HIV status and the results demonstrate that the NIHTB-CB was sensitive to discriminate differences between groups as Human Immune Virus (HIV) infected (HIV+) children performed below average and HIV-exposed, uninfected (HEU)

performed above average on the NIHTB-CB cognitive test. This entails that the NIHTB-CB composite score appeared to differentiate between the HIV-positive and HEU groups with participants with HIV scoring significantly lower on the NIHTB-CB.

4.5.3.2 Convergent validity

The NIHTB-CB being a neurological and behavioral assessment instrument capable of monitoring developmental milestones and other tasks involving any form of mental faculties is able to report accurately on all the cognitive activities undertaken therein. It was therefore cardinal to interrogate some other important variables related to cognitive function. Some of these related specific variables that could be used to determine cognitive function through performing Pearson's correlation with an average NIHTB-CB Z-score included age, z_unit2_iq (UNIT-2 Abbreviated IQ Standard Score), bistotal (brief impairment score total) and class rank.

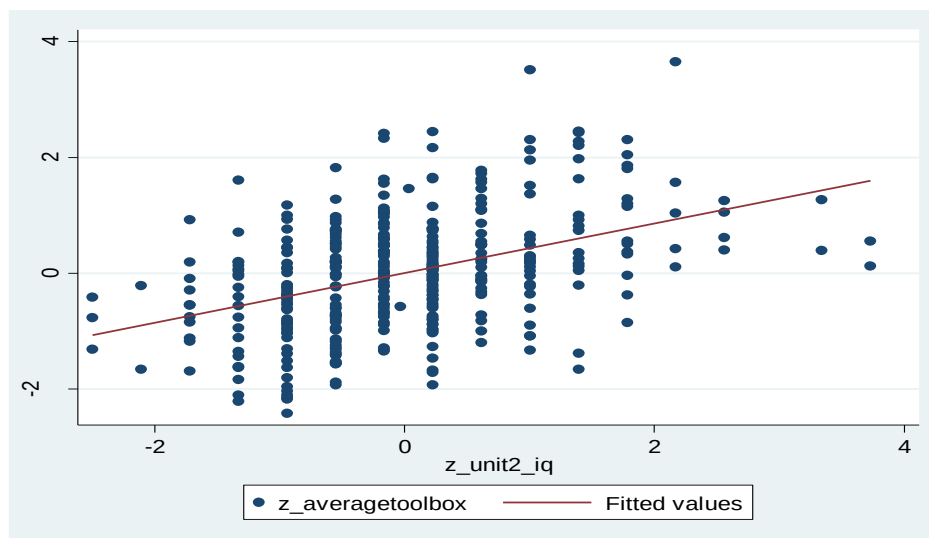


Figure 4.8: Construct (convergent) validity: NIHTB-CB Total Z vs z_unit2_iq (UNIT-2 Abbreviated IQ Standard Score)

Figure 11 demonstrates that there was a significant positive relationship between z_unit2_iq (UNIT-2 Abbreviated IQ Standard Score) and average performance on the NIHTB-CB Z-score ($r=0.43$, $p < 0.001$). This implies that z_unit2_iq (UNIT-2 Abbreviated IQ Standard Score) which measures the general intelligence had an influence on the NIHTB-CB performance. The study further performed Pearson's correlation between bistotal (brief impairment score total) and $z_average$ toolbox and the results are displayed below;

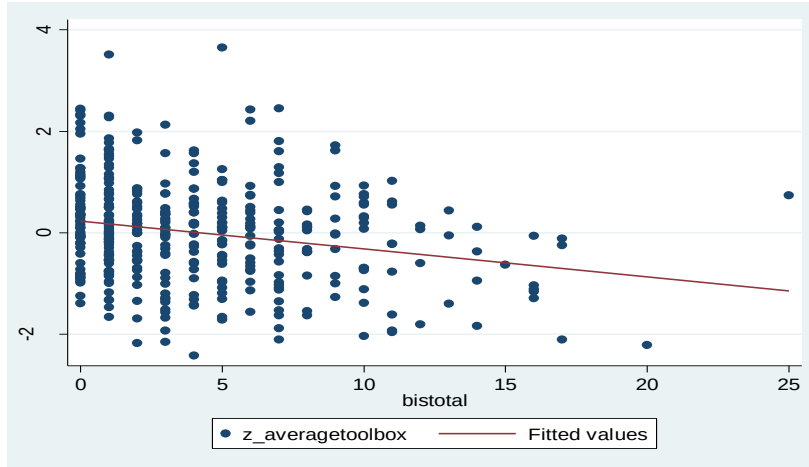


Figure 4.9: Construct (convergent) validity: NIHTB-CB Total Z vs bistotal (brief impairment score total)

Figure 9 shows that there was a significant weak negative relationship between bistotal (brief impairment score total) and z_average toolbox ($r=-0.23$, $p<0.001$). This entails that brief impairment score total had a negative influence on the Z-average toolbox.

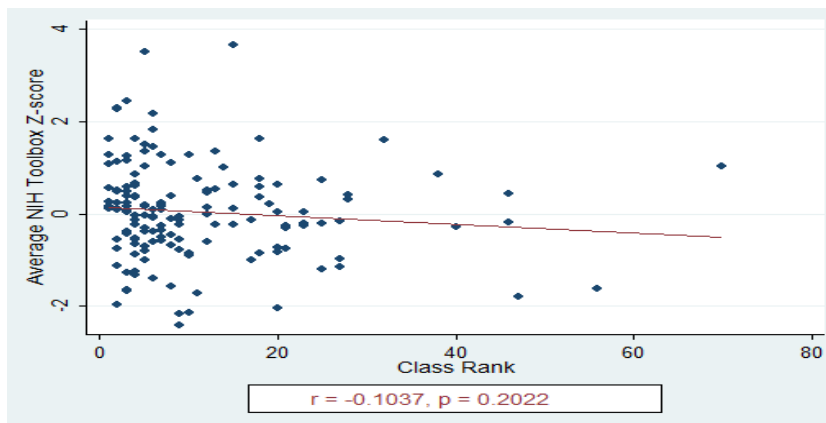


Figure 4.10: Construct (convergent) validity: NIHTB-CB Total Z vs Class Rank

Figure 10 shows that there was a negative relationship between class rank and z_average NIHTB-CB ($r=-0.10$, $p=0.2022$). This implies that class rank had a negative influence on the average NIHTB-CB Z-score.

4.5.4 Criterion validity

Criterion validity has two components, reflecting the extent to which an instrument is correlated with or predicts a current (concurrent validity) or future (predictive validity) event (Oluwatayo, 2012).

4.5.4.1 The NIHTB-CB scores vs Parental ranking of intelligence

In the current study, criterion validity was demonstrated by performing a Spearman correlation between the NIHTB-CB scores with parental ranking of intelligence based on a on 5-point Likert scales, with lower scores indicating worse function compared to peers (intelligence scholastics: 1 = “much worse/very bad and failing”, 5 = “much better/extremely well” than other children (Refer to **figure 11**);

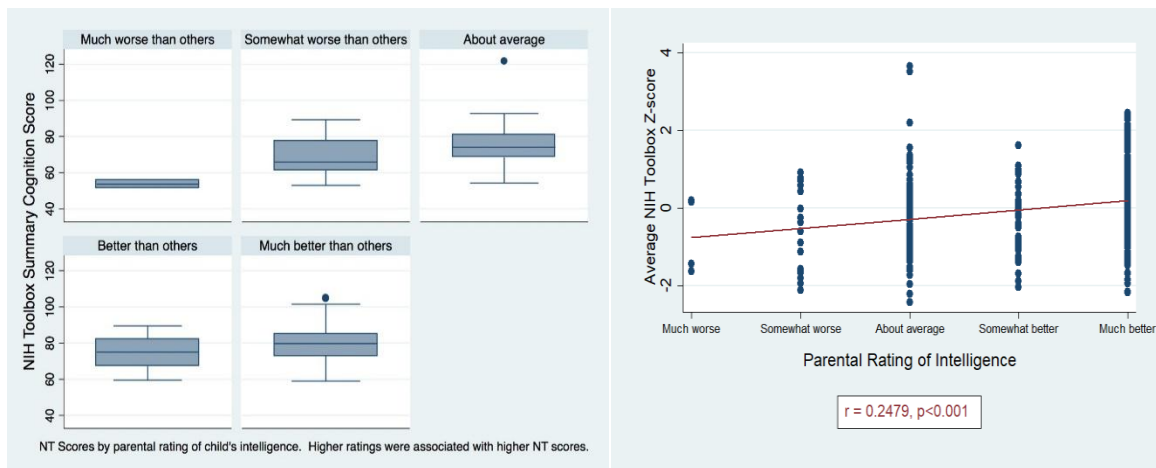


Figure 4.11: Criterion validity: NIHTB-CB composite Z-score and parental rankings of child’s intellectual ability.

Figure 11 demonstrates that there was a statistically significant ($p < 0.001$) positive correlation ($r = 0.25$) between the average NIHTB-CB Z-score and parental ranking of intelligence based on a 5-point Likert scale. Parental ranking of child’s intelligence implies that higher ratings were associated with higher scores and lower ratings with lower scores on the NIHTB-CB.

4.5.4.2 The NIHT-CB scores vs School performance

Another criterion validity was demonstrated by performing a Spearman’s correlation between NIHTB-CB summary cognitive score vs school performance based on a 5-point Likert scale, with

lower scores indicating worse function compared to peers (intelligence scholastic: “from very badly/failing” to “extremely well”), respectively.

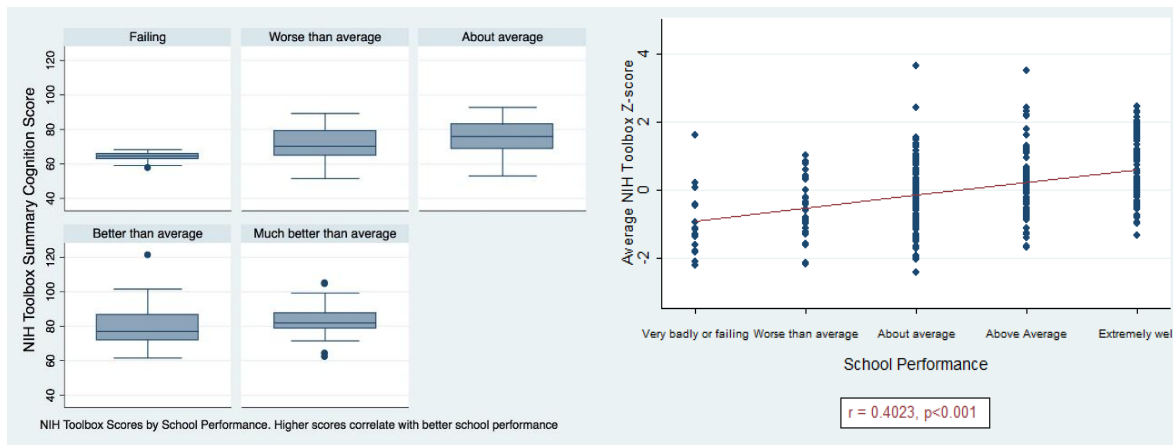


Figure 4.12: Criterion validity: NIHTB-CB composite Z-Score and Parental rankings of child’s school performance.

Figure 12 shows that there was a statistical significant ($p < 0.001$) positive correlation ($r = 0.40$) between average NIHTB-CB Z-score and school performance based on a 5-point Likert scale. The NIHTB-CB by school performance entails that, higher scores correlated with better school performance and lower scores correlated with poor performance on the NIHTB-CB.

4.5.4.3 The NIHTB-CB measures vs Non-NIHTB-CB measures

Further, criterion validity was also performed by comparisons between NIHTB-CB measures and Non-NIHTB-CB measures and the application of the Receiver operating characteristics (ROC) curve. Receiver operating characteristic (ROC) curve is a procedure used in assessing diagnostic properties of tests, comparing the diagnostic performance of two or more tests and in determining the optimal cut-off point of a test to determine whether a person with a certain score belongs to one or another category (Westin, 2001). Receiver operating characteristic curve demonstrates several things: Among others, it shows the tradeoff between sensitivity and specificity (any increase in sensitivity would be accompanied by a decrease in specificity), the closer the curve follows the upper-left border of the ROC space, the more accurate the test, the closer the curve comes to the 45-degree diagonal of the ROC space, the less accurate the test, the

slope of the tangent line at a cut-point gives the likelihood ratio (LR) for that value of the test and the area under the curve is a measure of accuracy (Sackett *et al*, 1977; Metz, 1978).

The optimal cut-off point is the one which maximizes sensitivity and specificity or one of them or minimizes sensitivity and specificity or one of them (Streiner and Cairney, 2007). Sensitivity, also called the true positive rate is defined as the probability that a test result becomes positive when the disease is present and specificity, also called the true negative rate, represents the probability that a test is negative when the disease is not present (Jokinen, Nordstrom and Nordstrom, 2008).

In this study, the optimal cut-off point was .41 with a sensitivity of 81% and specificity of 76%. This threshold was decided and selected based on a reason of maximizing sensitivity in order to correctly identify and include all the participants with attributes of interest (*cognitive impairment*) and minimizing on specificity with the intention of correctly classifying the participants without the attributes of interest (*cognitive impairment*). Cognitive impairment was determined using a global deficit score (GDS) approach. Test scores within each domain were transformed for normality and converted into z scores adjusted for age and sex (Blackstone, Moore and Franklin, 2012). Each domain score was then converted into a deficit score from 0 to 5 based on standard deviations below mean performance, and these domain specific deficit scores were averaged to create the GDS. By convention, cognitive impairment was defined as a GDS of 0.5 or greater (Adams *et al*, 2019). With respect to global deficit score (GDS) of 0.5 or greater, the study found that out of 389 respondents who completed all the visits for both the NIHTB-CB and neuropsychological tests, a total of 143 children and adolescents were diagnosed with cognitive impairment and this warranted the categorization or classification of children and adolescents using the Frascati diagnostic criteria.

In view of the above, the study further utilized Frascati diagnostic criteria to categorize and classify respondents with respect to the following requirements and conditions of either *Asymptomatic Neurocognitive Impairment*, *Minor Neurocognitive Disorder*, or *HIV-associated Dementia* as demonstrated below (Refer to **table 14**).

Table 4. 14: Frascati diagnostic criteria for HIV-associated neurocognitive dementia (HAND)

ANI:	Asymptomatic neurocognitive impairment (~30% of HIV+ individuals)
	• Neuropsychological performance at least 1 SD below demographically matched normative scores in at least 2 cognitive domains*.
	• Cognitive impairment does not interfere with everyday functioning
MND:	Minor/Mild neurocognitive disorder (20-30% of HIV+ individuals)
	• Neuropsychological performance at least 1 SD below demographically matched normative scores in at least 2 cognitive domains*.
	• Cognitive impairment results in mild interference in daily functioning
HAD:	HIV-associated dementia (2-8% of HIV+ individuals)
	• Neuropsychological performance at least 2 SD below demographically matched normative scores in at least 2 cognitive domains*.
	• Cognitive impairment results in marked interference in daily functioning
*Impairments must not be explained by comorbid conditions (such as central nervous system (CNS) opportunistic infections, drug or alcohol abuse, or prior brain injury), and individual may not meet criteria for delirium or dementia	

Source: Antinori (2006)

and conditions of the Frascati diagnostic criteria (Refer to **table 14**), the study found the following results tabulated as either Asymptomatic neurocognitive impairment (ANI), Minor/Mild neurocognitive disorder (MND), or HIV-associated dementia (HAD) in table below. Note that each of these variables was coded **0** (if they did not have impairment) or **1** (if they had an impairment) in order to aid with the classification or categorization process of each individual child in tandem with Frascati diagnostic criteria (Refer to **table 15**).

Table 4.15 Categorization/classification of impairment types based on Frascati diagnostic criteria

Type of Impairments	Asymptomatic Neurocognitive Impairment (ANI)	Mild Neurocognitive Disorder (MND)	HIV-Associated Dementia (HAD)
No impairment (*0)	323 (84%)	315 (82%)	370 (96%)
Having an Impairment (*1)	62 (16%)	69 (18%)	14 (4%)
Total	385	384	384

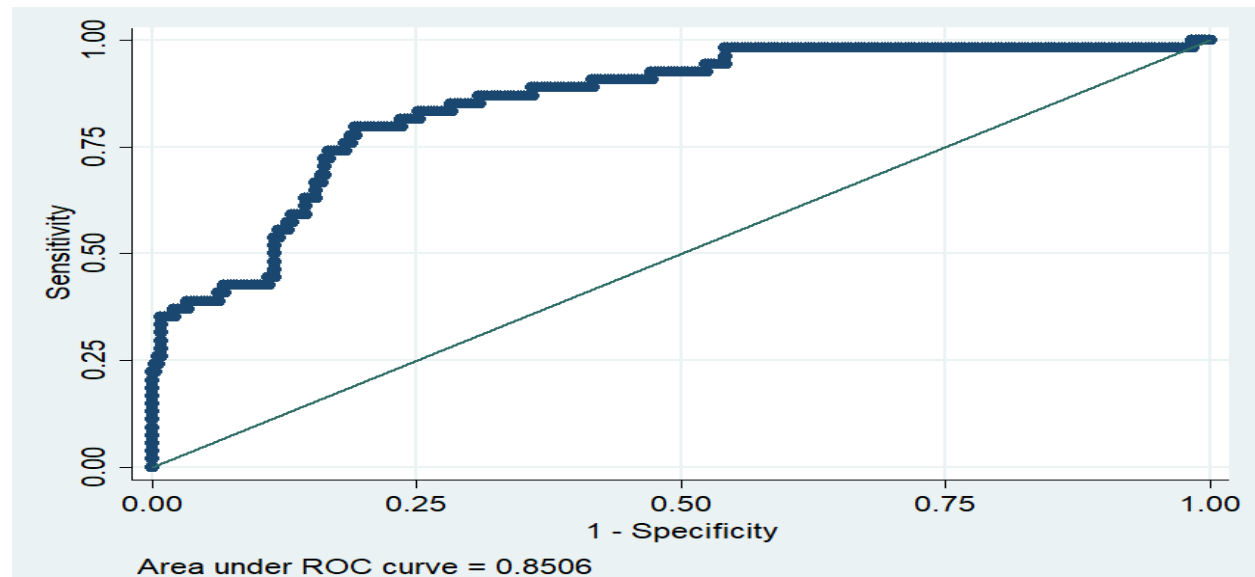
*0=those who did not have impairment), and *1=those who had an impairment)

****Note** that the total number of respondents/participants in the study kept on fluctuating from 389 to 385 for asymptomatic neurocognitive impairment while 384 for mild neurocognitive disorder and HIV-associated dementia on the Frascati diagnostic criteria table above due to the effects of COVID-19 pandemic.

Table 15 shows that a greater number 323 (83%) of children and adolescents did not have Asymptomatic neurocognitive impairment while a small number 62 (16%) of children and adolescents had this type of impairment. With regard to Minor/Mild neurocognitive disorder, a greater number 315 (82%) did not have this type of impairment while a small number 69 (18%) of children and adolescents had minor/mild neurocognitive disorder. Further, a greater number 370 (96%) of children and adolescents did not have HIV-associated dementia while a small number 14 (4%) had an HIV-Associated dementia in the study. This entails that 69 and 62 children and adolescents had a neuropsychological performance of at least 1 SD below demographically matched normative scores in least 2 cognitive domains while 14 had a neuropsychological performed of at least 2 SD below demographically matched normative scores in at least 2 cognitive domains.

The NIHTB-CB was able to identify participants with cognitive impairment according to gold standard of neuropsychological battery testing, with the ROC curve demonstrating an AUC of 0.85 (95% CI 0.8, 0.91; Refer to **Figure 13**). On the Receiver operating characteristic (ROC) curve below. Implying that the NIHTB-CB has a measure of accuracy or precision amounting to about 85% thereby making it more sensitive to aid in assessing cognitive function and identifying as well as classifying children and adolescents in the study according to either

Asymptomatic neurocognitive impairment (ANI), Minor/Mild neurocognitive disorder (MND), or HIV-associated dementia (HAD). More so, having an excellent degree trade off balance between sensitivity that is a true positive rate (81%) and specificity as a false positive rate (76%). This was further demonstrated by using Sackett, Richardson, Rosenberg and Haynes (1977)'s diagnostic scale as indicated below;



Sackett *et al.* (1997)'s Five Diagnostic Precision Scale: 0.90 1.00=Excellent;
0.80-0.90=Good; 0.70-0.80=Fair; 0.60-0.70=Poor; 0.50-0.60=Fail.

Figure 4.13: Criterion validity: Receiver operating characteristic (ROC) curve analysis of NIHTB-CB Z score for detection of cognitive impairment

4.6 Relationship between the composite Z-score of the standardized neuropsychological test battery and the composite scaled-score of the NIHTB-CB

4.6.1 Convergent validity

A question of whether there was a difference between the composite Z-score of the standardized neuropsychological battery test across all 8 cognitive domains with the composite scaled-score of the NIHTB-CB test in assessing children and adolescents aged 8-17 years was determined by convergent validity (Refer to **figure 14**). Convergent validity refers to the degree to which two

measures of constructs that theoretically should be related are in fact related (Elliott *et al*, 2001). Therefore, there was sufficient evidence to suggest that the results of the study demonstrated a positive correlation between the NIHTB-CB's composite score with the composite Z-score of the standardized neuropsychological battery test across all 8 cognitive domains ($r=0.68$, $p<0.001$). This implies that there was no statistical significant difference between the NIHTB-CB's composite score with the composite Z-score of the standardized neuropsychological battery test across all 8 cognitive domains.

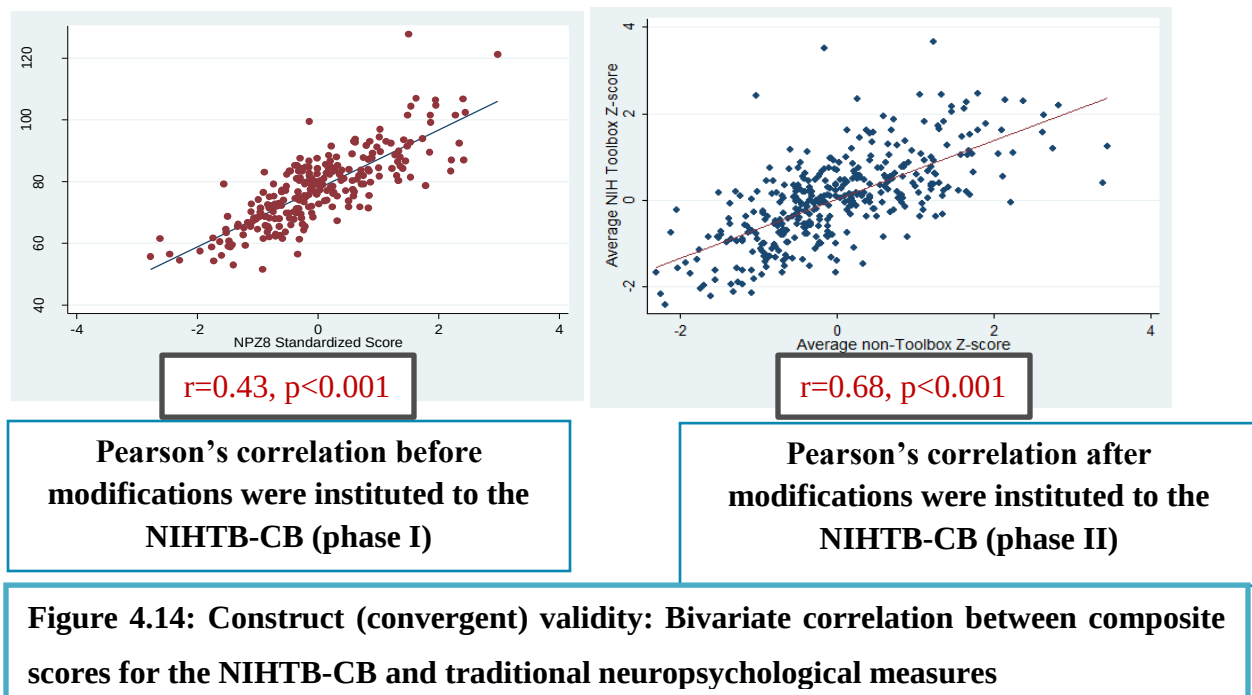


Figure 14 demonstrates that correlation between NIHTB-CB measures and the standardized neuropsychological battery test across all 8 cognitive was significantly strong as the composite scores' correlation was at an acceptable level of significance ($r=0.68$, $p<0.001$). However, the correlations varied according to the administration phases of the NIHTB-CB. For instance, the correlation between NIHTB-CB measures and the standardized neuropsychological battery test across all 8 cognitive before modifications were instituted to the NIHTB-CB was significant but not as stronger as after the modifications were instituted to the NIHTB-CB by a way of using the local and familiar language during administration in the second year or phase II of the study.

4.6.2 Concurrent validity

Concurrent validity refers to the extent to which the results of a particular test, or measurement, correspond to those of a previously established measurement for the same construct (Elliot *et al*, 2001). In brief, concurrent validity assesses the operationalization's ability to distinguish between groups. This explanation is further illustrated in the table below which shows the correlations between the NIHTB-CB's' individual variables against each measure of the same construct of the gold standard of neuropsychological assessment battery (Refer to **table 16**).

Table 4.16: Construct validity: Bivariate correlation coefficients between the NIHTB-CB and Non-NIHTB domain-based comparison measures

Domains	NIHTB- CB measure	Non-toolbox measure	Pearson's <i>r</i>
Processing Speed	Pattern Comparison Processing Speed	Trail Making Test Condition 1	0.43*
	Oral Symbol Digit		0.45*
Motor Speed	9 Hole Peg Test	Trail making Test Condition 5	0.29*
Verbal Learning Recall	Auditory Verbal Learning Test	CVLT-C ¹ , List A Total Trials 1-5	0.40*
Executive Function-Attention/Working Memory	List Sorting Working Memory	Digit Span Total	0.29*
		CVLT-C, Trial 1	0.12
Executive Function-Response Inhibition	Flanker Test	Pencil Tapping	0.15
Executive Function-Set Shifting/ Cognitive Flexibility	Dimensional Change Card Sorting Test	Wisconsin Card Sorting Test Total Correct	0.23*
		Trail Making Test Condition 4	0.38*

All P-values calculated using linear regression. P-values <0.05; p-values <0.001 are marked with *

Abbreviations:

D-KEFS TMT = Delis-Kaplan Executive Function System (D-KEFS) Trail Making Test

CVLT-C = California Verbal Learning Test Children's Version

WCST = Wisconsin Card Sorting Test

WISC-V = Wechsler Intelligence Scale for Children, Fifth Edition

NEPSY-II = A Developmental NEuroPSYchological Assessment, Second Edition

UNIT-2 = Universal Nonverbal Intelligence Test 2

NIH Toolbox = National Institute of Health Toolbox

DCCST = Dimensional Change Card Sort Test

When the NIHTB-CB and the non-NIHTB-CB domain-based comparison measures were further correlated individually against the other measures of the same or related constructs based on concurrent validity in the above table, the study demonstrated that the results were statistically significant ($p < 0.001$), with low to moderate positive correlation matrix which diverged at various levels. For instance, there was a positive weak correlation (0.419) between Picture comparison processing speed test and Trail making test condition 1, (0.454) between Oral symbol digit test and Trail making test condition 1, (0.294) between 9-hole peg test and Trail making test condition 5, (0.403) between Auditory verbal learning test and CVLT-C-List A Total Trail 1-5 Z-score, (0.291) between the NIHTB-List sorting working memory and Non-NIHTB-Digit span total, (0.121) between NIHTB-List sorting working memory and CVLT-C-Trail 1, (0.152) between NIHTB-Flanker and Pencil tapping, (0.231) between the NIHTB-DCCs and Wisconsin card sorting test total score and (0.376) between the NIHTB-DCCS and Trail making test condition 4.

4.7 Summary of the chapter

This chapter presented the findings of the study; it started with information on the associations between demographic characteristics and the HIV-status of the participants on various background variables to ascertain how each of these variables influenced the outcome based on their contributions. The chapter further presented information on the standardised administration of the NIHTB-CB and found that the Installation Qualification (IQ) of the NIHTB-CB was done in accordance with the manufacturers' specifications and its Operation Qualification (OQ) operated as expected by the manufacturer as it spelt out considerable details on standardised administration conditions and instructions. The performance qualification (PQ) in terms of psychometric properties of the NIHTB-CB to some extent had appropriate face and construct validity, with the exception of the Picture vocabulary test and Dimensional change card sort test which performed poorly due to requiring high levels of English language skills.

Further, the study found that children and adolescents encountered a number of challenges when administered with the NIHTB-CB such as poor skills in comprehending task instructions, poor literacy and numeracy skills, and were unfamiliar with most of the NIHTB-CB test materials on both List sorting working memory and Auditory verbal learning test. Additionally, the found that

to some extent, the face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity were not valid but after modifications were instituted to the NIHTB-CB, it was made valid for use in the Zambian population of children and adolescents. Furthermore, the study found a significantly strong correlation ($r=0.68$, $p<0.001$) between the composite Z-scores of the standardized neuropsychological test battery across all 8 cognitive domains with the composite scaled-score of the NIHTB-CB test. The subsequent chapter presents the discussion of research findings.

CHAPTER FIVE: DISCUSSION OF RESEARCH FINDINGS

5.1 Overview

The previous chapter presented the findings of the study following sub-headings which included; demographical characteristics of the participants on various background variables using univariate and bivariate analysis. The chapter further presented information on the standardised administration of the NIHTB-CB, challenges encountered by children and adolescents when tested with the NIHTB-CB, psychometric properties of the NIHTB-CB and relationship between the composite scores of the NIHTB-CB and neuropsychological testing battery. This chapter discusses the research findings based on research objectives outlined as follows;

1. The standardised administration of the NIHTB-CB in assessing cognitive function of children and adolescents aged 8-17 years in Lusaka Province.
2. Challenges encountered in the administration of the NIHTB-CB in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province.
3. The extent to which the NIHTB-CB was valid based on face validity, content validity, constructs validity, discriminant validity, convergent validity and criterion validity in assessing the cognitive function of children and adolescents aged 8-17 years in Lusaka Province.
4. The difference between the composite Z-score of the standardized neuropsychological battery test across all 8 cognitive domains with the composite scaled-score of the NIHTB-CB test in children and adolescents aged 8-17 years in Lusaka Province.

5.2 Standardised administration of the NIHTB-CB

The evaluation of the standardised administration of the NIHTB-CB was done based on delphil's three key principles of instrument validation process which included installation qualification (IQ), operation qualification (OQ) and performance qualification (PQ) using Delphi's tri-phased technique of instrument validation as advanced by (Davidson, 2013; Dalkey and Helmer, 1963).

5.2.1 Installation qualification of the NIHTB-CB in Zambia

On the installation qualification, the study found that the NIHTB-CB and its subsystems were installed in accordance to manufacturer's specifications. These specifications verified that all; components of the NIHTB-CB were functional, the local supply voltages conformed to the instrument, the ambient conditions existed for optimal instrument performance, correct versions of software were issued with the instrument and setting up of instrument parameters such as date, time, language, test protocol were done correctly and that there was supportive infrastructure for assessment and surveillance. This finding was echoed by Akshoomoof *et al*, 2014; Gershon, 2014; Weintraub *et al*, 2013) who contended that the goal of having a standardised procedure was to provide uniform information on the recommended specifications and how each measure was administered automatically by the available NIHTB-CB software based on a standardised format. This implies that the installation of the NIHTB-CB to some extent was done successfully in accordance to the manufacturer's specification for the assessment of cognitive function among the Zambian children and adolescents.

Contrary to the successful installation of the NIHTB-CB, the study found that in Zambia as in many resource-limited countries (RIC), there was limited infrastructure for surveillance and support the NIHTB-CB for the assessment of cognitive function in children and adolescents, a finding that was echoed by Nowinski, Victorson and Debb (2013) who carried out a study in the United States of America on the NIHTB-CB for assessment of neurological and behavioral function; input on the NIHTB-CB with inclusion criteria surveying the end-user community and indicated that there was lack or limited infrastructure for surveillance and this hindered the ability to support, share and interpret research results. This entails that if some communities in the United States of America could still experience challenges such as lack of infrastructure for surveillance and support of the NIHTB-CB's administration, a resource-limited country such as Zambia would not be spared, hence a deficit in terms of infrastructure for surveillance and support of the NIHTB-CB. Therefore, there is need for the schools and higher learning institutions to invest much in technological advancements so as to equip the student populace with the necessary educational innovative skills that would allow them compete favorably with other students across the globe.

5.2.2 Operational qualification of the NIHTB-CB in Zambia

Regarding operational qualification, the study found that the NIHTB-CB operated as expected by the manufacturer as it spelt out considerable details on standardised administration conditions and instructions to the examiners and researcher in the study. The administration steps included how to set up the testing room, what to do to provide clear, simple, concise and easy-to-follow administration instructions when a participant takes on the test. A hanging sign was put on the door to the room stating “Testing in Progress-Do Not Disturb”. The instructions also stated how to distribute the test and timing. The physical testing environment was well lit, ventilated with adequate working space, comfortable chairs, and structured in a child-friendly way.

Similarly, this finding was confirmed by Airasian (2001); McMillan (2001); Gay and Airasian (2000); Akshoomoof *et al*, (2014) who contended that most standardised instruments spell out considerable detail on how the instrument should be administered based on how to set up the testing room, what to do when a client takes on the test, how to distribute the test and answer sheets, and how to time the tests. Additionally, Weintraub *et al*, (2013) supported a finding on the physical testing environment that it should be well lit and ventilated with adequate working space and hang a sign on the door to the room that states “Testing in Progress-Do Not Disturb”. This was important because if the scripted-guide was not followed exactly, comparisons of participants’ performance with the population of children on which the instrument was principally normed could be invalid and difficult to interpret and to suggest areas of modification for the NIHTB-CB.

5.2.3 Performance qualification of the NIHTB-CB in Zambia

In terms of performance qualification, based on the NIHTB-CB’s psychometric properties for previous scores among the US population which had a sensitivity of .90; specificity of .85 and the area under the curve at .95) respectively, the study demonstrated that the psychometric properties of the NIHTB-CB when tested to the Zambian population of children and adolescents to some extent were not good and appropriate. This was because certain NIHTB-CB tasks were not culturally appropriate and applicable because the NIHTB-CB tasks used vocabulary and concepts were U.S.-centric and familiar to Western audiences but not encountered in everyday life by children in Zambia. Thus, this required translations when tested on the Zambian children

and adolescents. This made the NIHTB-CB's sensitivity (ability of the test to detect true positive), specific (ability of the test to exclude true negatives) and the area under the curve (AUC) (a measure of precision/accuracy) in the Zambian context to some extent poor to moderate (approximately sensitivity of .65; specificity of .60 and the area under the curve at .55) respectively, all these concepts of diagnostic tests were rated poor to moderate because they were slightly far below the acceptable threshold of a standardised instrument which ranged from 0.80-1.00. Further, correlations with standard neuropsychological tests were also low to moderate (all pairwise correlations $r=0.43$, $p<0.001$), because they were slightly far below the acceptable threshold of a valid instrument as contended by Maina *et al* (2019), Metz (1978) and Sackett *et al*, 1997) who proposed a five diagnostic scale which had the following points; 0.90-1.00 (Excellent), 0.80-0.90 (Good), 0.70-0.80 (Fair), 0.60-0.70 (Poor) and 0.50-0.60 (Fail).

Further, Sackett *et al.*, (1997) and Maina *et al*, (2019) recommend that the diagnostic accuracy indicators of a validated instrument range from .80-.90 (Good) to .90-1.00 (Excellent). Therefore, screening, diagnosing and suggesting interventional programmes using a classical NIHTB-CB which when tested on Zambian children and adolescents in the first year (phase I) demonstrated poor sensitivity, specificity and area under the curve AUC; approximately .65, specificity .60 and .55 respectively was not precise as opposed to a standard neuropsychological battery. It also demonstrated a low to moderate ($r=0.43$, $p<0.001$) correlations with neuropsychological tests which was questionable and inconsistent with the advocacy of the classical test theory or true score theory by Lord and Novick (1968) who contended that, there must be no difference between the test outcome of tool **A** and tool **B** (Tool **A**; Standard Neuropsychological Battery and Tool **B**; NIHTB-CB). This was dangerous and disastrous for a country because if the classical NIHTB-CB was left unchecked in terms of exposing it to the validation process could have increased the risk cost of false positive and negative results, leading to poor interventions and placement options in special schools. This suggest that validating the NIHTB-CB in Zambia among the children and adolescents was not only for academic expediency but also to be used as a critical component of policy and clinical practice in the country.

5.3 Challenges encountered by Zambian children and adolescents in the NIHTB-CB administration

5.3.1 Challenges encountered by Zambian children and adolescents when tested with the NIHTB-CB

As earlier presented in the previous chapter, challenges were expected in the current study as the NIHTB-CB which was developed, normed principally and validated for a United States (U.S.)-based English-speaking population was initially applied without being validated in Zambia which was contrary to the Clinical Laboratory Improvement Amendment (CLIA-42, 1988) regulations for Centre For Research (CFR). Among other challenges that Zambian children and adolescents encountered when tested with the NIHTB-CB were as follows;

5.3.1.1 Poor comprehension skills by Zambian children and adolescents when tested with the NIHTB-CB

Lack of English language skills and actual constructs; the study found that Zambian children and adolescents performed poorly on the NIHTB-CB tests such Picture vocabulary test-4th edition (PVT-IV) which required high levels of English language skills. The poor performance of participants on the PVT-IV which required high levels of English language skills was because several NIHTB-CB tasks which were selected for apparent minimal cultural influences were found not to be culturally relevant for children and adolescents in Zambia due to inclusion of unfamiliar vocabulary. Mwanza-Kabaghe, Mubanga, Matafwali, Kasonde-Ng'andu and Bus (2015) also found that language limitations had a negative effect on reading and writing and that the lack of English language skills in children in their study which focused on boosting early literacy among preschoolers was a possible explanation. This implies that becoming literate starts long before children receive formal reading instruction. As such, there is need for homes and schools to have stimulative literacy activities that would expose children to a daily experience of reading books in order to construct knowledge not only about text but also about print.

Further, the study found that with the PVT-IV, it was not only the vocabulary that presented the challenge of cultural differences between English usage in United States of America vs. Zambia,

but also the images / pictures used in the PVT-IV, and possible mis-match between pictures and words, within the local context. The PVT-IV showed four pictures and the child was asked to point to the word that matched the picture. For instance, a problem was encountered when the target picture was “maize” but the vocabulary word was “corn”. Here, the image was appropriate but the matching vocabulary was not, for the context of use (Zambian English). There were other problems that occurred when the picture itself was unfamiliar to the child (perhaps an animal or a place that he/she did not visit, or was uncommon in Zambia due to set loss error) such as scorpion or port.

In particular, the study had selected a simple test of receptive vocabulary within the neuropsychological assessment battery to aid in validation of an analog measure from the NIHTB-CB-Picture vocabulary test-4th edition (PVT-IV) and discovered that there were more items than expected and that participants reported lack of familiarity with the names of concepts used even when translated terms were provided in Chinyanja by study staff to assess whether the difficulties were due to a language barrier or unfamiliarity with the underlying concepts. This finding is line with the findings of scholars such as Weintraub, Bauer, Zelazo, (2013); Bauer and Zelazo, (2013); Gershon *et al*, (2013) who argued that the NIHTB-CB was developed and normed principally for a United States (U.S)-based English-speaking population as opposed to other settings.

They maintained that the NIHTB-CB tests were designed based on the United States (U.S) culture, values and beliefs across gender, race/ethnicity, and socioeconomic status groups. In order to address this challenge, the study came up with some suggested solutions and such solution to the aforementioned challenge was the removal of the NIHTB-CB-PVT-IV from the respective test batteries soon after the study was initiated and realization was attained that the test had challenges of cultural boundedness. In the light of this, a Zambia-adapted version was considered but was also deemed not suitable for the main sample of children ≥ 8 years old, as it was developed with item content only suitable for younger children ≤ 6 years old. This would have led to ceiling effects with the sample which enrolled adolescents as old as 19 years of age.

Where feasible for the NIHTB-CB tasks (when it would not interfere with task performance), instructions and task stimuli were modified by re-stating using Zambian-accent English and

administration instructions could also be presented in Chinyanja when necessary, but this did not make the researcher translate task stimuli themselves due to similar concerns of the NIHTB-CB's PVT-IV. An indication that the NIHTB-CB was not valid but after the removal of a PVT-IV, the NIHTB-CB was responsive and valid for use on Zambian population especially among children and adolescents. This implies that in principle, the NIHTB-CB was no longer the same in design and administration after undergoing a series of modifications in terms of removing and adding certain tests using a local administration manual in order to suit the new context of Zambia.

Further, the study demonstrated that lack of English language skills did not only apply on the NIHTB-CB; PVT-IV but even on other NIHTB-CB tasks such as; List sorting working memory Test, Auditory verbal learning test and Dimensional change card sort test. This was because the NIHTB-CB was developed and normed principally for a United States (U.S)-based English speaking population. Hence, it required the use of high English skill which in this case was limited in the Zambian children and adolescents thereby exhibiting poor performance on most of the NIHTB-CB tasks especially those that were requiring high levels of English language skills. This was contended on the premise that all children attending school receive instruction in English, and academic content in textbooks is provided in English.

Further, the study expected some children initially enrolled in the study (ages 10 years and older) to have had at least several years of English language exposure in school and to use English in performing everyday activities and transactions in the community. However, the study discovered soon after beginning enrollment that some children and adolescents with regular school attendance still struggled to understand cognitive test instructions in English. Suffice to say that although English is the official language and used as a medium of instruction from the fifth grade to tertiary education, Zambia is a country with 73 dialects spoken and that English is used as a second language, if not third in Zambia among most children, an observation that was also made by Mwanza-Kabaghe *et al* (2015). Therefore, questioning the validity based on testing in English rather than in the mother tongue is very relevant in the utilization of the instrument thereby making most of the tests which were administered in English difficulty for them.

Furthermore, Mbewe, Mwanza-Kabaghe and Matafwali (2016) argued that in Zambia, from Grade1-4 familiar or local languages are used as a medium of instruction while English is used as a medium of instruction from grade 5 to Tertiary level. Therefore, it is imperative to perform a test on children and adolescents using a familiar language as opposed to English that the NIHTB-CB uses for administration. As a way of providing a solution to the challenge of lack of English language skills among our participants, we have since instituted several solutions. First, test instructions for all NIHTB-CB and neuropsychological assessments have been translated/back-translated by local staff into Chinyanja, the vernacular language throughout Lusaka. Test stimuli were not translated, as this would have necessitated re-validation of the measures and establishment of vocabulary (in Chinyanja) of similar frequency and difficulty level as in English.

When children presented for study visits, local study staff ascertained their ability to converse and understand task instructions in English vs. Chinyanja, and proceed accordingly with the cognitive assessments (NIHTB-CB and neuropsychological battery). A field was added to the data collection forms to indicate whether task instructions were presented in English or in Chinyanja, this helped the participants to be free to settle for the administration in a language which they were more comfortable within the Zambian environment. This, in the long run made the administration of the NIHTB-CB and assessment of neuropsychological testing battery easy and friendly. As a result, most participants performed well on the subtests of the NIHTB-CB as opposed to when the instrument was still in its classical United States (U.S) design.

Another challenge encountered by children and adolescents when tested with the NIHTB-CB was lack of understanding of the voice intonation especially on Auditory verbal learning test. On the Auditory verbal learning test, different test items were mentioned by the NIHTB-CB-iPad which required the children and adolescents to remember and recite them to the examiner in any order. The test items included River, Drum, Curtain, Bell, Moon, Garden, School, Colour, Hat, Parent, Turkey, Nose, Farmer, Coffee and House. The voice intonation with an American English-accent was found to be culturally inappropriate and context bound as such it sounded and was received with difficulties to comprehend especially by the age group of 8-17 years that was a target enrolled in the study. The voice intonation (accent) was meant for the U.S

population as opposed to Zambian population more especially the younger group which the study had targeted.

The foregoing finding was consistent with other studies that argued that the use of Western-developed tests is not without problems as they have differences in cultural background and language (Ardila, 1995; Grigorenko, 2009, Lezak, Howieson, and Loring, 2004, Razani, Murcia, Tabares, and Wong 2006, Reitan and Wolfson, 1995, Segall, 1986). This entails that the tendency of importing instruments from Western countries to be used on African populations has always been questioned in as far as reliability and validity are concerned. This is because the tools may not be responsive enough when applied in different settings in Africa.

This scenario was true for Zambian children and adolescents as certain foods and animals as well as some words on the NIHTB-CB; Auditory verbal learning test were found to be culturally irrelevant for them. This prompted some suggested modifications to be instituted to the NIHTB-CB when permission would be granted by the NIHTB-CB developers in terms of the replacing and changing the test items/materials with local and familiar English words and names in a local administration manual which were not limited to; *River (Mumana), Ngoma (Dramu), Ketani (Ma-curtain), Bello (Ngilingili), Mwezi, Garden (Munda), Sukulu, Colour (Khala), Kasote, Kolo, Kalukuluku, Mphuno, Mulimi, Coffee (Kofi, Masamba) and Nyumba*. This shows the importance of subjecting the entire imported instrument to scrutiny through validation processes before recommending it for application in a new setting. The Clinical Laboratory Improvement Amendment-42, (1988) which stipulates that an instrument, which has been borrowed and made to move from one cultural locality to another, has to undergo validation in order to avoid differences in ecological demands, culture and language also advances this notion. As a way to provide a solution to this challenge, the study re-stated administration instructions to the examiner to be presenting instructions in Zambian-accent English and Chinyanja when necessary and this strategy worked for the Zambian children and adolescents as they demonstrated better understanding of the local words and names of test items which formed part of their everyday vocabulary.

Another challenge encountered by children and adolescents when tested with the NIHTB-CB was lack of familiarity with the names of test materials such as food and animals used in the test

due to cultural differences. For instance, the List sorting working memory test had a list of foodstuffs which included Blueberry, Cherry, Strawberry, Lemon, Pineapple, Pumpkin, Banana, Watermelon, Apple, Pear, Hamburger, Popcorn, Peach, Corn, Egg and Orange. Not all of these foodstuffs were common and culturally friendly to the participants in the study. Thus, most of the participants did not understand the names of the foodstuffs asked of them as they sounded strange because they were not common in Zambia. For instance, *corn* is commonly known as *maize* and banana remains banana in Zambian context while other foodstuffs such as blueberry, peach, hamburger and pear may not be widely known as they are quite rare in Zambia.

This finding was in tandem with the findings of Helena-Correia (2013) who contended that depending on country of origin, the names given to certain mundane objects or situations cannot be understood or may be interpreted different because of cultural diversity. “Banana,” for example, can be *plátano*, *banana*, *banano*, *cambur*, *guineo*, *inguri*, and *platanito* depending on whom one converses with. This implies that the issue of universal wording is especially significant in the context of memory-based and image identification tasks, because they involve word retrieval.

Contrary to lack of familiarity with the names of test materials such as food and animals, the NIHTB-CB relied on a computer-assisted evaluation with an audio component; therefore, some of the NIHTB-CB measures posed additional challenges for translation because some wording or the concepts had no equivalent in other languages. Therefore, it is imperative to use clear syntax, simple and common language when translating in order to avoid extreme colloquialisms which contribute to improving comprehension of the English source and to a certain extent that of the translated version, a requirement and standard that the current study adhered to in order to avoid such colloquialisms when translating all the NIHTB-CB tasks as demonstrated by the performance exhibited by the participants in all the aspects of the NIHTB-CB tasks translated versions in a local administration manual.

5.3.1.2 Poor literacy skills by Zambian children and adolescents when tested with the NIHTB-CB

The study found that children and adolescents also demonstrated poor literacy skills especially on Dimensional change card sort test (DCCST) as they were unable to read and understand

instructions during the administration of the NIHTB-CB. Dimensional change card sort test (DCCST) was about popping either colour or shape on the middle of the screen and giving corrective feedback to the participant to point on either colour or shape if one of them appeared on the middle of the screen. Initially, the older participants of ages 12 and above were not given corrective feedback only younger children of ages 8-11 years.

Lack of corrective feedback on the Dimensional change card sort test during the administration for the 12 years and above contributed to poor performance. This was because most of the participants were unable to read and understand instructions without any corrective feedback provided. This implies that participants had poor literacy skills which could have helped them perform well on the Dimensional change card sort test. This finding is in tandem with Mwanza-Kabaghe *et al* (2015) who also found no significant progress in reading levels among the majority of Zambian children as their literacy levels were still remarkably low in spite of a rich language policy in place and some of them being exposed to preschool.

Similar as these findings might be however, Mwanza-Kabaghe (2015)'s study looked at Preschool, executive functions and oral language as predictors of literacy and numeracy skills in first grade in Lusaka Province while the current study validated the NIHTB-CB in assessing cognitive function of children and adolescents aged 8-17 years in Lusaka Province. Therefore, there is a high possibility that some of the children that the current study involved in the validation process of the NIHTB-CB could potentially be the same children in Mwanza-Kabaghe (2015)'s study, considering the passage of time and that the two studies were conducted in Lusaka Province hence, relatively similar findings.

5.3.1.3 Poor numeracy skills by Zambian children and adolescents when tested with the NIHTB-CB

Further, the study found that poor numeracy was also a challenge among children and adolescents as this was evident on the Delis-Kaplan executive function system (DKEFS)-Trail making test (TMT), for which two sub-tasks require rapid, accurate sequencing of numbers (from 1-16) and the alphabet (letters A-P) in order, respectively, and a third sub-task (Number-Letter Switching) which required rapid alternation in the sequencing of numbers *and* letters (1-A,

2-B,) and Oral symbol digit test (OSDT) which required matching symbols with numbers respectively. An explanation provided for this was entirely as a result of lack of exposure to numeracy activities at an early age, a finding that is supported by Clay (1982) and Sulzby (1985) in Mwanza-Kabaghe *et al* (2015) who contended that most children demonstrated poor numeracy skills and that becoming numerate starts long before children receive formal computation instructions. This happens as a result of daily experiences gained through early exposure and numeracy materials as the way to constructing skills and knowledge.

To aid the aforementioned, the study added a brief screening at the beginning of the neuropsychological assessment battery to guide interpretation of the Delis-Kaplan executive function system (DKEFS)-Trail making test (TMT) results. In particular, the researcher asked all participants to read and write (to dictation) letters and numbers in English, and recite the English alphabet and numbers in order. The tasks were presented in the same way for each participant and responses were recorded on a standard data collection sheet. Eventually, the study removed a planned task, the “First Letter” task of the NEPSY Verbal Fluency test; this test involved rapid naming of words beginning with a specific first letter of the English alphabet and depended upon mastery of basic phonemic awareness (understanding of letter-sound correspondences). Further, the study instituted a modification to the NIHTB-CB iPad to start providing instructions in Chinyanja to each and every participant with corrective feedback regardless of their age group. This was done in order to help children and adolescents in reading and understanding of the Dimensional change card sort test (DCCST).

5.4 Validity of the NIHTB-CB among Zambian children and adolescents.

5.4.1 Face (expert) Validity

5.4.1.1 Participants’ comprehension of the NIHTB-CB’ tasks and administration instructions

On the NIHTB-CB’s tasks and administration instructions, the study found that participants’ descriptions and comprehension of the NIHTB-CB task and administration instructions were off target and poor. For instance, when the concept of interest (COI) was food as assessed by the List sorting working memory test, the NIHTB-CB’s instruction of “Corn” was deemed with

“poor comprehension even when instructions were simplified and the response was off target or not related to COI”, an instruction of “Maize” was deemed with “minor difficulties and the response was partially on target or partial correspondence with the COI”, and instruction of “*Milisi*” was deemed with “No difficulties and the response was on target or good correspondence with the COI”. This distinction was guided by a concern that some NIHTB-CB tasks and instructions used unfamiliar vocabulary or because the American-accent English of tasks using pre- recorded instructions limited comprehension.

This finding was in tandem with Franzan (2000) who argued that face validity could affect the decision-making process of potential users of the test because the test scores in and of themselves become meaningless and irrelevant unless they refer to a defined realm of observable and familiar concept of interest. This was true for the Zambian children and adolescents when tested with the NIHTB-CB whose test materials were unfamiliar and irrelevant within the Zambian context. This is because the examiners/experts formed some conclusions about children and adolescents in the study regarding what the NIHTB-CB tests were measuring on the basis of the content/concept of interest or high-level language skills which was not culturally appropriate in Zambia. Therefore, it is imperative to be using the concepts of interest that are meaningful and relevant considering the target population and the setting in order to avoid issues of making wrong judgements that may compromise the effectiveness of the instrument and validity of test outcomes.

4.5.1.2 Examiner/Experts’ perception towards the face validity of the NIHTB-CB

Regarding the face validity of the NIHTB-CB, the findings of the study demonstrated that the subtests of the NIHTB-CB had good and appropriate psychometric properties after some modifications were instituted to the Toolbox as demonstrated earlier in **Table 11**, Chapter Four of the study. This was because most examiners/experts (99-100%) rated the NIHTB-CB’s face validity based on Pattern comparison processing speed test, Flanker test, Dimensional change card sort test, List sorting working memory test, and Auditory verbal learning test as well as Oral symbol digit span test as good and appropriate. This was because face validity was the easiest validation process to undertake yet the weakest form of validity. This has been attributed to its

capacity of only evaluating the appearance of the questionnaire in terms of feasibility, readability, and consistency of style, formatting, and the clarity of the language used.

This finding was consistent with the results of Trochim (2001) and DeVon *et al*, (2007) who argued that face validity is a form of usability rather than reliability and seeks only to determine the clarity of the wording, the likelihood that the target audience would be able to answer the questions and the layout and consistency of style. In spite of the NIHTB-CB subtests demonstrating appropriate face validity, some of its subtests still required to be modified for them to show responsiveness and sensitivity to the Zambian population of children and adolescents. For instance, some of the NIHTB-CB subtests that required some modifications for they did not perfectly suit and perform in a new context of Zambia due to some cultural variations included List sorting working memory test and the NIHTB-CB; Auditory verbal learning test which exposed children and adolescents to different testing materials of both animals and foodstuffs and other strange words which were not common and user friendly to a Zambian child that needed to be localized into Zambian vocabulary. This finding aligns with the results of Weintraub (2013) who found that the psychometric characteristics such as face and construct validity of the NIHTB-CB were appropriate for the entire sample used in her study.

Weintraub (2013) further maintained in her findings that the appropriateness was however, noted with degree of variations in some tests that did not perform tandemly with her expectations due to some testing items which were deemed to be strange and difficult to understand by the participants in the study. This implies that though the psychometric properties of the NIHTB-CB were appropriate and sensitive among Zambian children and adolescents to some extent, there was need to further examine some of these subtests in order to make the NIHTB-CB more sensitive to meet the standard requirements, a recommended procedure and conditions which were considered in the rigorous undertaking of this study. As such, after a thorough examination of all the psychometric properties of the NIHTB-CB which ranged from content validity, face validity, constructs validity, divergent validity, convergent validity and criterion validity, implying that face validity alone could not be relied upon for making an instrument valid as it only takes a qualitative approach which is subjective as opposed to quantitative which is objective in nature.

5.4.2 Content (logical) validity

When the extent to which content validity of the NIHTB-CB was examined, the study found that the content validity of the NIHTB-CB was not representative enough to provide an adequate coverage of the investigative items as most of participants were unfamiliar with the vocabulary and some names of test materials used in the administration of the NIHTB-CB. The content validity of the NIHTB-CB was measured using a List sorting working memory test and Auditory verbal learning test by taking into account and isolating each of the following types of assessment errors namely; perseveration; intrusion and set loss error.

5.4.2.1 The NIHTB-CB; List sorting working memory test

The List sorting working memory test had both foodstuffs and animals as test items. On the part of the NIHTB-CB; List sorting working memory foodstuffs, the test had Blueberry, Cherry, Strawberry, Lemon, Pineapple, Pumpkin, Banana, Watermelon, Apple, Pear, Humberger, Popcorn, Peach, Corn, Egg and Orange. These foodstuffs as cited by List sorting working memory test were neither common nor culturally friendly to the participants in the study. The test also had names of animals which included Bear, Frog, Tiger, Cow, Elephant, Duck (Duckies), Dog, Turtle, Rabbit, Monkey, Butterfly, Cat, Pig, Lion, Bird, Mouse, Horse, Sheep, Camel and Bee.

The names of animals which were used in the NIHTB-CB were not common and familiar to Zambian children and adolescents as they were characterised by a number of set loss errors thereby presenting them with some difficulties to identify and perform. Odgen, Cooper, and Dudley (2003) also found that differences in cultures affect performance on neuropsychological tests when they are administered in cultures different from non-English-speaking populations as different names of things or animals might mean or be represented differently. This is not surprising because most neuropsychological tests are culturally biased since test developers have the tendency to develop tests that evaluate sample activities and behaviours that are valued in their communities as opposed to other settings. These foodstuffs and names of animals were not common and known to Zambian children and adolescents thereby presenting difficulties in identifying them as they were not part of their culture and vocabulary.

In order to ensure familiarity and easy understanding of different foodstuffs as well as names of animals in the NIHTB-CB, the study suggested some modifications to be instituted to the NIHTB-CB, the detail of which has been demonstrated in the suggested local administration manual of the study. Therefore, there was need to localize and use common names of foods and animals such as *Maize (Milisi), Mango, Orange, Bananas, Guavas, Nshima, Watermelon, Chips, Hungry-lion, Drink, Rice and Lemons*. Also, animals and their local and familiar names were *Dog (Galu), Cat (Pusi), Goat (Mbuzi), Bee (Nzimu) Camel (Gamila), Pig (Nkumba), Cow (Ngo'mbe) Horse (Hachi) and Sheep (Mbelele)* which are familiar and commonly used by children and adolescents and form part of their culture and vocabulary.

This finding was further echoed by Helena-Correia (2013) in the United States of America in her study of challenges of using the NIHTB-CB to the non-English speakers which revealed that the only option was translation and linguistic consideration that would create a new version of the NIHTB-CB to enable assessment of speakers who do not speak English or do not speak it well. She further maintained that depending on country of origin, the names given to certain mundane objects or situations could differ. “Banana,” for example, can be *plátano, banana, banano, cambur, guineo, inguri, and platanito* depending on to whom one converse with. This entails that translation of words regarding names of objects is not only recommended for the NIHTB-CB among Zambian children and adolescents but across the globe. By so doing, the-would be participants would participate freely as they could be mentioning the names of either Zambian foods or animals without difficulties thereby making the assessment tests reliable and valid within a specific context.

Furthermore, the study came up with a way of providing a solution to the aforementioned challenge by removing some names of foodstuffs and animals as well as some words and replacing them with the use of translated local and familiar names of foodstuffs such as *Maize (Milisi), Mango, Orange, Banana, Guavas, Pumpkin (Chipushi), Chinanazi, Pawpaw, Watermelon, Rice, hungry-lion and Lemons* which are yet to be implemented in the NIHTB-CB after permission is granted by the NIHTB-CB developers. In addition, animal names were given their local and familiar names such as *Galu, Pusi, Mbuzi, Nzimu, Chule, Nkumba, Mukango, Kanyoni, Kolwe, Ng'ombe, Njobvu, Fulu, Koswe, Kalulu, Gamila, Hachi and Mbelele* which were familiar and commonly used by children and adolescents and formed part of their culture

and vocabulary. Also, these local and familiar names of animals would be added to the NIHTB-CB when permission is granted by the NIHTB-CB developers as they are reflecting in a local administration manual for implementation.

By so doing, children and adolescents participated freely as they could mention by relating the names of either Zambian foods or animals without difficulties thereby making the assessment tests context bound. However, a word of caution must be noted as translation of words in itself is not always enough to enable equivalent translations as it poses some additional challenges. Therefore, in order to translate words in an instrument, it is always necessary to clarify their intended meaning in the particular item as most criteria applied to the development of the English version are not equally applicable to some languages. For instance, the words from the Vocabulary list, if simply translated, do not reflect the same level of difficulty in both languages. In this case, “moribund” belongs to a higher register in English whereas “moribundo” is easier to understand in Spanish.

This contestation was put forward by Helena-Correia (2013) who did a study in the United States of America on the challenges of using the NIHTB-CB to the non-English speakers and argued that Spanish language does not have, for instance, a term to encompass all the negative emotions contained in the multidimensional but simple English concept of “upset.” She further maintained that consideration of language register affects the creation of the NIHTB-CB Spanish version in that for some measures, the criteria applied to the development of the English version are not equally applicable to the Spanish version. Thus, in order to off-set all these translation and linguistic challenges, the current study translated the testing words and administration instructions of the NIHTB-CB from English to Chinyanja and back to English using a back-back translation technique for the purpose of maintaining wording or the concepts of equivalent even translated in other languages.

Similarly, Eremenco, Cella and Arnold (2005) also found and identified similar challenges and problems of “word-heavy” on the NIHTB-CB’s Health Status Questionnaires in Spanish Language which most of the United States (U.S) population were not comfortable with due to cultural and ecological diversity. However, a translatability review of Method for the Translation and Cross-cultural Validation of Health Status Questionnaires was instituted to offer alternative

wording solutions more suitable for a culturally diverse population, for translation, and for the survey's mode of administration focused on the “word-heavy” instruments and recommended different approaches which were adopted for each of the domains based on the specificity of the measures and criteria used to assess translatability which included the universality, cultural relevance, figure of speech or jargon, ambiguity, register, number of words, translation reversal, double-negative, double-barrel, sex and number agreement, parts of speech, oral, written, and mode of administration and technology. These approaches and criteria used to assess translatability of the NIHTB-CB from Spanish to English words also applied to the NIHTB-CB in the current study as most of its administration instructions, testing words and names for testing materials initially, revealed significant translatability issues which have since been worked on and translated in the local and familiar language that is culturally relevant to children and adolescents in the Zambian context.

5.4.2.2 The NIHTB-CB; Auditory verbal learning test

This equally applied to the NIHTB-CB-Auditory verbal learning test, which had different test items and required that participants remembered and recited them in any order to the examiner. These test items included; River, Drum, Curtain, Bell, Moon, Garden, School, Colour, Hat, Parent, Turkey, Nose, Farmer, Coffee and House. Therefore, certain foods and animals as well as some words on Auditory verbal learning test were found not to be culturally relevant and friendly to children and adolescents in Zambia due a number of set loss errors. Kathleen, Wallner-Allen and Fox (2013) also echoed similar results as they contended that the NIHTB-CB had potential threats to validity when complex instructions un-familiar items and testing objects which were not child-friendly were used.

The conflict in having unfamiliar test items prompted some suggested modifications to be instituted to the NIHTB-CB in terms of replacing and changing the test items/materials for implementation when permission would be granted by the NIHTB-CB developers. Therefore, as a way of providing a solution to the aforementioned challenge on auditory verbal learning test, the study suggested to institute by replacing some of the words with the use of local and familiar words and names which were not limited to; *River (Mumana), Ngoma (Dramu), Ketani (Maurtain), Bello (Ngilingili), Mwezi, Garden (Munda), Sukulu, Colour (Khala), Kasote, Kolo, Kalukuluku, Mphuno, Mulimi, Kofi (Masamba) and Nyumba* with the permission from the

NIHTB-CB developers. The whole essence of retaining and replacing some of the NIHTB-CB test words with local and familiar administration instructions and words was to come up with a comprehensive translation methodology that would produce a universal Chinyanja version appropriate for the majority of Zambian children and adolescents.

5.4.3 Construct validity

Construct validity was examined based on both divergent validity and convergent validity of the NIHTB-CB. Based on divergent validity, the results of the study demonstrated that the NIHTB-CB was sensitive enough to discriminate between different groups.

5.4.3.1 Divergent validity

In the study were two groups of individuals, those who were Human Immune Virus (HIV) infected (HIV+) children and those that were HIV-exposed, uninfected (HEU). In terms of discriminating between different groups based on performance regarding the NIHTB-CB tests, HIV infection (HIV+) performed below average as opposed to their counterpart the HIV-exposed, uninfected (HEU) who performed above average on the NIHTB-CB tests. This finding was not only observed in Zambia but also in Netherlands by Cohen and Ter Stege (2015) on their study of Poorer Cognitive Performance in Peri-natally Human Immune Virus (HIV)-Infected Children versus Healthy Socioeconomically Matched Controls and Boivin *et al* (2017) in the United States of America who focused on Neuropsychological Outcomes in a Two-year African-Based Pediatric Observational Study and argued that Human Immune Virus (HIV) infected children perform poorly on tests of cognitive function as opposed to their counterpart (HEU). A reason enough that could be attributed to poor performance as they scored worse on almost all the cognitive domains of the NIHTB-CB such as working memory, processing speed, executive function, episodic memory, attention and language. This explains and justifies how the NIHTB-CB's sensitivity in Zambia was as it could discriminate between different groups of individuals in this study based on the NIHTB-CB scores in the expected direction, with the HIV-infected group performing lower than the HEU group. This therefore, suggests that the NIHTB-CB is a promising instrument to be utilized for testing of Human Immune Virus (HIV)-associated cognitive disorders among Zambian children and adolescents.

5.4.3.2 Convergent validity

When *z_unit2_iq* (UNIT-2 Abbreviated IQ Standard Score) was interrogated in the study and correlated with Average NIHTB-CB Z-score, the study's findings demonstrated that there was a statistically significant positive relationship between *z_unit2_iq* (UNIT-2 Abbreviated IQ Standard Score) and average performance on the NIHTB-CB Z-score. This was because testing at an alpha of ($r=0.43$; $p<0.001$), there was sufficient statistical evidence to conclude that there was a statistically significant positive relationship between *z_unit2_iq* (UNIT-2 Abbreviated IQ Standard Score) and average performance on the NIHTB-CB Z-score.

This finding was in tandem with the results of the following studies (Zuilkowski *et al*, 2016; Mwanza-Kabaghe *et al*, 2015; Serpell and Jere-Folotiya, 2008), which used a full standardised neuropsychological test battery with *z_unit2_iq* (UNIT-2 Abbreviated IQ Standard Score) being a major instrument and was able to show consistent, reliable and valid results in identifying cognitive function and establishing levels of general intelligence among children in both urban and rural Zambia with other tests. This significance relationship in correlation between *z_unit2_iq* (UNIT-2 Abbreviated IQ Standard Score) and average performance on the NIHTB-CB Z-score, entails that the NIHTB-CB is valid and therefore shows consistency and reliable results in a manner a gold standard of neuropsychological test battery does because the two batteries of cognitive tests; the neuropsychological test battery and the NIHTB-CB have demonstrated invariance. This suggests that *z_unit2_iq* (UNIT-2 Abbreviated IQ Standard Score) which measured the general intelligence among children and adolescents in the study had a significance relationship with the NIHTB-CB test performance, implying that the NIHTB-CB can widely be used as an innovative tool as opposed to a traditional neuropsychological test battery as it has been fully modified to assess the cognitive functions of the Zambian population of children and adolescents.

5.4.4 Criterion validity

Criterion validity focused on the ability of the NIHTB-CB to screen for neurological and behavioral functions (cognitive impairment) with the help and application of the Receiver operating characteristics (ROC) curve. The Receiver operating characteristic (ROC) curve analysis helped to determine the optimal cut-off point and suggested reasonable sensitivity (81)

and specificity (76) of the NIHTB-CB for detecting cognitive impairment (benchmarked against the reference-gold standard of traditional neuropsychological measures, with a threshold of 0.80-1.00). **Figure. (13)**; therefore, demonstrates that the NIHTB-CB performed well with the ROC curve demonstrating an Area Under the Curve (AUC) of .85 (95% CI 0.8-0.91), implying that the NIHTB-CB was .85 accurate in assessing cognitive function among children and adolescents in Zambia equivalent or within a threshold of a gold standard of full neuropsychological testing battery whose precision level was between 0.80-1.00. This entails that the precision level of the NIHTB-CB lies within a significant and acceptable threshold of .80-1.00 of a gold standard of full neuropsychological testing battery as observed and recommended by Maina et al, (2019); Sackett *et al*, (1997 and Metz, (1978). This was so, because the most appropriate cut-off point was a trade-off between sensitivity and specificity which was at .41. The optimal cut-off for the NIHTB-CB (sensitivity 81, specificity 76). Since the NIHTB-CB was meant to be used as an interventional, diagnostic and screening tool, the optimal cut-off point was one with high sensitivity and an acceptable specificity which helped in the identification of cognitive impairment.

In the same vein, the study further demonstrated that the NIHTB-CB was sensitive to categorize and classify the respondents/participants on the three levels of impairments. For instance, 62 children and adolescents were classified as having asymptomatic neurocognitive impairment (ANI), while 69 had mild neurocognitive disorder (MND) and 14 had HIV-Associated Dementia (HAD) using the Frascati diagnostic criteria with the help of a correct and appropriate optimal cut-off point and threshold. This entails that, 69 and 62 children and adolescents had a neuropsychological performance of at least 1 SD below demographically matched normative scores in least 2 cognitive domains while 14 had a neuropsychological performed of at least 2 SD below demographically matched normative scores in at least 2 cognitive domains. This finding is in tandem with the requirements and conditions of Frascati diagnostic criteria as observed by Antinori (2006).

Similarly, Shapiro, Solari and Petscher, (2008) echo the principle and concept of categorization/classification as spelt out by Frascati diagnostic criteria as they argued that a high and sensitive diagnostic or screening tool with correct and appropriate ROC analysis is usually used with increased frequency particularly in examining or categorizing individuals with various

conditions such as obsessive-compulsive disorder neuropsychological, and cognitive impairment among other related disorders. This implies that any diagnostic or screening tool should have an appropriate optimal cut-off points and thresholds that would maximize sensitivity in order to correctly identify and include all the respondents/participants with attributes of interest (*cognitive function/impairment*) and minimize on specificity with the intention of correctly classifying the respondents/participants without the attributes of interest. Such an instrument should be recommended for utilization in screening and interventional programmes as it would be able to pinpoint and distinguish the exact attributes of interest for a quick and alternative interventions.

Further, a local study by Chipimo and Fylkesnes (2010) also applied the concepts of ROC analysis and found that the most appropriate cut-off point was a trade-off between sensitivity and specificity, one with high sensitivity and an acceptable specificity similar decision and technique as utilised by the current study. While the principles of optimal cut-off point were a trade-off between sensitivity and specificity, one with high sensitivity and an acceptable specificity based on the ROC analysis were invariant in both studies. However, Chipimo and Fylkesnes (2010)'s study validated different screening instruments among primary health care clinic attendees and also assessed the face, content and criterion validity of the Self-Reported Questionnaire (SRQ). He further maintained by determining the most commonly reported symptoms for mental in Lusaka, Zambia using a Diagnostic and Statistical Manual of Mental Disorder 4th Edition as a gold standard. On the other hand, the current study validated the entire NIHTB-CB with the help of a gold standard of a full neuropsychological test battery by scrutinizing the psychometric properties of the NIHTB-CB against that of a full neuropsychological test battery as a benchmark. After a successful validation process of a novel innovation of the NIHTB-CB in Zambian context, the study further recommends it for use in schools and health centres in assessing cognitive function and detecting cognitive impairments for appropriate placement options. The study also endeavours to customize the NIHTB-CB through instituting a number of modifications to be the first reliable and innovative tool, friendly-to-use especially for cognitive functioning among children and adolescents in Zambia.

5.4.4.1 The NIHTB-CB vs Parental ranking of intelligence and school performance

The study demonstrated criterion validity by correlating the NIHTB-CB scores with parental ranking of intelligence and school performance using a 5-point Likert scales in which the results revealed that 80-90% of parent rankings of children's intelligence with statistical evidence level at alpha of ($r=0.25$, $p<0.001$) and school performance at ($r=0.40$, $p<0.001$), suggested moderate to strong correlation with the NIHTB-CB score and a small number (1%) of parents ranked their children's intelligence otherwise. This showed that the rankings of parents about their children's intelligence and school performance matched with the results that the NIHTB-CB displayed on its spreadsheet records. This indicates how sensitive the NIHTB-CB was to be utilised in assessing cognitive function in Zambia, as it was able to synchronise verbal rankings of information and the actual test performance as exhibited by the children on the NIHTB-CB.

This was also true in relation to parents' ranking about their children's overall school performance and intelligence as observed by Akshoomoff (2014) who looked at the associations of Toolbox cognitive scores with reported school performance and intelligence ratings of parents and reported a strong correlation between parents' ratings about their children's overall school performance and intelligence. Though, subjective in nature, the rankings of intelligence and school performance could be attributed to good executive function among children and adolescents. For instance, 90% of participants exhibited good executive function skills in all the subdomains of executive function which included; inhibitory control, self-monitor, shift, initiate, working memory, plan/organize, task-monitor and organisation of materials. Similar results were echoed by Mwanza-Kabaghe *et al*, (2015); Kalumba, (2017); Simlesa, Cepanec and Ljubsic, (2017), although investigated the link and role of executive functions in promoting numeracy, literacy and language comprehension skills in preschoolers and second graders in schools. This shows how important executive function is in improving academic performance through improved numeracy, literacy and language comprehension skills and calls for concerted efforts from the relevant authorities particularly in the Ministry of education in planning school activities that are rich and stimulative in order to enhance executive function skills among school going children.

The NIHTB-CB's accuracy in reporting and capturing the relationship between parent rankings and school performance shows that the NIHTB-CB is reliable and valid to be utilised among Zambian children and adolescents though with caution because parent's rankings of children's intelligence was subjective based on a 5 Point-Likert scale which in one way or another could be bias to the extent of either over or underrating the intelligence of their children. Additionally, there is also a contestation that intelligence may not be a good predictor of school performance as it is compounded with numerous cultural factors as observed by Gottfredson (1997) who argues that there is a prevailing agreement that intelligence predicts many achievements also outside the school realm. For instance, what constitutes intelligence in one setting/locality's culture may vary from another setting/locality. However, the findings of this study reported a positive significant relationship between intelligence and school performance of children based on the rankings from parents and performance on the NIHTB-CB tests. Therefore, the NIHTB-CB should be made readily available for public appreciation especially to the stakeholders in the Ministry of Education to adopt it for use as a yardstick in the institutions of learning particularly in schools for assessment protocols to help with the decision-making process for placement purposes of children with and without special needs in schools.

5.5 Relationship between the composite Z-score of the standardized neuropsychological test battery and the composite scaled-score of the NIHTB-CB

5.5.1 Convergent validity

Convergent validity was demonstrated through determining the relationship between the composite Z-score of the standardized neuropsychological test battery and the composite scaled-score of the NIHTB-CB. On whether or not there was a relationship between the composite Z-score of the standardized neuropsychological battery test across all 8 cognitive domains and the composite scaled-score of the NIHTB-CB test in assessing children and adolescents aged 8-17 years, the findings of the study demonstrated that there was a positive correlation between the NIHTB-CB's composite score with the composite Z-score of the standardized neuropsychological battery test across all 8 cognitive domains with a level of significance at alpha of ($r=0.68$, $p<0.001$). This implies that the NIHTB-CB could have in one way or another met the ecological requirements within the Zambian context as its composite score presented no significant different with that of standardised neuropsychological test battery across all 8

cognitive domains which was used as a gold standard in the study. Therefore, refuting the assertion that there is a differences between the composite Z-score of the NIHTB-CB and the composite Z- score of a standardized neuropsychological test battery.

This finding was in agreement with the theory of classical test or true score theory by Lord and Novick (1968) on which the study was grounded which states that there must be no difference in the test outcomes between tool **A** and tool **B**, where tool **A** (Full neuropsychological test battery) is a gold standard and tool **B** (NIHTB-CB) is a test tool as demonstrated by the results of the study with a positive strong relationship between the two instruments. This finding was further supported by Spearman (1902) who asserts that the principle of correlation stipulates that the relationship between test scores must be invariant as the case is with the finding in this study regarding the relationship between the composite score of the NIHTB-CB and the composite score of a standardised neuropsychological testing battery.

Despite the strong correlation ($r=0.68$; $p<0.001$) between the composite score of the NIHTB-CB and the composite score of a standardised neuropsychological testing battery, when the NIHTB-CB and the Non-NIHTB-CB domain-based comparison measures were further correlated using pairwise correlation, the results of the study demonstrated that correlations were low to moderate. For instance, there was a low to moderate positive correlation ($r=0.419$) between Picture comparison processing speed test and Trail making test condition 1, ($r=0.454$) between Oral symbol digit test and Trail making test condition 1, ($r=0.294$) between 9-hole pegboard test and Trail making test condition 5, ($r=0.403$) between Auditory verbal learning test and CVLT-C-List A Total Trail 1-5 Z-score, ($r=0.291$) between the NIHTB-List sorting working memory and Non-NIHTB-Digit span total, ($r=0.121$) between NIHTB-List sorting working memory and CVLT-C-Trail 1, ($r=0.152$) between NIHTB-Flanker and Pencil tapping, ($r=0.231$) between the NIHTB-DCCs and Wisconsin card sorting test total score and ($r=0.376$) between the NIHTB-DCCS and Trail making test condition 4.

In this case, the lowest/weakest correlation was established between the NIHTB; List sorting working memory test and the California verbal learning test-Children (CVLT-C)-Trail 1 at ($r=0.12$; $p<0.018$) while the highest/strongest correlation was at (0.45 , $p<0.001$) between the

NIHTB-CB-Oral symbol digit and Delis-Kaplan executive function system (D-KEFS)-Trail Making Test condition 1; as illustrated in Table 16; in chapter four of the study. The low to moderate correlations with individual neuropsychological tests measuring the similar or related constructs in some cases was attributed to numerous reasons and some of them were the fact that each NIHTB-CB subtest measures multiple constructs, at the same time measuring speed and accuracy which could not be easily disaggregated. For instance, the NIHTB-CB Flanker test measures set shifting and inhibition of pre-potent responses, but also processing speed. In addition, that the assessment tests for NIH-CB battery and a standard of full Neuropsychological Test Battery were not conducted on the same day but a month apart. This implies that a correlation was high and strong when an average composite score of the NIHTB-CB was paired with an average composite score of the non-NIHTB-CB as opposed to individual variable correlations. So, in order to be assured of high, accurate and strong correlation power, there is need to adopt the strategy of combining all performance-based measures into a global measure of cognitive function and transform it into a Z-score referred to as the Neuropsychological Global Composite Z Score (NPZ) as demonstrated in the study between the NIHTB-CB composite score against the composite score of the standardised neuropsychological testing battery.

5.6 Originality of the Thesis

The originality of this thesis took shape in the second year or phase II of the study which was characterized by massive modifications made to the classical United States (U.S) NIHTB-CB. Through a number of modifications, the NIHTB-CB developed a novel innovative design that depicted and encompassed the cultural aspirations of the Zambian context. In view of this, the originality that the study contributed was applicable at both operational and strategical levels. Operational originality in the sense that there have been some novel inclusions in terms of test items to the operating system of the NIHTB-CB through the validation process. Similarly, strategical originality was also realised in that, the Zambian validated NIHTB-CB has been made suitable for use as an innovative tool as opposed to a traditional neuropsychological test battery for the assessment of cognitive function in children and adolescents in Lusaka Province.

For the operational and strategical originality to be realised in the study, first and foremost, the NIHTB-CB that were designed based on the United States (U.S) culture, values and beliefs across gender, race/ethnicity, and socioeconomic status groups were modified to suit the

Zambian context by the removal of the NIHTB-CB-Picture vocabulary test-4th edition (PVT-IV) from their respective test batteries soon after the study was initiated and realization was attained that the test had challenges of cultural boundedness. In the light of this, the NIHTB-CB in its modified state has no PVT-IV. To compensate for this modification, a Zambia-adapted version was considered but also deemed not suitable for the main sample of children ≥ 8 years old, as it was developed with item content only suitable for younger children ≤ 6 years old, a scenario that would have led to ceiling effects with the sample which enrolled adolescents as old as 19 years of age. Similarly, administration instructions and task stimuli were modified by re-stating using Zambian-accented English and administration instructions could also be presented in Chinyanja when necessary. However, this did not make the researcher translate task stimuli themselves due to similar concerns as with the PVT-IV.

Another novel knowledge that the current study could claim to have contributed to the pool of knowledge is that since the Toolbox used United States (U.S)-based English in administration to the Zambian population of children and adolescents who lacked the required level of English language skills, the study instituted several solutions. First, test instructions for all NIHTB-CB and neuropsychological assessments have been translated/back-translated by local staff into Chinyanja, the vernacular language throughout the Lusaka community. Test stimuli were not translated, as this would have necessitated re-validation of the measures and establishment of vocabulary (in Chinyanja) of similar frequency and difficulty level as in English.

When respondents presented for study visits, local study staff ascertained their ability to converse and understand task instructions in English vs. Chinyanja, and proceeded accordingly with the cognitive assessments (NIHTB-CB and neuropsychological battery). They added a field to the data collection forms to indicate whether task instructions were presented in English or in Chinyanja in order to account for any challenge.

Further, originality about this thesis in terms of novel knowledge contributed to the body of empirical evidence is that the study innovatively replaced and modified the content validity of the NIHTB-CB which had two parts; NIHTB-CB; Auditory verbal learning test and NIHT-CB-List sorting working memory test. On the part of the NIHTB-CB; Auditory verbal learning test

were testing items which included the River, Drum, Curtain, Bell, Moon, Garden, School, Colour, Hat, Parent, Turkey, Nose, Farmer, Coffee and House which were mentioned and given by the NIHTB-CB iPad with an American English-accent which was not culturally appropriate and context bound and has since been suggested to be replaced by some local and familiar words and names which included *River (Mumana), Ngoma (Dramu) Ketani (Ma-curtain), Bello (Ngilingili), Mwezi, Garden (Munda), Sukulu, Colour (Khala), Kasote, Kolo, Kalukulu, Mphuno, Mulimi, Coffee (Kofi) and Nyumba* to be implemented once permission is granted by the NIHTB-CB developers.

Furthermore, this innovation in contribution to the body of knowledge was also appreciated on the part of the NIHTB-CB; List sorting working memory test foodstuffs such as Blueberry, Cherry, Strawberry, Lemon, Pineapple, Pumpkin, Watermelon, Apple, Pear, Hamburger, Popcorn, Peach, Corn and Egg which were not common and culturally friendly to the participants in the study. The study instead instituted local and familiar names of foodstuffs such as *Banana, Orange, Mango, Guava and Maize (Milisi)*. For instance, corn is commonly known as maize in Zambian setting while other foodstuffs such as blueberry, peach, hamburger and pear were not known as they were quite rare in Zambia, hence, removed and replaced.

On the part of the NIHTB-CB; List sorting working memory test were names such as Bear, Frog, Tiger, Cow, Elephant, Duck (Duckies), Dog, Turtle, Rabbit, Monkey, Butterfly, Cat, Pig, Lion, Bird, Mouse, Horse, Sheep, Camel and Bee. Modifications were suggested to be instituted to the NIHTB-CB; List sorting working memory test by replacing names of animals with some local and familiar words and names to *Dog (Galu), Cat (Pusi), Goat (Mbuzi), Bee (Nzimu), Frog (Chule), Pig (Nkumba), Lion (Mukango), Bird (Kanyoni), Monkey (Kolwe), Cow (Ng'ombe), Elephant (Njobvu), Tortoise (Fulu), Rat (Koswe), Rabbit (Kalulu), Horse (Hachi) and Sheep (Mbelele)* which were familiar and commonly used by children and adolescents and form part of their culture and vocabulary but not yet so because permission has to be sought from the NIHTB-CB developers.

The study also added an innovation of a brief screening at the beginning of the neuropsychological assessment battery to guide interpretation of the Delis-Kaplan executive function system (D-KEFS)-Trail Making Test (TMT) results. In particular, the researcher now

asks all participants to read and write (to dictation) letters and numbers in English and recite the English alphabet and numbers in order. The tasks are presented in the same way for each participant and responses are recorded on a standard data collection sheet. Finally, the study has removed a planned task, the “First Letter” task of the NEPSY Verbal Fluency test; this test involved rapid naming of words beginning with a specific first letter of the English alphabet and depends upon mastery of basic phonemic awareness (understanding of letter-sound correspondences). Further, the study has since instituted a modification to the NIHTB-CB iPad battery to start providing instructions in Chinyanja to participant with corrective feedback regardless of their age group as opposed to giving corrective feedback only to younger children of ages 8-11 years. This was done in order to help these children and adolescents in reading and understanding the Dimensional change card sort test (DCCST).

The other novel knowledge of this study is that it was unique and the first of its kind to have endeavored to validate the NIHTB-CB based on a composite test score strategy and made it feasible to administer to Zambian children and adolescents in Lusaka Province. In this regard, the study staged a comparison or correlations between the NIHTB-CB tasks with traditional or standardised neuropsychological measures in this population and demonstrated a strong positive relationship between the NIHTB-CB composite test score with a traditional neuropsychological composite test score.

Further, this study is unique and first of its kind to have used a traditional neuropsychological test battery as a gold standard with a predetermined threshold of .80-1.00 to validate the NIHTB-CB by interrogating their psychometric properties. Similarly, the application of concepts of Receiver operating characteristic (ROC) curve was achieved by determining the optimal cut-off point and the area under the curve (AUC) which was .85 at (95% CI) after having a tradeoff balance between sensitivity which is a true positive rate and specificity as a false positive rate as opposed making agreements based on Kappa strategy.

Furthermore, the study has also demonstrated novel knowledge contribution in an area of the NIHTB-CB being made sensitive enough to distinguishes between Zambian children and adolescents with HIV infection and HIV-exposed, uninfected children and adolescents based on the NIHTB-CB test scores. This was so, because children and adolescents with HIV infection

scored significantly lower on the NIHTB-CB as compared to those who were HIV-exposed but uninfected.

Note that! According to the University of Zambia Intellectual Property Rights Policy (2009) which states that any matters related to intellectual property rights in academic research are recognised with the need to take particular care and protect the interests of all the students and stakeholders who contribute in the process of innovations and inventions and further mandated to facilitate the registration process of such innovations or inventions with Patent Companies Registration Agency (PACRA), bearing the proprietor’ details/initials. This is also in tandem with the Registered Industrial Design Act Chapter 402 of the National Intellectual Policy of 2009 which;

Provides for intellectual property rights that protect the visual design of objects or models. The registration of a design under Zambian law gives to the registered proprietor copyright protection in the registered design for a period of five years from the date of registration after which it can be renewed.

Therefore, based on the National and University of Zambia Intellectual Property Rights Policy, there is need to **re-name** a classical United States (U.S) NIHTB-CB with suggested modifications which have been fully functions within the Zambian context using Principal Investigator’s Details/Initials as follows (**PEKA’S MODIFIED NIHTB-CB**) which is grounded on the prevailing cultural conditions, circumstances and upon which it has been instituted through the validation process.

Table 5.17: A summary of theorisation process towards the originality of the thesis.

Classical U.S. NIHTB-CB	NIHTB-CB’s limitations in Zambia	PEKA’s Modified NIHTB-CB
Use of U.S. English Accent in Administration	Poor comprehension skills	<i>Suggested use of Zambian English Accent and Chinyanja.</i>
Sensitivity-.90	Sensitivity-.65	<i>Sensitivity-.81</i>
Specificity-.85	Specificity-.60	<i>Specicificity-.76</i>
Area under the Curve-.95	Area under the Curve-.55	<i>Area under the Curve-.85</i>

Presence of Picture Vocabulary Test 4 th Edition.	Poor performance (Only a small number 1%)	<i>Suggested Zambian Translated Version.</i>
NIHTB-CB's List Sorting Working Memory.	Poor Performance (Only a small number 1%)	<i>Suggested use of local names of foodstuff and animals.</i>
NIHTB-CB's Auditory Verbal Learning Test	Poor Performance (Only a small number 1%)	<i>Suggested use of local and familiar words.</i>
Required High Levels of Literacy Skills.	Poor performance (Only a small number 1%)	<i>Suggested to recite English Alphabet Letters from A-Z.</i>
Required High Level of Numeracy Skills.	Poor Performance (Only a small number 1%)	<i>Suggested to count numbers from 1-20 Forward and 20-1 Backward.</i>
Corrective Feedback provided on Dimensional Change Card Sort Test to 12 years and below children.	Poor Performance (Only a small number 1%)	<i>Suggested corrective Feedback provided on Dimensional Change Card Sort Test to all children regardless of age.</i>

5.7 Summary of the chapter

This chapter discussed the findings of the study. It started by discussing information on the standardised administration of the NIHTB-CB and found that the installation qualification (IQ) of the NIHTB-CB was done in accordance with the manufacturers' specifications and its operation qualification (OQ) operated as expected by the manufacturer as it spelt out considerable details on standardised administration conditions and instructions. The performance qualification (PQ) in terms of psychometric properties of the NIHTB-CB to some extent had appropriate face and construct validity, with the exception of the Picture vocabulary test and Dimensional change card sort test which performed poorly due to requiring high levels of English language skills.

Further, the study found that children and adolescents encountered a number of challenges when administered with the NIHTB-CB such as poor skills in comprehending task instructions, poor literacy and numeracy skills, and were unfamiliar with most of the NIHTB-CB test materials on both List sorting working memory and Auditory verbal learning test. Additionally, the found that

to some extent, the face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity were not valid but after modifications were instituted to the NIHTB-CB, it was made valid for use in the Zambian population of children and adolescents. Furthermore, the study found a significantly strong correlation ($r=0.68$, $p<0.001$) between the composite Z-scores of the standardized neuropsychological battery test across all 8 cognitive domains with the composite scaled-score of the NIHTB-CB test. The subsequent chapter presents the conclusion and recommendations based on the findings of the study.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Overview

This study was conducted with the intention to validate the NIHTB-CB by following its standardised procedures of administration, in the process ascertaining the challenges encountered by Zambian children and adolescents as it was designed for the United States (U.S) population, also determine the extent to which the NIHTB-CB was valid based on face validity, content validity, constructs validity, divergent validity, convergent validity and criterion validity in assessing the cognitive function. This was on the premise that empirical evidence in instrument validation confirms the critical part these dynamics play during instrument adoption and validation processes.

The purpose of this study was precisely to validate the NIHTB-CB in the population of Zambian children and adolescents by comparing its composite score against the composite score of the standardised neuropsychological battery testing as a gold standard. The study also endeavored to establish and address the challenges encountered by the Zambian children and adolescents in the administration of the NIHTB-CB in its classical United States (U.S) version. The study further aimed at determining the extent to which the psychometric properties of the NIHTB-CB in terms

of content validity, face validity, constructs validity, convergent validity, discriminant validity and criterion validity were valid in assessing the cognitive function of children and adolescents in Zambia and later suggest, if necessary, some modifications to the NIHTB-CB with respect to the prevailing ecological validity in the light of the Zambian context.

Validating assessment instruments regarding cognitive functions attends to and improves many areas in educational psychology. The first purpose being providing evidence in order to make the users able to trust the results, make judgments and some critical appraisal of remaining knowledge gaps. Another purpose was to make the validator sort and sift among the myriad possibilities to identify the assessment solutions that best meets his or her immediate needs with some potential solutions include selecting an existing instrument, adapting an existing instrument, combining elements of several instruments, or creating a novel instrument from scratch and lastly, equipping the validators with skills and knowledge not only about trustworthiness of scores, but also the logistics and practical issues such as cost, acceptability, and feasibility that arise during test implementation and administration. A summary of the most significant study findings is presented below as follows;

6.2 Conclusion

The study employed an explanatory sequential research design mixed method in a longitudinal study conducted in Lusaka Province aimed at validating the NIHTB-CB by comparing its cognitive measures against that of a full standardised neuropsychological testing battery in assessing the cognitive function of 389 successful cases of children and adolescents in Zambia. Standardised full neuropsychological testing battery was used as a gold standard.

6.2.1 Standardised administration of the NIHTB-CB

On the standardised administration of the NIHTB-CB, the study considered the three principles of instrument validation namely; Installation qualification, Operation qualification and Performance qualification. On installation and operation qualifications, the study found that the NIHTB-CB and its subsystems were installed in accordance to manufacturer's specifications and operated as expected by the manufacturer. Further, the performance qualification of the NIHTB-CB was found not to be good and appropriate. This was because certain tests were not culturally appropriate and applicable because the NIHTB-CB tasks used vocabulary and concepts were

U.S.-centric and familiar to Western audiences but not encountered in everyday life by children in Zambia and this required translations when administered to the Zambian children and adolescents.

6.2.2 Challenges encountered by Zambian children and adolescents when tested with the NIHTB-CB

With regard to challenges encountered by the Zambian children and adolescents during the NIHTB-CB administration, the study established lack of English language skills and actual constructs. This was because Zambian children and adolescents performed poorly on the NIHTB-CB tests such PVT-IV, List sorting working memory test and Auditory verbal learning test which required high levels of English language skills because the tests were designed based on the U.S culture, values and beliefs across gender, race/ethnicity, and socioeconomic status groups. In order to address this challenge, the study came up with some suggested solutions. Such solution to the aforementioned challenge was the removal of the NIHTB-CB-(PVT-IV) from their respective test batteries soon after the study was initiated and realization attained that the test had challenges of cultural boundedness.

In the light of this, a Zambia-adapted version was considered but also deemed not suitable for the main sample of children ≥ 8 years old, as it was developed with item content only suitable for younger children ≤ 6 years old. This would have led to ceiling effects with the sample which enrolled adolescents as old as 19 years of age. Where feasible for the NIHTB-CB tasks (when it would not interfere with task performance), instructions and task stimuli were modified by re-stating using Zambian-accented English and administration instructions could also be presented in Chinyanja when necessary. However, this did not make the researcher translate task stimuli themselves due to similar concerns as with the Picture vocabulary test (PVT-IV).

Additionally, the study found that children and adolescents also demonstrated poor literacy especially on Dimensional change card sort test (DCCST) as they were unable to read and understand instructions during the administration of the NIHTB-CB. Also, the study found poor numeracy on the Delis-Kaplan executive function system (DKEFS)-Trail making test (TMT), for which two sub-tasks require rapid, accurate sequencing of numbers (from 1-16) and the alphabet (letters A-P) in order, respectively, and a third sub-task (Number-Letter Switching) requires

rapid alternation in the sequencing of numbers and letters (1-A, 2-B,) and so on in order respectively.

A plausible explanation provided for this was entirely as a result of lack of exposure to literacy at an early age. As a way of addressing concerns related to limited literacy skills, the study added a brief screening at the beginning of the neuropsychological assessment battery to guide interpretation of the Delis-Kaplan executive function system (DKEFS)-Trail making test (TMT) results in which the assessor now asked all participants to read and write (dictation) letters and numbers in English, and recite the English alphabet and numbers in order. Finally, the study had removed a planned task, the “First Letter” task of the NEPSY Verbal Fluency test. This test involved rapid naming of words beginning with a specific first letter of the English alphabet and depended upon mastery of basic phonemic awareness (understanding of letter-sound correspondences). The NIHTB-CB iPad was then able to provide instructions in Chinyanja with corrective feedback regardless of age.

6.2.3 Validity of the NIHTB-CB.

The study demonstrated that the psychometric properties in terms of the face validity and construct validity of the NIHTB-CB were good and appropriate. However, content invalid was initially found surrounding the NIHTB-CB; List sorting working memory test with the names of foodstuffs such as Blueberry, Cherry, Strawberry, Pineapple, Apple, Pear, Hamburger, Popcorn, Peach, Corn and names of animals such as Bear, Frog, Tiger, Cow, Elephant, Duck (Duckies), Turtle, Rabbit, Butterfly, Mouse, Horse, Sheep, Camel and Bee. The NIHTB-CB’ content has since been made validity by localizing to ensure familiarity and easy understanding of different foodstuffs as well as names of animals such as Maize (*Milisi*), *Mangoes*, *Oranges*, *Bananas*, *Quavas* and *Lemons*. Also, animals and their local names ranging from Dog (*Galu*), Cat (*Pusi*), Goat (*Mbuzi*), Bee (*Nzimu*), Frog (*Chule*), Pig (*Nkumba*), Lion (*Mukango*), Bird (*Kanyoni*), Monkey (*Kolwe*), Cow (*Ng’ombe*), Elephant (*Njobvu*), Tortoise (*Fulu*), Rat (*Koswe*), Rabbit (*Kalulu*), Horse (*Hachi*) and Sheep (*Mbelele*) which were familiar and commonly used by children and adolescents and form part of their culture.

On the NIHTB-CB Auditory verbal learning test, there were words such as River, Drum, Curtain, Bell, Moon, Garden, School, Colour, Hat, Parent, Turkey, Nose, Farmer, Coffee and

House. The study replaced some of the words with the use of local and familiar words and names such as *Mumana*, *Ngoma* (Drum), *Ma-curtain* (Ketani), *Bello* (Ngilingili) , *Mwezi*, *Garden* (Munda), *School* (Sukulu), *Colour* (Khala) , *Kasote*, *Kolo*, *Kalukulu*, *Mphuno*, *Mulimi*, *Coffee* (Kofi) and *Nyumba*.

With regard to divergent validity, the study demonstrated that the NIHTB-CB was sensitive enough to discriminate between different groups of those who were Human Immune Virus (HIV) infection (HIV+) children and those that were HIV-exposed, uninfected (HEU). The discrimination was based on the NIHTB-CB function tests performance. In terms of other variables, the study established a significant positive correlation between *z_unit2_iq* (UNIT-2 Abbreviated IQ Standard Score) and average performance on the NIHTB-CB Z-score ($r=0.43$, $p<0.001$). However, a significant negative correlation was shown between bistotal (brief impairment score total) and *z_average* NIHTB-CB ($r=-0.23$, $p<0.001$) and between class rank and Average NIHTB-CB Z-score ($r=-0.10$, $p=0.202$).

6.2.4 Relationship between the Composite scores of the NIHTB-CB and a standardised neuropsychological testing battery

With regard to criterion validity and convergent validity, overall, the NIHTB-CB demonstrated good criterion validity at the optimum cut off point of .41 with the area under the curve (AUC) being .85 with good and appropriate sensitivity and specificity (81 and 76 respectively). The composite score of the NIHTB-CB highly correlated with the composite score of the standardised neuropsychological testing battery (0.68, $p<0.001$), notwithstanding the fact that when the NIHTB-CB and non-NIHTB-CB domain-based comparison measures were correlated individually, the results demonstrated that pairwise correlations were low to moderate ($r=0.12$, $p<0.018$) due to multiplicity of domains as well as measuring of accuracy and processing speed by the NIHTB-CB which may be difficulty to aggregate. The study also demonstrated a significant positive correlation between the NIHTB-CB scores with parental ranking of intelligence ($r=0.25$, $p<0.001$) and school performance at ($r=0.40$, $p<0.001$). The correlation between the results of the NIHTB-CB and a gold standard of neuropsychological test battery shows the relevance and applicability of classical test theory which guided and informed the study.

Table 6.18: A summary on the effectiveness and advantages of a Zambian validated NIHTB-CB over a traditional of full neuropsychological testing battery

The NIHTB-CB	Traditional neuropsychological test battery
<i>The NIHTB-CB's measurement precision is .85, which lies within the acceptable and standardised threshold.</i>	Neuropsychological Testing Battery's measurement precision .80-1.00
<i>Innovation and adaptive for change in measurement.</i>	Traditional and rigid in administration
<i>Electronic and ipad based battery</i>	Paper work based battery
<i>Takes only approximately 30-45 minutes for administration (Less time consuming)</i>	Takes approximately about 1 hour 30 minutes for administration (Time consuming)
<i>Self-computerised with a provision of a spread-sheet for results</i>	Computes the test results manually
<i>Self-administration with instructions embedded within it.</i>	Administration instructions comes from an examiner physically.
<i>Minimises on computation and administration human errors.</i>	Prone to inaccurate computation and administration human errors.
<i>Data is safe stored in the REDCap via data-server.</i>	Data can be lost and destroyed due to paper work storage.
<i>Brevity and easy to use in administration</i>	Complex and complicated for administration.
<i>Requires less training</i>	Requires more training
<i>Objective in nature</i>	Subjective in nature

6.3 Recommendations

Based on the findings of this study, the following recommendations are made;

- I. Compared to a traditional neuropsychological testing battery as a gold standard, after a successful validation process of the NIHTB-CB in Zambia, it should be adopted as an innovation tool for use in screening and placement options for children in special education schools.
- II. After validating the NIHTB-CB with a view of Zambia being a multilingualism country, there is need to translate the NIHTB-CB in other languages based on the part

of the country where it will be administered as it has been validated using the Chinyanja of Lusaka community only.

- III. The NIHTB-CB has been validated among Zambian children and adolescents as it has demonstrated robust results, therefore, there is need to roll it out for public usage in the education sectors as it helps in the screening and monitoring of academic performance through cognitive functions.
- IV. Due to the high demand of modern infrastructure and surveillance of the NIHTB-CB as demonstrated in the study, schools should ensure that the testing environments for the NIHTB-CB are built with the required facilities that promote and support its administration protocols with necessary expertise in all education and health centres across the country.

6.4 Implications for future research practice

- I. The study has validated the NIHTB-CB in Zambia with an urban bias perspective in assessing the cognitive functions of Lusaka Province based on children and adolescents. Therefore, there is need to validate the NIHTB-CB in the rural parts of the country.
- II. The study has successfully validated the NIHTB-CB with a sample of Zambian children and adolescents as the main respondents of ages 8-17 years. Therefore, there is also need to validate the NIHTB-CB using a sample of Zambian adults across the age span from 20-85 years.
- III. The NIHTB-CB is a multidisciplinary brief of tests that measures four domains that include cognitive, emotion, sensory and motor skills. The current study fully validated the NIHTB-CB mainly by exploiting fully the cognitive domain as opposed to other three domains. Therefore, there is need for a future study to interrogate other domains fully rather than cognitive function among children and adolescents in Lusaka Province.

- IV. The current study has only fully addressed aspects of face validity, content validity, construct validity, convergent validity, divergent validity and criterion validity of the NIHTB-CB. Therefore, internal consistency, and test-retest reliability of the NIHTB-CB should be assessed in future studies.

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**THE UNIVERSITY OF ZAMBIA
DIRECTORETE OF RESEARCH AND GRADUATE STUDIES
SCHOOL OF EDUCATION
DEPARTMENT OF EDUCATIONAL PSYCHOLOGY, SOCIOLOGY AND SPECIAL
EDUCATION**

APPENDICES

Appendix 1: The NIHTB-CB Questionnaire

Dear Respondents/Participants

I am a postgraduate student at the University of Zambia pursuing a Doctor of Philosophy of Education Degree in Educational Psychology. I am conducting research entitled “**The validation of the NIHTB-CB in the assessment of cognitive Function of children and adolescents in Lusaka Province, Zambia**”. Kindly feel free, open and honest in your responses as all answers you give will be treated confidentially. However, should you feel at any point of the study like during interview that you cannot continue, you are free to withdraw.

Date

-
1. What is the participant's HIV status?
 - ☐ Negative
 - ☐ Positive
 2. If positive, is the participant aware of their HIV status?
 - ☐ Yes
 - ☐ No
 3. Age (can approximate if exact age unknown)

-
4. Gender
 - ☐ Female
 - ☐ Male
 - ☐ Other
 5. Reason for visit to PCOE Routine Care
 - ☐ Illness
 - ☐ Sibling of a child followed at PCOE
 - ☐ Solely for study enrollment
 - ☐ Other
 6. Specify if other reason for visit to PCOE

Exclusion Criteria Questions

1. Is the participant planning to leave the area, or transfer care away from the PCOE, in the next two years?
 - ☐ Yes
 - ☐ No
2. If positive, is the participant currently taking antiretroviral drugs?
 - ☐ Yes
 - ☐ No
3. If negative, was the participant's mother infected with HIV at the time of pregnancy?
 - ☐ Yes
 - ☐ No

4. Does the participant have at least one parent alive who is able to complete an interview?

☐ Yes

☐ No

5. Has the participant ever had a brain infection such as meningitis or encephalitis?

☐ Yes

☐ No

6. Is the participant currently taking steroids or other immunosuppressive drugs?

☐ Yes

☐ No

7. Is the child participant able to communicate in English, that is, do they have at least some basic English skills?

☐ Yes

☐ No

At this point, determine if subject is eligible for study. If eligible, engage parent and child in consent discussion and obtain informed consent if family is interested.

1. Informed consent obtained?

☐ Yes

☐ No

2. Consent obtained by:

3. Record type

☐ Control

☐ Case

☐ Ineligible

☐ Refused

4. Reason for refusal or exclusion

1. Has subject withdrawn from study or been lost to follow up?

☐ Yes

☐ No

2. Next expected study visit

3. Does the subject have a sibling who is also enrolled in the study?

☐ Yes

☐ No

4. If so, what is the sibling's study ID

5. Additional notes on tracking

Page 5 of 109 **Tracking form**

Note: Information from this instrument does not get entered or uploaded into REDCap and is for purposes of tracking, matching to informed consent and prevention of double enrollment. Complete paper form only and file in patient's chart.

1. Study ID:

ARV File Number

Child's Date of Birth

Child's last name

Child's First name

Parents name (list parent who is completing survey here)

Parent's Contact phone number

Child's contact phone number, if applicable

Alternate contact name and phone number, if applicable

Notes on tracking participant (e.g. alternate phone numbers, who to contact, etc.)

Home address and directions to participant's dwelling (have participant draw map if possible)

Page 6 of 109 **Geographic location form**

1. What neighborhood does the subject live in?

Longitude

Latitude

Notes

Page 7 of 109 **Ten-Question Screen (Parent)**

Data collected by:

- ☐ Millimo Mweemba
- ☐ Beauty Matoka

- ☐ Priscilla Mweemba
- ☐ Pelekelo Kabundula
- ☐ Esau Mbewe
- ☐ David Bearden
- ☐ Other

I want to start out by asking you some questions about your child's development. For example, when they walked and talked compared to other children their age.

1. Compared with other children, did (name) have any serious delay in sitting, standing, or walking?
 - ☐ Yes
 - ☐ No
2. Compared with other children does (name) have difficulty seeing?
 - ☐ Yes
 - ☐ No
3. Does (name) appear to have difficulty hearing?
 - ☐ Yes
 - ☐ No
4. When you tell (name) to do something, does he/she seem to have trouble understanding what you are saying?
 - ☐ Yes
 - ☐ No
5. Does (name) have difficulty in walking or moving his/her arms or does he/she have weakness or stiffness in the arms or legs?
 - ☐ Yes
 - ☐ No
6. Does (name) sometimes have fits, become rigid, or lose consciousness?
 - ☐ Yes
 - ☐ No
7. Does (name) have difficulty learning to do things like other children his/her age?
 - ☐ Yes
 - ☐ No
8. Does (name) have trouble speaking (does he/she have difficulty making himself/herself understood in words; saying any recognizable words)?
 - ☐ Yes
 - ☐ No
9. Is (name)'s speech in any way different from normal?
 - ☐ Yes
 - ☐ No

10. Compared with other children of his/her age, does (name) appear in any way mentally backward, dull or slow?

- ☐ Yes
- ☐ No

Note: Any yes answers to questions above are abnormal and further details should be requested and documented below.

Notes on Ten-Question Screen

Page 16 of 109 Data Collection Form-Parent

Date

Demographics Information

Note: The following questions should be asked of the participant's parent. When the questions in this section about "you," they are referring to the parent. When the question asks about (pname) or participant, they are referring to the child.

When (pname) occurs in the questions below, interviewer should insert the child's name.

1. What is the main language you speak at home?

- ☐ Nyanja
- ☐ Bemba
- ☐ Tonga
- ☐ English
- ☐ Other
- ☐ None

2. What other languages do you speak?

- ☐ Nyanja
- ☐ Bemba
- ☐ Tonga
- ☐ English
- ☐ Other
- ☐ None

3. I'm going to ask you to rate your English language Very good skills. Would you say your English is:

- ☐ Okay
- ☐ Not very good

4. Does not speak English or hardly speaks any English

- ☐ Yes
- ☐ No

5. Where does (pname) live most of the time?

- ☐ Lusaka

- ☐ Lusaka suburbs or surrounding area
- ☐ Village or rural area
- ☐ Other
- 6.** Who is the main caretaker for (pname)? By this I mean both parents the relative or other adult who spends the most time with the child.
 - ☐ Mother only
 - ☐ Father only
 - ☐ Grandparent
 - ☐ Other relative
 - ☐ Other
- 7.** Is (pname) currently enrolled in school?
 - ☐ Yes
 - ☐ No
- 8.** Child is enrolled in school, but does not attend regularly. Why is the child not in school (or not attending Health problems (for example, child is often sick school regularly)? and misses school)
 - ☐ The child has special needs compared to other children so was not able to attend regular school
 - ☐ Unable to afford school fees
 - ☐ The child flunked out or failed school
 - ☐ The child just didn't want to attend so dropped out
 - ☐ The child has other commitments (like work) that prevent them from going to school
 - ☐ The subject finished school to a certain level and was not interested in pursuing further education.
 - ☐ Other
 - ☐ Don't know

Other reason for not attending school:

-
- 1.** What type of school does (pname) attend?
 - ☐ Public school
 - ☐ Private School
 - ☐ Special school for children with disabilities or special education program within other school
 - 2.** What grade is (pname) in?

(Record a number only)

- 3.** How does (pname) do in school?
 - ☐ Very badly or failing
 - ☐ Worse than average

- ☐ About average
- ☐ Above average
- ☐ Extremely well
- 4.** What do you think is the main reason the child has Health problems (for example, child is often sick trouble in school? and misses school)
 - ☐ The child has trouble learning compared to other children
 - ☐ The child does not try very hard
 - ☐ The child has problems with attention
 - ☐ The child has behavior problems that interfere with school
 - ☐ The child has other commitments (like work) that prevent them from concentrating on school
 - ☐ Other
 - ☐ Don't know

Other reason for school problems:

1. Is the participant's mother alive?

- ☐ Yes
- ☐ No

2. Is the participant's mother involved with the family?

- ☐ Yes
- ☐ (Note: Only answer "No" if mother has left the No family and is not in regular contact with the child).

3. Years of maternal education

4. Attended college/professional school

- ☐ Yes
- ☐ No

5. Maternal occupation

- ☐ Not working
- ☐ Subsistence farming
- ☐ Service employee (food service, cleaning, selling items on the street, etc.)
- ☐ Professional
- ☐ Student
- ☐ Other

6. Maternal occupation other

7. Is the participant's father alive?

- ☐ Yes

- ☐ No
- 8.** Is the child's father involved with the family?
 - ☐ Yes
 - ☐ (Note: Only answer "No" if father has left the No family and is not in regular contact with the child).
- 9.** Years of paternal education

10. Attended college/professional school

- ☐ Yes
- ☐ No

11. Paternal occupation

- ☐ Not working
- ☐ Subsistence farming
- ☐ Service employee (food service, cleaning, driving, etc.)
- ☐ Professional
- ☐ Student
- ☐ Other

12. Paternal occupation other

-
- 1.** I want you to think about the total amount of money, Yes in Kwacha, that all family members together bring in No every month. Are you able to estimate an amount? Would you say that the total amount in kwacha that 0-2,000 kwa per month all family members bring in is:
 - ☐ 2,001-5,000 kwa per month
 - ☐ 5,001 and greater kwa per month
 - ☐ Unable to estimate or refuse to answer
 - 2.** What is the exact Total Monthly Family income (per month), if known _____?

Now I'm going to ask you some questions about facilities in (Pname's) primary residence. By primary residence, I mean the place where (pname) lives most of the time.

- 1.** Is there running water in the primary residence?
 - ☐ Yes
 - ☐ No
- 2.** What is the water source for the primary residence?
 - ☐ Piped water inside the residence
 - ☐ Piped water outside the residence
 - ☐ Well
 - ☐ River or stream
 - ☐ Other
- 3.** What are the toilet facilities like in the primary residence?

- ☐ Pit latrine
- ☐ Flush toilet
- ☐ Other
- ☐ None
- 4. Is there electricity in the primary residence?
 - ☐ Yes
 - ☐ No
- 5. Does your family have any difficulty getting enough food?
 - ☐ Yes
 - ☐ No
- 6. On a typical day, how many meals does (pname) eat?

7. In a typical week, how many meals does pname eat that include meat or fish?

8. Check off all of the following that are owned by the family.

- ☐ Radio
- ☐ Refrigerator
- ☐ Gas or electric stove
- ☐ Mobile phone
- ☐ Television
- ☐ Computer
- ☐ Car
- 9. Rater's assessment of SES
 - ☐ Much lower than typical PCOE patients
 - ☐ Lower than typical PCOE patients
 - ☐ About average for PCOE patients
 - ☐ Higher than typical PCOE patients
 - ☐ Much higher than typical PCOE patients

Notes on SES

Now I am going to ask you some questions about your child's overall level of functioning. I want you to think about how your child is doing compared to other children his or her age over the last year.

1. Overall, how would you rate your child's behavior?
 - ☐ Much worse than other children his or her age
 - ☐ Somewhat worse than other children his or her age
 - ☐ About average compared to other children his or her age
 - ☐ Somewhat better than other children his or her age
 - ☐ Much better than other children his or her age
2. Overall, how would you rate your child's intelligence?

- ☐ Much worse than other children his or her age
- ☐ Somewhat worse than other children his or her age
- ☐ About average compared to other children his or her age
- ☐ Somewhat better than other children his or her age
- ☐ Much better than other children his or her age
- 3. Overall, how would you rate how sad or depressed your child appears compared to other children?
 - ☐ My child does not seem sad or depressed
 - ☐ My child sometimes seems sad or depressed, but is similar to other children their age
 - ☐ My child seems sad or depressed more often than other children their age
 - ☐ My child often seems sad or depressed, much more than other children their age
- 4. Overall, how would you rate how worried or anxious your child appears compared to other children?
 - ☐ My child does not seem anxious or worried
 - ☐ My child sometimes seems anxious or worried, but is similar to other children their age
 - ☐ My child seems anxious or worried more often than other children their age
 - ☐ My child often seems anxious or worried, much more than other children their age
- 5. Over the past year, have you noticed any change in your child's thinking or intelligence?
 - ☐ Yes, there has been a decline in thinking or intelligence
 - ☐ No
 - ☐ Yes, there has been improvement in thinking or intelligence
- 6. Over the past year, have you noticed any change in your child's mood?
 - ☐ No
 - ☐ Yes, my child has seemed more sad or depressed over the last year.
 - ☐ Yes, my child has seemed less sad or depressed over the last year.
 - ☐ Other

Notes on above.

Page 24 of 109 **Medical Update Form (Parent)**

Date

1. Data Source
 - ☐ (that is, parent or guardian being Mother interviewed)
 - ☐ Father
 - ☐ Other Guardian or caregiver
2. Since your child was last seen as part of this study, have there been any major changes to your child's health?
 - ☐ Yes

☐ No

3. Describe changes

4. Since your child was last seen as part of this study, have there been any changes to your child's medications?

☐ Yes

☐ No

5. Describe any med changes

6. Since your child's last visit, would you say that your child's mood has stayed the same, gotten worse, or improved?

7. Describe any changes in mood

8. Since your child was last seen as part of this study, has your child had any changes in their ability to think clearly?

☐ No

☐ Yes, they are having more trouble with thinking clearly

☐ Yes, their ability to think clearly has improved

9. Describe any changes in cognition

10. Do you know what your child's current ranking in their class at school is?

☐ Yes

☐ No

11. What is your child's current rank in their class? (For example, if child is first in their class, put 1)

12. Approximately how many children are in your child's class at school?

Page 25 of 109 **Follow Up Data Collection Form--Parent**

Demographics Information

Note: The following questions should be asked of the participant's parent.

When (pname) occurs in the questions below, interviewer should insert participant's name.

1. Data Source

☐ Mother

☐ Father

☐ Other Caretaker or guardian

2. Is this the same parent as completed the enrollment interview?

☐ Yes

- ☐ No
 - 3.** Where does (pname) live most of the time?
 - ☐ Lusaka
 - ☐ Lusaka suburbs or surrounding area
 - ☐ Village or rural area
 - ☐ Other
 - 4.** Is (pname) currently enrolled in school?
 - ☐ No
 - ☐ Yes
 - 5.** Child is enrolled in school, but does not attend regularly. Why is the child not in school (or not attending Health problems (for example, child is often sick school regularly)? and misses school)
 - ☐ The child has special needs compared to other children so was not able to attend regular school
 - ☐ Unable to afford school fees
 - ☐ The child flunked out or failed school
 - ☐ The child just didn't want to attend so dropped out
 - ☐ The child has other commitments (like work) that prevent them from going to school
 - ☐ Other
 - ☐ Don't know
 - 6.** What grade is (pname) in?
-
- 7.** How does (pname) do in school?
 - ☐ Very badly or failing
 - ☐ Worse than average
 - ☐ About average
 - ☐ Above average
 - ☐ Extremely well
 - 8.** What do you think is the main reason the child has Health problems (for example, child is often sick trouble in school? and misses school)
 - ☐ The child has trouble learning compared to other children
 - ☐ The child does not try very hard
 - ☐ The child has problems with attention
 - ☐ The child has behavior problems that interfere with school
 - ☐ The child has other commitments (like work) that prevent them from concentrating on school
 - ☐ Other
 - ☐ Don't know

Now I am going to ask you some questions about your child's overall level of functioning. I want you to think about how your child is doing compared to other children his or her age over the last year.

1. Overall, how would you rate your child's behavior?
 - ☐ Much worse than other children his or her age
 - ☐ Somewhat worse than other children his or her age
 - ☐ About average compared to other children his or her age
 - ☐ Somewhat better than other children his or her age
 - ☐ Much better than other children his or her age
2. Over the last year, have you noticed any change in your child's behavior?
 - ☐ No, there has been no significant change in my child's behavior
 - ☐ Yes, my child's behavior has gotten worse over the last year
 - ☐ Yes, my child's behavior has improved over the last year
3. Overall, how would you rate your child's intelligence?
 - ☐ Much worse than other children his or her age
 - ☐ Somewhat worse than other children his or her age
 - ☐ About average compared to other children his or her age
 - ☐ Somewhat better than other children his or her age
 - ☐ Much better than other children his or her age
4. Over the past year, have you noticed any change in your child's thinking or intelligence?
 - ☐ No
 - ☐ Yes, there has been a decline in thinking or intelligence
 - ☐ Yes, there has been improvement in thinking or intelligence
5. Overall, how would you rate how sad or depressed your child appears compared to other children?
 - ☐ My child does not seem sad or depressed
 - ☐ My child sometimes seems sad or depressed, but is similar to other children their age
 - ☐ My child seems sad or depressed more often than other children their age
 - ☐ My child often seems sad or depressed, much more than other children their age
6. Overall, how would you rate how worried or anxious your child appears compared to other children?
 - ☐ My child does not seem anxious or worried
 - ☐ My child sometimes seems anxious or worried, but is similar to other children their age
 - ☐ My child seems anxious or worried more often than other children their age
 - ☐ My child often seems anxious or worried, much more than other children their age
7. Over the past year, have you noticed any change in your child's mood?
 - ☐ No

- ☐ Yes, my child has seemed more sad or depressed over the last year.
- ☐ Yes, my child has seemed less sad or depressed over the last year.
- ☐ Other

Notes on above.

Page 28 of 109 **PROMIS Parent Proxy SF v1.0 - Cog Function 7a (Parent)**

"Now I'm going to ask you some questions about your child's ability to pay attention and think clearly in the last 4 weeks. For each of these questions, I want you to tell me whether a problem happens none of the time, a little of the time, some of the time, most of the time, or all of the time."

1. In the past 4 weeks, has it been hard for your child to pay attention to one thing for more than 5-10 minutes?
 - ☐ None of the time
 - ☐ A little of the time
 - ☐ Some of the time
 - ☐ Most of the time
 - ☐ All of the time
2. In the past 4 weeks, has your child had trouble keeping track of what he/she is doing if he/she gets interrupted?
 - ☐ None of the time
 - ☐ A little of the time
 - ☐ Some of the time
 - ☐ Most of the time
 - ☐ All of the time
3. In the past 4 weeks, has your child had to read things several times to understand them?
 - ☐ None of the time
 - ☐ A little of the time
 - ☐ Some of the time
 - ☐ Most of the time
 - ☐ All of the time
4. In the past 4 weeks, did your child forget things easily?
 - ☐ None of the time
 - ☐ A little of the time
 - ☐ Some of the time
 - ☐ Most of the time
 - ☐ All of the time
5. In the past 4 weeks, has your child had to work really hard to pay attention or he/she makes mistakes
 - ☐ None of the time

- ☐ A little of the time
- ☐ Some of the time
- ☐ Most of the time
- ☐ All of the time
- 6. In the past 4 weeks, did your child has trouble remembering to do things like school projects or chores?
 - ☐ None of the time
 - ☐ A little of the time
 - ☐ Some of the time
 - ☐ Most of the time
 - ☐ All of the time
- 7. Promis Cognitive Function Parent Report Total Score

Notes on questions above

Page 29 of 109 **Executive function assessment--parent**

1. Data source
 - ☐ Mother
 - ☐ Father
 - ☐ Other caregiver

I'm going to ask you some questions about (pname's) behavior over the last three months. For each question, I want you to tell me if the behavior happens rarely or never, sometimes, or often.

2. How often does (pname) become angry or upset for no reason?
 - ☐ Rarely or never
 - ☐ Sometimes
 - ☐ Often
3. How often does (pname) interrupt others when they are talking?
 - ☐ Rarely or never
 - ☐ Sometimes
 - ☐ Often
4. How often does (pname) have trouble completing tasks? (For example, school work or house work)
 - ☐ Rarely or never
 - ☐ Sometimes
 - ☐ Often
5. How often does (pname) have trouble with attention?
 - ☐ Rarely or never
 - ☐ Sometimes

- ☐ Often
- 6. How often does (pname) get into trouble for bad behavior?
- ☐ Rarely or never
- ☐ Sometimes
- ☐ Often

EF Score.

Note: For each of the questions above-----

Give 0 points for each Rarely or never, 1 point for Sometimes, and 2 points for each Often, and document the sum here. Score should be between 0-10 inclusive.

Page 30 of 109 Brief Impairment Scale (Parent)

The questions I am going to ask you now have to do with how (name of child) has been doing overall. Please answer them thinking only of the last twelve months keeping in mind what one would expect of children of the same age and sex as (name of child).

1. Over the last 12 months, how much of a problem has he/she had getting along with his/her father/stepfather/foster father?
 - ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Not applicable (no father figure)
 - ☐ Don't know
2. Over the last 12 months, how much of a problem has he/she had getting along with his/her mother/stepmother/foster mother?
 - ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Not applicable (no mother figure)
 - ☐ Don't know
3. How about problems getting along with her/her brothers and sisters?
 - ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Not applicable (no brothers or sisters)
 - ☐ Don't know

- 4.** How about problems getting involved in activities together with the rest of the family?
- ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Not applicable (no father figure)
 - ☐ Don't know
- 5.** Over the last 12 months, how much of a problem has he/she had with her/her teachers at school? (If not some problem in school, ask with her/her superiors at work)
- ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Not applicable (has not worked or been in school in past year)
 - ☐ Don't know
- 6.** How much of a problem has he/she had getting along with other adults outside of the family?
- ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Not applicable
 - ☐ Don't know
- 7.** How much of a problem has he/she had making friends?
- ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Don't know
- 8.** How much of a problem has he/she had getting along with the friends that he/she has?
- ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem

- ☐ Refused
- ☐ Don't know

School/Work Subscale

1. During the last 12 months, has he/she often missed school or work?

- ☐ Never misses school/work
- ☐ Occasionally (once a month or less)
- ☐ Many times (2-4 times/month)
- ☐ Quite frequently (more than 5 times/month)
- ☐ Refused
- ☐ Not applicable, not in school and not working during last 12 months
- ☐ Don't know

2. Was this because he/she was too sick to go to school or work?

- ☐ Yes
- ☐ No

3. Were missed school days primarily due to medical appointments?

- ☐ Yes
- ☐ No

4. During the last twelve months, has the child ever had to miss a prolonged period of school (more than two weeks) due to illness?

- ☐ Yes
- ☐ No

5. During the last 12 months, how well has he/she been doing in school?

- ☐ Better than average
- ☐ Just average
- ☐ Somewhat below average
- ☐ Markedly below average
- ☐ Refused
- ☐ Not applicable (not in school)
- ☐ Don't know

6. Has he/she dropped out of school in the last year?

- ☐ Yes
- ☐ No

7. Has he/she been suspended from school during the past 12 months?

- ☐ No
- ☐ Yes
- ☐ Refused
- ☐ Not applicable (not in school)
- ☐ Don't know

- 8.** Has he/she been expelled from school or fired from a job in the past year?
- ☐ No
 - ☐ Yes
 - ☐ Refused
 - ☐ Not applicable (has not been in school in past year)
 - ☐ Don't know
- 9.** In general, how much of a problem has he/she had getting his/her schoolwork or work done on time?
- ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Not applicable (not in school or working over the past year)
 - ☐ Don't know
- 10.** During the last 12 months, how much of a problem has he/she had doing what he/she is expected to do at home?
- ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Not applicable (not in school or working over the past year)
 - ☐ Don't know
- 11.** How much of a problem has he/she had been responsible at school/work or in jobs he/she took on outside of his home?
- ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Not applicable (not in school or working over the past year)
 - ☐ Don't know
- 12.** In the last 12 months, how many times were you asked to come to his/her school to discuss some problem that he/she had?
- ☐ Never
 - ☐ Once
 - ☐ More than once

- ☐ Refused
- ☐ Not applicable
- ☐ Don't know

Self-Subscale

1. To what extent does he/she get involved in sports?
 - ☐ Frequently or member of a team
 - ☐ Some involvement, but not steady
 - ☐ Very rarely involved
 - ☐ Not involved at all
 - ☐ Refused
 - ☐ Not applicable, no opportunities for participation in sports
 - ☐ Don't know
2. Over the past 12 months, to what extent did he/she get involved in activities other than sports?
 - ☐ Frequently involved in other activities
 - ☐ Only occasionally
 - ☐ Rarely got involved or dropped out easily
 - ☐ Never got involved in other activities
 - ☐ Refused
 - ☐ Don't know
3. To what extent would you say he/she is a person who has interests? Again think specifically about has some interests the last 12 months. Would you say he/she has few things to interest him/her?
 - ☐ Has many and varied interests
 - ☐ Has no interests, is generally bored
 - ☐ Refused
 - ☐ Don't know
4. Compared to other kids of the same age, how neat is like most kids his/her age his/her physical appearance most of the time? Remember that we are talking of how it's been during considerably more sloppy or peculiar than most the last 12 months. Would you say he/she is extremely sloppy or bizarre compared to others?
 - ☐ A bit sloppier than most kids his/her age
 - ☐ Refused
 - ☐ Don't know
5. Compared to others his/her age, how well does he/she takes good care of him/herself take care of his/her health?
 - ☐ Is somewhat careless about his/her health
 - ☐ Is quite careless about his/her health
 - ☐ Is extremely careless about his/her health

- ☐ Refused
- ☐ Don't know
- 6. How safety conscious is he/she?**
 - ☐ Very careful, attentive to safety rules
 - ☐ Somewhat careless
 - ☐ Quite careless
 - ☐ Extremely careless
 - ☐ Refused
 - ☐ Don't know
- 7. Does he/she seem to have a problem having fun and enjoying life? Again, think of how it's been during the last 12 months. Would you say he/she had;**
 - ☐ No problem
 - ☐ Some problem
 - ☐ A considerable problem
 - ☐ A serious problem
 - ☐ Refused
 - ☐ Don't know

Interpersonal Subscale: Items 1,2,3,4,5,6,7,8 School/work Subscale: Items 9,10,11,12,13,14,15,16 Self-Subscale: Items 17,18,19,20,21,22,23

SCORING INSTRUCTIONS

- 1. Each valid item must have been scored 0, 1, 2, or 3. Refusals (7), Not applicable (8), or Don't knows (9) are not summed in the score. (For the scale a subscale to be valid, at least half of the items have to have valid scores.) 2) For the total scale or for each subscale, add the sum of the valid items, divide by the number of valid items, and multiply times the number of items on the scale or subscale.**

Interpersonal subscale score

School/work Subscale

Modified BIS School Subscale

Self-Subscale score

Total BIS Score

Page 35 of 109 Data Collection Form Child

Data collected by:

- ☐ Millimo Mweemba
- ☐ Beauty Matoka
- ☐ Priscilla Mweemba
- ☐ Pelekelo Kabundula
- ☐ Esau Mbewe
- ☐ David Bearden
- ☐ Other

I'm going to ask you some questions about your health, your family, and your mood. Please let me know if you don't understand any of the questions I am asking you.

1. How old are you? (record in years) _____
2. What is the main language that you speak at home?
 - ☐ Nyanja
 - ☐ Bemba
 - ☐ Tonga
 - ☐ English
 - ☐ Other
3. I'm going to ask you to rate your English language skills Would you say your English is:
 - ☐ Very good
 - ☐ Okay
 - ☐ Not very good
 - ☐ Does not speak enough English to understand question or rates self as not speaking any English
4. How would you describe your general health?
 - ☐ Very good
 - ☐ Somewhat good
 - ☐ Okay, neither good nor bad
 - ☐ Somewhat bad
 - ☐ Very bad
 - ☐ Unable to answer or don't know
5. How would you describe your life overall?
 - ☐ Very good
 - ☐ Somewhat good
 - ☐ Okay, neither good nor bad
 - ☐ Somewhat bad

- ☐ Very bad
- ☐ Unable to answer or don't know
- 6.** Are you currently enrolled in school?
 - ☐ Yes
 - ☐ No
- 7.** How often have you had to miss school over the last 3 months?
 - ☐ Never
 - ☐ Less than once a month
 - ☐ More than once a month but less than once a week
 - ☐ Once a week or more
 - ☐ I am enrolled in school but don't attend at all
 - ☐ Don't know
- 8.** Overall, how would you say that you are doing in school?
 - ☐ Very badly or failing
 - ☐ Worse than average
 - ☐ About average
 - ☐ Above average
 - ☐ Extremely well
- 9.** What do you think is the main reason that you are Health problems (for example, child is often sick having trouble at school? Choose the best answer. and misses school)
 - ☐ Trouble learning compared to other children
 - ☐ I do not try very hard
 - ☐ I have problems with attention
 - ☐ I have other commitments (like work) that prevent me from concentrating on school
 - ☐ Other
 - ☐ Don't know

Now, I am going to ask you some questions about your family.

- 10.** Who else lives at home with you?
 - ☐ Mother
 - ☐ Father
 - ☐ Grandparent
 - ☐ Other adult relative
 - ☐ Boyfriend or girlfriend
 - ☐ Other non-relative
 - ☐ Stepmother or Stepfather
 - ☐ Other
 - ☐ Siblings
 - ☐ No one, subject lives alone

11. Who is the person who is most responsible for helping to take care of you?

- ☐ Mother
- ☐ Father
- ☐ Grandparent
- ☐ Other relative
- ☐ Boyfriend/girlfriend or other romantic partner
- ☐ Other non-relative
- ☐ No one
- ☐ Stepmother or Stepfather

12. How would you describe your relationship with your mother?

- ☐ Very good
- ☐ Somewhat good
- ☐ Somewhat bad
- ☐ Very bad
- ☐ I do not have a relationship with my mother
- ☐ Not applicable, mother is deceased

13. How would you describe your relationship with your father?

- ☐ Very good
- ☐ Somewhat good
- ☐ Somewhat bad
- ☐ Very bad
- ☐ I do not have a relationship with my father
- ☐ Not applicable, father is deceased

14. How would you describe your relationship with your stepmother or stepfather?

- ☐ Very good
- ☐ Somewhat good
- ☐ Somewhat bad
- ☐ Very bad
- ☐ I do not have a relationship with them
- ☐ Not applicable, no step-parent

15. How would you describe your relationship with the rest of your family?

- ☐ Very good
- ☐ Somewhat good
- ☐ Somewhat bad
- ☐ Very bad
- ☐ I do not have a relationship with any other family members
- ☐ Not applicable, there are no other living family members

16. How would you describe your relationship with your friends?

- ☐ Very good
- ☐ Somewhat good
- ☐ Somewhat bad
- ☐ Very bad
- ☐ I do not have any friends
- ☐ Not applicable or unknown

17. Who typically comes to doctor's appointments with you?

- ☐ Mother
- ☐ Father
- ☐ Grandparent
- ☐ Other relative
- ☐ Boyfriend/girlfriend or other romantic partner
- ☐ Other non-relative
- ☐ No one

18. Do you take any medications regularly?

- ☐ Yes
- ☐ No

19. Does anyone else help you in remembering to take your medication?

- ☐ Yes
- ☐ No

20. Who helps you in remembering to take medication?

- ☐ Mother
- ☐ Father
- ☐ Grandparent
- ☐ Other relative
- ☐ Boyfriend/girlfriend or other romantic partner
- ☐ Other non-relative
- ☐ No one

Page 42 of 109 **Medical Update Form (Child)**

Data Collected by:

- ☐ Millimo Mweemba
- ☐ Beauty Matoka
- ☐ Priscilla Mweemba
- ☐ Pelekelo Kabundula
- ☐ Esau Mbewe
- ☐ David Bearden

☐ Other

Date

1. Since you were last seen as part of this study, have there been any major changes to your health?

☐ Yes

☐ No

2. Describe changes

3. Would you say that since your last visit, your mood has:

☐ Stayed the same

☐ Gotten worse

☐ Improved

4. Describe any changes in mood

5. Since you were last seen as part of this study, have you had any changes in your ability to think clearly?

☐ No

☐ Yes, I am having more trouble with thinking clearly

☐ Yes, my ability to think clearly has improved

6. Describe any changes in cognition

7. Are you currently enrolled in school?

☐ Yes

☐ No

8. What grade in school are you in?

9. Overall, how would you say that you are doing in school?

☐ Very badly or failing

☐ Worse than average

☐ About average

☐ Above average

☐ Extremely well

10. Compared to the last time we saw you in this study (prompt: about 3 months ago), how are you doing in school?

☐ I am doing better in school

☐ I am doing about the same in school

☐ I am doing worse

☐ I have failed out of school

☐ I am no longer in school for reasons other than poor performance/failing

11. What do you think is the main reason that you are having Health problems (for example, child is often sick having trouble at school? Choose the best answer. and misses school)
- ☐ Trouble learning compared to other children
 - ☐ I do not try very hard
 - ☐ I have problems with attention
 - ☐ I have other commitments (like work) that prevent me from concentrating on school
 - ☐ Other
 - ☐ Don't know
12. You are going to be taking several tests today to measure how you are thinking and feeling. Is there anything that would make it hard to concentrate on the tests today?
- ☐ No
 - ☐ Yes
13. Describe any conditions which would make it difficult for subject to concentrate. If significant problems concentrating due to acute change, consider rescheduling NIH Toolbox testing.

Page 44 of 109 Follow up Data collection form--Child

I'm going to ask you some questions about your health, your family, and your mood. Please let me know if you do not understand any of the questions I am asking you.

1. How would you describe your general health?
- ☐ Very good
 - ☐ Somewhat good
 - ☐ Okay, neither good nor bad
 - ☐ Somewhat bad
 - ☐ Very bad
 - ☐ Unable to answer or don't know
2. How would you describe your life overall?
- ☐ Very good
 - ☐ Somewhat good
 - ☐ Okay, neither good nor bad
 - ☐ Somewhat bad
 - ☐ Very bad
 - ☐ Unable to answer or don't know
3. Overall, how would you say that you are doing in school?
- ☐ Very badly or failing
 - ☐ Worse than average
 - ☐ About average
 - ☐ Above average
 - ☐ Extremely well

- ☐ Not applicable, not in school

Now, I am going to ask you some questions about your family.

4. Who is the person who is most responsible for helping to take care of you?

- ☐ Mother
- ☐ Father
- ☐ Grandparent
- ☐ Other relative
- ☐ Boyfriend/girlfriend or other romantic partner
- ☐ Other non-relative
- ☐ No one
- ☐ Stepmother or Stepfather
- ☐ Sibling

5. How would you describe your relationship with your mother?

- ☐ Very good
- ☐ Somewhat good
- ☐ Somewhat bad
- ☐ Very bad
- ☐ I do not have a relationship with my mother
- ☐ Not applicable, mother is deceased

6. How would you describe your relationship with your father?

- ☐ Very good
- ☐ Somewhat good
- ☐ Somewhat bad
- ☐ Very bad
- ☐ I do not have a relationship with my father
- ☐ Not applicable, father is deceased

7. How would you describe your relationship with the rest of your family?

- ☐ Very good
- ☐ Somewhat good
- ☐ Somewhat bad
- ☐ Very bad
- ☐ I do not have a relationship with any other family members
- ☐ Not applicable, there are no other living family members

8. How would you describe your relationship with your friends?

- ☐ Very good
- ☐ Somewhat good
- ☐ Somewhat bad

- ☐ Very bad
- ☐ I do not have any friends
- ☐ Not applicable or unknown
- 9.** Who typically comes to doctor's appointments with you?
 - ☐ Mother
 - ☐ Father
 - ☐ Grandparent
 - ☐ Other relative
 - ☐ Boyfriend/girlfriend or other romantic partner
 - ☐ Other non-relative
 - ☐ No one
- 10.** Does anyone else help you in remembering to take your medication?
 - ☐ Yes
 - ☐ No
- 11.** Who helps you in remembering to take medication?
 - ☐ Mother
 - ☐ Father
 - ☐ Grandparent
 - ☐ Other relative
 - ☐ Boyfriend/girlfriend or other romantic partner
 - ☐ Other non-relative
 - ☐ No one

Page 50 of 109 Executive Function Assessment (Child)

I'm going to ask you some questions about your behavior over the last three months. For each question, I want you to tell me if the behavior happens rarely or never, sometimes, or often.

- 1.** How often do you become angry or upset for no reason?
 - ☐ Rarely or never
 - ☐ Sometimes
 - ☐ Often
- 2.** How often do you interrupt others when they are talking?
 - ☐ Rarely or never
 - ☐ Sometimes
 - ☐ Often
- 3.** How often do you have trouble completing your work? (For example, school work or house work)
 - ☐ Rarely or never
 - ☐ Sometimes
 - ☐ Often

- ☐ Rarely or never
- ☐ Sometimes
- ☐ Often
- 4. How often do you have trouble paying attention? (For example, paying attention in school)
 - ☐ Rarely or never
 - ☐ Sometimes
 - ☐ Often
- 5. How often do you get into trouble for bad behavior?
 - ☐ Rarely or never
 - ☐ Sometimes
 - ☐ Often

EF Score.

Note: For each of the questions above, Give 0 points for each Rarely or never, 1 point for Sometimes, and 2 points for each Often, and document the sum here.

Score should be between 0-10 inclusive.

1. Rater determination of executive function.

Executive Function is normal for age

Minor issues with executive function

Moderate issues with executive function

Severe issues with executive function

Notes on EF assessment

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"Now I'm going to ask you some questions about how easy it is for you to pay attention and think clearly. For each of these questions, I want you to tell me whether a problem happens very much, quite a bit, somewhat, a little bit, or not at all."

2. I forget schoolwork that I need to do. For children not in school modify to somewhat "I forget things that I am supposed to do."

Not at all

A little bit

Quite a bit

Very much

3. I sometimes forget what I was going to say

Not at all

A little bit

Somewhat

Quite a bit

Very much

4. I react slower than most people of my age when I play games

Not at all

A little bit

Somewhat

Quite a bit

Very much

5. I forget things easily

Not at all

A little bit

Somewhat

Quite a bit

Very much

6. I have trouble remembering to do things (e.g., school projects)

Not at all

A little bit

Somewhat

Quite a bit

Very much

7. It is hard for me to concentrate in school. For children not in school can modify to: "It is hard for me to concentrate."

Not at all

A little bit

Somewhat

Quite a bit

Very much

8. I have trouble paying attention to the teacher. For children not in school can modify to somewhat

"I have trouble paying attention."

Not at all

A little bit

Quite a bit

Very much

9. I have to work really hard to pay attention or I will make a mistake

Not at all

A little bit

Somewhat

Quite a bit

Very much

Notes regarding above fields

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Date of Toolbox assessment

Who administered/supervised the NIH Toolbox administration?

○ Milimo

- Beauty,
 - Priscilla
 - Other or multiple administrators
- Who administered the Toolbox, if other:

1. Cognitive Battery

Picture Vocabulary Test Uncorrected Standard Score

Picture Vocabulary Test Age-corrected Standard Score

List Sorting Working Memory Test Raw Score

List Sorting Working Memory Test Uncorrected Standard Score

List Sorting Working Memory Test Age Corrected Standard Score

Pattern Comparison Processing Speed Raw Score

Pattern	Comparison	Processing	Speed	Uncorrected	Standard	Score
Pattern	Comparison	Processing	Speed	Age-corrected	Standard	Score

Flanker Raw Score

Flanker uncorrected standard score

Flanker Age-corrected standard score

Dimensional Change Card Sort Test Raw Score

Dimensional Change Card Sort Test Uncorrected Standard Score

Dimensional Change Card Sort Test Age corrected Standard Score

Auditory Verbal Learning Raw Score

Oral symbol digit raw score

2. Emotion Battery

Emotional Support Raw Score

Emotional Support T score

Emotional Support fully corrected T score

Fear Raw Score

Fear T-score
Fear fully corrected T-score
Perceived Stress Raw Score
Perceived Stress T score
Perceived Stress Fully Corrected T score
Sadness Raw score
Sadness T score
Sadness fully corrected T score
Maternal Relationship Raw Score
General Life Satisfaction Raw Score
General Life Satisfaction T score
General Life Satisfaction Fully Corrected T score
Self-Efficacy Raw Score
Self-Efficacy T Score
Self-Efficacy Fully Corrected T Score

3. Motor Battery

9-hole pegboard uncorrected standard score dominant
9-hole pegboard age corrected standard score dominant
9-hole pegboard Uncorrected standard score non-dominant
9-hole pegboard age-corrected standard score non-dominant
4-meter walk gait speed raw score
4-meter walk gait speed computed score

1. Page 56 of 109 NIHTB-CB Parent reported emotion battery

Fear T-score

Sadness Raw Score

Perceived Stress T score

Positive Parent Relationship Raw score

Self-efficacy T score

Domain specific life satisfaction raw score

Appendix 2: The NIHTB-CB Qualitative Assessment

Picture vocabulary

1. Did you have any trouble understanding what you were supposed to do on this test?

☐ Yes

☐ No

2. What did you think was the purpose of this test?

3. Rate the difficulty the child had in understanding the directions on this instrument.

☐ **NO DIFFICULTY:** Child demonstrates excellent understanding of how to complete the test. Note, the child may still make errors on the test, but fully understands the test instructions.

☐ **MINOR DIFFICULTY:** Child has minor difficulty understanding the instructions, but fully understands the test after receiving simple / brief clarification. This clarification is in accordance with the test design (i.e., test provides 'teaching' items and/or allows corrective feedback).

- ☐ **MODERATE DIFFICULTY:** Child has difficulty understanding the test instructions, even if re-teaching or corrective feedback is provided in accordance with test design (i.e., using 'teaching' items or allowable corrective feedback).
 - ☐ **Child does not understand test instructions at all**, but could complete test if instructions were modified or simplified.
 - ☐ **Child would not understand how to complete test**, even if instructions were modified or simplified.
 - 4. Rate how well you felt this instrument measured the desired construct (e.g. receptive vocabulary) vs. some unrelated construct (e.g. attention) in this Not very well child.
 - ☐ Very well
 - ☐ Moderately well
 - ☐ Not at all
- Notes on picture vocabulary test validity

List Sorting Working Memory

- 5. Did you have any trouble understanding what you were supposed to do on this test?
 - ☐ Yes
 - ☐ No
 - 6. What did you think was the purpose of this test?
-
- 7. Rate the difficulty this child had in understanding the directions on this instrument.
 - ☐ **NO DIFFICULTY:** Child demonstrates excellent understanding of how to complete the test. Note, the child may still make errors on the test, but fully understands the test instructions.
 - ☐ **MINOR DIFFICULTY:** Child has minor difficulty understanding the instructions, but fully understands the test after receiving simple / brief clarification. This clarification is in accordance with the test design (i.e., test provides 'teaching' items and/or allows corrective feedback).
 - ☐ **MODERATE DIFFICULTY:** Child has difficulty understanding the test instructions, even if re-teaching or corrective feedback is provided in accordance with test design (i.e., using 'teaching' items or allowable corrective feedback).
 - ☐ **Child does not understand test instructions at all**, but could complete test if instructions were modified or simplified.
 - ☐ **Child would not understand how to complete test**, even if instructions were modified or simplified.
 - 8. Rate how well you felt this instrument measured the desired construct (e.g. working memory) compared to some other construct.
 - ☐ Very well
 - ☐ Not very well
 - ☐ Moderately well
 - ☐ Not at all

Pattern Comparison Processing Speed

9. Did you have any trouble understanding what you were supposed to do on this test?

- ☐ Yes
- ☐ No

10. What did you think was the purpose of this test?

11. Rate the difficulty this child had in understanding the directions on this instrument.

- ☐ **NO DIFFICULTY:** Child demonstrates excellent understanding of how to complete the test. Note, the child may still make errors on the test, but fully understands the test instructions.
- ☐ **MINOR DIFFICULTY:** Child has minor difficulty understanding the instructions, but fully understands the test after receiving simple / brief clarification. This clarification is in accordance with the test design (i.e., test provides 'teaching' items and/or allows corrective feedback).
- ☐ **MODERATE DIFFICULTY:** Child has difficulty understanding the test instructions, even if re-teaching or corrective feedback is provided in accordance with test design (i.e., using 'teaching' items or allowable corrective feedback).
- ☐ **Child does not understand test instructions at all**, but could complete test if instructions were modified or simplified.
- ☐ **Child would not understand how to complete test**, even if instructions were modified or simplified.

12. Rate how well you felt the instrument measured the desired construct (i.e. processing speed).

- ☐ Very well
- ☐ Moderately well
- ☐ Not very well
- ☐ Not at all

Notes on pattern comparison processing speed validity

Flanker

13. Did you have any trouble understanding what you were supposed to do on this test?

- ☐ Yes
- ☐ No

14. What did you feel was the purpose of this test?

15. Rate the difficulty this child had in understanding the directions on this instrument.

- ☐ **NO DIFFICULTY:** Child demonstrates excellent understanding of how to complete the test. Note, the child may still make errors on the test, but fully understands the test instructions.

- **MINOR DIFFICULTY:** Child has minor difficulty understanding the instructions, but fully understands the test after receiving simple / brief clarification. This clarification is in accordance with the test design (i.e., test provides 'teaching' items and/or allows corrective feedback).
- **MODERATE DIFFICULTY:** Child has difficulty understanding the test instructions, even if re-teaching or corrective feedback is provided in accordance with test design (i.e., using 'teaching' items or allowable corrective feedback).
- **Child does not understand test instructions at all,** but could complete test if instructions were modified or simplified.
- **Child would not understand how to complete test,** even if instructions were modified or simplified.
- 16. Rate how well you felt the instrument measured the desired construct (i.e. sustained attention and executive function).
- Very well
- Moderately well
- Not very well
- Not at all

Notes on Flanker validity

Dimensional Change Card Sort Test

17. Did you have any trouble understanding the directions for this test?

- Yes
- No

18. What did you feel was the purpose of this test?

19. Rate the difficulty this child had in understanding the directions on this instrument.

- **NO DIFFICULTY:** Child demonstrates excellent understanding of how to complete the test. Note, the child may still make errors on the test, but fully understands the test instructions.
- **MINOR DIFFICULTY:** Child has minor difficulty understanding the instructions, but fully understands the test after receiving simple / brief clarification. This clarification is in accordance with the test design (i.e., test provides 'teaching' items and/or allows corrective feedback).
- **MODERATE DIFFICULTY:** Child has difficulty understanding the test instructions, even if re-teaching or corrective feedback is provided in accordance with test design (i.e., using 'teaching' items or allowable corrective feedback).
- **Child does not understand test instructions at all,** but could complete test if instructions were modified or simplified.

- ☐ **Child would not understand how to complete test**, even if instructions were modified or simplified.

20. Rate how well you felt the instrument measured the desired construct (i.e. executive function, ability to shift to a new task).

- ☐ Very well
- ☐ Moderately well
- ☐ Not very well
- ☐ Not at all

Notes on dimensional change card sort validity

Auditory Verbal Learning Test

21. Did you have any trouble understanding what you were supposed to do on this test?

- ☐ Yes
- ☐ No

22. What did you think was the purpose of this test?

23. Rate the difficulty this child had in understanding the directions on this instrument.

- ☐ **NO DIFFICULTY:** Child demonstrates excellent understanding of how to complete the test. Note, the child may still make errors on the test, but fully understands the test instructions.
- ☐ **MINOR DIFFICULTY:** Child has minor difficulty understanding the instructions, but fully understands the test after receiving simple / brief clarification. This clarification is in accordance with the test design (i.e., test provides 'teaching' items and/or allows corrective feedback).
- ☐ **MODERATE DIFFICULTY:** Child has difficulty understanding the test instructions, even if re-teaching or corrective feedback is provided in accordance with test design (i.e., using 'teaching' items or allowable corrective feedback).
- ☐ **Child does not understand test instructions at all**, but could complete test if instructions were modified or simplified.
- ☐ **Child would not understand how to complete test**, even if instructions were modified or simplified.

24. Rate how well you felt the instrument measured the desired construct (i.e. verbal learning).

- ☐ Very well
- ☐ Moderately well
- ☐ Not very well
- ☐ Not at all

Notes on Auditory Verbal Learning validity

Oral Symbol Digit

25. Did you have any trouble understanding what you were supposed to do on this test?

- ☐ Yes
- ☐ No

26. What did you understand to be the purpose of this test?

27. Rate the difficulty this child had in understanding the directions on this instrument.

- ☐ **NODIFFICULTY:** Child demonstrates excellent understanding of how to complete the test. Note, the child may still make errors on the test, but fully understands the test instructions.
- ☐ **MINOR DIFFICULTY:** Child has minor difficulty understanding the instructions, but fully understands the test after receiving simple / brief clarification. This clarification is in accordance with the test design (i.e., test provides 'teaching' items and/or allows corrective feedback).
- ☐ **MODERATE DIFFICULTY:** Child has difficulty understanding the test instructions, even if re-teaching or corrective feedback is provided in accordance with test design (i.e., using 'teaching' items or allowable corrective feedback).
- ☐ **Child does not understand test instructions at all**, but could complete test if instructions were modified or simplified.
- ☐ **Child would not understand how to complete test**, even if instructions were modified or simplified.

28. Rate how well you felt the instrument measured the desired construct (i.e. processing speed).

- ☐ Very well
- ☐ Moderately well
- ☐ Not very well
- ☐ Not at all

Notes on oral symbol digit validity

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Date

1. Who administered/supervised administering the toolbox?

- ☐ Milimo
- ☐ Beauty,
- ☐ Priscilla
- ☐ Other

If other, who administered the toolbox?

Pattern Comparison Processing Speed Raw Score

Pattern	Comparison	Processing	Speed	Uncorrected	Standard	Score
Pattern	Comparison	Processing	Speed	Age-corrected	Standard	Score
Flanker Raw Score						
Flanker uncorrected standard score						
Flanker Age-corrected standard score						
Dimensional Change Card Sort Test Raw Score						
Dimensional Change Card Sort Test Uncorrected Standard Score						
Dimensional	Change	Card	Sort	Test	Age corrected	Standard Score
Perceived Stress Raw Score						
Perceived Stress T score						
Perceived Stress Fully Corrected T score						
Sadness Raw score						
Sadness T score						
Sadness fully corrected T score						

Appendix 3: NIHTB-CB test visit update form

Date

1. Age of child (Please report in years and months, for example, 8 years ten months.)
2. Since you were last seen as part of this study, have there been any major changes to your health?
 - ☐ Yes
 - ☐ No
3. Describe changes
4. Think about your overall health. How are you feeling today compared to how you usually feel?

- ☐ I feel about the same as I usually feel
- ☐ I feel a little bit worse than usual
- ☐ I feel much worse than usual.
- ☐ I feel better than usual.
- 5. Since you were last seen as part of this study, have there been any changes in your mood?
 - ☐ No, my mood has not changed
 - ☐ Yes, my mood has gotten worse since the last visit.
 - ☐ Yes, My mood has gotten better since the last visit
- 6. Describe any changes in mood

-
- 7. Since you were last seen as part of this study, have you had any changes in your ability to think clearly?
 - ☐ No, there has been no change
 - ☐ Yes, my ability to think clearly has gotten worse
 - ☐ Yes, my ability to think clearly has gotten better
 - 8. Describe any changes in cognition

-
- 9. You are going to be taking several tests today to measure how you are thinking and feeling. Is there anything that would make it hard to concentrate on the tests today?
 - ☐ Yes
 - ☐ No

If patient feels that they are unable to concentrate, or are feeling much worse than usual, offer to reschedule neuropsychological testing for another day.

Notes on above

Appendix 4: NIHTB-CB Test Score Sheet

Date of birth

-
- 1. Gender
 - ☐ Female
 - ☐ Male
 - 2. Date NP test administered

-
- 3. Calculated age

NP Testing administered by: (Note: If different tests were administered by different people, list each test and the person who administered it separately).

Letter/Number reading and writing task

- 1. Has the subject complete letter reading with 100% accuracy?

☐ Yes

☐ No

Time to complete in seconds

2. Did the subject complete number reading with 100% accuracy?

☐ Yes

☐ No

Time to complete in seconds

3. Did the subject complete letter writing with 100% accuracy?

☐ Yes

☐ No

4. Did the subject complete number writing with 100% accuracy?

☐ Yes

☐ No

5. Did the subject complete the alphabet task with 100% accuracy?

☐ Yes

☐ No

Time to complete in seconds

6. Did the subjects complete numbers forward 1-20 with 100% accuracy?

☐ Yes

☐ No

Time to complete in seconds

7. Did the subjects complete numbers backwards with 100% accuracy?

☐ Yes

☐ No

Time to complete in seconds

Appendix 5: PHQ-9 Depression Screen (Parent Report)

Data collected by (examiner's name):

Patient Health Questionnaire: Depression Screen (Parent Report)

1. Was the PHQ-9 Administered to the Parent?

☐ Yes

☐ No

2. Why wasn't the test administered?

☐ Parent refused to complete test

☐ Parent has sensory or motor handicap

☐ Examiner or technical administration error

☐ Other

Test not administered = other (please provide reason):

OVER THE PAST ONE WEEK, HOW OFTEN HAS YOUR CHILD BEEN BOTHERED BY ANY OF THE FOLLOWING PROBLEMS?

1. Feeling down, depressed, irritable, or hopeless?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

2. Little interest or pleasure in doing things?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

3. Trouble falling asleep, staying asleep, or sleeping too much?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

4. Poor appetite or overeating?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

5. Feeling tired or having little energy?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

6. Feeling bad about himself/herself- or feeling that they are a failure or that they have let themselves or their family down?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

7. Trouble concentrating on things like school work, reading, or watching TV?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

8. Moving or speaking so slowly that other people could have noticed? Or, the opposite - being so fidgety or restless that they were moving around a lot more than usual?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

9. Saying that they would be better off dead or saying they will hurt them-self in some way?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

PHQ9 Total Score (Parent Report)

If any problems were selected, how difficult have those problems made it for your child to do things at school, at home, or get along with other people?

- ☐ Not difficult at all
- ☐ Somewhat difficult
- ☐ Very difficult
- ☐ Extremely difficult

Appendix 6: PHQ-9 Depression Screen (Child Report)

Data collected by: (examiner's name)

Patient Health Questionnaire: Depression Screen (Child Report)

1. Was the PHQ-9 Administered to the Child?

- ☐ Yes
- ☐ No

2. Why wasn't the test administered?

- ☐ Child refused to complete test
- ☐ Acute illness
- ☐ Sensory or motor handicap
- ☐ Examiner or technical administration error
- ☐ Other

Test not administered = other (please provide reason):

OVER THE PAST ONE WEEK, HOW OFTEN HAVE YOU BEEN BOTHERED BY ANY OF THE FOLLOWING PROBLEMS?

1. Feeling down, depressed, irritable, or hopeless?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

2. Little interest or pleasure in doing things?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

3. Trouble falling asleep, staying asleep, or sleeping too much?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

4. Poor appetite or overeating?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

5. Feeling tired or having little energy?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

6. Feeling bad about yourself - or feeling that you are a failure or that you have let yourself or your family down?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

7. Trouble concentrating on things like school work, reading, or watching TV?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

8. Moving or speaking so slowly that other people could have noticed? Or, the opposite - being so fidgety or restless that you were moving around a lot more than usual?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

9. Thoughts that you would be better off dead, or of hurting yourself in some way?

- ☐ Not at all
- ☐ Several days
- ☐ More than half the days
- ☐ Nearly every day

PHQ9 Total Score (Child Report)

If any problems were selected, how difficult have those problems made it for you to do things at school, at home, or get along with other people?

- ☐ Not difficult at all
- ☐ Somewhat difficult
- ☐ Very difficult
- ☐ Extremely difficult

Appendix 7: BRIEF-2 Parent Form

1. Was the BRIEF-2 Administered?

- ☐ Yes
- ☐ No

2. Why wasn't the BRIEF-2 administered?

- ☐ Parent refused to complete test
- ☐ Parent has sensory or motor handicap
- ☐ Examiner or technical administration error
- ☐ Other

Test not administered = other (please provide reason):

Inhibit RAW SCORE

Inhibit T SCORE

Self-Monitor RAW SCORE

Self-Monitor T SCORE

Shift RAW SCORE

Shift T SCORE

Emotional Control RAW SCORE

Emotional Control T SCORE

Initiate RAW SCORE

Initiate T SCORE

Working Memory RAW SCORE

Working Memory T SCORE

Plan/Organize RAW SCORE

Plan/Organize T SCORE

Task Monitor RAW SCORE

Task Monitor T SCORE

Organization of Materials RAW SCORE

Organization of Materials T SCORE

Behavior Regulation Index RAW SCORE

Behavior Regulation Index T SCORE

(BRIEF-2 Professional Manual: Appendix A (p 183))

Emotion Regulation Index RAW SCORE

Emotion Regulation Index T SCORE

(BRIEF-2 Professional Manual: Appendix A (p 183))

Cognitive Regulation Index RAW SCORE

Cognitive Regulation Index T SCORE

(BRIEF-2 Professional Manual: Appendix A (p 183))
Global Executive Composite (GEC) RAW SCORE

(GEC raw score = sum of the raw scores for all scales)
Global Executive Composite (GEC) T SCORE

Appendix 8: Event Instrument

Event note completed by:

- ☐ Millimo Mweemba
- ☐ Beauty Matoka
- ☐ Priscilla Mweemba
- ☐ Pelekelo Kabundula
- ☐ Esau Mbewe
- ☐ David Bearden
- ☐ Sylvia Mwanza-Kabaghe
- ☐ Other

Date

1. What type of event has occurred?

- ☐ Child Participant Death
- ☐ Adult Participant Death

- ☐ Subject Withdrawal
 - ☐ Subject lost to follow up
 - ☐ Other event type
 - ☐ Safety event
 - ☐ Hospitalization
 - ☐ No event has occurred, subject has completed the study
2. Description of other event type

Reason for hospitalization

3. What type of safety event has occurred?

- ☐ Assessment of suicidality
- ☐ Assessment of abuse
- ☐ Other safety event

Notes on safety event

4. Has patient determined to be at imminent risk of harm?

- ☐ Yes
- ☐ No

If subject is in imminent risk and cannot go home Escorted for evaluation at PCOE safely from the visit, or cannot remain home safely, Escorted for admission to hospital discuss with Sylvia or other study investigator. Other whether to escort patient for assessment at PCOE or escort for admission to them hospital. Document here what course of action was taken.

5. Cause of death?

- ☐ Opportunistic infection
- ☐ Malnutrition
- ☐ Accident
- ☐ Other infection (e.g. malaria)
- ☐ Other non-infectious cause
- ☐ Unknown

Notes on cause of death

6. Reason for withdrawal

- ☐ Leaving area
- ☐ Time commitment is too much
- ☐ Other
- ☐ Unknown

If child is withdrawing from the study, please complete an exit interview via phone completing if possible both the parent and child exit interview form.

Other event notes

Appendix 10: Exit Interview for Subjects Withdrawing--child

You indicated you are going to be withdrawing from the study. I would like to ask you some final questions. Please let me know if you don't understand any of the questions I am asking you.

- 1.** First, are you withdrawing from the study because of any issues with your health or your mood?

- ☐ Yes
- ☐ No

Specify reason if yes:

-
- 2.** How would you describe your general health?

- ☐ Very good
- ☐ Somewhat good
- ☐ Okay, neither good nor bad
- ☐ Somewhat bad
- ☐ Very bad

- ☐ Unable to answer or don't know
- 3.** How would you describe your life overall?
 - ☐ Very good
 - ☐ Somewhat good
 - ☐ Okay, neither good nor bad
 - ☐ Somewhat bad
 - ☐ Very bad
 - ☐ Unable to answer or don't know
- 4.** Overall, how would you say that you are doing in or failing school?
 - ☐ Very badly
 - ☐ Worse than average
 - ☐ About average
 - ☐ Above average
 - ☐ Extremely well

Appendix 11: Exit Interview for Subjects Withdrawing--Parent

Demographics Information

Note: The following questions should be asked of the participant's parent.

When (pname) occurs in the questions below, interviewer should insert participant's name.

- 1.** Data Source
 - ☐ Mother
 - ☐ Father
 - ☐ Other Caretaker or guardian
- 2.** Is this the same parent as completed the enrollment interview?
 - ☐ Yes
 - ☐ No
- 3.** Where does (pname) live most of the time?
 - ☐ Lusaka
 - ☐ Lusaka suburbs or surrounding area village or rural area
 - ☐ Other
- 4.** Is (pname) currently enrolled in school?
 - ☐ Yes

- ☐ No
- 5. Child is enrolled in school, but does not attend regularly Why is the child not in school (or not attending Health problems (for example, child is often sick school regularly)? and misses school)
 - ☐ The child has special needs compared to other children so was not able to attend regular school
 - ☐ Unable to afford school fees
 - ☐ The child flunked out or failed school
 - ☐ The child just didn't want to attend so dropped out
 - ☐ The child has other commitments (like work) that prevent them from going to school
 - ☐ Other
 - ☐ Don't know
- 6. Is the reason the subject is withdrawing from the study related to changes in health or school performance? (For example, moving away because of doing badly in school)
 - ☐ Yes
 - ☐ No

If yes, give details:

7. What grade is (pname) in now?

8. How does (pname) do in school?

- ☐ Very badly or failing
- ☐ Worse than average
- ☐ About average
- ☐ Above average
- ☐ Extremely well

9. What do you think is the main reason the child has Health problems (for example, child is often sick trouble in school? and misses school)

- ☐ The child has trouble learning compared to other children
- ☐ The child does not try very hard
- ☐ The child has problems with attention
- ☐ The child has behavior problems that interfere with school
- ☐ The child has other commitments (like work) that prevent them from concentrating on school
- ☐ Other
- ☐ Don't know

Other school notes

Now I am going to ask you some questions about your child's overall level of functioning. I want you to think about how your child is doing compared to other children his or her age over the last year.

1. Overall, how would you rate your child's behavior?
 - ☐ Much worse than other children his or her age
 - ☐ Somewhat worse than other children his or her age
 - ☐ About average compared to other children his or her age
 - ☐ Somewhat better than other children his or her age
 - ☐ Much better than other children his or her age
2. Over the last year, have you noticed any change in your child's behavior?
 - ☐ No, there has been no significant change in my child's behavior
 - ☐ Yes, my child's behavior has gotten worse over the last year
 - ☐ Yes, my child's behavior has improved over the last year
3. Overall, how would you rate your child's intelligence?
 - ☐ Much worse than other children his or her age
 - ☐ Somewhat worse than other children his or her age
 - ☐ About average compared to other children his or her age
 - ☐ Somewhat better than other children his or her age
 - ☐ Much better than other children his or her age
4. Over the past year, have you noticed any change in your child's thinking or intelligence?
 - ☐ No
 - ☐ Yes, there has been a decline in thinking or intelligence
 - ☐ Yes, there has been improvement in thinking or intelligence
5. Overall, how would you rate how sad or depressed your child appears compared to other children?
 - ☐ My child does not seem sad or depressed
 - ☐ My child sometimes seems sad or depressed, but is similar to other children their age
 - ☐ My child seems sad or depressed more often than other children their age
 - ☐ My child often seems sad or depressed, much more than other children their age
6. Overall, how would you rate how worried or anxious your child appears compared to other children?
 - ☐ My child does not seem anxious or worried
 - ☐ My child sometimes seems anxious or worried, but is similar to other children their age
 - ☐ My child seems anxious or worried more often than other children their age
 - ☐ My child often seems anxious or worried, much more than other children their age
7. Over the past year, have you noticed any change in your child's mood?
 - ☐ No
 - ☐ Yes, my child has seemed more sad or depressed over the last year.
 - ☐ Yes, my child has seemed less sad or depressed over the last year.

○ Other
Notes on above.

**Appendix 12: A gold standard of full neuropsychological testing battery precision level of
0.80-1.00**

BY

KABUNDULA PELEKELO. P

THE UNIVERSITY OF ZAMBIA

SCHOOL OF EDUCATION

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY, SOCIOLOGY AND

SPECIAL EDUCATION

LUSAKA, ZAMBIA

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Subject #: _____

Visit #: _____

Visit Date: _____

HANDZ Neurocognitive Assessment Visit Order of Assessments

Before or after administering tests to child, present the BRIEF & PHQ-9 to the parent. Review these forms to confirm they are correctly completed.

- 
- ___1. California Verbal Learning Test for Children (CVLT-C)
List A Trials 1-5, List B, Short Delay Free Recall, Short Delay Cued Recall
 - ___2. Universal Nonverbal Test of Intelligence – 2nd edition (UNIT-2)
Note, there must be an approximately 20 minute delay before presenting CVLT-C Delayed Recall Trials. Therefore, it may be necessary to stop the UNIT-2 after presenting Analogic Reasoning. If so, please remember to give UNIT-2 Symbolic Memory after the CVLT-C Delayed Recall & Recognition Trials
 - ___3. CVLT-C Delayed Recall & Recognition Trials
[] (3.1) *May give UNIT-2 Symbolic Memory here, if necessary*
 - ___4. Delis-Kaplan Executive Function System - Trail Making Test (DKEFS-TMT)

Offer a brief break (10 – 15 mins) to child
 - ___5. NEPSY-2 Word Generation
 - ___6. NEPSY-2 Affect Recognition
 - ___7. Digit Span Test
 - ___8. Wisconsin Card Sorting Test
 - ___9. Pencil Tapping Test
 - ___10. PHQ-9 Child (assessment of depression). You can read the questions to the child if necessary
[] *Include PHQ-9 safety assessment if suicidal risk is found (PHQ-9 Item #9)*

ALSO ADMINISTER TO THE PARENT

- ___11. BRIEF-2. If parent completes BRIEF-2 alone (without examiner), you must review the responses. Is it complete? (no missing items) & correct (only one item per line, etc.
- ___12. PHQ-9 Parent (assessment of depression). You can read the questions to the parent if necessary
[] *Include PHQ-9 safety assessment if suicidal risk is found (PHQ-9 Item #9)*

ver date: 21Jun2018

NP test visit update form

Date

Age of child (Please report in years and months, for example, 8 years ten months.)

Since you were last seen as part of this study, have there been any major changes to your health?

- ☐ Yes
☐ No

Describe changes

Think about your overall health. How are you feeling today compared to how you usually feel?

- ☐ I feel about the same as I usually feel
☐ I feel a little bit worse than usual
☐ I feel much worse than usual.
☐ I feel better than usual.

Since you were last seen as part of this study, have there been any changes in your mood?

- ☐ No, my mood has not changed
☐ Yes, my mood has gotten worse since the last visit.
☐ Yes, My mood has gotten better since the last visit

Describe any changes in mood

Since you were last seen as part of this study, have you had any changes in your ability to think clearly?

- ☐ No, there has been no change
☐ Yes, my ability to think clearly has gotten worse
☐ Yes, my ability to think clearly has gotten better

Describe any changes in cognition

You are going to be taking several tests today to measure how you are thinking and feeling. Is there anything that would make it hard to concentrate on the tests today?

- ☐ Yes
☐ No

If patient feels that they are unable to concentrate, or are feeling much worse than usual, offer to reschedule neuropsychological testing for another day.

Notes on above

HANDZ LETTER / NUMBER Test

1. LETTER/NUMBER READING (see Reading / Writing Card for stimuli)

Instructions: Say, ***“I want you to look at the letters (numbers) on this line.”***(point to letters [numbers] on reading card). ***“Read to me the letters (numbers) one-by-one across the line. Start here*** (point to first letter / number) ***and go in order.”***Do not tell the child if his /her answers are right or wrong, but allow child to spontaneously correct their answer if they wish to do so.

1A. Letter Reading: L C I J N A F B G D H E P O K M

1B. Number Reading: 12 1 9 5 6 10 14 2 7 4 3 16 13 15 11
8

Scoring: Circle each correct letter or number. Draw a single line through each incorrect letter or number. Count the number of correct responses.

Example: (J) N (A) (F) B

2. LETTER/NUMBER WRITING: (see Reading / Writing Card for instructions & stimuli)

3. SAYING THE ALPHABET AND NUMBERS

Instructions: Write the letters / numbers in the exact order that the child says them. If the child repeats any letters /numbers, you will include the repetition.

3A. Alphabet: ***Now please tell me the English alphabet, from A to Z. Go in order and make sure you do not skip any.***

Child's response: _____

3B. Numbers Forward: ***Now I want you to count from 1 to 20. Start from number one and go in order; do not skip any.***

Child's response: _____

3C. Numbers Backward: ***Last, I want you to count backward from 20 to 1. Start from 20 and go down to number 1; do not skip any.***

Child's response: _____

HANDZ LETTER / NUMBER Test

Letter / Number Writing Response Sheet

Letter Writing

[illegible]

Number Writing

[illegible]

CVLT-C[®] CALIFORNIA VERBAL LEARNING TEST[®]

CHILDREN'S VERSION

Dean C. Delis, Joel H. Kramer, Edith Kaplan, Beth A. Ober

Record Form

Name _____ Gender _____ Handedness _____

School _____ Grade _____

Examiner _____ Referral Source _____

Reason for Referral _____

	Year	Month	Day
Date Tested			
Date of Birth			
Age			

Current Medications _____

Evidence of Hearing Impairment _____

Raw and Standard Scores for Key CVLT-C Measures

Level of Recall (Number Correct) and Contrast Scores	Raw Score	Scaled Score	Learning Characteristics, List A Trials 1-5	Raw Score	Scaled Score
List A Total Trials 1-5 _____			Semantic-Cluster Ratio (Observed/Expected)* _____		
Confidence Interval List A Total Trials 1-5 _____			Serial-Cluster Ratio (Observed/Expected)* _____		
List A Trial 1 Free Recall _____			Percent of Total Recall from: Primacy Region _____		
List A Trial 5 Free Recall _____			Percent of Total Recall from: Middle Region _____		
List B Free Recall _____			Percent of Total Recall from: Recency Region _____		
	Percentage Change	Difference Score	Learning Slope* _____		
List B Free Recall vs. List A Trial 1 Free Recall _____			Percent Recall Consistency* _____		
	Raw Score	Scaled Score	Recall Errors		
List A Short-Delay Free Recall _____			Perseverations (Free and Cued Recall Total) _____		
	Percentage Change	Difference Score	Free-Recall Intrusions (Total) _____		
Short-Delay Free Recall vs. List A Trial 5 _____			Cued-Recall Intrusions (Total) _____		
	Raw Score	Scaled Score	Intrusions (Free and Cued Recall Total) _____		
List A Short-Delay Cued Recall _____			Recognition Measures and Contrast Score		
List A Long-Delay Free Recall _____			Correct Recognition Hits* _____		
	Percentage Change	Difference Score	Discriminability* _____		
Long-Delay Free Recall vs. Short-Delay Free Recall _____			Recognition Discriminability vs. Long-Delay Free Recall _____	Percentage Change	Difference Score
	Raw Score	Scaled Score			
List A Long-Delay Cued Recall _____			False Positives (Total) _____	Raw Score	Scaled Score
			Response Bias _____		

* Index not easily computed by hand. See CVLT-C Scoring Assistant Software.

PEARSON

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PsychCorp

35 36 37 38 A B C D E

277206-4 9876

Product Number 0154033979

List A Monday List
bananas
sweater
puzzle
jacket
grapes
blocks
watermelon
shorts
crayons
peaches
balloons
hat
strawberries
belt
marbles

List A (Monday List): Immediate Free-Recall Trials

Record the child's responses *verbatim*.

Observe prompting procedures as described in the CVLT-C Manual.

Instructions to Child:

Trial 1:

Let's pretend that you are going shopping on Monday. I'm going to read a list of things for you to buy. Listen carefully, because when I am through I want you to tell me as many of the things as you can. You can say them in any order, just say as many of them as you can. Are you ready?

(Read the words at approximately *one word per second*.)

Now tell me as many as you can.

Trial 2:

I'm going to read the Monday shopping list again. Like before, tell me as many of the things as you can, in any order. Be sure to also say things on the list that you told me the first time.

(Read List A.)

Trial 3:

I'm going to read the Monday shopping list again. Like before, tell me as many of the things as you can, in any order, including things on the list that you've said before.

(Read List A.)

Key for Coding	
C = Correct	I = Intrusion
P = Perseveration	SC = Semantic Cluster

Trial 1 Responses		Response Type	Observed Semantic Cluster Score
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Total C			
Total P			
Total I			
Total SC			

Trial 2 Responses		Response Type	Observed Semantic Cluster Score
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Total C			
Total P			
Total I			
Total SC			

Trial 3 Responses		Response Type	Observed Semantic Cluster Score
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Total C			
Total P			
Total I			
Total SC			

List A (Monday List): Immediate Free-Recall Trials 4 & 5

Read List A for Trial 4 and again for Trial 5.

I'm going to read the Monday shopping list again. Like before, tell me as many of the things as you can, in any order, including things on the list that you've said before.

Trial 4 Responses		Response Type	Observed Semantic Cluster Score
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Total C			
Total P			
Total I			
Total SC			

Trial 5 Responses		Response Type	Observed Semantic Cluster Score
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Total C			
Total P			
Total I			
Total SC			

Table of Free-Recall Word Order						Short Delay	Long Delay
List A	Immediate						
(Monday List)	1	2	3	4	5		
bananas							
sweater							
puzzle							
jacket							
grapes							
blocks							
watermelon							
shorts							
crayons							
peaches							
balloons							
hat							
strawberries							
belt							
marbles							
Observed Serial Cluster							

Behavioral Observations _____

Serial Position Recall List A Immediate Free-Recall Trials 1-5		
Region	Number Correct	Percent of Total
Primacy		
Middle		
Recency		
Total		100%

**List B (Tuesday List):
Free-Recall Trial**

Now, let's pretend that you are going shopping again, this time on Tuesday. I'm going to read a new list of things for you to buy. When I'm through, I want you to tell me as many of the things from this new list as you can. You can say them in any order.

(Read List B at approximately *one word per second*.)

Now, tell me as many as you can.

List B Tuesday List	Recall Order
doughnuts	
cherries	
table	
plums	
cookies	
lamp	
ice cream	
pears	
bed	
candy	
rug	
lemons	
brownies	
pineapple	
desk	
Total SC	

Responses	Response Type	Observed Semantic Cluster Score
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
Total C		
Total P		
Total I		
Total SC		

**List A (Monday List):
Short-Delay Free-Recall Trial**

(Do not read List A or List B to the child.)

Now, I want you to tell me all of the things you can from the Monday shopping list. The Monday list was the first list, the one I read to you five times. Don't tell me things that were on the Tuesday List. Tell me only things that were on Monday's list.

Responses	Response Type	Observed Semantic Cluster Score
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
Total C		
Total P		
Total I		
Total SC		

Behavioral Observations _____

**List A (Monday List):
Short-Delay Cued-Recall Trial**

Tell me all the things from the Monday shopping list that are things to wear.

(Repeat the entire set of instructions for *things to play with* and *fruits*.)

Responses	Response Type
1. Things to Wear	
2. Things to Play With	
3. Fruits	
Total C	
Total P	
Total I	

Starting Time of Long-Delay Free-Recall Trial	____:____
Finishing Time of Short-Delay Cued-Recall Trial	____:____
Total Delay	____:____
Note. The total delay should be about 30 minutes.	

**List A (Monday List):
Long-Delay Free-Recall Trial**

(Do not read List A or List B to the child.)

I read two different shopping lists to you before—the Monday list and the Tuesday list. I want you to tell me all of the things you can from the Monday list—that was the first list, the one that I read to you five times.
Go ahead.

Responses	Response Type	Observed Semantic Cluster Score
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
Total C		
Total P		
Total I		
Total SC		

(Do not read List A or List B to the child.)

(Repeat the entire set of instructions for *things to play with* and *fruits*.)

Responses		Response Type
1. Things to Wear		
2. Things to Play With		
3. Fruits		
Total C		
Total P		
Total I		

Now, I'm going to read to you a bunch of things that people can buy. After I read each one to you, You say "Yes" if it was on the Monday list, or "No" if it was not on the Monday list.

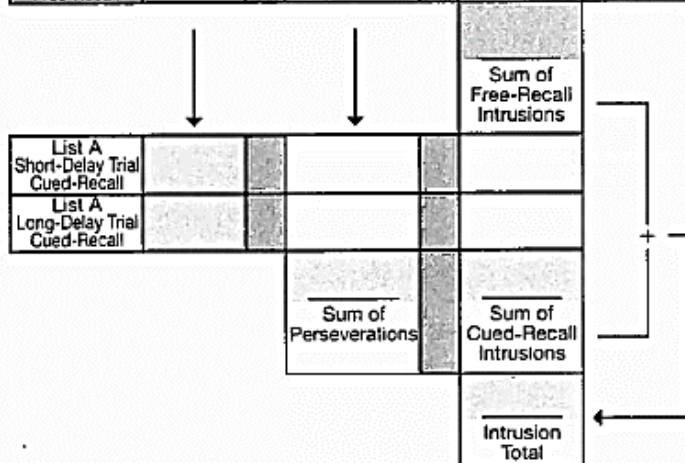
For each "Yes" response, place a (✓) in the one blank space to the right of the word; for each "No" response, leave the space blank.

- A = List A Correct (Hits)
BS = List B Shared
BSS = List B Superordinate Shared
BN = List B Nonshared
NP = Neither List Prototypical
PS = Neither List Phonemically Similar
UN = Neither List Unrelated

Item	List A	BS	BSS	BN	NP	PS	UN
shorts							
glasses							
table							
crayons							
pants							
cherries							
mop							
bananas							
cat							
marbles							
cookies							
apples							
desk							
muzzle							
keys							
hat							
grapes							
candy							
ball							
rug							
watermelon							
banners							
magazine							
blocks							
oranges							
sweater							
ice cream							
drapes							
plums							
jacket							
strawberries							
balloons							
pincapple							
doll							
roses							
pears							
bell							
puzzle							
doughnuts							
lamp							
toothbrush							
peaches							
belt							
dress							
clocks							
Total Possible	15	4	4	4	6	6	6
	List A	BS	BSS	BN	NP	PS	UN
Target Words							
False Positives							

Summary of Indices Table

List A Immediate Free-Recall Trials	Number Correct		Number of Perseverations		Number of Intrusions		Total # of Words Recalled (including Perseverations and Intrusions)	Observed Semantic Cluster Score
Trial 1		+		+		=		
Trial 2		+		+		=		
Trial 3		+		+		=		
Trial 4		+		+		=		
Trial 5		+		+		=		
Trials 1-5 Total								
List B Trial								
List A Short-Delay Trial Free-Recall								
List A Long-Delay Trial Free-Recall								



List A (Monday List): Long-Delay Recognition Scoring

Total							
Possible	15	4	4	4	6	6	6
A		BS	BSS	BN	NP	PS	UN

Total Number of Hits _____
 Misses = 15 - Hits = _____

- A = List A Correct (Hits)
- BS = List B Shared
- BSS = List B Superordinate Shared
- BN = List B Nonshared
- NP = Neither List Prototypical
- PS = Neither List Phonemically Similar
- UN = Neither List Unrelated

Discriminability

$$\left(1 - \frac{\text{False Positives} + \text{Misses}}{45}\right) \times 100$$

$$= \left(1 - \frac{\quad}{\quad}\right) \times 100 = \quad$$

Response Bias

$$\frac{\text{False Positives} - \text{Misses}}{\text{False Positives} + \text{Misses}} = \frac{\quad}{\quad}$$

Note: If False Positives = 0 or Misses = 0, substitute a value of 1 when computing Response Bias.



Universal Nonverbal Intelligence Test-Second Edition Examiner Record Form

Bruce A. Bracken ■ R. Steve McCallum

Section 1. Identifying Information

Student's Name _____

Gender: Female ☐ Male ☐ Grade _____

School/Agency _____

Examiner _____

Examiner's Title _____

	Year	Month	Day
Testing Date			
Birth Date			
Age			

Section 2. Subtest Performance ☐ Scores Are Prorated

Subtest	Raw Score	Scaled Score	Memory	Reasoning	Quantitative	Abbreviated Battery	Standard Battery w/ Memory	Standard Battery w/o Memory	Full Scale Battery
Symbolic Memory (SyM)									
Nonsymbolic Quantity (NsQ)									
Analogic Reasoning (AR)									
Spatial Memory (SpM)									
Numerical Series (NS)									
Cube Design (CD)									
Sum of Scaled Scores									

Section 3. Composite Performance

Composite	Sum of Scaled Scores	Index Score	Percentile Rank	% Confidence Interval	Descriptive Classification
Memory				to	
Reasoning				to	
Quantitative				to	
Abbreviated Battery				to	
Standard Battery w/ Memory				to	
Standard Battery w/o Memory				to	
Full Scale Battery				to	

Section 4. Descriptive Classifications

Scaled Scores	1-3	4-5	6-7	8-12	13-14	15-16	17-20
Descriptive Terms	Very Delayed	Delayed	Below Average	Average	Above Average	Superior	Very Superior
Index Scores	<70	70-79	80-89	90-109	110-119	120-129	≥130

Nonsymbolic Quantity

For younger examinees (ages 5–7 years), start with Demonstration Item 1; older examinees (ages 8–21 years) begin with Demonstration Item 8. If older examinees fail Checkpoint Item 8 and Item 9 and Checkpoint Item 10, return to Demonstration Item 1. For all examinees, discontinue testing after three consecutive scores of 0 on scored items, including checkpoint items.

Circle the examinee's response and score for each item administered.

Correct responses are printed in bold capital letters.

Start Age		Score		Score
5–7	Demonstration Item 1	A b		
	Sample Item 1	a B		
	• Checkpoint Item 1	A b	1	0
	• Checkpoint Item 2	a B	1	0
	Item 3	A b c d	1	0
	Item 4	a b C d	1	0
	Item 5	a B c d	1	0
	Item 6	a b C d	1	0
	Item 7	a b c D	1	0
8–21	Demonstration Item 8	a B c d		
	Sample Item 8	A b c d		
	• Checkpoint Item 8	a b C d	1	0
	Item 9	a b c D	1	0
	Demonstration Item 10	a B c d		
	Sample Item 10	a b c D		
	• Checkpoint Item 10	a b c D	1	0
	Item 11	a B c d	1	0
	Item 12	a b C d	1	0
	Item 13	a b C d	1	0
	Item 14	A b c d	1	0
	Item 15	a B c d	1	0
	Item 16	a b c D	1	0
	Item 17	a B c d	1	0
	Item 18	A b c d	1	0
	Item 19	a b C d	1	0
	Item 20	a b c D	1	0
	Item 21	A b c d	1	0
	Item 22	a B c d	1	0
	Item 23	a b c D	1	0
	Item 24	a b C d	1	0
	Item 25	a B c d	1	0
	Item 26	a b C d	1	0
	Item 27	a b c D	1	0
	Item 28	a B c d	1	0
	Item 29	a b C d	1	0
	Item 30	a b c D	1	0
	Item 31	a B c d	1	0
	Item 32	A b c d	1	0
	Item 33	a B c d	1	0
	Item 34	a b c D	1	0

• Checkpoint Items—Examiner should correct examinee's response, if necessary.

Score

Item 35	a b C d	1 0
Item 36	A b c d	1 0
Item 37	a B c d	1 0
Item 38	A b c d	1 0
Item 39	A b c d	1 0
Item 40	A b c d	1 0
Item 41	a b C d	1 0
Item 42	a b c D	1 0
Item 43	a b c D	1 0
Item 44	a B c d	1 0
Item 45	A b c d	1 0
Item 46	a B c d	1 0
Item 47	a b C d	1 0
Item 48	a b c D	1 0

Nonsymbolic Quantity

Total Raw Score

Analogic Reasoning

For younger examinees (ages 5–7 years), start with Demonstration Item 1; older examinees (ages 8–21 years) begin with Demonstration Item 9. If older examinees fail Checkpoint Item 9 and Items 10 and 11, return to Demonstration Item 1. For all examinees, discontinue testing after three consecutive scores of 0 on scored items, including checkpoint items.

Circle the examinee's response and score for each item administered.

Correct responses are printed in bold capital letters.

Start Age		Score		Score
5–7	Demonstration Item 1	A b c d	Item 15	a b C d
	Sample Item 1	a b c D	Item 16	a b c D
	Demonstration Item 2	A b c d	Item 17	a B c d
	Sample Item 2	a B c d	Item 18	A b c d
	• Checkpoint Item 1	a B c d	Item 19	a B c d
	• Checkpoint Item 2	a b C d	Item 20	a B c d
	Item 3	a B c d	Item 21	a b c D
	Item 4	A b c d	Item 22	a B c d
	Item 5	A b c d	Item 23	a B c d
	Item 6	a B c d	Item 24	a B c d
	Item 7	a B c d	Item 25	A b c d
	Item 8	A b c d	Item 26	a b c D
8–21	Demonstration Item 9	a b c D	Item 27	a b c D
	Sample Item 9	a b C d	Item 28	a B c d
	• Checkpoint Item 9	a b C d	Item 29	a b c D
	Item 10	a b c D	Item 30	a B c d
	Item 11	A b c d	Item 31	a b c D
	Item 12	A b c d	Item 32	a B c d
	Item 13	a B c d	Item 33	a b C d
	Item 14	A b c d	Item 34	a b C d

• Checkpoint Items—Examiner should correct examinee's response, if necessary.

				Score	
Item 35	a	b	c	D	1 0
Item 36	A	b	c	d	1 0
Item 37	a	b	C	d	1 0
Item 38	a	b	c	D	1 0
Item 39	a	B	c	d	1 0
Item 40	a	b	C	d	1 0
Item 41	a	b	C	d	1 0
Item 42	a	b	c	D	1 0
Item 43	a	B	c	d	1 0
Item 44	a	b	c	D	1 0
Item 45	A	b	c	d	1 0

				Score	
Item 46	a	B	c	d	1 0
Item 47	a	b	c	D	1 0
Item 48	a	b	c	D	1 0
Item 49	a	B	c	d	1 0
Item 50	A	b	c	d	1 0
Item 51	a	b	c	D	1 0
Item 52	a	b	C	d	1 0
Item 53	a	b	c	D	1 0
Item 54	a	b	C	d	1 0
Item 55	a	B	c	d	1 0
Item 56	a	b	C	d	1 0

Analogic Reasoning
 Total Raw Score

Spatial Memory

For younger examinees (ages 5–7 years), start with Demonstration Item 1; older examinees (ages 8–21 years) begin with Demonstration Item 5. If older examinees fail Checkpoint Item 5 and Checkpoint Item 6 and Item 7, return to Demonstration Item 1. For all examinees, discontinue testing after three consecutive scores of 0 on scored items, including checkpoint items.

Circle the score for each item administered.

Start Age	Score	Examinee's View
5–7		
		Demonstration Item 1
		Sample Item 1
	• Checkpoint Item 1	1 0
	• Checkpoint Item 2	1 0
	Item 3	1 0
	Item 4	1 0
8–21		
		Demonstration Item 5
		Sample Item 5
	• Checkpoint Item 5	1 0

• Checkpoint Items—Examiner should correct examinee's response, if necessary.

Score	Examinee's View
• Checkpoint Item 6	
1 0	
Item 7	1 0
Item 8	1 0
Item 9	1 0
Item 10	1 0
Item 11	1 0
Item 12	1 0
Item 13	1 0
Item 14	1 0

Score			Examinee's View
Item 15	1	0	
Item 16	1	0	
Item 17	1	0	
Item 18	1	0	
Item 19	1	0	
Item 20	1	0	
Item 21	1	0	
Item 22	1	0	
Item 23	1	0	
Item 24	1	0	

Score			Examinee's View
Item 25	1	0	
Item 26	1	0	
Item 27	1	0	
Item 28	1	0	
Item 29	1	0	
Item 30	1	0	
Item 31	1	0	
Item 32	1	0	
Item 33	1	0	

Spatial Memory
 Total Raw Score



Name _____ Age _____

ID _____ Date _____

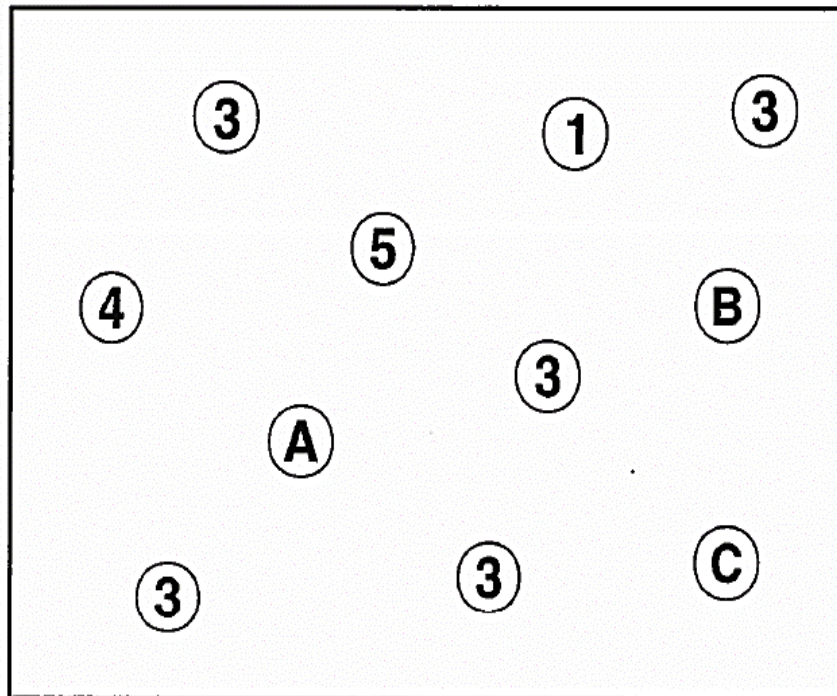
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Notes _____

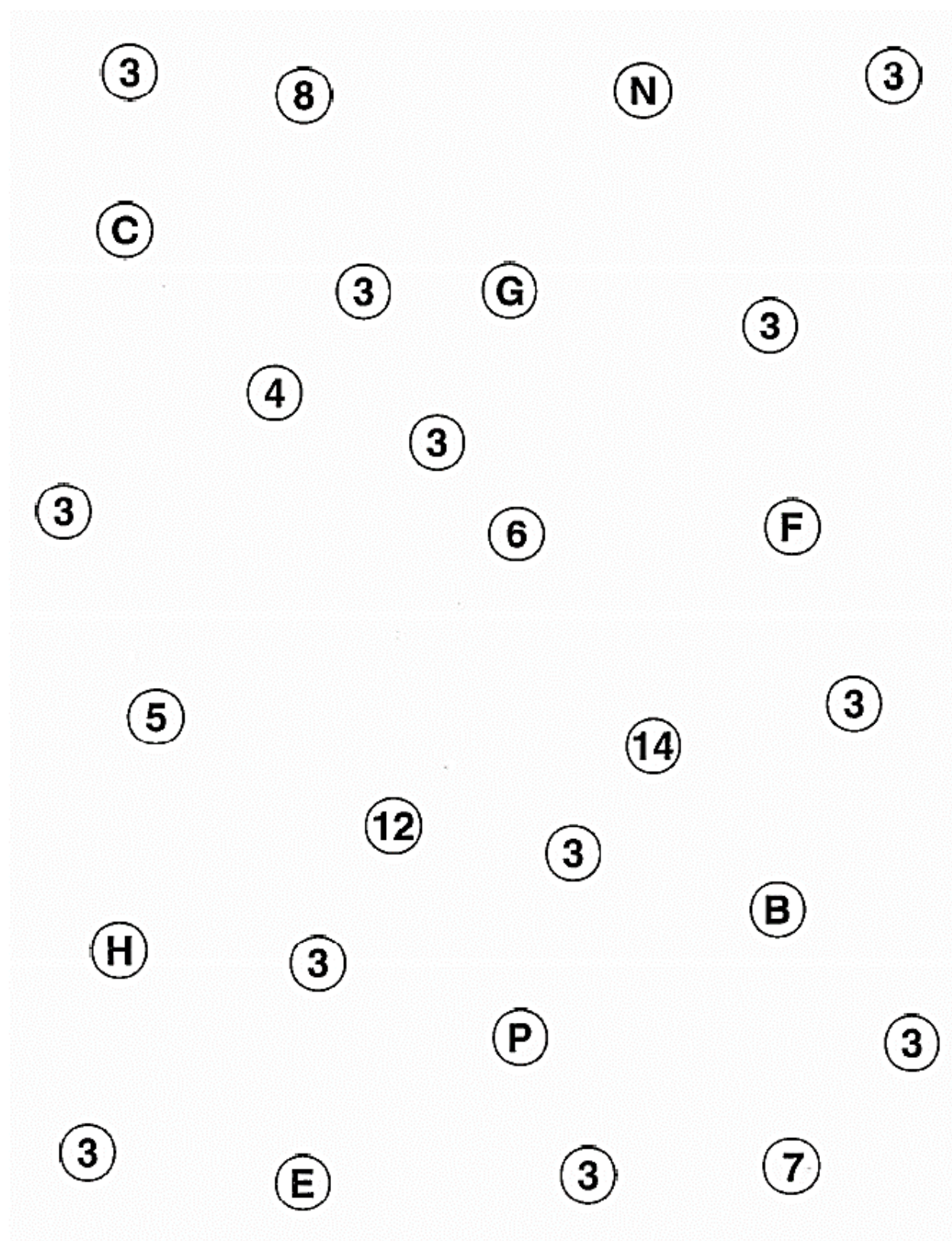
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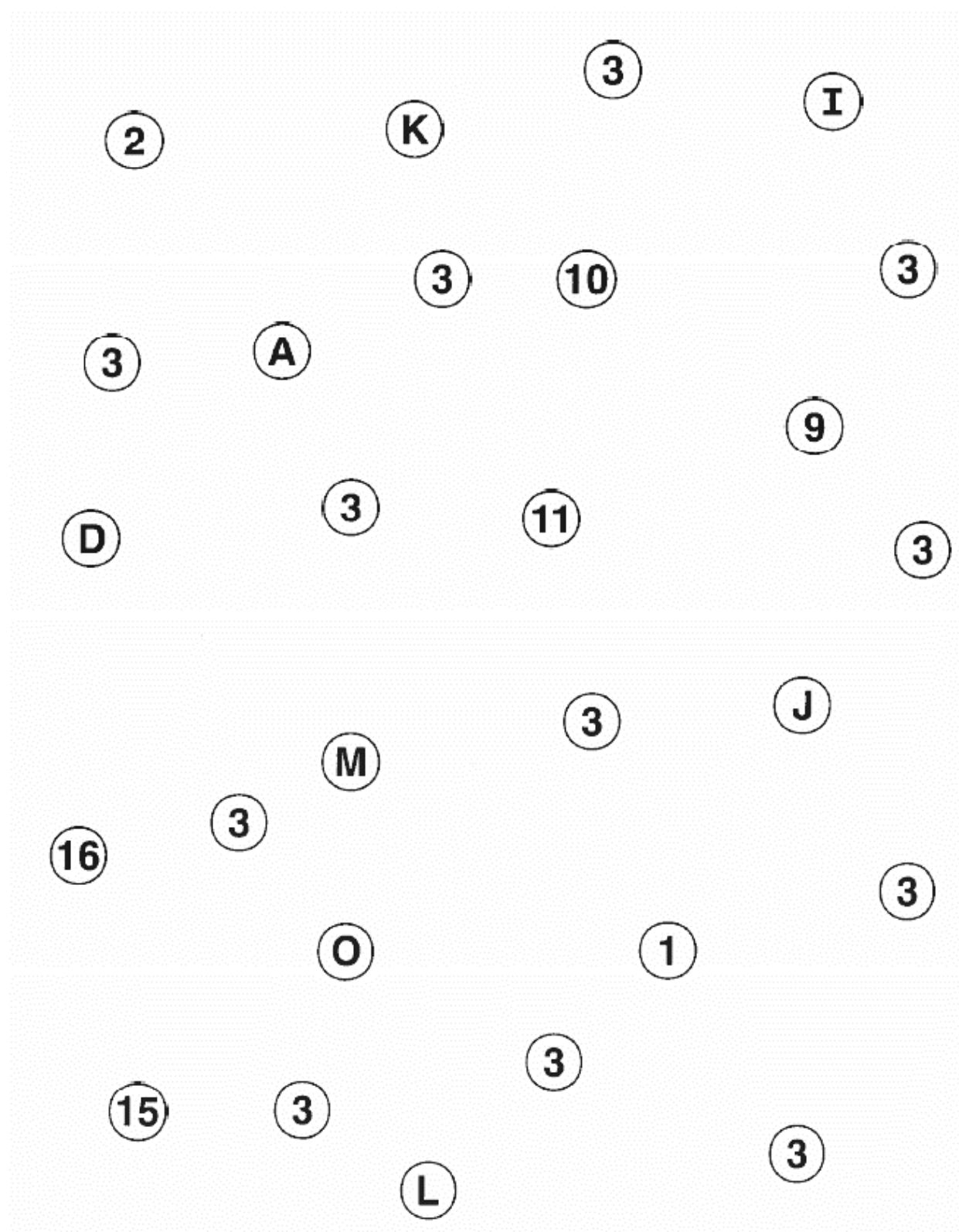
Condition 1 Visual Scanning

Practice



35 36 37 38 39 40 A B C D E







Name _____ Age _____

ID _____ Date _____

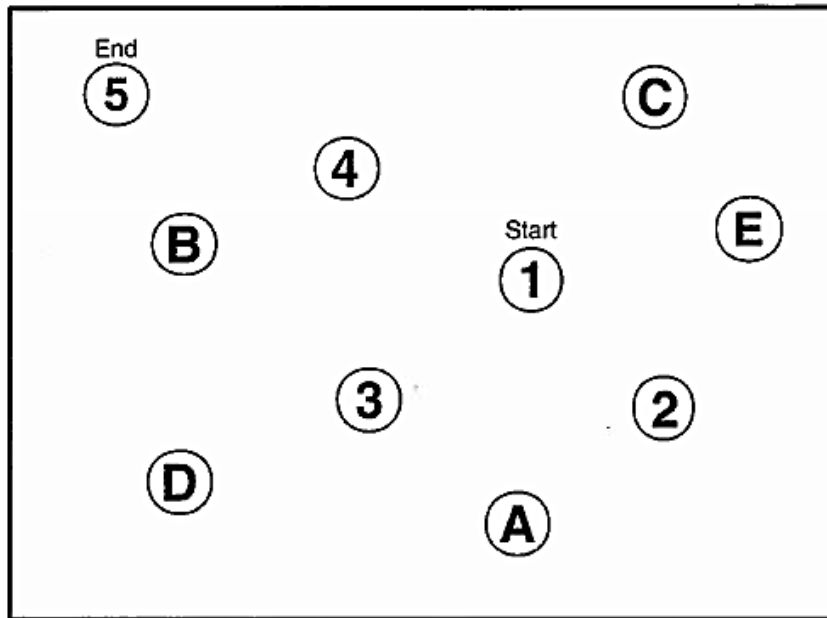
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Notes _____

Trail Making Test

Condition 2
Number Sequencing

Practice

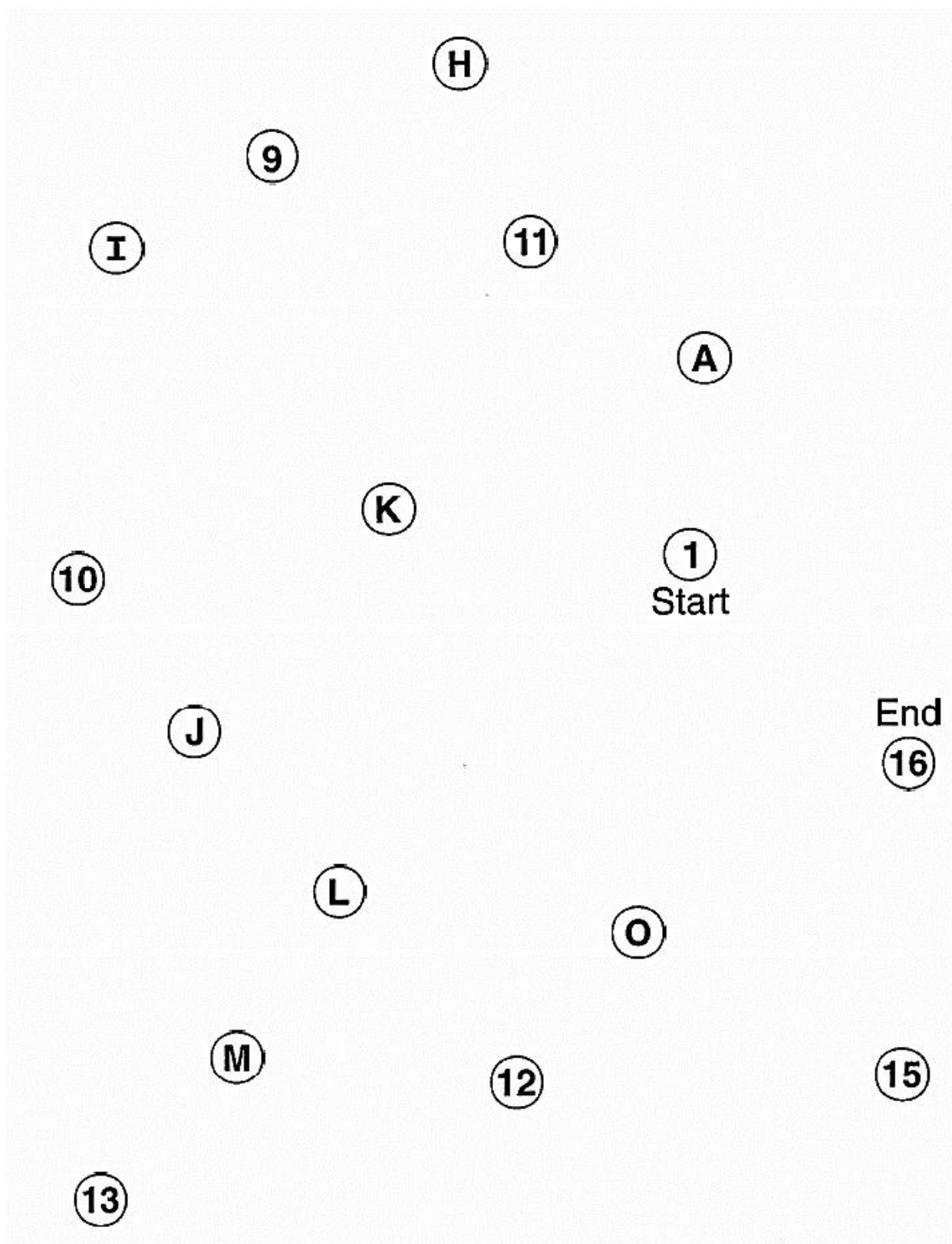


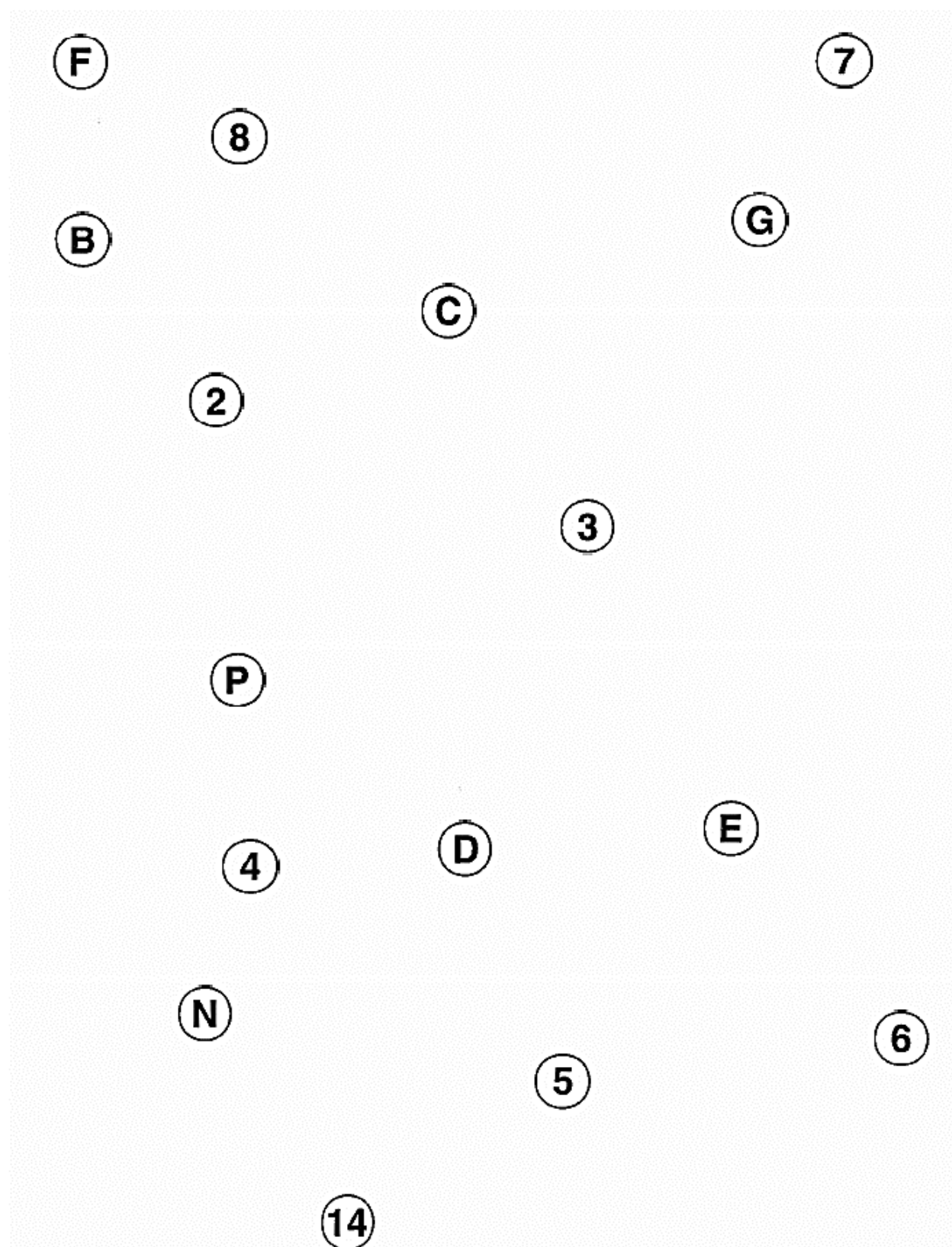
35 36 37 38 39 40 A B C D E

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Name _____ Age _____

ID _____ Date _____

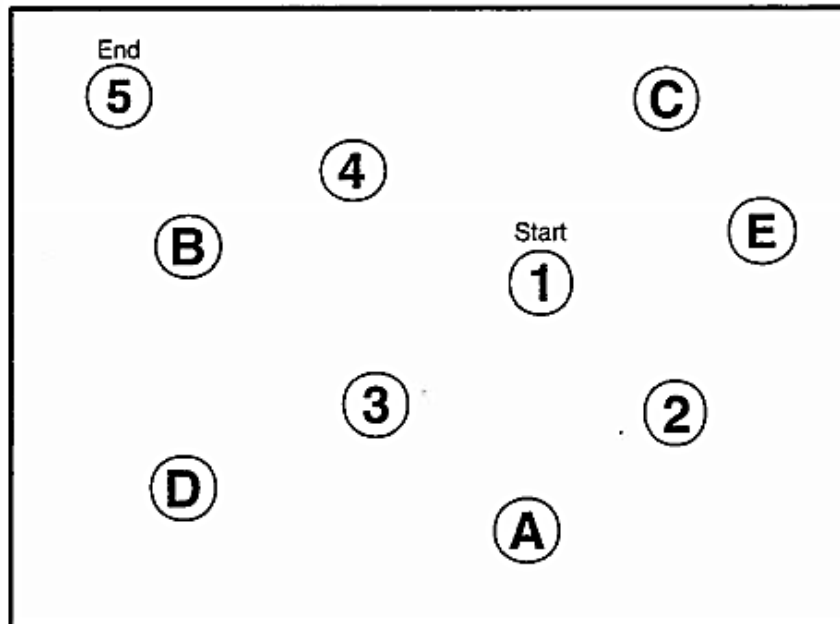
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Notes _____

Trail Making Test

Condition 2
Number Sequencing

Practice

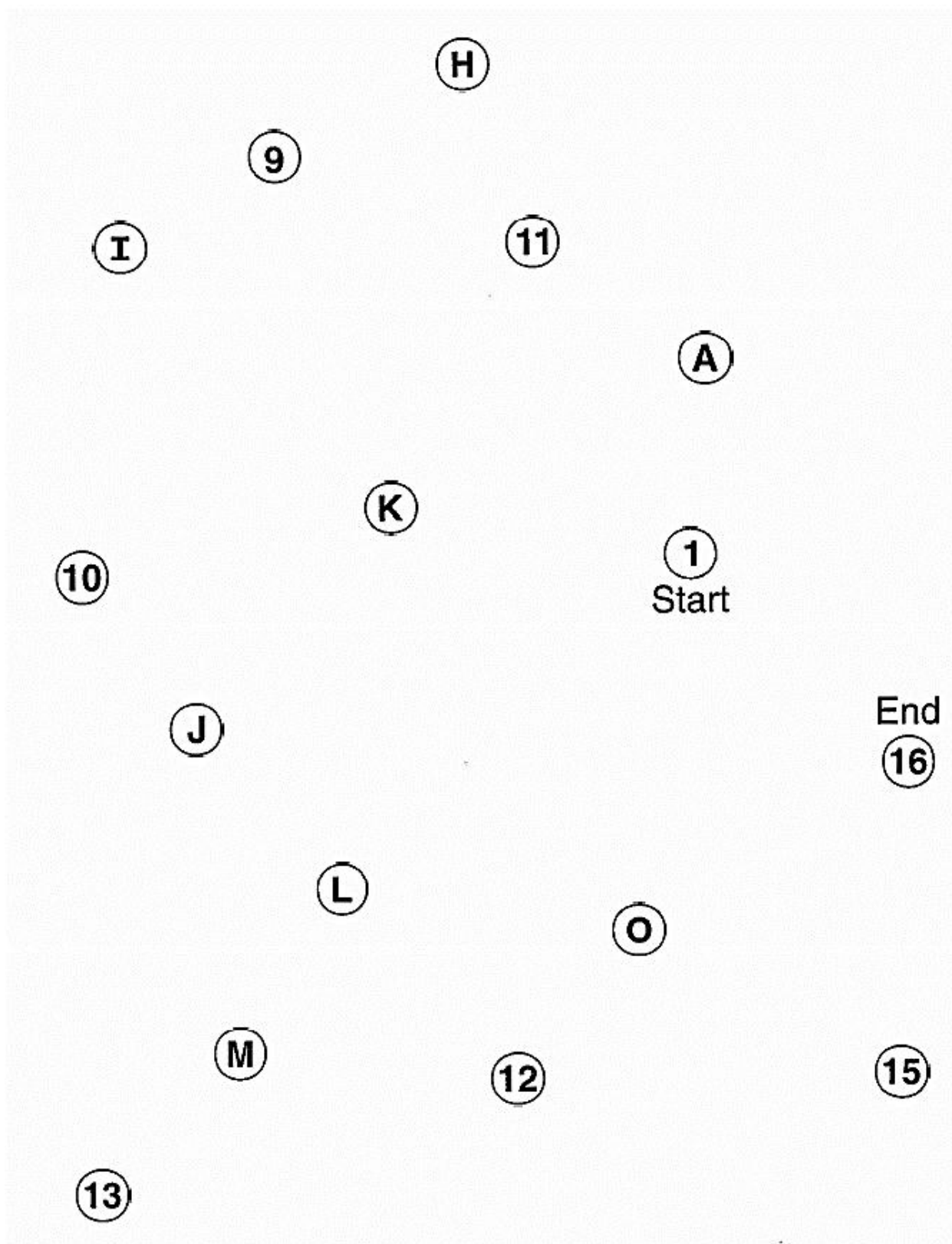


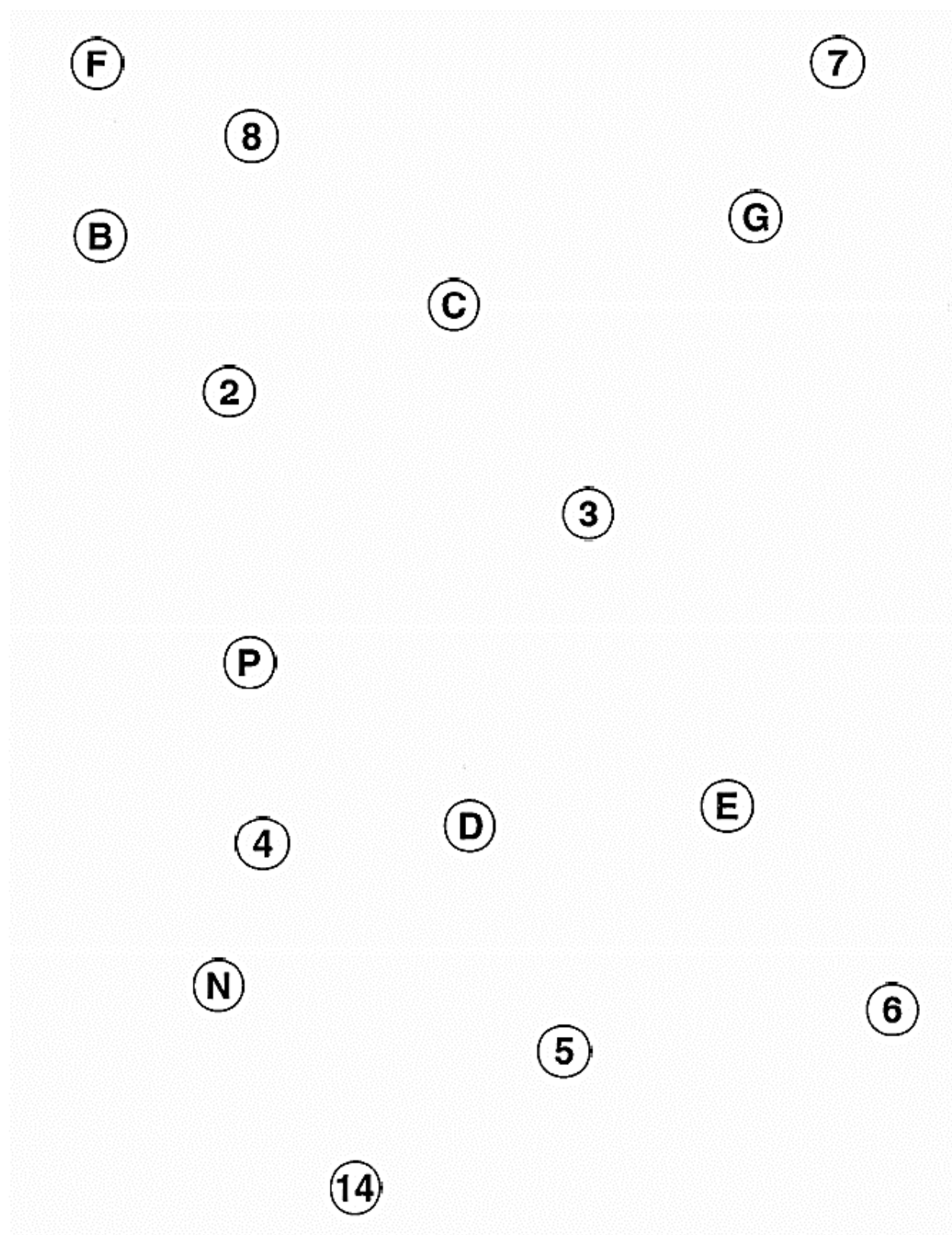
35 36 37 38 39 40 ABCDE

PEARSON

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Name _____ Age _____

ID _____ Date _____

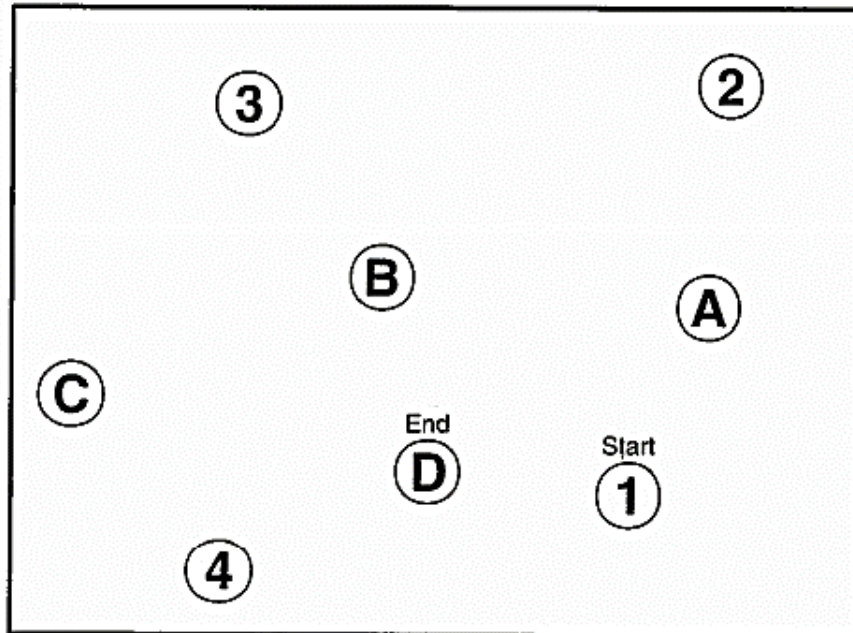
Examiner _____

Notes _____

Trail Making Test

Condition 4 Number-Letter Switching

Practice

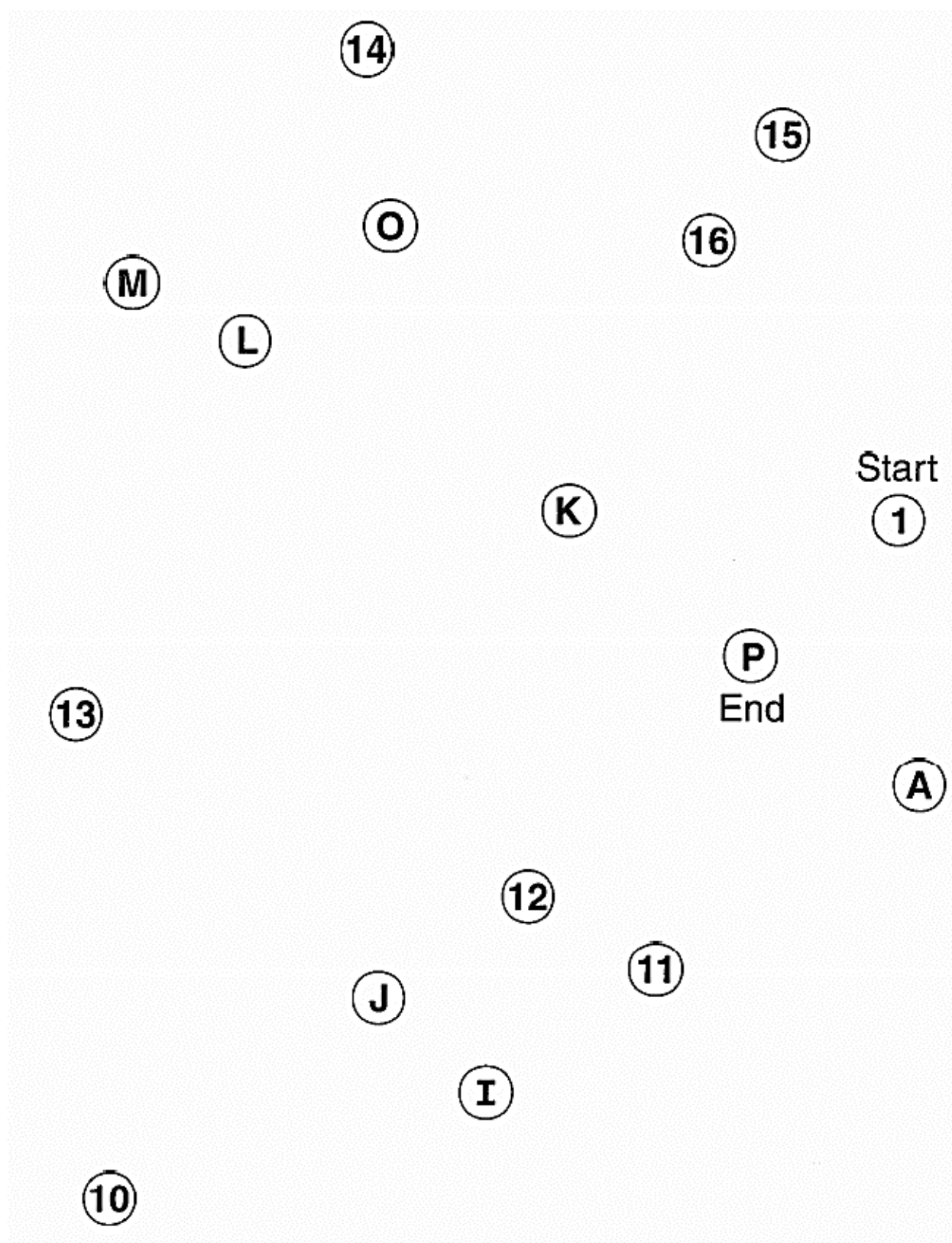


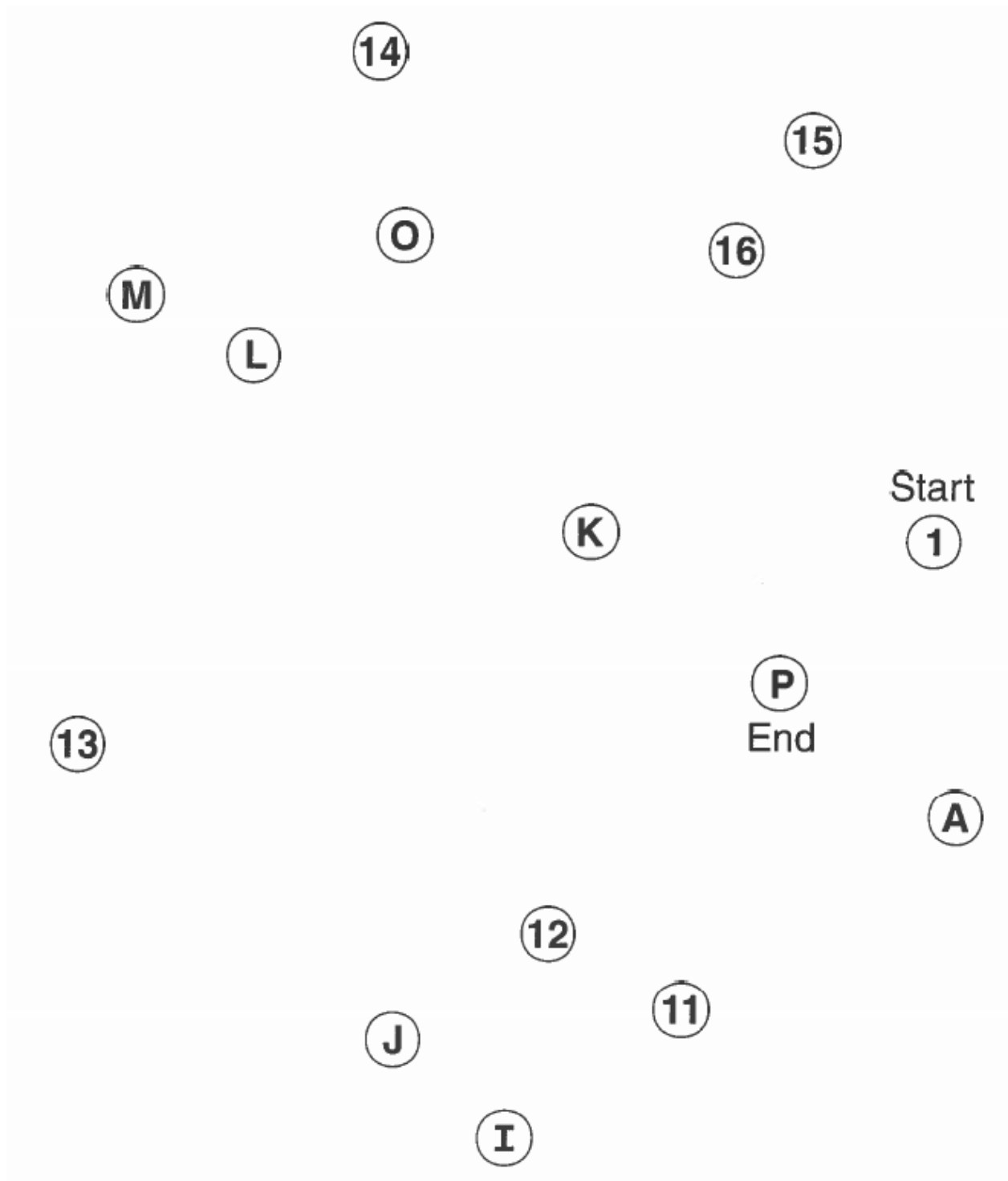
36 37 38 39 40 A B C D E

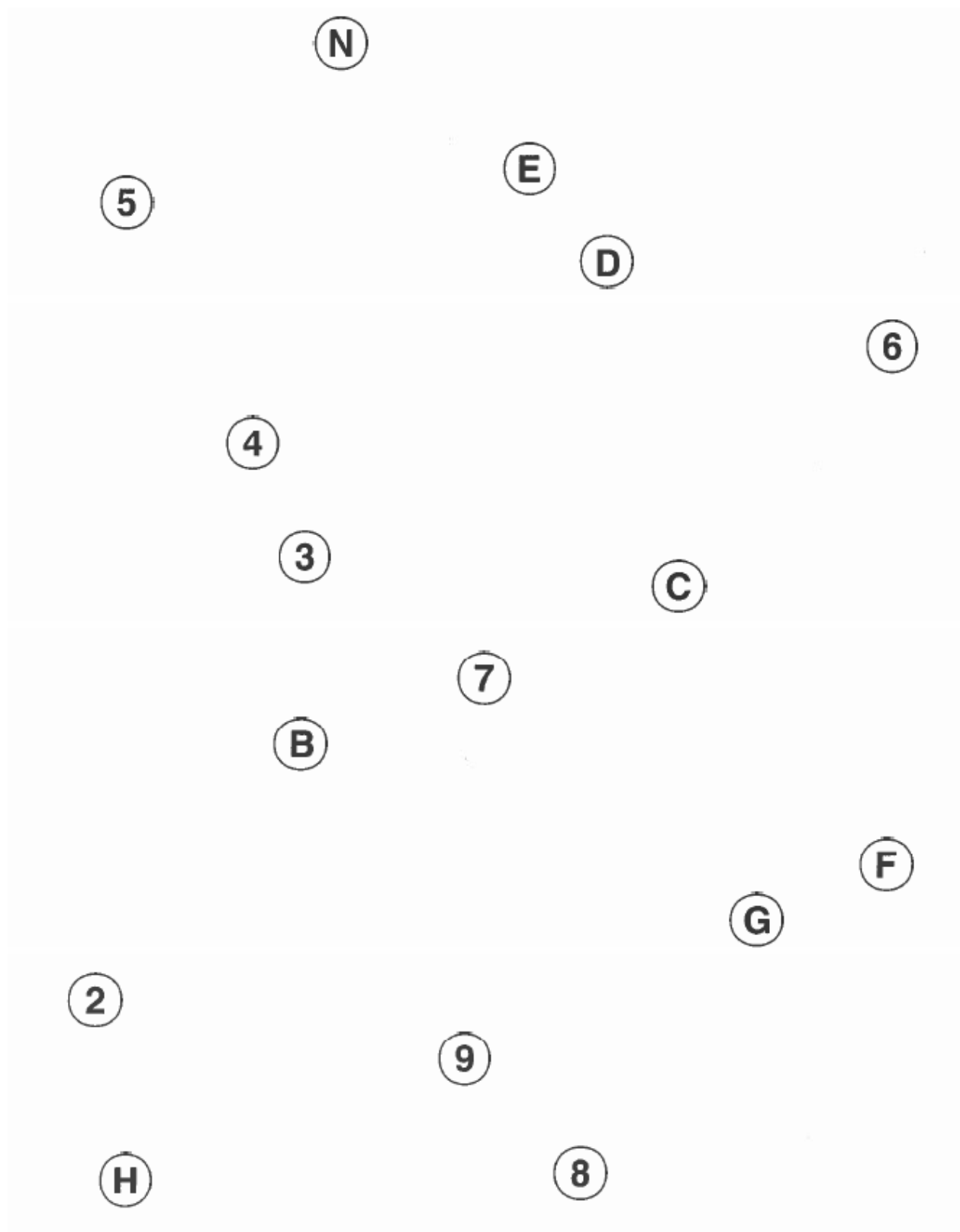
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Name _____ Age _____

ID _____ Date _____

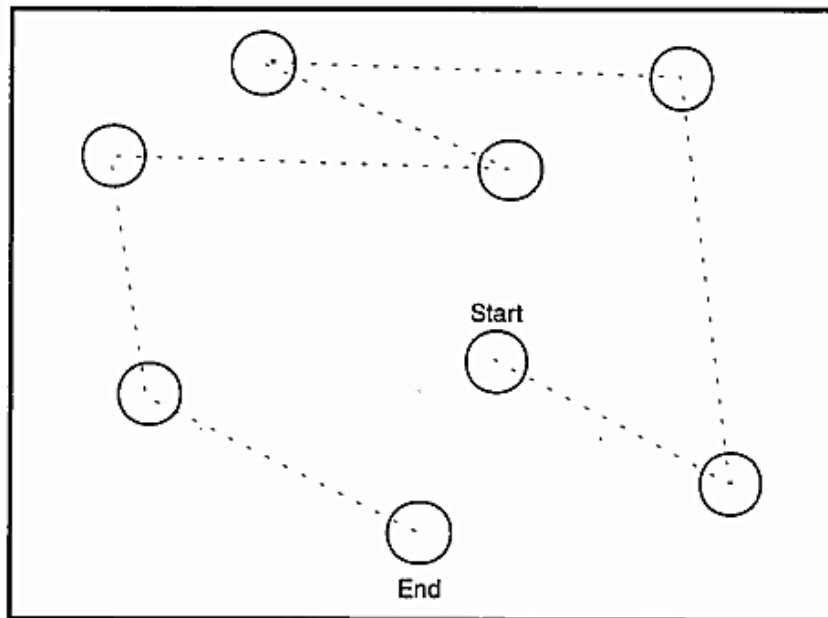
Examiner _____

Notes _____

Trail Making Test

Condition 5
Motor Speed

Practice

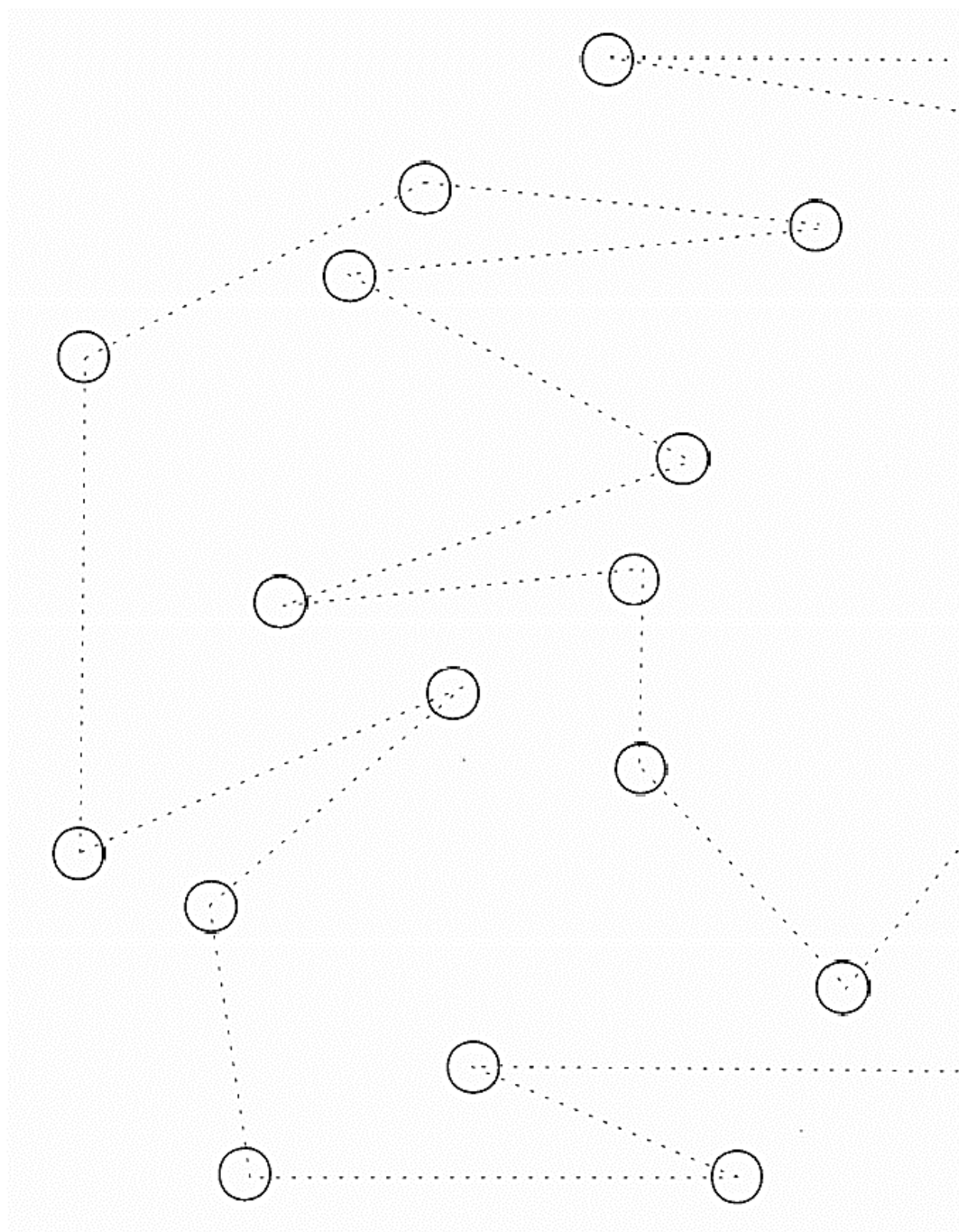


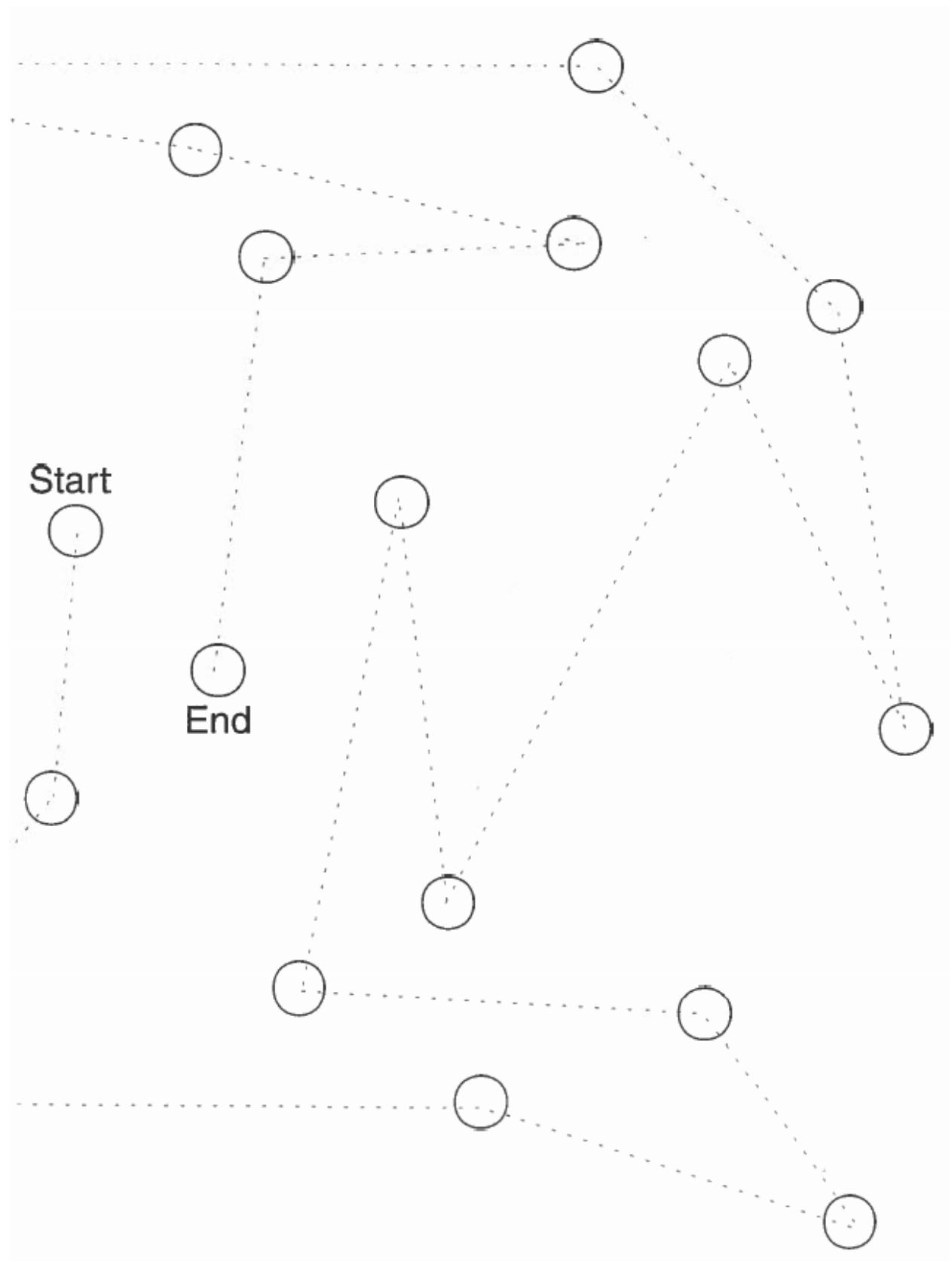
34 35 36 37 38 39 40 A B C D E

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HANDZ
Neuropsychological Test Visit: NEPSY-II Word Generation

Subject # _____

Visit #: _____

Date of Evaluation: _____

1. Say, "See how many different animals you can name, like cat or dog. Say them as quickly as you can. Are you ready? Go." Begin timing. If the child does not produce any words within a 15-second period, say, "Tell me some (more) animals." At 60 seconds, say "Stop"

2. "Now see if you can name some things you can eat or drink. Say as many different ones as you can, like pizza or milk. Do it quickly. Ready? Go." Begin timing. If the child does not produce any words within a 15-second period, say, "Tell me some (more) things you can eat or drink". At 60 seconds, say "Stop"

ANIMALS:

Total correct = _____ Total repetition errors = _____ Total Set Loss errors = _____

EAT / DRINK:

Total correct = _____ Total repetition errors = _____ Total Set Loss errors = _____

Ages 5-16



Affect Recognition

Materials	Start	Reverse Rule	Discontinue Rule	Stop	Time Limit (Timing)
Manual Stimulus Book 1 Stopwatch	5-6: Item 9 7-16: Item 17	If a score of 0 is obtained on either of the first two items administered, reverse until two consecutive scores of 1 are obtained, then proceed forward.	Discontinue after 5 consecutive scores of 0.	5-6: Stop after Item 25. 7-16: Stop after Item 24.	Items 26-35: Present each item stimulus for 5 seconds.

Items 1-8 do not contribute to the emotion error totals.

Item	Response	Score
1.	Y N	0 1
2.	Y N	0 1
3.	Y N	0 1
4.	Y N	0 1
5.	Y N	0 1
6.	Y N	0 1
7.	Y N	0 1
8.	Y N	0 1
9.	1 2 3 N	0 1
10.	1 2 3 H	0 1
11.	1 2 3 H	0 1
12.	1 2 3 S	0 1
13.	1 2 3 4 F F A	0 1
14.	1 2 3 4 H S F	0 1
15.	1 2 3 4 S A N	0 1
16.	1 2 3 4 S F D	0 1
17.	1 2 3 4 A N F	0 1
18.	1 2 3 4 H N D	0 1
19.	1 2 3 4 S S F	0 1
20.	1 2 3 4 H A N	0 1
21.	1 2 3 4 A N D	0 1
22.	1 2 3 4 D N	0 1
23.	1 2 3 4 F A	0 1
24.	1 2 3 4 A S	0 1

5-6

7-16

Behavioral Observations

Spontaneous
Comments Total

Item	Response	Score
25.	1 2 3 4 S N	0 1
26.	1 2 3 4 5 6 N F S S	0 1
27.	1 2 3 4 5 6 N H N D	0 1
28.	1 2 3 4 5 6 F A N D	0 1
29.	1 2 3 4 5 6 H F D S	0 1
30.	1 2 3 4 5 6 H S A H	0 1
31.	1 2 3 4 5 6 N D D S	0 1
32.	1 2 3 4 5 6 A S F D	0 1
33.	1 2 3 4 5 6 F N A A	0 1
34.	1 2 3 4 5 6 A F S D	0 1
35.	1 2 3 4 5 6 N F D A	0 1

5-6

AR Total Score
(5-6: Max. = 25) (7-16: Max. = 35)

AR Scaled Score

A.1

Total Happy (H) Errors
(5-6: Max. = 5) (7-16: Max. = 9)

Happy Errors
Percentile Rank

A.1

Total Sad (S) Errors
(5-6: Max. = 7) (7-16: Max. = 14)

Sad Errors
Percentile Rank

A.1

Total Neutral (N) Errors
(5-6: Max. = 8) (7-16: Max. = 15)

Neutral Errors
Percentile Rank

A.1

Total Fear (F) Errors
(5-6: Max. = 6) (7-16: Max. = 14)

Fear Errors
Percentile Rank

A.1

Total Angry (A) Errors
(5-6: Max. = 7) (7-16: Max. = 14)

Angry Errors
Percentile Rank

A.1

Total Disgust (D) Errors
(5-6: Max. = 4) (7-16: Max. = 11)

Disgust Errors
Percentile Rank

A.1

4. Digit Span

The child is read a sequence of numbers and recalls the numbers in the same order (Forward task), reverse order (Backward task), and ascending order (Sequencing task).



Materials

Administration and Scoring Manual

Record Form



Start

Forward

Ages 6–16: Item 1

Backward

Ages 6–16: Sample Item, then Item 1

Sequencing

Ages 6–7: Qualifying Item, Sample Items A & B, then Item 1

Ages 8–16: Sample Items A & B, then Item 1



Discontinue

Forward

Ages 6–16: Discontinue after scores of **0** on *both trials* of an item.

Backward

Ages 6–16: Discontinue after scores of **0** on *both trials* of an item.

Sequencing

Ages 6–7: Discontinue after an incorrect response to the Qualifying Item OR after scores of **0** on *both trials* of an item.

Ages 8–16: Discontinue after scores of **0** on *both trials* of an item.

General Directions

- Digit Span includes three tasks: Digit Span Forward (Forward), Digit Span Backward (Backward), and Digit Span Sequencing (Sequencing). Administer *all three tasks* to the child.
- Each test item is composed of two trials. Administer *both trials* of each item.

Item Administration

Forward

6-18 → Items 1-9

Say, I'm going to say some numbers. Listen carefully, I can only say them one time.
When I stop, you say them back to me in the same order. Just say what I say.
Proceed to Item 1.

Administer Trial 1 and Trial 2 of each item. Proceed to the next item if the
discontinue criterion has not been met.

Administer Backward and Sequencing regardless of the child's performance
on Forward.

Correct Responses (*Forward*)

Item	Trial
1.	2 - 9
	5 - 4
2.	3 - 9 - 6
	6 - 5 - 2
3.	5 - 4 - 1 - 7
	9 - 1 - 6 - 8
4.	8 - 2 - 1 - 9 - 6
	7 - 2 - 3 - 4 - 9
5.	5 - 7 - 3 - 6 - 4 - 8
	3 - 8 - 4 - 1 - 7 - 5
6.	2 - 1 - 8 - 9 - 4 - 3 - 7
	7 - 8 - 5 - 2 - 1 - 6 - 3
7.	1 - 8 - 4 - 2 - 7 - 5 - 3 - 6
	2 - 7 - 9 - 6 - 3 - 1 - 4 - 8
8.	7 - 2 - 6 - 1 - 9 - 4 - 8 - 3 - 5
	4 - 3 - 8 - 9 - 1 - 7 - 5 - 6 - 2
9.	6 - 2 - 5 - 3 - 1 - 9 - 8 - 5 - 4 - 7
	9 - 4 - 3 - 8 - 7 - 5 - 2 - 9 - 6 - 1

Correct Responses (*Backward*)

Item	Trial	Correct Response
S.	9-4	4-9
	5-6	6-5
1.	2-1	1-2
	1-3	3-1
2.	3-9	9-3
	8-5	5-8
3.	2-3-6	6-3-2
	5-4-1	1-4-5
4.	4-5-8	8-5-4
	2-7-5	5-7-2
5.	7-4-5-2	2-5-4-7
	9-3-8-6	6-8-3-9
6.	2-1-7-9-4	4-9-7-1-2
	5-6-3-8-7	7-8-3-6-5
7.	1-6-4-7-5-8	8-5-7-4-6-1
	6-3-7-2-9-1	1-9-2-7-3-6
8.	8-1-5-2-4-3-6	6-3-4-2-5-1-8
	4-3-7-9-2-8-1	1-8-2-9-7-3-4
9.	3-1-7-9-4-6-8-2	2-8-6-4-9-7-1-3
	9-8-1-6-3-2-4-7	7-4-2-3-6-1-8-9

Correct Responses (Sequencing)

Item	Trial	Correct Response
SA.	3-1	1-3
	8-6	6-8
SB.	5-2-4	2-4-5
	4-3-3	3-3-4
1.	4-1	1-4
	3-2	2-3
2.	5-2-7	2-5-7
	1-8-6	1-6-8
3.	7-5-8-1	1-5-7-8
	4-2-9-3	2-3-4-9
4.	1-5-6-2-8	1-2-5-6-8
	2-8-4-7-9	2-4-7-8-9
5.	3-3-6-1-5	1-3-3-5-6
	4-9-4-6-9	4-4-6-9-9
6.	8-5-2-5-3-7	2-3-5-5-7-8
	6-1-4-7-9-3	1-3-4-6-7-9
7.	9-7-9-6-2-6-8	2-6-6-7-8-9-9
	3-1-7-5-1-8-5	1-1-3-5-5-7-8
8.	6-9-6-2-1-3-7-9	1-2-3-6-6-7-9-9
	1-4-8-5-4-8-7-4	1-4-4-4-5-7-8-8
9.	2-5-7-7-4-8-7-5-2	2-2-4-5-5-7-7-7-8
	9-1-8-3-6-3-9-2-6	1-2-3-3-6-6-8-9-9

Name _____ Test Date ____/____/____
 ID # _____ Birth Date ____/____/____
 Gender ____ Race ____ Handedness ____ Age ____
 Occupation ____ Education ____
 Examiner _____

Referral Information

Referral Question _____

Background Information/Presenting Complaints _____

Current Medications/Dosage _____

Behavioral Observations _____

TESTING SITUATION		
Rapport	Cooperation	Effort on Test
☐ Excellent	☐ Excellent	☐ Excellent
☐ Good	☐ Adequate	☐ Adequate
☐ Fair	☐ Variable	☐ Fair
☐ Poor	☐ Resistant	☐ Variable
	☐ Noncompliant	☐ Poor

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CATEGORY SEQUENCE: C F N C F N

___ 1. C F N O	___ 17. C F N O	___ 33. C F N O	___ 49. C F N O
___ 2. C F N O	___ 18. C F N O	___ 34. C F N O	___ 50. C F N O
___ 3. C F N O	___ 19. C F N O	___ 35. C F N O	___ 51. C F N O
___ 4. C F N O	___ 20. C F N O	___ 36. C F N O	___ 52. C F N O
___ 5. C F N O	___ 21. C F N O	___ 37. C F N O	___ 53. C F N O
___ 6. C F N O	___ 22. C F N O	___ 38. C F N O	___ 54. C F N O
___ 7. C F N O	___ 23. C F N O	___ 39. C F N O	___ 55. C F N O
___ 8. C F N O	___ 24. C F N O	___ 40. C F N O	___ 56. C F N O
___ 9. C F N O	___ 25. C F N O	___ 41. C F N O	___ 57. C F N O
___ 10. C F N O	___ 26. C F N O	___ 42. C F N O	___ 58. C F N O
___ 11. C F N O	___ 27. C F N O	___ 43. C F N O	___ 59. C F N O
___ 12. C F N O	___ 28. C F N O	___ 44. C F N O	___ 60. C F N O
___ 13. C F N O	___ 29. C F N O	___ 45. C F N O	___ 61. C F N O
___ 14. C F N O	___ 30. C F N O	___ 46. C F N O	___ 62. C F N O
___ 15. C F N O	___ 31. C F N O	___ 47. C F N O	___ 63. C F N O
___ 16. C F N O	___ 32. C F N O	___ 48. C F N O	___ 64. C F N O

SCORING AREA

	Raw score	Standard score	T score	Percentile score
Total Number Correct				
Total Number of Errors				
Perseverative Responses				
Perseverative Errors				
Nonperseverative Errors				
Conceptual Level Responses				

	Raw score	Percentile range
Number of Categories Completed		
Trials to Complete First Category		
Failure to Maintain Set		
Learning to Learn		

Normative table _____

Learning to Learn Score Worksheet				
Category number	Number of trials	Errors	Percent errors	Percent errors difference score
1				
2				
3				
4				
5				

Subject ID:

Date:

Pencil Tapping Test

Give one pencil to the child, and keep one pencil for yourself

Say, "We are going to play a new game now. When I tap my pencil on the table once (demonstrate), I want you to tap your pencil twice. Can you do that?"

Allow child to practice until they tap correctly.

"When I tap my pencil twice, I want you to tap your pencil once. Can you do that?"

Allow child to practice until they tap correctly.

"When I tap my pencil three times, don't tap your pencil at all. Now let's try it."

Tap once, then twice, then three times, then repeat. Allow the child to practice until they are able to do three sequences in a row correctly.

"Great, now we are ready to play the game. When I tap one time, I want you to tap two times. When I tap two times, I want you to tap one time. When I tap three times, don't tap at all. Are you ready?" If child expresses that they are ready, begin.

Examiner Taps	Incorrect?		Incorrect?
1		1	
2		2	
2		1	
2		2	
1		3	
1		1	
1		1	
3		2	
2		2	
1		1	
2		3	
3		1	
1		1	
1		1	
2		3	
1		2	
2		1	
2		1	
2		1	
1		3	
Total Errors=		Total Score (40-total errors):	

Subject # _____

Visit #: _____

Date of Evaluation: _____

HANDZ**PHQ-9 Depression Screen: Child Form**

How often have you been bothered by each of the following symptoms during the past 7 days? For each symptom put an "X" in the box beneath the answer that best describes how you have been feeling.

		Not at all	Several days	More than half the days	Nearly every day
1.	Feeling down, depressed, irritable, or hopeless?				
2.	Little interest or pleasure in doing things?				
3.	Trouble falling asleep, staying asleep, or sleeping too much?				
4.	Poor appetite, weight loss, or overeating?				
5.	Feeling tired, or having little energy?				
6.	Feeling bad about yourself—or feeling that you are a failure, or that you have let yourself or your family down?				
7.	Trouble concentrating on things like school work, reading, or watching TV?				
8.	Moving or speaking so slowly that other people could have noticed? Or the opposite—being so fidgety or restless that you were moving around a lot more than usual?				
9.	Thoughts that you would be better off dead, or of hurting yourself in some way?				
		Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
If any problems were selected, how difficult have those problems made it for you to do things at school, at home, or get along with other people?					

Subject # _____

Visit #: _____

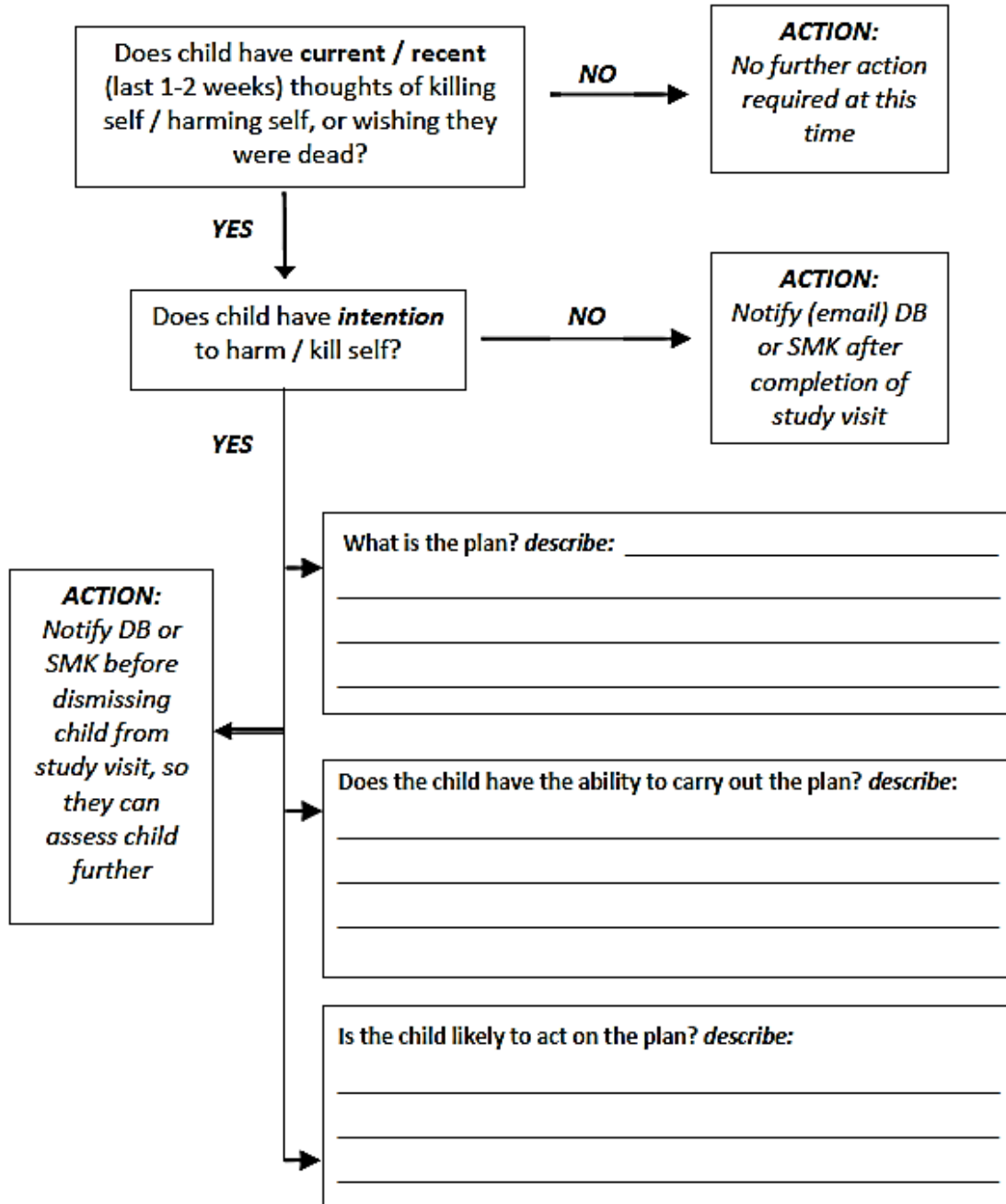
Date of Evaluation: _____

HANDZ

PHQ-9 Depression Screen: Child Form

SAFETY ASSESSMENT GUIDELINES:

IF PHQ9 – Item 9 (suicidality) is endorsed at any level, obtain the following information from the child:



Subject # _____

Visit #: _____

Date of Evaluation: _____

HANDZ**PHQ-9 Depression Screen: Parent Form**

How often has your child been bothered by each of the following symptoms during the past 7 days? For each symptom put an "X" in the box beneath the answer that best describes how your child has been feeling.

		Not at all	Several days	More than half the days	Nearly every day
1.	Feeling down, depressed, irritable, or hopeless?				
2.	Little interest or pleasure in doing things?				
3.	Trouble falling asleep, staying asleep, or sleeping too much?				
4.	Poor appetite or overeating?				
5.	Feeling tired or having little energy?				
6.	Feeling bad about himself/herself - or feeling that they are a failure or that you have let themselves or their family down?				
7.	Trouble concentrating on things like school work, reading, or watching TV?				
8.	Moving or speaking so slowly that other people could have noticed? Or the opposite—being so fidgety or restless that they were moving around a lot more than usual?				
9.	Saying that they would be better off dead, or saying that they will hurt themselves in some way?				
		Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
If any problems were selected, how difficult have those problems made it for your child to do things at school, at home, or get along with other people?					

Subject # _____

Visit #: _____

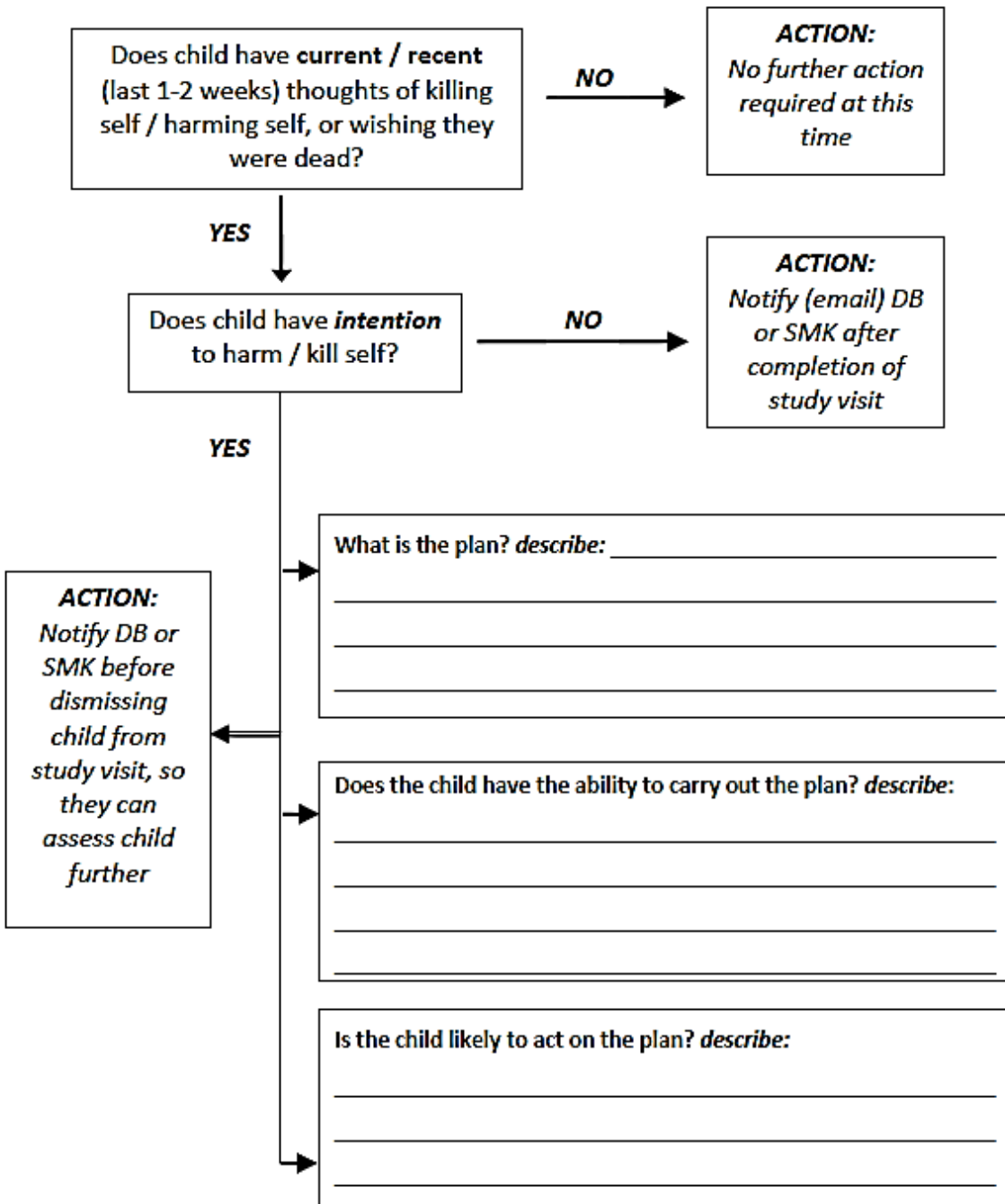
Date of Evaluation: _____

HANDZ

PHQ-9 Depression Screen: Parent Form

SAFETY ASSESSMENT GUIDELINES:

IF PHQ9 – Item 9 (suicidality) is endorsed at any level, obtain the following information from the parent:



BRIEF[®] 2

Behavior Rating Inventory of Executive Function[®], Second Edition

PARENT FORM

Gerard A. Gioia, PhD, Peter K. Isquith, PhD,
Steven C. Guy, PhD, and Lauren Kenworthy, PhD

Instructions

On the following pages is a list of statements that describe children. We would like to know if your child has had problems with these behaviors over the past 6 months. Please answer all the items the best that you can. Please **DO NOT SKIP ANY ITEMS**. Think about your child as you read each statement and circle:

- N** if the behavior is **Never** a problem
- S** if the behavior is **Sometimes** a problem
- O** if the behavior is **Often** a problem

For example, if your child **never** has trouble completing homework on time, you would circle **N** for this item:

Has trouble completing homework on time ☒ N S O

If you make a mistake or want to change your answer, **DO NOT ERASE**. Draw an "X" through the answer you want to change and then circle the correct answer:

Has trouble completing homework on time ☒ N ☒ S O

Before you begin answering the items, please fill in your child's name, gender, age, grade, your relationship to the child, today's date, and child's date of birth in the spaces provided at the top of the next page.

PAR • 16204 N. Florida Ave. • Lutz, FL 33549 • 1.800.331.8378 • www.parinc.com

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BRIEF'2 PARENT FORM

Date of birth _____

Child's name _____ Gender _____ Age _____ Grade _____

Rater's name _____ Relationship to child _____ Today's date _____

	N = Never	S = Sometimes	O = Often
1. Is fidgety	N	S	O
2. Resists or has trouble accepting a different way to solve a problem with schoolwork, friends, tasks, etc.	N	S	O
3. When given three things to do, remembers only the first or last	N	S	O
4. Is unaware of how his/her behavior affects or bothers others	N	S	O
5. Work is sloppy	N	S	O
6. Has explosive, angry outbursts	N	S	O
7. Does not plan ahead for school assignments	N	S	O
8. Cannot find things in room or school desk	N	S	O
9. Is not a self-starter	N	S	O
10. Does not think before doing (is impulsive)	N	S	O
11. Has trouble getting used to new situations (classes, groups, friends, etc.)	N	S	O
12. Has a short attention span	N	S	O
13. Has poor understanding of own strengths and weaknesses	N	S	O
14. Has outbursts for little reason	N	S	O
15. Gets caught up in details and misses the big picture	N	S	O
16. Gets out of control more than friends	N	S	O
17. Gets stuck on one topic or activity	N	S	O
18. Forgets his/her name	N	S	O
19. Has trouble with chores or tasks that have more than one step	N	S	O
20. Does not realize that certain actions bother others	N	S	O
21. Written work is poorly organized	N	S	O
22. Small events trigger big reactions	N	S	O
23. Has good ideas but does not get job done (lacks follow-through)	N	S	O
24. Talks at the wrong time	N	S	O
25. Has trouble finishing tasks (chores, homework, etc.)	N	S	O
26. Does not notice when his/her behavior causes negative reactions	N	S	O
27. Reacts more strongly to situations than other children	N	S	O
28. Has trouble remembering things, even for a few minutes	N	S	O
29. Makes careless errors	N	S	O
30. Gets out of seat at the wrong times	N	S	O
31. Becomes upset with new situations	N	S	O
32. Has trouble concentrating on tasks, schoolwork, etc.	N	S	O

	N = Never	S = Sometimes	O = Often
33. Has poor handwriting	N	S	O
34. Mood changes frequently	N	S	O
35. Has good ideas but cannot get them on paper	N	S	O
36. Has trouble counting to three	N	S	O
37. Leaves messes that others have to clean up	N	S	O
38. Needs to be told to begin a task even when willing	N	S	O
39. Acts too wild or "out of control"	N	S	O
40. Thinks too much about the same topic	N	S	O
41. Forgets what he/she was doing	N	S	O
42. Does not check work for mistakes	N	S	O
43. Angry or tearful outbursts are intense but end suddenly	N	S	O
44. Becomes overwhelmed by large assignments	N	S	O
45. Loses lunch box, lunch money, permission slips, homework, etc	N	S	O
46. Needs help from an adult to stay on task	N	S	O
47. Forgets to hand in homework, even when completed	N	S	O
48. Has trouble putting the brakes on his/her actions	N	S	O
49. Resists change of routine, foods, places, etc.	N	S	O
50. Has trouble getting started on homework or tasks	N	S	O
51. Mood is easily influenced by the situation	N	S	O
52. Underestimates time needed to finish tasks	N	S	O
53. Does not bring home homework, assignment sheets, materials, etc	N	S	O
54. Cannot find the front door of home	N	S	O
55. Does not take initiative	N	S	O
56. Becomes upset too easily	N	S	O
57. Starts assignments or tasks at the last minute	N	S	O
58. Has trouble moving from one activity to another	N	S	O
59. Has trouble carrying out the actions needed to reach goals (saving money for special item, studying to get a good grade, etc.)	N	S	O
60. Is disturbed by change of teacher or class	N	S	O
61. Has trouble organizing activities with friends	N	S	O
62. Becomes too silly	N	S	O
63. Leaves a trail of belongings wherever he/she goes	N	S	O

Test Rater Evaluation of performance

Study ID _____

What language was used for the assessment?

- ☐ English was used for all parts of the assessment
- ☐ Nyanja (or other local language) was used for all parts of the assessment (except for the test stimuli, such as the CVLT-C words, that were given in English)
- ☐ A mix of English and Nyanja (or other local language) was used for the assessment: Test instructions were given in English but Nyanja was sometimes used to clarify or explain

Rate the overall validity of the testing

- ☐ No issues with validity.
- ☐ Minor issues that could interfere with test validity, e.g. background noise.
- ☐ Major issues that could interfere with test validity, e.g. child not fully cooperative.
- ☐ Test not at all valid, e.g. child not at all cooperative, or too ill to complete testing.

Rate the child's ability to pay attention during examination

- ☐ 1. Child spends most of time off-task, inattentive.
- ☐ 2. Child's attention frequently drifts and requires frequent prompts.
- ☐ 3. Child's attention occasionally drifts, particularly at the end of activities, but is responsive to prompts.
- ☐ 4. Child fully attends to and complies with interviewer.

Rate the child's interest in accuracy

- ☐ 1. Child is frequently haphazard and unfocused when answering items.
- ☐ 2. Child is careless at times.
- ☐ 3. Child is generally careful but interest flags, particularly at end of testing session
- ☐ 4. Child takes the time to look and appears to make thoughtful choices, particularly on hard items.

Rate the child's ability to focus sustained attention on tasks

- ☐ 1. Child not able to concentrate or persist on much of the assessment.
- ☐ 2. Child frequently distracted, requires multiple prompts from tester.
- ☐ 3. Child occasionally distracted but generally persistent, but does not require prompt from tester.
- ☐ 4. Child able to concentrate and persist with task, even toward end of tasks and with distractions.

Rate whether the child acts careless or destructive

- ☐ 1. Child gets too "rowdy" with materials and breaks or damages test materials.
- ☐ 2. Child is repeatedly careless but does not damage materials, paper. Needs repeated reminders.
- ☐ 3. Child is careless or slightly destructive one time. Can include kicking, dropping object on floor "by mistake."
- ☐ 4. Child is not careless and is not destructive.

Rate the child's impulsivity

- ☐ 1. Child is impulsive throughout assessment, needs lots of boundary-setting; transitions between tasks made difficult because of child's activity level/impulsivity.
- ☐ 2. Child is often impulsive across multiple tasks or highly impulsive during one activity; child needs multiple prompts to wait while tester gathers materials for new task.
- ☐ 3. A few instances of impulsive behavior; child sometimes shows anticipation for interesting task materials but rarely needs a reminder.
- ☐ 4. Child waits before pointing to materials, reaching for blocks, etc., and waits patiently for new tasks to begin; no ambiguous or impulsive behaviors.

Rate the child's ability to remain appropriately seated during testing.

- ☐ 1. Out of seat frequently or difficult to manage (e.g. runs around room, climbs on furniture).
- ☐ 2. Needs multiple reminders to return to seat, sit up but listens and responds to prompts.
- ☐ 3. Gets out of seat 1x (including sliding off chair), returns to seat when prompted.
- ☐ 4. Does not climb, open closets, grab objects. (Occasional adjustment in body position is appropriate)

Rate whether the child is engaged vs. withdrawn

- ☐ 1. Child seems "shut down" and difficult to engage in starting task.
- ☐ 2. Child repeatedly withdraws from testing situation and needs encouragement to finish task.
- ☐ 3. Child generally interacts, but at times turns away, lowers head, takes "break" from interaction.
- ☐ 4. Child participates in interaction; body posture suggests relaxed engagement with the interviewer

Rate how cooperative the child is with the examiner.

- ☐ 1. Child does not cooperate even when tasks are easy.
- ☐ 2. Child shows significant resistance, noncompliance and needs multiple prompts to get through assessment.
- ☐ 3. Child shows minor indications of resistance, boredom (e.g. frowns, sighs) but completes tasks.
- ☐ 4. Child attempts to do task as instructed even if task is difficult.

Rate how confident the child appears in completing tasks

- ☐ 1. Child shows hesitation or reluctance on easy items, gives up easily (e.g., "I can't do this.").
- ☐ 2. Less confident child shows repeated hesitation or asks questions that indicate a lack of confidence.
- ☐ 3. Child is diligent, straightforward in answering tester's questions.
- ☐ 4. Child shows confidence by comments such as "I know this one." Child is eager, energetic.

Rate whether the child seems defiant towards the examiner

- ☐ 1. Child actively, directly refuses to comply with tester's request or direction.
- ☐ 2. Child tests limits but responds to tester's prompt or restatement or request.
- ☐ 3. Child says "no," but then follows tester's initial request. Tester does not have to "say it again."
- ☐ 4. Child never exhibits active defiance.

Initial

Page 3 of 3

Rate whether the child seems tentative and responsive to the examiner

- ☐ 1. Child appears not to hear instruction, even when tester repeats request.
- ☐ 2. Child ignores tester but responds to prompt when tester repeats request/directive.
- ☐ 3. Child seems slow to comply. Tester does not restate request, but wonders if child heard.
- ☐ 4. Child hears requests and responds appropriately.

Rate how well the child is able to self-regulate

- ☐ 1. Child becomes over-aroused and has difficulty regaining self-control.
- ☐ 2. Child becomes over-aroused (sad, frustrated, silly) and needs prompt from tester but is able to calm down.
- ☐ 3. Child becomes briefly over-aroused (sad, frustrated, silly) but quickly calms without help from adult tester.
- ☐ 4. Child highly regulated. Never becomes sad, frustrated, or silly.

Appendix: 13 A **Zambian adapted NIHTB-CB administration manual: 3-85 Years**

ENGLISH-CHINYANJA VERSION

BY

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SCHOOL OF EDUCATION

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY,

SOCIOLOGY AND SPECIAL EDUCATION

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1. LIST SORTING WORKING MEMORY: *English Vs Chinyanja, Ages 7-85*

1-List Condition

REVIEW: The 1-List practice items all have the same format of questions. First the examiner asks for the names of the pictures in size order from smallest to largest. If the participant answers incorrectly, there are two more opportunities to get a correct answer. The first comes after a verbal explanation and a repeat of the question; the second comes after replaying the item on the screen and repeating the question. If after three opportunities, the participant continues to answer incorrectly, the test will be discontinued and no more items will be presented. Both practice items are detailed below.

Introduction

Say: I'm going to show you some pictures one at a time on the screen. After each set of pictures, you will see a blank screen. When you see the blank screen, I want you to tell me the names of the pictures in size order from smallest to biggest. For example, if I show you a motorcycle, a bus, and a car, you would say: motorcycle, car, bus. Do you have any questions? Let's practice

Kamba: Ndizaku langizani mapikicha imodzi-imodzi pa nthawi yamene ili paka pa kascreen. Ukaſiliza ku kuonesa mapikicha yoyamba, uzaona sikilini ilibe kalikose. Pamene uzaona sikilini ilibe kalikose, nifuna uniuze nazina yamapikicha kuyamila yan'ono kufilika yakulu maningi. Monga ngati, nikakulangi Honda, basi na, ungani uze ati, Honda, Motoka na basi. Uliko Namanfuso? Tiyeſi tichite.

Click **START TEST**.

1-List Practice Item 1:

Trial 1: Click **PLAY**; when screen is blank, Say **(Kamba): Ndiuze Ngati pasikilini palibe vilivonse, (Niuze nyama kulingana naukulu waka, bwino bwino.** (Tell me the animals in size order).

Correct Response: If participant says DOG, HORSE, Say **(Kamba): Wachita bwino.** Click #1; then click **NEXT**. Computer automatically goes to next item.

Incorrect Response: If participant does not say DOG, HORSE, Say **(Kamba): Tiye tiyeseko futi**

Trial 2: Say **(Kamba): Unaona Galu na Hachi; Galu nain'ono ndipo Hachi nimukulu. Uniuze madzina yanyamaizi bwino bwino kuyambila naing'ono kufikila ukulu.** If participant says DOG, HORSE, Say **(Kamba): Wachita bwino** Click #2; then click **NEXT**. Computer automatically goes to next item. If participant does not say DOG, HORSE, Say **(Kamba): Tiye tiyeseko futi.**

Trial 3: Click **PLAY** again; when screen is blank, Say **(Kamba): Unaona Galu na Hachi; Galu nain'ono ndipo Hachi nimukulu.**

Uniuze madzina yanyamaizi bwino bwino kuyambila naing'ono kufikila ukulu.

Manje uniuze nyama ing'ono. (Wait for response). Manje uniuze nyama ikulu. If participant says DOG, HORSE, Say **(Kamba): Wachita bwino** Click #3; then click **NEXT**. Computer automatically goes to next item. If participant answers one or both parts of the question *incorrectly* after 3 trials, click #4; then click **NEXT**. **Test will be discontinued.**

1-List Practice Item 2:

Say **(Kamba): Manje tizachita masobela yo mobwereza. Wakonzeka mwati?**

Trial 1: Click **PLAY**; when screen is blank, Say **(Kamba): Niuze nazina yanyama bwino bwino kuyambila naing'ono kufikila ikulu, kuyambila inong'ono maningi.**

Correct Response: If participant says RABBIT, SHEEP, ELEPHANT, Say **(Kamba): Wachita bwino.** Click #1; then click **NEXT**. Computer automatically goes to next item.

Incorrect Response: If participant does not say RABBIT, SHEEP, ELEPHANT, Say **(Kamba): Tiye tiyeseko masobela aya.**

Trial 2: Say **(Kamba): Unawona KALULU, MBELELE ndi NJOBVU; KALULU ndi mng'ono, MBELELE ndiyaikuluko, ndipo NJOBVU ndi yaikuklu kwambiri.**

Ndiuze maina ya nyama izi mu m'ndanda poyambila yaing'ono kufikila yaikulu, kuyambila yaing'ono kwambiri. Unaona KULULU, MBELELE na NJOBVU; KALULU ni ing'ono, MBELELE nikulu ndipo NJOBVU nikulu maningi.

Niuze mazina ya nyama izi bwino bwino kuyambila ing'ono. If participant says RABBIT, SHEEP, ELEPHANT, Say **(Kamba): Wakhoza. Wachita bwino** Click #2; then click NEXT. Computer automatically goes to next item. If participant does not say RABBIT, SHEEP, ELEPHANT, Say (Kamba): **Tiye teyesenso masewera awa. Tiye tiyeseko masobela aya.**

Trial 3: Click **PLAY** again; when screen is blank, Say **(Kamba): Unawona KALULU, MBELELE ndi NJOBVU; KALULU ndi mng'ono, MBELELE ndiyaikuluko, ndipo NJOBVU ndi yaikuklu kwambiri.**

Ndiuze maina ya nyama izi mu m'ndanda poyambila yaing'ono kufikila yaikulu, kuyambila yaing'ono kwambiri. Unaona KULULU, MBELELE na NJOBVU; KALULU ni ing'ono, MBELELE nikulu ndipo NJOBVU nikulu maningi.

Niuze mazina ya nyama izi bwino bwino kuyambila ing'ono. If participant says RABBIT, SHEEP, ELEPHANT, Say **(Kamba): Wakhoza. Wachita bwino** Click #3; then click NEXT. Computer automatically goes to next item. If participant answers any part of the question *incorrectly* after 3 trials, click #4; then click NEXT. **Test will be discontinued.**

1-List Test Items:

Say **(Kamba): Manje nizakuonetsa zinthu izi zinango mozi ikila ndipo kamodzi-kamodzi. Ukasiliza kuona izi zinthu, ndipo nikaliza kukuonetsa izi zinthu. Sinizakuonesa zinango. Ndipo nikasiliza kukuonetsa izi zinthu nifuna kuti mazina yazinthu kuyambila kang'ono kufilila kuchilu. Nichofunika maningi kuikako nzeru mwamene zionekela kuti izi ike bwino bwino kuyabila ing'ono kufilikila ikulu.** Click NEXT. Click **PLAY**; Say **(Kamba)** (for the first item and then only as necessary): **Ngati nasiliza kukuonetsa izi zinthu, uzaniuza zamene waona kuyambila chipikicha yainong'ono kufilila chikulu.** Mark the item *CORRECT* (Yes) or *INCORRECT* (No) based on the participant's response.

2-List Condition

REVIEW: The 2-List practice items have the same format. First the examiner asks for the food from smallest to largest and then for the animals from smallest to largest. If the answer is correct, the examiner moves on to the next question. If the participant answers incorrectly, there are two more opportunities to get a correct answer. The first comes after a verbal explanation and a repeat of the question; the second comes after replaying the item on the screen and repeating the

question. If after a total of three opportunities, the participant continues to answer incorrectly, the test will be discontinued and no more items will be presented. The practice items are detailed below.

Introduction

Say **(Kamba):** Manje tisa sobela masobela yonse pa nthawi imodzi. Apa uzaona vakudya ndi nyama pa chipikicha chimodzi Nifuka kuti uniuze vakudya poyambilila zamene uzaona ndipo uzaniuza zanyama. Ngati nasiliza kukuonetsa izi zinthu, uzani uza zamene waona kuyambila chipikicha cha ing'ono kufikila ukulu maningi. Ndichofunika kwambili kuikako nzeru mwamene vionekela ivi vinthu poviika bwino bwino kuyambila ing'ono kufikila chikulu. Tiye tiyambe kuona manje pa izi zinthu Click **NEXT**.

2-List Practice Item 1:

Trial 1: Click **PLAY**; when screen is blank, Say **(Kamba):** Niuze Vakudya, futi uniuze vinyama
Correct Response: If participant says BANANA, BEAR, Say **(Kamba): Wachita bwino**. Click #1; then click **NEXT**. Computer automatically goes to next item.

Incorrect Response: If participant does not say BANANA, BEAR, Say **(Kamba): Tiye tiyeseko masobela aya**.

Trial 2: Say **(Kamba): nchenzi ndi nyama; nthoci ndi zakudya. Tsopano undiuze zakudya poyamba, ndipo undiuzenso nyama** Mbeba ni nyama; banana nichakudya If participant says BANANA, BEAR, Say **(Kamba): Wachita bwino** Click #2; then click **NEXT**.

Computer automatically goes to next item. If participant does not say BANANA, BEAR, Say **(Kamba): Tiye teyesenso masewera awa. Tiyeni tiyeseko futi masobela aya**

Trial 3: Click **PLAY** again; when screen is blank, Say **(Kamba): nchenzi ndi nyama; nthoci ndi zakudya. Tsopano undiuze zakudya poyamba, ndipo undiuzenso nyama**. If participant says BANANA, BEAR, Say **(Kamba): Wakhoza**. Click #3; then click **NEXT**. Computer automatically goes to next item. If participant answers any part of the question *incorrectly* after 3 trials, click #4; then click **NEXT**. **Test will be discontinued**.

2-List Practice Item 2:

Say **(Kamba): Tsopano tiye tiyesenso masewera awa mobwereza. Manje tiyeni tiyeseko futi masobela kubwezapo bwezapo.**

Trial 1: Click **PLAY**; when screen is blank, Say **(Kamba): Ndiuze zakudya kuyambila cakudya cacing'ono kumalizila cacikulu, ndiponso ndiuze nyama kuyambila yaing'ono kumalizila yaikulu. Niuze vakudya kuyambila chakudya ching'ono kuliza nachikulu, Futi uniuze nyama kuyambila ing'ono kusiliza naikulu.**

Correct Response: If participant says PINEAPPLE, FROG, TIGER, Say **(Kamaba): Wakhoza. Wachita bwino** Click #1; then click **NEXT**. Computer automatically goes to next item.

Incorrect Response: If participant does not say PINEAPPLE, FROG, TIGER, Say **(Kamba): Tiye teyesenso masewera awa. Tiyeni tiyeseko futi masobela aya**

Trial 2: Say **(Kamba): Unawona cule, apulo, ndi kaingo; apulo ndi cakudya, cule nyama ndi yaing'ono, kaingo ndi nyama yaikulu kwambiri. Unaona chule, apo ndi kaingo, apo nichakudya, chule ninyama ing'ono.**

Ndiuze zakudya kuyambila cakudya cacing'ono kumalizila cacikulu, ndiponso ndiuze nyama kuyambila yaing'ono kumalizila yaikulu.

If participant says PINEAPPLE, FROG, TIGER, Say **(Kamba): Wachita bwino** Click #2; then click **NEXT**. Computer automatically goes to next item.

If participant does not say PINEAPPLE, FROG, TIGER, Say **(Kamba): Tiye teyesenso masewera awa.**

Trial 3: Click **PLAY** again; when screen is blank, Say **(Kamba): Unawona chule, apo, ndi kaingo; apo ndi chakudya, chule nyama ndi yaing'ono, kaingo ndi nyama yaikulu kwambiri.**

Ndiuze zakudya kuyambila chakudya cacing'ono kusilizila chachikulu, ndiponso ndiuze nyama kuyambila yaing'ono kusilizila yaikulu.

. If participant says PINEAPPLE, FROG, TIGER, Say **(Kamba): Wachita bwino.** Click #3; then click **NEXT**. Computer automatically goes to next item. If participant answers any part of the question *incorrectly* after 3 trials, click #4; then click **NEXT**. **Test will be discontinued.**

2-List Test Items

Say (for the first item and then only as necessary): **Kamba: Manje ndidzakuwonetsa zithunzi kapena mapikicha ena mwa mokhazikila komanso mwachimodzi cimodzi. Ukatsiliza kuwona mapikicha aya, ndipo ndi kasiliza kukuwonetsa mapikicha aya, sindidzakuwonetsanso zina. Ndipo nikasiliza kukuwonetsa mapikicha, ndifuna kuti undiuze zakudya kuyambila chakudya chaching’ono kusilizila chachikulu, ndiponso ndiuze nyama kuyambila yaing’ono kusilizila yaikulu.** Click **PLAY**; mark the item *CORRECT* (Yes) or *INCORRECT* (No) based on the participant’s response.

✓ SUMMARY TABLE LIST WORKING SORTING TEST

NAMES OF FOODSTUFFS		NAMES OF ANIMALS	
PHASE I	PHASE II: <i>Suggested test items in a local administration manual.</i>	PHASE I	PHASE II: <i>Suggested test items in a local administration manual.</i>
Blueberry	<i>Banana</i>	Bear	<i>Lion</i>
Cherry	<i>Watermelon</i>	Frog	<i>Frog</i>
Strawberry	<i>Mango</i>	Cow	<i>Cow</i>
Pineapple	<i>Orange</i>	Turtle	<i>Tortoise</i>
Apple	<i>Lemon</i>	Rabbit	<i>Kalulu</i>
Humberger	<i>Pawpaw</i>	Butterfly	<i>Elephant</i>
Popcorn	<i>Chips</i>	Mouse	<i>Rat</i>
Peach	<i>Rice</i>	Horse	<i>Horse</i>
Corn	<i>Nshima</i>	Sheep	<i>Cat</i>
Pears	<i>Guava</i>	Bee	<i>Dog</i>
Corn	<i>Maize (Milisi)</i>	Camel	<i>Pig</i>
Pumpkin	<i>Drink</i>	Tiger	<i>Bird</i>

2. PATTERN COMPARISON PROCESSING SPEED: English Vs Chinyanja, Ages 8-85+

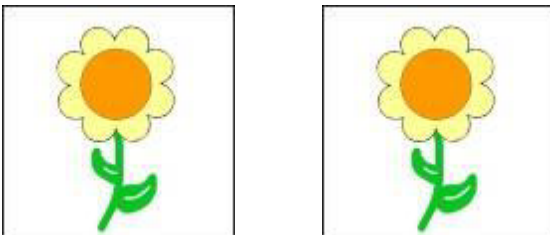
Administration Instructions; Most instructions are on the examiner's screen.

1. Say. I am going to show you some pictures. **Kamba: Ndidzakuwonetsa zithunzi/ mapikicha Zithunzi kapena mapikicha aya yali awili awil. Nthawi zina mapikicha awili ankhalala olingana, ndipo nthawi zinanso mapikicha aya yaoneka kusiyana. Ngati mapikicha yaoneka yolingana, sankha kuyankha kuti INDE. Ngati mapikicha aya siyolingana, sankha yankho IYAI. Ngati Uzaponya kapena yakufela pa nthawi yophunzira, uza udziwa kuti uyese nafuti. Ningakonde kuti ugwilitse nchito chikumo chakumanja ya. (Dominant) manja kapena manzele (show appropriate finger) pa kuyankha mafunso.**

2. Say (**Kamba**): **Tiye tiyambe Manje. Click NEXT.**

REVIEW: The pattern comparison practice items all have the same format. The examiner asks if the two pictures are the same or not the same. If the participant answers correctly, the computer Say (**Kamba**): **Wachita bwino.** If participant answers incorrectly, the computer explains how the response is wrong and the examiner Say (**Kamba**): **Tiye tiyese nafuti. Kodi zithunzi izi kapena ma pikicha ndiyo Lingana?** If the participant does not choose the correct response on the second try, the computer moves to the next practice item after repeating the explanation above. The first practice item is detailed below and other items are outlined.

3) Ages 8-85 Practice Item 1:



Say (**Kamba**): **Kodi ma pikicha aya ndiyolingana?**

If correct (**YES**), computer Says (**Ikamba**): **Wachita bwino.** Next item will appear.

If incorrect (**NO**), computer Says (**Ikamba**): **Mapikicha aya yaoneka yolingana; mapikicha yonse ndi maluwa, manje yankha kuti INDE. YES, will flash and item will stay on screen.**

Say **(Kamba): Tiye tiyese nafuti. Kodi mapikicha aya ndi yolingana??** If participant has chosen **YES**, computer says: **Wachita bwino!**

NOTE: If the participant does not respond correctly after both trials on 2 of the 6 practice items, testing will automatically terminate.

Otherwise, Say **(Kamba): Manje tizayesa nafuti. Kumbukila kuti uyenera kugwilitsa nchito chikumocha kukwanja yamene umagwilitsira nchito la manja kapena manzele** (Dominant hand) **pakuyankha. Sankha yankho INDE. Ngati mapikicha aya siyolingana sankha yankho IYAI. Nikofunikila kwambili kuti usankhe mwamsanga monga mwamene unga kwanitsire.**

3. FLANKER

Everything said to the participant is on the screen

	Participant(P) screen written content	Examiner (E) Action
PRACTICE Introduction	In this task, you will see a row of arrows. You should choose the button that matches the way the MIDDLE arrow is pointing. Tsopano udzawona mbali ina kuli m'kondo woduka kumbuyo. Iwe uyenera kusankha mbali yodukayo pofuna kulumikidza m'kondo uyu pogwilitsa ntchito komwe mbali yapakatiyo yaloza.	Points to left arrow on the P's screen and demonstrates use of index finger to choose the correct arrow.
	If the MIDDLE arrow is pointing this way, choose this button. Ngati m'kondo wodukayo ukuloza uku, uyenera kusankha cakupansi ici.	Demonstrates use of keyboard.
	If the MIDDLE arrow is pointing that way, choose that button. Ngati m'kondo wodukayo ukuloza kwinaku, uyenera kusankha cakupansi ici.	Demonstrates use of keyboard.
	Sometimes all the arrows point the same way. Sometimes the middle arrow faces or points a different way, like this [picture of incongruent arrows]. You should always choose the button that matches the way the MIDDLE arrow is pointing. You will see the word MIDDLE to remind you. Nthawi zina mikondo yonse ingaloze kumodzi. Nthawi zina mikondo yonse ingaloze mbali zosiyana, monga (cithunzi ici cosatha). Uyenera kusankha cakupansi comwe cigwilizana ndi komwe ca pakati caloza nthawi zonse. Udzawona mau akuti pakati kuti ukumbukire.	Demonstrates use of Keyboard.

Transition to practice items	<p>Now you try. Manje yesako kuchita</p> <p>Keep your eyes on the star. Ufunika kuikako meno kwambili paka star.</p> <p>Answer as fast as you can without making mistakes. Ufunika kuyanka mwamusanga osasokoneza ayi.</p> <p>If you make a mistake, just keep going. Ngati waona kuti wasokoneza, ufunika kupililiza chabe,</p>	Clicks NEXT on E's screen.
	4 practice items. Zocita zilifo	
More practice, if needed	<p>Let's practice some more. If the MIDDLE arrow is pointing this way, choose this button. Tiyeni tichitemo futi. Ngati chapakati chimukondo chiyangana mbali iyi, ufunika kusanka batani iyi.</p>	Demonstrates use of Keyboard.
	<p>If the MIDDLE arrow is pointing this way, choose that button. Ngati chapakati chimukondo chilangana mbali iyi, ufunika kusanka batani iyi.</p>	Demonstrates use of keyboard.
Transition to more practice items	<p>Now you try. Manje yesako kuchita,</p> <p>Keep your eyes on the star. Ufunika kuika meso paka star.</p> <p>Answer as fast as you can without making mistakes. Ufunika kuyanka mwamusanga osasokoneza ayi.</p> <p>If you make a mistake, just keep going. Ngati waona kuti wasokoneza, ufunika kupililiza chabe,</p>	Clicks NEXT on E's screen.
	4 practice items. Vochita vilifo	
More practice, if needed	<p>Let's practice some more. If the MIDDLE arrow is pointing this way, choose this button. Tiyeni tichitemo futi. Ngati ca pakati ca m'kondo caloza mbali iyi, uyenera kusankha ca kupansi ici</p>	Demonstrates use of keyboard.
	<p>If the MIDDLE arrow is pointing this way, choose that button. Ngati m'kondo wodukayo ukuloza uku, uyenera kusankha cakupansi ici.</p>	Demonstrates use of keyboard.

Transition to more practice items	<p>Now you try. Manje yesako kuchita</p> <p>Keep your eyes on the star. Ufunika kuika meso paka star</p> <p>Answer as fast as you can without making mistakes. Ufunika kuyanka mwamusanga osasokoneza ayi</p> <p>If you make a mistake, just keep going. Ngati waona kuti wasokoneza, ufunika kupililiza chabe,</p>	Clicks NEXT on E's screen.
	4 practice items. Vochita vilifo	
Test Items Introduction	<p>Now you're ready to do this without me. Manje ndiwe okozeka kuchita kulibe ine</p> <p>Keep your eyes on the star. Ufunika kuika meso paka star</p> <p>Answer as fast as you can without making mistakes. Ufunika kuyanka mwamusanga osasokoneza ayi</p> <p>If you make a mistake, just keep going. Ngati waona kuti wasokoneza, ufunika kupililiza chabe,</p>	Clicks NEXT on E's screen.

4. DIMENSIONAL CHANGE CARD SORT TEST

	Participant's screen written content	Examiner (E) Actions
Practice-Intro all ages	We're going to play a matching game with colors and shapes. Tidza sewera masewera ndi zinthu zosiyana mitundu komanso mawonekedwe	Reads screen; then clicks NEXT on E's screen
SHAPE intro	We'll play the SHAPE game first. In the SHAPE game, choose the picture that's the same SHAPE as the picture in the middle of the screen. If it's a BOAT, choose this picture. Tidza sewera masewera yazinthu zosiyana siyana mawonekedwe poyamba. Mu masewera aya, sankhapo pikicha yolingana ndi pikicha ili pakati pa skrini apa. Ngati ndi bwato, sankha pikicha iyo.	Points to BOAT; demonstrates Use of index finger.
	If it's a RABBIT, choose that picture Ngati ndi kalulu, sankha pikicha iyo	Points to RABBIT; then demonstrates use of Keyboard.
Transition	Now you try. Manje yesa izi Keep your eyes on the star. Ika maso yako pali ka (Nyezi) star. Answer as fast as you can without making mistakes. Yankha mwansanga monga mwamene ungakwanitsire popanda kulakwitsa ai. If you make a mistake, just keep going. Ngati waona	Reads screen; then clicks NEXT on E's screen.

	kuti walakwitsa, pitiliza cabe.	
Shape Practice	4 items sorted by shape. Zinthu zinai zogawidwa kulingana ndi mawokedweake	
More practice, if needed	Let's practice that some more. In the SHAPE game, choose the picture that's the same SHAPE as the picture in the middle of the screen. If it's a BOAT, choose this picture. Tiye tisewerenso masewera aya kachibwereza. Mu masewera aya, sankhapo pikicha yomwe ioneka kulingana ndi pikicha ili pa kati apa. Ngati ndi bwato, sankha pikicha iyi.	Chooses BOAT.
	If it's a RABBIT, choose that picture. Ngati ndi kalulu, sankha pikicha iyo	Chooses RABBIT.
Transition	Now you try manje yesa izi Keep your eyes on the star Ika maso yako pali ka star Answer as fast as you can without making mistakes. Yankha mwamsanga monga mwamene unga kwanitsire popanda kulakwitsa ai. If you make a mistake, just keep going. Ngati waona kuti walakwitsa, pitiliza chabe.	Reads screen; then clicks NEXT on E's screen.
Shape Practice again	4 items sorted by shape. Zinthu zinai zogawidwa kulingana ndi mawonekedwe ake	
More practice, if needed	Let's practice that some more. In the SHAPE game, choose the picture that's the same SHAPE as the picture in the middle of the screen. If it's a BOAT, choose this picture. Tiye tisewerenso masewera awa	Chooses BOAT.

	kachibwereza. Mu masewera aya, sankhapo pikicha yomwe iwoneka yolingana ndi pikicha ili pa kati apa. Ngati ndi bwato, sankha pikicha iyi ici.	
	If it's a RABBIT, choose that picture. Ngati ndi kalulu, sankha pikicha iyo	Chooses RABBIT.
Transition	<p>Now you try. Manje yesa izi</p> <p>Keep your eyes on the star. Iya maso yako pali ka star</p> <p>Answer as fast as you can without making mistakes.</p> <p>Yankha mwamsanga monga mwamene ungakwanitsire popanda kulakwitsa ai.</p> <p>If you make a mistake, just keep going. Ngati waona kuti walakwitsa, pitiliza cabe.</p>	Reads screen; then clicks NEXT on E's screen.
Shape Practice again	4 items sorted by shape. Zinthu zinai zogawidwa kulingana ndi mawonekedwe ake	
COLOR intro	We can also match by COLOR. In the COLOR game, choose the picture that's the same COLOR as the picture in the middle of the screen. If it's BROWN, choose this picture. Tinga linganizenso ndi mitundu. Mu masewera amitundu aya, sankha pikitcha yomwe ili ndi mtundu yolingana ndi pikicha ili pakati apa. Ngati ndi mtundu wa cikasu, sankha pikicha iyi	Points to; then chooses BROWN picture.
	If it's WHITE, choose that picture. Ngati ndi ca mtundu woyera, sankha pikicha iyo	Points to; then chooses WHITE picture.

Transition	<p>Now you try. Manje yesa izi</p> <p>Keep your eyes on the star. Ika maso yako pali ka star</p> <p>Answer as fast as you can without making mistakes.</p> <p>Yankha mwamsanga monga mwamene ungakwanitsire popanda kulakwitsa ai.</p> <p>If you make a mistake, just keep going. Ngati waona kuti walakwitsa, pitiliza cabe.</p>	Reads screen; then clicks NEXT on E's screen
More practice, if Needed	<p>Let's practice some more. In the COLOR game, choose the picture that is the same COLOR as the picture in the middle of the screen. If it's WHITE, choose this picture. Tiye tisewerenso masewera aya kachibwereza. Mu masewera amitundu aya, sankhapo pikicha yomwe iwoneka ndi mtundu yolingana ndi wa pikicha ili pa kati apa. Ngati ndi mtundu woyera, sankha pikicha iyo</p>	Chooses WHITE picture
Transition	<p>Now you try. Manje yesa izi</p> <p>Keep your eyes on the star. Ika maso yako pali ka star</p> <p>Answer as fast as you can without making mistakes.</p> <p>Yankha mwamsanga monga mwamene ungakwanitsire popanda kulakwitsa ai.</p> <p>If you make a mistake, just keep going. Ngati waona kuti walakwitsa, pitiliza cabe.</p>	Reads screen; then clicks NEXT on E's screen
Color Practice again	4 items sorted by color	

More practice, if Needed	Let's practice some more. In the COLOR game, choose the picture that is the same COLOR as the picture in the middle of the screen. If it's WHITE, choose this picture. Tiye tisewerenso masewera awa kachibwereza. Mu masewera aya, sankhapo pikicha yomwe iwoneka ndi mtundu yolingana ndi ya pikicha ili pakati apa. Ngati ndi ya mtundu woyera, sankha pikicha iyo	Chooses WHITE picture.
	If it's BROWN, choose that picture. Ngati ndi mtundu wa cikasu, sankha pikicha iyo.	Chooses BROWN picture
Transition	Now you try. Manje yesa izi. Keep your eyes on the star. Ika maso yako pali ka star. Answer as fast as you can without making mistakes. Mwansanga mongamwamene ungakwanitsire popanda kulakwitsa ai. If you make a mistake, just keep going. Ngati waona kuti walakwitsa, pitiliza chabe.	Reads screen; then clicks NEXT on E's screen.
Color Practice again	4 items sorted by color	
Test item intro	Now we're going to play both games together. Remember when you see the word SHAPE, choose the picture that's the same SHAPE as the picture in the middle of the screen. When you see the word COLOR, choose the picture that's the same COLOR as the picture in the middle of the screen. Tsopano tidza sewera masewera onse nthawi imodzi. Kumbukila kuti ngati waona mau akuti MAWONEKEDWE, ndiye kuti uyenera kusankha pikicha ili ndi mawonekedwe yolingana ndi pikicha ili pakati apa. Ndipo ngati waona mau akuti mtundu, ndiye kuti uyenera kusankha pikicha cili ndi	Reads screen; then clicks NEXT on E's screen.

	mtundu olingani pikicha ili pakati apa	
Transition	Now you try. Manje yesa izi. Keep your eyes on the star. ika maso yako pali ka star. Answer as fast as you can without making mistakes. Yankha mwamsanga mongamwamene ungakwanitsire popanda kulakwitsa ai. If you make a mistake, just keep going. Ngati waona kuti walakwitsa, pitiliza cabe.	Reads screen; then clicks NEXT on E's screen
Test items	30 mixed items	

Everything said to the participant is on the screen

5. AUDITORY VERBAL LEARNING TEST

Point to the participants sheet and Say (Kamba); “ **Napapata langanani pali vizibiso pamwamba yapepala. Chizibiso chilichonse chiyendelana ndi nambala.** Point to the pairs and show how they are arranged across the row” (**Sontani pali nambala ndi vizibiso vamene voonelako kulangizila nambala mumundandala wamumuzela.**)

(Kamba): **Manje langana apa.”** (point to the row of symbols without numbers) **sonta muzela wavizibiso ilibe manambala)”** nifuna kuti uniuze chiziwiso chamene chiyendelani ndi nambala monga so, apo paja pali vizibiso koma kopanda manambala. **Waona chizibiso ichi,”** (sonta pali O)” **iyi yayendelana ndi nambala 6,”** (sonta pali kiyi),” **manje uzakambaolo kuniuza `6`.**iyi yakonkapo vizibiso “(sonta pali X) “iyendelana ndi 8” (sonta), **manje ungakambe nangu kuniuza `8`.** Kodi vamveka?”

Say (Kamba):” **Manje yeselela mizela zasala ukalibe kuyamba kuteya. Kumbuka kukamba nambala iliyonse kukambisa kuti nikazimvetsesa.”**

Ngati otengako mbali ayankha mwamenemo, kamba kuti wachita bwino!” Ngati otengako mbali ayanka musokwanilitsira, mu’uzeni yankho yazoonadi .bwezamponi kuyeselela futi ngati ufuna. Munga bwezepo futi ngati otengako mbali sanamvetsese bwino kuti avichite bwino bwino.

Ngati otengako, mbali asiliza kuyeselela mu muzela, kambani kuti:” wachita bwino. Popeza kuti waziba kuchita izi, nizakuuza kuchita zomwezi zambili futi.

Say (Kamba): “Manje nizapindamula iyi pepala elo uzaoona mizela yambili yali ndi vizibiso, koma yambili manambala yomwe yayenda nayo ayi;” (Pindamulani uku pepala lili lochingiliziwa ndi pulasitiki bwino kuti uone vintu viliko.)

Continue to say (Pitilizani kukamba):” Nikakauza kuti yamba nifuna kuti uchite zomwezo wachita pali pepala iyi. Niuze ma nambala yamene yayendelana ndi vizibiso. Nizafuna usebenze mwamusanga mwamene ungasebenzele kopanda kujumpila kabokosi kalikonse olo kopanda kusokonezapo. Ngati wasiliza ndi muzela wachiyambi, pitiliza kuli yokonkapo. Pitiliza kusebenza paka umvele kangilingili kalile pali aka ka ipad e lo nizakuuza kuti lekeza. Ngati wasokonezapo, niuze chabe yankho yazoono elo upitilize. Ndiwe okonzeka?

Note to examiner “Yikankoni nzelu kuli opunzisa”: Pali ka ipad pa skrini, ngati otengako mbali ali okonzeka, dinizani poyambila kuyesa elo kambani:” Start (Yamba)”. Dinizani zinthu zonse zili mu mzela ndi ku chonga. Correct (Mwachendi). Dinizani futi kuichosapo. Kufunikila, telelesani kakumo pansi kuti muone zinthu zina pamene otengako mbali afikapo. Ngati nichofanika, mu kumbukitseni otengako mbali kuti asajumphile mizela zilizonse.

Trial 1

Say (Kamba): Manje tizachitako chimozi chokumbukila mau. Uzamvela mau yotantikiwa kuchokela muli iyi ipad. Mvesesa bwino bwino; ngati mau yasiya, uzafunika kubwezekezapo kukamba mau yamene uzakumbukila. Chili chabe bwino mulimonse mwamene uzayakambila yonse. Yesesesa kukumbukila maningi yambili yamene ukumbukila maningi yambili yamene ukwanisa kukamba. Ndiwe okonzeka?”

Dinizani poyamba kuteya. Elo gwilani yonse mau yamene otengako mbali akamba (gwilani futi ngati mufuna kuchosapo olo kufuta).

Drum (Ngoma, Dramu)	Curtain (Ma-curtain, Ketani)	Bell (Bello, Ngilingili)
Coffee (Masamba, Kofi)	School (Sukulu)	Parent (Kolo)
Moon (Mwezi)	Garden (Munda)	Hat (Kasote)
Farmer (Mulimi)	Nose (Mphuno)	Turkey (Kalukuluku)
Color (Colour, Khala)	House (Nyumba)	River (River, Mumana)

TRIAL 2

Say (Kamba):” Ngati mwamvela mau yamozi nayamozi kuchokela kuli iyi ipad, elo futi ngati liu lasiya, nizafuna kuti uniuze mau yambili monga mwamene uza kumbukila mulimonse olokuti wayakamba kudala, ndiwe okonzeka?”

Dinizani poyambila kuyamba. Futinso gwila palimau pamene ukamba (gwila futi kuti usanke ngati motelo).

Drum (Ngoma, Dramu)	Curtain (Ma-curtain, Ketani)	Bell (Bello, Ngilingili)
Coffee (Masamba, Kofi)	School (Sukulu)	Parent (Kolo)
Moon (Mwezi)	Garden (Munda)	Hat (Kasote)
Farmer (Mulimi)	Nose (Mphuno)	Turkey (Kalukuluku)
Color (Colour, Khala)	House (Nyumba)	River (River, Mumana)

Trial 3

Say (Kamba): “Nafuti uzamvela mau yachimozi mozi, elo futi ngati mau yasila kumveka, nizafuna kuti uniuze mau yambili yamene uzakumbukila, olo kapena wayamba kale kudala. Ndiwe okonzeka?”

Dinizani poyambila kuyamba.” Press play to start” Elo futi dinizani pali mau yamene yakambiwa kuli otengako mbali (dinizani futi ngati mufuna kuchosapo kufuta mukafuna).

Drum (Ngoma, Dramu)	Curtain (Ma-curtain, Ketani)	Bell (Bello, Ngilingili)
Coffee (Masamba, Kofi)	School (Sukulu)	Parent (Kolo)
Moon (Mwezi)	Garden (Munda)	Hat (Kasote)
Farmer (Mulimi)	Nose (Mphuno)	Turkey (Kalukuluku)
Color (Colour, Khala)	House (Nyumba)	
River (River, Mumana)		

✓ **SUMMARY TABLE OF AUDITORY VERBAL LEARNING TEST**

NIH Toolbox's Auditory Verbal Learning Test	MEMORY FOR ENGLISH WORDS	
	PHASE I	PHASE II: <i>Suggested familiar words in the local administration manual</i>
	River	<i>River (Mumana)</i>
	Drum	<i>Ngoma (Dramu)</i>
	Curtain	<i>Ketani (Ma-curtain)</i>
	Bell	<i>Bello (Ngilingili)</i>
	Moon	<i>Mwezi</i>
	Garden	<i>Garden (Munda)</i>
	School	<i>Sukulu</i>
	Colour	<i>Colour (Khala)</i>
	Hat	<i>Kasote</i>
	Parent	<i>Kolo</i>
	Turkey	<i>Kalukuluku</i>
	Nose	<i>Mphuno</i>
	Farmer	<i>Mulimi</i>
	Coffee	<i>Kofi (Masamba)</i>
	House	<i>Nyumba</i>

6. ORAL SYMBOL DIGIT SPAN *English Vs Chinyanja, All Ages 3 - 85+*

Administration Instructions

Point to the participant's sheet and say: "Please look at the symbols at the top of the page. Each symbol is paired with a number. " (Point to the pairs and show how they are arranged across the row.)

Sontani pali chi pepala cha otengako mbali elo futi kambani: langanani ziolangiza ziziwisoo pamwamba pa pepala iyi. Vizibiso vilivonse viyendelana ndi manambala." (Sontani pali mizela mwamene ziyendelana elo futi langizani mwamene zatantikiwa mumizela

Say: " Now look here. " (Point to the row of the symbols without numbers.) " Here there are symbols but no numbers. I would like you to tell me the number that goes with each symbol, like this: You see this symbol, " (point to the O) "It is matched with the number 6, " (point to the key), " so you would say or tell me "6"; this next symbol" (point to the X) " is paired with 8" (point), " so you would say or tell me '8'. Does this make sense?"

KAMBANI:" Manje langanani kuno." (Sontani mizela zavizibiso zopanda manambala.)"
apa pali vizibiso kopanda manambala .ningafune mwaniuzako manambala yamene yayendelana ndi vizibiso ,monga izi :mwaona ichi chizibiso ."(sontani pali O)iyi iyendelana ndi nambala 6,"sontani pali key),koma muzakamba olo muzaniuza kuti "6; ichi chizibiso chokonkapo "(sontani pali X)" iyendelana ndi 8"(sontani),"muzaniuza nangu kukamba '8'.kodi zamveka izi?"

Say: “ Now you try the rest of the row for practice. Remember to say each number out loud so that I can hear you.”

KAMBA:” Manje yeselelani izi mizela zoyeselela pakuchita izi. Kumbukilani kukamba panambala kukambisa kuti nikazimvesesa zomwe mukamba,”

If the participant responds correctly, say: “ that’s right. “ If the participant responds incorrectly, correct the response. Repeat these practice items if necessary, until participant understands and gets practice items correct.

Ngati otengako mbali ayanka Vazoon, kamba:” nimwamene wakoza.” Nati otengako mbali ayanka vaboza, muuzeni momwe ifunika kunkalila. Bwezekezaniponi kuyeselela uku ngati mufuna kuti otengako mbali paka azibe nomvesesa noziba mochitila izi bwino mokozaa.

After the participant has completed the practice row, say: “Good. Now that you know how to do this, I am going to ask you to do some more.”

Ngati otengako mbali asiliza kuyeselela muzela, kambani:” wakoza. Manje mwaziba kuchita izi, nizakupempani kuchitilapo izi zambili.

Say: “ Now I will turn this sheet and you will see more rows which have symbols, but not the numbers that go with them.” (Turn over laminated sheet to reveal test items.)

Kamba: Manje nizapindamula pepala iyi ndipo uzaona mizela zina zili ndi zisonyezo, koma kulibe ma nambala yoendela nayeve. ‘(Turn over the laminated sheet to reveal test items)’

Continue by saying: “ When I tell you to begin, I want you to do the rows on this page the same way-tell me the number that goes with each symbol. I want you to work as quickly as you can without skipping any of the boxes or making mistakes. When you are finished with the first row, move onto the next one. Continue working until you hear a bell sound on this iPad and I tell you to stop. If you make a mistake, just tell me the correct answer and keep going. Ready?”

Pitilizani mukukamba kuti: nikaku uza kuti yamba, nifuna kuti uchite mizela pa pepala iyi mwa chimozi mozi. Niuze nambala yamene iyendelana ndi chisonyezo chake. Nifuna kuti usebenze mwamusanga mwamene ungakwansile kulibe kujumpila ka bokosi kalikonse olo

ku lakwisa. Ngati wasiliza ndi mizela zo yamba, yenda Pali yo konkhapo. Pitoliza kusebenza paka umvele ka Bello olo kangilingili pa Ipad iyi Kalila ndipo ine nakuuza kuti leka. Ngati walakwisa, Niuza chabe yankho yazoona ndipo pitiliza. Wakonzeka?”

Note to examiner: on the next screen, once the participant is ready, touch **START TEST** and say: Begin! Touch each item listed to score it as correct; touch it again to deselect it. As needed, slide your finger on the screen to scroll down to see more items as the participant reaches them. If necessary, remind the participant not to skip any items.

Gwila zonse zamene zili zolembedwa apa kuti ichongedwe mwazoona. Gwilapo futi kuti vichokepo. Mwamene chifanikila, telelesa kakumo pa skrini kuyenda pansu kuti uone vinthu vina pamene otengako mbali ifikapo. Ngati nichofunikila, kumbukitsani otengako mbali kuti asajumphe zinthu zilizonse izi.

✓ **SUMMARY TABLE OF ORAL SYMBOL DIGIT SPAN KEY AND TEST**

–	□	□	L	U	O	^	X	=	
1	2	3	4	5	6	7	8	9	
O	X	□	=	U	L	–	^	□	U
X	^	□	U	O	L	^	□	□	□
U	X	O	L	□	–	^	X	□	–
O	U	^	L	□	O	–	X	U	^

7. 9-HOLE PEGBOARD DEXTERITY: *English Vs Chinyanja, All Ages 3 - 85+*

Administration Instructions; Most instructions are on the examiner's screen.

Say (Kamba): Pa nthawi iyi nizafuna kuona mwamene ungakwanisire kugwila chito mwamusanga. If handedness not known, use protocol. If examiner knows,

Say (Kamba): Uma sebenzesa kwanja iyi pogwila nchito zoonza? (Point to dominant hand.)

Dominant Practice: Say (Kamba): Ichi ndi choikako ma pegzi ndipo aya ndiye ma pegzi. Aya yonse ma pegzi niyolingana. Utenge ma pegzi aya imodzi imodzi posenenzesa kwanja ya (dominant hand, say: manja or manzele) yekha. Uyaike mapegzi aya mu tumigodi utu imodzi imodzi kufikila ku migodi zili asanu ndi anai paka zazula. Manje uyachotse mu tumigodi kamodzi kamodzi pochita (Demonstrate). Mapegzi aya yanga aikidwe mu tumigodi kapenanso kuya chotsa mu tumigodi munjila iliyonse. Ndilinayo mapegzi yambili, ina ngati yagwa pansu, osadoba ndizaikamo ina. Continue: Tiye tichite izi (point; Say (Kamba): DYzanja lako la manja or manzele). Ungasebenzese kwanja inango pogwila choikako ma pegzi Wakonzeka? 3, 2, 1, yamba! Start timer on screen when you say go, move cursor to stop button, and stop timer when participant places final peg in cup.

Test Trial (dominant): Say (Kamba): manje nifuna kuona nthawi yamene uzatenga pochita izi. Utenge ma pegzi aya imodzi imodzi pogwilitsa nchito kwanja la (point; Say (Kamba): Manja or manzele). Uyaike mapegzi aya mu mibo/ tumigodi izi imodzi imodzi kufikila mu tumigodi tonse tuli asanu ndi anai twazula. Ndipo uyachotse mutumigodi kamodzi modzi. Mapegzi aya yanga ikidwe mu migodi kapenanso kuyachotsa mumigodi munjila iliyonse. Kumbukila kuchita izi mwamsanga monga mwamene unga kwanitsile. Wakonzeka? 3, 2, 1, yamba! Start timer on screen when you say go, move cursor to stop button, and stop timer when

participant places final peg in cup. As participant is placing final peg, Say **(Kamba): Manje yachose mu tumigodi.** Non-Dominant Practice:

Turn pegboard around, Say **(Kamba): Manje tidzachita cimodzi modzi koma ndi kwaanja inango. Tengafuti mapegzi aya imodzi imodzi pogwilitsa nchito kwanja la** (point; Say **(Kamba): Manja** or **manzele**). Uyaike mapegzi aya mu migodi izi imodzi imodzi kufikila mayenje onse asanu ndi anai atadzala. Ndipo uyacotse mumayenje imodzi imodzi. Mapegisi aya yanga ikidwe mumayenje kapenanso kuyacotsa mumayenje munjila iliyonse. Continue: **Tiye ticite izi. Ungagwilitse nchito dzanja linalo kugwilira coikako mapegisi. Wakonzeka? 3, 2, 1, yamba!** Start timer on screen when you say **go**, move cursor to **stop** button, and stop timer when participant places final peg in cup.

Test Trial (non-dominant): Say **(Kamba): Manje nifuna kuona nthawi yamene uzatenga pakuchita izi. Utenge ma pegzi aya imodzi imodzi pogwila nchita ndi kwanja ya** (point; Say **(Kamba): Manja** or **manzele**) **yeka.** Uyaike mapegzi aya mu tumigodi utu imodzi imodzi kufikila tumigodi tonse tuli asanu ndi anai twazula. Ndipo uyachotse mumanja imodzi imodzi. Mapegzi aya yangaikidwe mutumigodi kapenanso kuyachotsa mutumigodi munjila iliyonse. **Kumbukila kuchita izi mwamsanga mongamwamene unga kwanitsile. Wakonzeka? 3, 2, 1, yamba!** Start timer on screen when you say **go**, move cursor to **stop** button, and stop timer when participant places final peg in cup. As participant is placing final peg, Say **(Kamba): manje yachotse mumanja.**

**Appendix 14: Biological Research Ethics Committee and Handz Research Subject Review
Board Approval Letters**

TO

KABUNDULA PELEKELO.P

THE UNIVERSITY OF ZAMBIA

SCHOOL OF EDUCATION

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY, SOCIOLOGY AND

SPECIAL EDUCATION

LUSAKA, ZAMBIA

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APPROVAL OF MODIFICATION AND CONTINUING REVIEW

September 29, 2020

The RSRB approved the modification on 9/29/2020.

The RSRB also re-approved this study effective as of 9/29/2020 through 9/28/2021 inclusive.

Type of Review:	Modification and Continuing Review
Title:	HIV Associated Neurocognitive Disorders in Zambia (HANDZ)
Investigator:	David Bearden
Study ID:	STUDY00001415
Submission ID:	MODCR00001442
Funding:	National Institute of Neurological Disorders and Stroke (NINDS) University of Rochester Medical Education Awards Program Mcgowan Charitable Fund University of Rochester
Groups Notified:	All active subjects
Notification Methods:	Re-consent with new consent document(s)
Documents Approved:	HANDZ consent form for independent adolescents, Assent Form version 3.1, HANDZ 2020 Consent Addendum 2, HANDZ standard CRFs for Ages 8-17, Information sheet for clinicians 2020, HANDZ parental consent form version 3.1, K23 application, Protocol version 3.1

This study was reviewed and approved under the OHSP and UR policies, and in accordance with appropriate Federal regulations. As the Principal Investigator, you are responsible for ensuring compliance with [Policy 901 Investigator Responsibilities](#) and the regulatory requirements outlined on your initial approval letter. Also, any unanticipated problems involving risks to subjects or others (including unexpected deaths, hospitalizations or serious injuries, breach of confidentiality, loss of privacy) must be reported according to [Policy 801 Reporting Research Events](#).



Letter of Initial Approval

RSRB: RSRB00068985 Principal Investigator: [David Bearden](#)

Study Title: HIV Associated Neurocognitive Disorders in Zambia (HANDZ)

Initial Approval: 10/23/2017

Approval Expires: 10/22/2018

Length of Review: 1 year

Level of Risk:

- Adults – Minimal Risk
- Children – Minimal Risk (45 CFR 46.404 / 21 CFR 50.51)

Note: if subjects turn 18 during their participation in this study, their consent to continue must be obtained.

Review Level: Expedited

Expedited Category(ies):

- 2a - blood samples from healthy non-pregnant adults (< 550 ml over 8 wks)
- 2b - blood from non-healthy adults (< 50 ml over 8 wks) or children (<50 ml or 3ml/kg over 8 wks)
- 5 - materials that have been/will be collected solely for non-research purposes
- 7 - individual or group characteristics or behavior

Regulatory Findings Regarding Consent:

- Informed Consent obtained and documented
- Parent Permission obtained and documented

Regulatory Findings Regarding HIPAA:

- Waiver of HIPAA Authorization - PI must track disclosures using the URM Log of Disclosures of PHI

Documentation In Electronic Health Record:

- There should be no documentation about this study in the subject's chart.

List of Materials Approved by the RSRB:

- Protocol 9/1/2017
- Consent 10/4/2017
- Assent 10/4/2017
- Consent turning 18, 10/3/2017
- Measures (3)

This study was reviewed and approved under the OHSP and UR policies, and in accordance with Federal regulation 45 CFR 46 under the University's Federalwide Assurance (FWA00009386).

This approval is contingent upon the research being conducted in compliance with the approved study protocol including all requirements

and/or determinations of the RSRB. Consent must be obtained and documented in the manner approved by the RSRB (unless a waiver of consent is specified above). Only the most currently approved version of consent forms and recruitment materials bearing an RSRB approved watermark may be used when obtaining consent and recruiting subjects. Consent forms/recruitment letters must be printed on department letterhead.

As the Principal Investigator, you are responsible for ensuring compliance with Policy 901 Investigator Responsibilities. Click here for the [Summary of Responsibilities for Investigators Conducting Non-FDA Regulated Research](#). Also, any unanticipated problems involving risks to subjects or others (including unexpected deaths, hospitalizations or serious injuries, breach of confidentiality, loss of privacy) must be reported according to [Policy 801 Reporting Research Events](#).

All study documentation, including RSRB approved materials, should be maintained as required by applicable regulatory requirement(s). This includes all pages of the signed consent form for at least three years after the research is completed (six years if protected health information was collected as part of the research), or for a longer term if required by FDA regulations or other contractual agreements.

Carolyn Jones, RSRB Chair 10/23/2017

Saunders Research Building - 265 Crittenden Blvd, Suite 1.250 - Box CU420628 - Rochester, NY 14642-0628
585.273.4127 - 585.273.1174 fax

APPROVAL

October 8, 2019

The RSRB approved the following submission from 10/8/2019 to 10/7/2020 inclusive.
This approval is effective as of 10/8/2019.

Type of Review:	Continuing Review
Title:	HIV Associated Neurocognitive Disorders in Zambia (HANDZ)
Investigator:	David Bearden
Study ID:	STUDY00001415
Funding:	Mcgowan Charitable Fund
Regulatory Findings Consent:	None
Regulatory Findings HIPAA:	None
Documents Reviewed:	HANDZ parental consent form version 2, HANDZ consent addendum, HANDZ info sheet for clinicians revised december 2018.pdf, HANDZ consent form for independent adolescents, Assent Form, handz rsrb protocol edited December 2018 clean.pdf

This study was reviewed and approved under the OHSP and UR policies, and in accordance with Federal regulation 45 CFR 46 under the University's Federal-wide Assurance (FWA00009386). As the Principal Investigator, you are responsible for ensuring compliance with [Policy 901 Investigator Responsibilities](#). Click here for the [Summary of Responsibilities for Investigators Conducting Non-FDA Regulated Research](#). Also, any unanticipated problems involving risks to subjects or others (including unexpected deaths, hospitalizations or serious injuries, breach of confidentiality, loss of privacy) must be reported according to [Policy 801 Reporting Research Events](#).



THE UNIVERSITY OF ZAMBIA
BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
E-mail: unzarec@unza.zm
Assurance No. FWA00000338
IRB00001131 of IORG0000774

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

9th October, 2017.

Your Ref: 004-08-17.

Dr. David Bearden,
University of Rochester Medical Center,
Department of Neurology,
Child Neurology Division,
601 Elmwood Avenue,
P.O Box 631,
Rochester, NY 14642.

Dear Dr. Bearden,

RE: RESUBMITTED RESEARCH PROPOSAL: "HIV-ASSOCIATED NEUROPSYCHIATRIC DISORDERS IN ZAMBIA (HANDZ)" (REF. 004-08-17)

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 28th September, 2017. The proposal is 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).
- Apply in writing to National Health Research Authority for permission before you embark on the study.
- Ensure that a final copy of the results is submitted to this Committee.

Yours sincerely,

Prof. M.C Maimbolwa PhD
CHAIRPERSON

Date of approval: 9th October, 2017.

Date of expiry: 8th October, 2018.



**UNIVERSITY OF ZAMBIA
BIOMEDICAL RESEARCH ETHICS COMMITTEE**

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Federal Assurance No. FWA00000338

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia
E-mail: unzarec@unza.zm
IRB00001131 of IORG0000774

14th October, 2019.

Your Ref: 004-08-17.

Dr. David Bearden,
UTH NRO,
P/Bag RW1X,
Ridgeway – UTH,
Lusaka.

Dear Dr. Bearden,

**RE: RENEWAL REQUEST OF “HIV-ASSOCIATED NEUROPSYCHIATRIC
DISORDERS IN ZAMBIA” STUDY (REF: NO. 004-08-17)**

We acknowledge receipt of the progress report and request for renewal for the aforementioned study.

Renewal has been granted for the period 6th November, 2019 to 5th November, 2020.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Sody Munsaka'.

Sody Mweetwa Munsaka, BSc., MSc., PhD
CHAIRPERSON
Tel: +260977925304
E-mail: s.munsaka@unza.zm



**UNIVERSITY OF ZAMBIA
BIOMEDICAL RESEARCH ETHICS COMMITTEE**

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IRB00001131 of IORG0000774

14th October, 2019.

Your Ref: 004-08-17.

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UTH NRO,
P/Bag RW1X,
Ridgeway – UTH,
Lusaka.

Dear Dr. Bearden,

**RE: RENEWAL REQUEST OF “HIV-ASSOCIATED NEUROPSYCHIATRIC
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Yours sincerely,

A handwritten signature in black ink, appearing to read 'Sody Munsaka'.

Sody Mweetwa Munsaka, BSc., MSc., PhD

CHAIRPERSON

Tel: +260977925304

E-mail: s.munsaka@unza.zm

Appendix 15: Certificates of Competence in Research Ethics Requirements

FOR

KABUNDULA PELEKELO. P

THE UNIVERSITY OF ZAMBIA

SCHOOL OF EDUCATION

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY, SOCIOLOGY AND

SPECIAL EDUCATION

LUSAKA, ZAMBIA

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Zertifikat Certificat

Certificado Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale
Promoting the highest ethical standards in the protection of biomedical research participants



Certificat de formation - Training Certificate

Ce document atteste que - this document certifies that

pelekelo kabundula

a complété avec succès - has successfully completed

Introduction to Research Ethics

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training programme in research ethics evaluation

Release Date: 1969/12/31
CID: 1X7W30#M3

Professeur Dominique Sprumont
Coordinateur TRREE Coordinator



Continuing Education Program (C. Chablin)
Programme de Formation continue (C. Chablin)

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Pharmaceutica
Helvetica

FPH

Programmes de formation
continue

Continuing Education Program
Programme de Formation continue

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Swiss Academy of Medical Science (SAMSWISSAMSW) (www.samsw.ch) - Commission for Research Partnership with Developing Countries (www.life.ch)

(REV : 201701/0)



Zertifikat Certificat

Certificado Certificate

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Certificat de formation - Training Certificate

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Research Ethics Evaluation

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training programme in research ethics evaluation

Release Date: 1969/12/31
CTD : n2018yNak

Professeur Dominique Sprumont
Coordinateur TRREE Coordinator



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[REV : 201703/03]



Zertifikat Certificat

Certificado Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale
Promoting the highest ethical standards in the protection of biomedical research participants



Certificat de formation - Training Certificate

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Informed Consent

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training programme in research ethics evaluation

Release Date: 2018/11/29
CIB - IC1-TRREE

Professeur Dominique Sprumont
Coordinateur TRREE Coordinator



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European and Developing Countries Clinical Trials Partnership (EDCTP) (www.edctp.org) - Swiss National Science Foundation (www.snf.ch) - Canadian Institutes of Health Research (<http://www.cihr-irsc.gc.ca/2011/0001>) -
Swiss Academy of Medical Sciences (SAMS/ASSM/SAMW) (www.sams.ch) - Commission for Research Partnerships with Developing Countries (www.fph.ch)

[REV : 201703/08]



NATIONAL HEALTH RESEARCH AUTHORITY
The Health Research Act
(Act No. 2 of 2013)



CERTIFICATE OF REGISTRATION

THIS IS TO CERTIFY THAT

Kabundula Pelekelo

has been registered as a Health Researcher

Dated this 25th Day of June 2022

Registration Number NHRAR-R-598/26/06/2022



DIRECTOR
PROF. GODFREY BIEMBA