Neurocognitive Screening Following Acquired Brain Injury: An Adaptation of the Birmingham Cognitive Screen for Zimbabwe (Zim-BCoS)

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Declaration

This study was conducted from 2014 to 2020 under the supervision of Dr Progress Njomboro.

I, Debra Machando, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be, submitted for another degree in this or any other university. I authorize the University of Cape Town to reproduce for research either the whole, or any portion, of the contents of this thesis in any manner whatsoever.

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Abstract

Neuropsychology as a discipline has not taken root in low- and middle-income countries. Most neurocognitive tests used in these countries were developed and normed in high-income, mostly western countries. The psychometric robustness of these tests is often weak when they are used on low to middle-income clinical populations. The objectives of this study were to select, adapt and generate normative data for a suitable neurocognitive screen for use in Zimbabwe. To achieve these objectives, we divided the study into 4 phases. In Phase 1 of the study, we did a systematic review that identified 83 neurocognitive assessment instruments commonly used in low- and middle-income countries on patients who have suffered a stroke. From these instruments, we selected, adapted and normed the Birmingham Cognitive Screen (BCoS; Humphreys al., 2012) through phases 2 to 4 of this study. The screen offers a robust and sufficiently broad but shallow assessment tool for cognitive deficits across key cognitive domains commonly impaired following a stroke. In particular, in Phase 2 of the study, we evaluated the cross-cultural sensitivity of BCoS on healthy participants (*N*=105). We then performed surveys using the Delphi method on a panel of experts to culturally adapt BCoS for use in Zimbabwe (Zim-BCoS). We evaluated the inter-rater and test-retest reliability of the translated and validated Zim-BCoS and also compared its agreement with the original BCoS version to determine its robustness. In Phase 3, we evaluated the effects of demographic variables on performance on the cognitive domains assessed by Zim-BCoS. To do this, we performed multiple linear regression analyses to calculate regression-based norms using scores from a sample of healthy participants (*N*=412). From these analyses, participants' age, level of education and sex had significant effects, mainly on subtests in the language cognitive domain (Picture Naming, Sentence/Word Reading/Writing and Instruction Comprehension). In Phase 4 of the study, we performed neurocognitive assessments using Zim-BCoS (and other tests) to assess and determine the frequency of specific neurocognitive deficits in patients who had suffered a stroke and were attending two major hospitals in Harare, Zimbabwe's capital city (*N*=103). We also compared the performance of these patients to a matched control sample (*N*=103). To determine the psychometric stability of Zim-BCoS we determined its validity and reliability by comparing scores on its subtests to parallel neurocognitive tests that assess similar cognitive domains. We also assessed the predictive value of Zim-BCoS on patients' neuropsychiatric and functional outcomes. We evaluated the convergence and predictive validity as well as the inclusivity of Zim-BCoS to assess patients with aphasia. We used the Zim-BCoS test scores to establish prevalence rates of cognitive deficits and other post-stroke sequelae in the sample of patients with stroke. We also assessed the predictive value of Zim-BCoS subtests on patients' neuropsychiatric and functional outcomes. All comparisons of Zim-BCoS against standard cognitive tests and post-stroke sequelae measures had statistically significant convergence, predictive validity and inclusivity. In this study, we demonstrated the utility of Zim-BCoS for assessing cognitive impairment in patients who have suffered a stroke, particularly in resource poor contexts typical of low-income countries. We concluded that Zim-BCoS is a robust neuropsychological screen suitable for research and clinical use in Zimbabwe. The screen has the potential to offer a cost effective and easy to use neurocognitive screen for patients with acquired neurological changes in low-income countries in Southern Africa.

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Abbreviations

ACE	Addenbrooke’s Cognitive Examination
ADLs	Activities of Daily Living
AIDS	Acquired Immunodeficiency Syndrome
AMT	Abbreviated Mental Test
ANT	Animal Naming Test
AUC	Area Under the Curve
BCB	EDU- Brief Cognitive Battery
BCoS	Birmingham Cognitive Screen
BDAE	Aphasia Examination
BMSE	Mini-Mental State Examination – Bengali Version
BNT	Boston Naming Test
BSAT	Brixton Spatial Anticipation Test
BVMT	Benton Visual Retention Test
CAT	Comprehensive Aphasia Test
CCST	California Card Sorting Test
CDR	Clinical Dementia Rating
CDT	Clock Drawing Test
CERAD	Consortium to Establish a Registry for Alzheimer’s Disease
COSMIN	Consensus-Based Standard for the Selection of Health Measurement Instruments

COWA	Controlled Word Association Test
CSI-D	Community Screening Instrument for Dementia
CVA	Cerebrovascular Accident
DMN	Default-Mode Network
FABCS	Frontal Assessment Battery – Changsha Version
FAS-COWA	Verbal Fluency Test - Controlled Oral Word Association Test
FIM	Functional Independence Measure
GAD-7	Generalized Anxiety Disorder -7-Items
HIV	Human Immunodeficiency Virus
ICC	Intra-Class Correlation
INECO IFS	Instituto de Neurología Cognitiva − Frontal Screening
IGT	Iowa Gambling Task
IST	Isaacs Set Test
KCSB	Kolkata Cognitive Screening Battery
LLT	Location Learning Test
LOTCA	Lowenstein Occupational Therapy Cognitive Assessment
Brief MAC Battery	Montreal Communication Evaluation Battery – Brief Version
AES	Apathy Evaluation Scale
MCI	Mild Cognitive Impairment
MDRS	Mattis Dementia Rating Scale
MMSE	Mini-Mental State Examination

MOCA	Montreal Cognitive Assessment
MRCZ	Medical Research Council of Zimbabwe
MTL-BR	Montreal-Toulouse Language Assessment Battery-Brazilian
MWCST	Modified Wisconsin Card Sorting Test
NEUPSILIN	Brief Neuropsychological Assessment Battery
NEUPSILIN	Brief Neuropsycholinguistic Evaluation for Expressive Aphasics
NEWSQOL	Newcastle Stroke-Specific Quality of Life
NICE	National Institute for Health and Care Excellence
NIHSS	National Institute of Health Stroke Scale
NINDS	National Institute of Neurological Disorders and Stroke
NINDS-CSN	National Institute of Neurological Disorders and Stroke and Canadian Stroke Network
NPI-Q	Neuropsychiatric Inventory Questionnaire
NUCOG	Neuropsychiatry Unit Cognitive
PACS	Partial Anterior Circulation Stroke Syndrome
PHQ-9	The Patient Health Questionnaire-9-items
POCS	Posterior Circulation Stroke Syndrome
PRISMA	Preferred Items Reporting for Systematic Reviews
PROMS	Patient-Reported Outcome Measures
PROSPERO	Prospective Register of Systematic Reviews
RAVLT	Rey Auditory Verbal Learning Test

RBMT	Rivermead Behavioural Test
RCFT	Rey-Osterrieth Complex Figure Test
ROC	Receiver Operating Curve
RuS-BCoS	Russian Birmingham Cognitive Screen
SA	South Africa
SD	Standard Deviation
SDMT	Symbol Digit Modalities Test
SPSS	Statistical Package for Social Sciences
SRTT	Serial Reaction Time Task
TACS	Total Anterior Circulation Stroke Syndrome
TIA	Transient Ischaemic Attack
TMT	Trail Making Test
UK	United Kingdom
UK-BCoS	United Kingdom Birmingham Cognitive Screen
VIF	Variance Inflation Factor
VNB	Vascular Neuropsychological Battery
WAIS	Wechsler Adult Intelligence Scale
WAIS-R	Wechsler Adult Intelligence Scale-Revised – Brazilian Version
MWCST	Modified Wisconsin Card Sorting Task
WDRT	Words List Learning and Delayed Recall Tests
WHO-UCLA	World Health Organization - University of California-Los Angeles

WHO-UCLA AVLT	World Health Organization - University of California-Los Angeles Auditory Verbal Learning Test
WMS-R	Wechsler Memory Scale-Revised
WMS-RC	Wechsler Memory Scale – Chinese Version
WRDT	Ten Words List Learning
Zim-BCoS	Zimbabwe Birmingham Cognitive Screen

Chapter 1: Overview of the Thesis

> "The process of neurocognitive assessment depends to a large extent on the reliability and validity of neurocognitive tests": (Strauss et al., 2006, p.3).

Most neurocognitive tests are developed and normed in high-income countries where demographic and contextual variables within the normative samples likely differ from populations in low- and middle-income countries. Application of these tests in settings different from those of their original normative settings likely weakens their psychometric properties. For this reason, there is a need to adapt the tests and make them suitable for use especially in low- and middle-income countries (Coetzer et al., 2017; Cockcroft et al., 2015). Our main aim in this study was to select, culturally adapt, norm, and validate a neurocognitive screen for assessing cognitive fallouts in patients with neurological changes.

Neurological changes resulting from acquired brain injuries from events such as strokes, road traffic accidents, assaults and neurodegenerative processes cause physical, emotional, behavioural, and cognitive impairments. These impairments can limit a person's functional capacity and, in most cases, also result in significant caregiver burden and a high cost to the health service delivery system (Kruithof et al., 2016; Chen et al., 2013).

Cognitive impairments are common outcomes among people with an acquired brain injury and typically affect treatment outcomes and disease prognosis (Kuzmina et al., 2017). In many instances, these cognitive impairments are, in comparison to physical impairments generally overlooked despite the adverse effects of these cognitive weaknesses on both the patients and their caregivers if left untreated. Ideally, all patients who suffer neurological changes due to conditions such as a stroke would benefit from interventions that are informed by standard neurocognitive screening. A timely and accurate diagnosis can help mitigate further neurological deterioration and inform potential treatment options. Early post-brain injury screening for cognitive impairments is, therefore, a critical clinical process for the identification and treatment of deficits. Despite the importance of neurocognitive tools in clinical settings, their usage is still quite minimal in low- and middle-income countries due to persistent barriers (Wong et al., 2014).

There are several barriers to the development and usage of neurocognitive screening tests in low- and middle-income countries, most of which are due to inadequate resources. In most instances, developing countries face resource limitations for constructing locally relevant tests and developing appropriate normative data such as a lack of specialized expertise to develop tests and readily accessible funding structures (Kosmidis, 2018; Rabbin et al., 2019; Babatunde et al., 2019). The same problem applies to the clinical application of tests in these contexts where there is little expertise in the use and administration of these tools as well as the interpretation of the results (Moser et al., 2015; Veerbeek et al., 2011; Wright et al., 2011). Beyond the issue of resource availability and accessibility, is the issue of the cross-cultural applicability of tests. The lack of relevant local norms for neurocognitive tools hampers their use in low- and middle-income countries (Ferret et al., 2013; Robbins et al., 2013; Yang et al., 2012).

It is unlikely that a test developed in one cultural context will be ideal for use in a different population without some alterations to it. There are likely to be some linguistic biases and culturally specific items built into the tests (Adjorlolo, 2018; He et al., 2012). Appropriate normative data is critical because the utility of neurocognitive screening batteries is dependent upon the psychometric properties of the tests included in those screens. Without relevant norms, the tests often yield uninformative results (Oakland et al., 2013 & Dugbartey, 2014). Misuse of cognitive tests through reliance on inappropriate norms may perpetuate social problems, such as racism and other forms of discrimination, due to inaccurate assessment outcomes (Cockcroft et al., 2015). The cross-cultural utility of neurocognitive tests can be improved through adaptation, norming and validation to make them more suitable for use in the target population. Cross-cultural issues in neurocognitive screening will be discussed further in Chapter 2.

1.1 Neurocognitive Screening in Zimbabwe

Zimbabwe, like many low-income countries has an inadequate supply of healthcare facilities and shortages of trained clinical professionals, particularly mental health specialists (Hollander, 1986). For instance, in 2017 there were 17 Psychiatrists and 25 Clinical Psychologists in the country, which roughly translates to one mental health professional to approximately half-a-million people (Kidia et al., 2017). There has not been a significant change from this situation because as in 2020, there are no postgraduate training programs on offer within Zimbabwe in the fields of clinical psychology and neuropsychology. Emigration has further strained the already inadequate health resources (Chibanda et al., 2016 & Mangezi & Chibanda, 2010).

Emigration has mainly been due to political and economic instability, leading to a significant number of health professionals leaving the country over the last three decades in search of better working conditions. These same issues also reduce the attraction of foreign-educated professionals to Zimbabwe (Writter et al., 2019; Semrau et al., 2019). Mental health has also not been a priority in terms of government funding compared to other health-care sectors. As in most low- and middle-income countries, the mental health sector receives less than 1% of the health-care funding (Kidia et al., 2017; WHO, 2014). Diseases such as HIV & AIDS, malaria, and more recently, infectious diseases such as cholera tend to get priority. Consequently, the country is operating at below 25% health staff capacity overall (Kevany et al., 2012). This situation makes it challenging to prioritize time-consuming processes such as neurocognitive test development and testing. These challenges highlight the need for brief comprehensive neurocognitive screening batteries.

Despite the potential benefits of neurocognitive testing, minimal testing is taking place in Zimbabwean clinics because of resource constraints. To date, no test development is taking place either. Like in other African countries, the few tests currently in use were developed and normed on western populations and are being administered without adjustment or validation Mate-Kole et al., 2013 & Atrjololo, 2018). There is a need to address this gap in testing and test development.

1.2 Adaptation of Neurocognitive Tests

Faced with the need for neurocognitive screening tools and the reality of limited expertise and resources, test adaptation seems to be the most feasible and practical solution to address these issues. Adapting already published tests is a more effective and cheaper way to avail instruments for use in clinical practice and research (Mate-Kole et al., 2013 & Atrjololo, 2018), especially considering the resource constraint status of most developing countries such as Zimbabwe.

Internationally, adaptation studies have worked on translating tests developed in the high-income countries and in generating relevant norms for cross-cultural groups such as the Hispanic Latinos, African Americans and Asian Americans. In Africa, Egypt translated western tests into Arabic in the 1920s (Casaletto & Heaton, 2017). There have also been some efforts to translate and norm neurocognitive tests in South Africa and Zambia (see Balchin, 2008; Boon & Steel, 2005; Cavé & Grieve, 2009; Chan et al., 2013; Claassen et al., 2001; Cofresi & Gorman, 2004; Ford et al., 2019; Grieve & Viljoen, 2000; Grieve & van Eeden, 2010; Hestad et al., 2016; Høegh & Høegh, 2009; Jansen & Greenop, 2008; Kalungwana-Mambwe, 2017; Kitsao-Wekulo et al., 2012; Knoetze et al., 2005; Shuttleworth-Edwards, et al., 2004; Shuttleworth-Jordan, 1996; Skuy et al., 2001).

Given the lack of relevant test norms in Zimbabwe, it is essential to adapt a neurocognitive assessment battery that is comprehensive, accessible, affordable and easy to administer. The National Institute of Neurological Disorders and Stroke (NINDS) in the United States of America recommends that a neuropsychological battery should ideally contain minimum tests. These tests should cover the following cognitive domains: executive function/activation, language, visuospatial abilities and memory. Furthermore, the neuropsychological battery should be able to isolate contamination from typical post-stroke deficits such as aphasia, praxis and neglect. Bonini and Radanovic (2015) advocate for neurocognitive batteries that can accommodate people with aphasia. Such batteries help to minimize sub-optimal diagnosis for people with aphasia; otherwise, the test results would be misleading and uninformative (Kuzmina et al., 2017). Identifying a tool meeting these recommendations ensures the best use of resources.

1.3 Theoretical Framework for Neurocognitive Testing

Various scholars have made contributions to the field of neuropsychology, for instance, Oliver Zangwill, (considered the father of British neuropsychology). He studied localization of function among other things. Elizabeth Warrington focused on understanding, in the broadest terms, brain and behaviour relationships, and, in particular, the neural basis of our cognitive abilities (Beaumont et al., 2008). Her work has contributed to neurocognitive testing. Brenda Milner also made contributions towards understanding the role of the different parts of the brain, for instance, showing that the temporal lobes of the brain play a key role in memory.

There are different approaches to assessing cognitive deficits. This includes brief cognitive screening tests. Neurocognitive screens can be used to determine cognitive deficits. These screens are usually narrow and brief (Roebuck-Spencer et al., 2017). Their function is to detect cognitive impairment. They are usually used in primary health centres or community centres to detect conditions in at risk populations. Some of the commonly used tests include the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) and the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005). Screening tests are the initial assessments for cognitive impairment and inform whether there is a need for a comprehensive neuropsychological assessment (Roebuck-Spencer et al., 2017). For instance, they can indicate a need for further evaluation or preliminary intervention, and they may be administered as part of a routine care. They may also be useful in determining progress of interventions. The other advantage is that they can be administered by staff, self-administered and they are not diagnostic. A n identified potential case of cognitive deficits may be referred for a comprehensive neuropsychological examination.

Neuropsychological assessment on the other hand are more comprehensive, providing a more detailed picture of the clinical condition of the patient's multiple domains. They are useful in determining the diagnosis, function and treatment plan as well as incorporating the psychological issues that are associated with the type and level of impairment. They include observations and data collected from clinical interviews (Roebuck-Spencer et al., 2017).

The ultimate choice of the approach, however, depends on the goals of the assessment and resources available (Ardila, 2009). For purposes of this study, I will evaluate two paradigms; the Psychometric (Normative) Approach and Luria's Hypothetico-deductive Approach (Lezak et al., 2012; Goldstein et al., 1997).

1.3.1 The Psychometric Approach.

The psychometric approach traces back to the 18th century and is based on the premise that the brain and behavior are related, and that damage to the brain manifests behaviorally (Lezak et al., 2012). The psychometric approach relies on the use of neuropsychological batteries which consist of an array of grouped cognitive tests (Goldstein et al., 1997).

When evaluating cognitive deficits in neurological disorders, there is a need for a systematic, empirical procedure with sufficient cases for comparison. A neurocognitive battery provides systematic quantitative data on the location, nature and severity of neurological diseases (Casaletto & Heaton, 2017). The tests are administered and scored by trained individuals, and the data can be statistically analyzed (Goldstein et al., 1997).

Neurocognitive batteries are broad and can comprehensively screen for potential cognitive problems. Cognitive impairments are likely to be missed where the scope of testing is narrowed by focusing on hypothesis-driven assessments. Therefore, a comprehensive battery ideally covers all possible cognitive domains (Goldstein et al., 1997). There are two ways of obtaining the normative standard, that is, the normative comparison of scores standard and the individual comparison of scores standard (Lezak et al., 2012).

1.3.1.1 Normative Comparison of Scores Standard. The concept of measuring deficits assumes that there is an ideal level of function that a person was operating at before the brain was damaged and that the prior level is comparable to a standard level of functioning. This level of functioning is referred to as the normative standard (Lezak et al., 2012).

1.3.1.2 Individual Comparison of Scores Standard. This standard is useful when assessing within-subject performance, that is in pre- and post-intervention or determining damage or recovery through comparing premorbid function against post-injury function (Lezak et al., 2012). While critics of the psychometric approach argue that normative data are merely figures which ignore the human behind the score, for this study, such data is a useful springboard for neuropsychological assessments.

1.3.2 Luria's Approach to Neuropsychological Testing.

Unlike the psychometric approach, Luria's approach is an alternative way of neuropsychological testing. It is patient-centred, qualitative in nature, flexible and tailor-made for the individual patient to target specific identified needs (Goldstein et al., 1997). This method has been coined the 'Process Approach' because its strength is hinged on its emphasis on the qualitative analysis of the test-taking process and not the end-product of test scores (Cole et al., 2014).

While Luria’s approach is helpful and therapeutic, its focus is not necessarily to establish or quantify a patient’s cognitive status. As a result, the tests are not standardized, which consequently introduces variability in the testing procedures (Cole et al., 2014; Goldstein et al., 1997). Luria’s approach has been widely criticized as being invalid because of its subjective nature. This approach, therefore, is not ideal for instances where neuropsychology is in its infancy, such as in Zimbabwe.

Like most cultures, African people have their own peculiar language, culture and ways of communication. For instance, they too have proverbs that could be used in evaluating executive function, similar to the proverbial interpretation used on evaluating executive function on the Mental Status Examination (Mate-Kole et al., 2013). In low resourced countries, a batter approach has a number of merits. For instance, usually, it requires lesser expertise compared to the process approach (Leposavić et al., 2010). This is usually because the approach is more focused on scores. While scores may not capture the nuances of testing, they are a starting point for screening , for example, routine screening of at- risk populations for early detection of cognitive deficits. The current approach was selected as a starting point for promoting the use of neuropsychological tests, initiating the process of developing original neuropsychological tests, while providing an instrument that can be of clinical and practical use in the country (Leposavić et al., 2010).

This study selected the psychometric approach and made use of a fixed neurocognitive battery because with this approach, both deficits and preserved functions can be noted. In essence, the purpose of neuropsychological testing under the psychometric approach allows for the assessment of whether or not an individual’s test scores suggest brain pathology. If the scores deviate from the normative scores, then it can be determined whether or not these results imply diminished function secondary to brain lesions (Nakling et al., 2017). The advantage of using the psychometric approach in this study is that it provides empirical data as opposed to a subjective qualitative judgement (Goldstein et al., 1997). Normative data is beneficial as a starting point to distinguish between cognitively impaired and cognitively healthy individuals (Ardila, 2009; Goldstein et al., 1997).

This study is premised on the normative comparison standard, which refers to a comparative normative score obtained from a healthy population with similar demographic profiles to the target clinical sample (Lezak et al., 2012). To produce normative data, we used a fixed battery of tests. These broad batteries are useful when there is a need to test large numbers of patients for research or in primary care settings where it may be impractical to 'tailor-make' a battery for each patient (Goldstein et al., 1997). We also utilised the individual comparison of scores in determining recovery in the stroke patient sample. We generated normative scores from 'healthy' participants. Generating normative data is the initial point to objectively determining cognitive impairment (Lezak et al., 2012) with 'normality' defined as a range of behaviours expected within a group with similar social, cultural and educational backgrounds (Oosterhuis et al., 2016 & Nakling et al., 2017). We collected the scores of stroke patients and evaluated them against the pegged expected normative scores. Cut-off scores were predetermined to imply neurologically based deficits (Lezak et al., 2012).

1.4 Statement of the Problem

There is a lack of culturally relevant normative data in Zimbabwe for neurocognitive tests developed in high-income countries to assess cognitive fallouts in patients with acquired brain damage, such as that resulting from a stroke. It is essential, therefore, to select, adapt and generate normative data for a robust neuropsychological battery that is not necessarily disease-specific, for broader use in Zimbabwe.

1.5 Aim, Research Questions and Objectives

We aimed to culturally adapt, norm and validate a standard neurocognitive screen for use on patients with acquired brain damage in Zimbabwe. To achieve these objectives, we conducted the study in the four phases described below.

1.5.1 Phase 1

Our main aim in phase 1 of the study was to evaluate neurocognitive instruments that have been used in low- and middle-income countries for post-stroke sequelae through a systematic review. The psychometric properties of these instruments were then appraised to identify a robust neurocognitive screen suitable for adaptation for use in Zimbabwe. The specific objectives of this phase were to:

1) Identify neurocognitive tools used to assess cognitive deficits on stroke patients in low- and middle-income countries.
2) Identify a robust neurocognitive battery that assesses broad cognitive profiles that can be adapted for use in Zimbabwe.

In this phase we aimed to answer the following research questions:

1) What are the tools that are used to assess neurocognitive deficits in stroke patients in low- and middle-income countries?
2) Which one of these neurocognitive instruments is sufficiently robust and feasible for application in Zimbabwe?

1.5.2 Phase 2

The main objective in phase two of this study was to evaluate the cross-cultural sensitivity of the identified neurocognitive screen and to adapt it for use in Zimbabwe, using the Delphi approach. We wanted to answer the following research questions:

1) Are there culturally inappropriate test items for the Zimbabwean context in the identified neurocognitive battery?
2) What are the psychometric properties of the adapted and translated instrument?

The specific objectives were to:

1) determine the cross-cultural sensitivity of the identified instrument,
2) adapt culturally inappropriate test items for use in Zimbabwe,
3) translate the adapted test into the major indigenous language in Zimbabwe, which is Shona,
4) determine the psychometric properties of the adapted and translated screen by investigating the following:
    a. Inter-rater reliability
    b. Test-retest reliability
    c. Shona/English agreement of the original against the adapted version of the instrument.

1.5.3 Phase 3

Our aim in phase 3 of the study was to generate local (Zimbabwean) normative data for the adapted neurocognitive screen using a sample of cognitively intact, healthy, community-dwelling adults.

1.5.4 Phase 4

Our aim in phase 4 was to evaluate the screening agreement of the normed instrument with commonly used neurocognitive tools and other post-stroke measures. The research questions addressed here were as follows:

1) What are the psychometric properties of the normed instrument in terms of:
    a) Convergence validity
    b) Predictive validity?

2) How inclusive is the instrument to assess patients with post-stroke aphasia and neglect?

1.6 Justification and Significance of the Study

There has been a limited number of validation studies for neurocognitive tests in Zimbabwe. These studies were mostly on brief screening tools on HIV populations and people living with a disability (e.g., Chibanda et al., 2016; Verhey et al., 2018). To our knowledge, no work has been undertaken to generate normative data for a comprehensive neurocognitive screening tool. This study follows the World Health Organization's recommendation for the implementation of post-stroke intervention strategies that are both culturally appropriate and cost-effective (Saxena et al., 2014). The findings from this study will help to guide policy directions towards the implementation of the recently launched Zimbabwe's National Mental

Health Strategy (2020-2023). This study is the first one to adapt and derive normative data for a neurocognitive instrument in Zimbabwe. The study paves the way for the integration of neurocognitive tests in research and practice, and hopefully, the development and/or adaptation of more tests. The significant contributions of this thesis are that it also provides guidelines for the procedure of cross-cultural adaptation, translation and derivation of normative data, following international standards. Additionally, it avails normative data for a neurocognitive instrument which is not necessarily disease-specific.

1.7 Structure of the Thesis

The target for this thesis is to chronicle the phases of how we conducted a systematic review, selected a neurocognitive tool and, subsequently, adapted, normed and validated it for use in Zimbabwe.

This first chapter gives an introduction and an overview of the whole project. Chapter 2 focuses on the literature that addresses the burden of stroke, the cognitive domains commonly affected by a stroke and the neurocognitive tests that are commonly used to evaluate cognitive dysfunction in patients with stroke. Chapter 3 describes the systematic review of instruments that have been used to screen for neurocognitive deficits in stroke patients, together with their resultant psychometric properties in low- and middle-income countries. The main objective of this review is the identification of the most robust testing instrument for adaptation in Zimbabwe. Through the systematic review, the Birmingham Cognitive Screen (BCoS) was identified as the target screen for adaptation (Pan et al., 2015). Chapter 4 gives an overview of the BCoS. In Chapter 5, we conducted the cross-cultural adaptation and translation of the BCoS on 105 community-dwelling healthy participants and also used the Delphi technique and a panel of language and subject matter experts to inform our investigation. We then evaluated the adapted instrument's test-retest, and inter-rater reliability, and compared the level of agreement between the English and the translated Shona version. Following the adaptation of the BCoS, the next step was to derive local normative data for the adapted 'Zim-BCoS' as set out in Chapter 6. To generate norms, we first investigated the predictive effect of demographic variables (age, sex and education) on a sample of 412 healthy participants. We then computed regression-based norm tables corrected for these variables and compared the Zim-BCoS norms to previously published United Kingdom, Russian and Cantonese BCoS norms.

In Chapter 7, our objective was to evaluate the psychometric properties of Zim-BCoS on a sample of 103 stroke patients and matched controls. Here we investigated convergence and predictive validity by comparing the Zim-BCoS tests against other commonly used cognitive tests for similar cognitive deficits and measures of post-stroke sequelae. We also documented the prevalence of cognitive impairment and post-stroke sequelae. The thesis ends with a broad discussion and conclusion of the whole project in Chapter 8. Table 1.1 below gives a summary of the research process and research objectives in each chapter:

Table 1.1
Structure of the Thesis

Chapter	**Study Process and Objectives**
Chapter 1: Introduction	Study overview: Theoretical framework, Study objectives
Chapter 2: Literature Review	Review the literature on neurocognitive testing, its benefits and challenges
	Phase 1
Chapter 3: A Systematic Review of Neurocognitive Tools Used in Low and Middle-Income Countries	Psychometric properties of neurocognitive tests used on stroke patients in low- and middle-income countries
Chapter 4: An Overview of the Birmingham Cognitive Screen	Description of the BCoS properties and its cognitive tasks
	Phase 2

Chapter 5: Zimbabwean Adaptation of the Birmingham Cognitive Screen	Difficulty index determination of BCoS test items Delphi expert panel on the adaptation of BCoS Adapted BCoS test internal consistency reliability: -test-retest of Zim-BCoS -inter-rater reliability -Agreement of English and Shona version
Phase 3	
Chapter 6: Regression-based norms for Zim-BCoS	Age, education and gender-stratified normative data of BCoS screen Comparison of Zim-BCoS norms with previously published UK, Russian and Cantonese norms
Phase 4	
Chapter 7: Validation of Zim-BCoS on patients with stroke	Zim-BCoS compared with other cognitive tests and measures of post-stroke sequelae to evaluate Convergence and Predictive validity of Zim-BCoS screen. Prevalence of cognitive impairment and post-stroke sequelae
Chapter 8: General Discussion and Conclusion	Overview of the whole study

Some chapters of this thesis take the format of a manuscript detailing the abstract, rationale, methodology, participants, materials, procedures, data analyses, and results sections. The findings and discussion of each phase are embedded in each study for clarity and ease of reference.

Chapter 2. Literature Review

In this chapter I review literature that relates to key themes of the research. This includes the description of cognitive domains that are commonly affected by a stroke and the standard neuropsychological tests that are usually used to assess these particular domains. I also highlight the benefit of screening for cognitive deficits in cases of neurological change, pointing out some of the barriers hindering routine screening in clinical settings. All these issues are discussed in light of cross-cultural factors that influence test performance since these can be modified to improve the integrity of neuropsychological tests.

2.1 The Burden of Stroke

Strokes are one of the major causes of debilitating neurological change. Epidemiological studies put the number of stroke sufferers at 15 million per year. Of these, 5 million suffer fatal strokes while a further 5 million are left with a permanent post-stroke disability and the rest recover (Corbyn, 2014). Consequently, about 33 million people are currently living with the disabling effects of a stroke. Over 69% of these strokes occur amongst people living in low- and middle-income countries where resources for stroke-related interventions and rehabilitation are limited (Corbyn, 2014; Feigin et al., 2017; Katan & Luft, 2018). Two systematic reviews evaluated the continent-wide burden of stroke cases in Africa. They revealed that stroke cases, and the subsequent number of survivors living with a post-stroke disability, is significantly high and is increasing at a rate of about 10% annually (Adeloye 2014; Owolabi et al., 2015).

The increase in stroke survivors has been attributed to changes in demographics and epidemiological profiles. This escalation is due to the improvement in health care, such as better diagnosis and management, particularly an increase in access to Active Antiretroviral

Therapy (Carod-Artal et al., 2009; Feigin et al., 2016; Ghousal et al., 2014). Another contributing factor is that strokes no longer only occur amongst the aged. There has been an increase in stroke incidence among young adults within the 18-45 years age range, and even among adolescents (Mozaffarian et al., 2015). A recent systematic review of people living with HIV in Sub-Saharan Africa illustrated that the Human Immuno-Virus (HIV) is a high-risk factor for a stroke. According to that review, the median age range for people living with HIV and AIDS who experience strokes was low, ranging from 32 to 43 years (Abdallah et al., 2018).

There is limited data on the burden of stroke in Zimbabwe, partly because of poor access to diagnostic tools (Kasese et al., 2018; Matenga et al., 1986; Smit et al., 2018). However, there is some evidence from an old report by Matenga et al. (1986) that suggests the burden of stroke is generally high and increasing. According to this report, the incidence of strokes rose from 30.7/100 000 to 57/100 000 in one decade (Matenga et al., 1986). Kaseke et al. (2017) suggest that the burden of stroke is likely to be high in Zimbabwe, although, as is the case in most low- and medium-income countries, it may be under-reported.

2.2 Neurocognitive Sequelae of Stroke

Neurological changes from strokes result in vascular cognitive impairments, that is, a syndrome affecting at least one cognitive domain following a clinical stroke or subclinical vascular brain injury (Gorrelick et al., 2011). The syndrome can range from mild cognitive impairment to severe vascular dementia.

Cognitive impairment is the most prevalent disorder in stroke survivors (Corbyn, 2014). However, studies differ on the prevalence of cognitive impairment following stroke, with statistics ranging from 24% to as high as 74% within the six months' post-stroke period. The differences in the prevalence of cognitive impairment may be attributed to study characteristics. Study differences such as post-stroke period, diagnostic instruments and criteria used, types of stroke, study setting (for example, rural, urban, hospital or community) are likely to yield different prevalence of cognitive impairment. Hospital patients in the acute phase of the post-stroke period are likely to be more cognitively impaired (Makin et al., 2013; Qu et al., 2015).

Cognitive impairments affect treatment and prognosis (Kuzmina et al., 2017). They double the risk of post-stroke survivors degenerating to dementia (Yang et al., 2014). Studies show that about 39% of stroke survivors usually degenerate eventually into post-stroke dementia (Akinyemi et al., 2015; Chaiyawat & Kulkantrakorn, 2012; Chen et al., 2015; Custodio et al., 2017; Pan et al., 2015; van Rooji et al., 2014). This fact was also confirmed by Das et al. (2013) who followed up on a community-based sample of over 100 000 people in India and found the period prevalence of post-stroke dementia to be 13.88% at a 95% confidence interval. Progression of mild cognitive impairment to dementia was 3.53% per year (95% CI, 2.09-5.5%). As such, dementia is one of the most common neuropsychiatric symptoms occurring in over a third of stroke survivors. It is common, therefore, to have one in every three stroke suffers experience cognitive impairment within three months (van Rooij et al., 2014) and memory loss due to dementia in 20% of stroke survivors within six months (Party, 2012).

Cognitive impairments limit a patient's functional capacity and result in a massive burden for caregivers and the health service delivery system. This damage is significantly associated with poor functional outcomes and an increase in the patient's length of hospital stay (Campanholo et al., 2015; Bindawas et al., 2018). For instance, stroke survivors experience challenges with learning, planning, making complex decisions, working with numbers, engaging effectively with their environment or concentrating on tasks. These limitations consequently hinder patients' recovery, but, worst of all, cognitive impairment shortens their lifespan (Das et al., 2013; Humphreys et al., 2012). This situation occurs because cognitive impairments may compromise a patient's ability to adhere to treatment regimens and to carry out general self-care, thus negatively affecting the potentially therapeutic outcomes of such routines.

2.3 Cognitive Domains Commonly Affected by Stroke

Some of the domains commonly impaired as a consequence of neurological damage include the capacities involved in attention, praxis, memory, executive functioning, enumeration, language processing, psychomotor activities and visuospatial abilities (Lezak et al., 2012). It is essential, therefore, to screen patients for deficits in these specific cognitive capacities following brain damage. The following sections give brief descriptions of each of these cognitive domains and how to assess patients suffering from the effects of a stroke.

2.3.1 Language Domain

This cognitive domain covers the receptive/comprehension and expressive abilities of oral and written language. Usually, standard neuropsychological batteries profile language capacities that relate to the comprehension and expression of fluent speech, either in written or oral form (Lezak et al., 2012). The most commonly assessed abilities include spontaneous speech, speech comprehension, object/picture naming, reading, writing and repetitions to determine fluency. For instance, the Mini-Mental Status Examination (Folstein et al., 1975) uses a tongue twister whereby a person has to repeat a phrase; "No ifs, ands or buts" to evaluate both receptive and expressive abilities. The most common acquired disturbances of the comprehensive or expressive language functions may result in different forms of aphasic syndromes and defective articulation such as dysarthria (Bobba et al., 2019), for instance, Wernicke's aphasia, Brocca, global and anomic aphasia. In Wernicke's aphasia, patients have difficulty in mentally comprehending speech while sufferers of Broca's aphasia have difficulty in physically expressing speech. Anomic aphasia presents as mild difficulties in expressive fluency where an individual struggles finding the right kind of words to say, mainly nouns and verbs. Global aphasia is severe, involves difficulties in both expressive and receptive language skills (Bobba et al., 2019).

Literature shows that up to 50% of stroke patients suffer some form of aphasia (Bonini & Radanovic, 2015; Kuzmina et al., 2017; Humphreys et al., 2012; Pagliarin et al., 2014; Riddoch et al., 2017). This situation creates challenges to neuropsychological testing because performance on most neurocognitive tests relies on verbal comprehension and expression. For instance, routine language abilities are assessed using verbal fluency tasks that require picture naming and word generation, such as the Boston Naming Test (BNT; Kaplan et al., 1983; Strauss et al., 2006).

Aphasic syndromes interfere with participants' performance on tests of other cognitive domains that require preserved auditory and written language comprehension (Kuzmina et al., 2017). For instance, the Montreal Cognitive Assessment subtests (MoCA; Nasreddine et al., 2005) require examinees to distinguish phonemes, which is a challenge when they suffer from Wernicke's aphasia. This is done by asking the participant is required to generate as many words that begin with the letter F in one minute. This requirement, therefore, may compromise the performance of patients with aphasia due to their limited language processing ability (Bobba et al., 2019).

Bonini and Radanovic (2015) compared the cognitive performance of patients with and without aphasia. They noted that patients with aphasia had worse outcomes on tests of attention, mental control, working, verbal and visual memory. They illustrated that patients with aphasia perform poorly on cognitive tests due to the language demands of these tests and not the challenges with the targeted cognitive deficit itself. In practice, clinicians tend to avoid the testing challenges associated with aphasia by excluding patients with aphasia from testing (Bonini & Radanovic, 2015; Cardoso et al., 2015; Chaiyawat et al., 2012). This rejection discriminates against aphasia sufferers. For instance, Carod-Artal et al. (2009) reported excluding 25% of potential participants in their study on determinants of post-stroke depression because of aphasia. Given the high prevalence of aphasia among stroke survivors, neuropsychological batteries should be sensitive enough to register and control for the effects of aphasia on their test performances (Pagliarin et al., 2014).

2.3.2 Attention Domain

The Attention domain involves the cognitive process of one's ability to receive, process and respond to stimuli. Attentional abilities influence one's capacity to engage in a task, focus on it and sustain that focus until the task is completed (Myers et al., 2017; Cohen et al., 2014). There are different aspects of attention. For instance, *focused* or *selective* attention which refers to one's ability to concentrate on the target stimulus, while consciously suppressing responses to other stimuli. On the other hand, *alternating attention* refers to the ability to shift focus from one stimulus to the other as required by task demands. In contrast, *divided* attention is the ability to multi-task, such as when simultaneously attending to more than one stimulus. Furthermore, *sustained attention* is the ability to be vigilant to stimuli over a long period while the *span of attention* refers to how effectively a person can immediately grasp stimulus with little effort (Demeter, 2016; Myers et al., 2017). Other aspects include attentional capacity and speed of processing information. These different forms of attention have important implications for performance in other cognitive domains, such as the memory domain, because intact attention is required for all other cognitive functions.

A significant proportion of patients with memory deficits following brain injury also experience impaired attentional processing. For instance, these patients are slower at information processing, face difficulties in multi-tasking and usually experience information overload (Demeter, 2016; Cohen et al., 2014). Impaired attention capacity can result in various difficulties, such as distractibility, and may also culminate in poor decision-making abilities, especially in complex real-world situations (Myers et al., 2017; Cohen et al., 2014). There are numerous means of testing attention due to the variability in forms of attention. Typical attention tests usually require the participant to count or spell backwards, repeat increasingly complex numbers, perform serial subtractions or tap in response to target stimuli. Research shows that deficits in aspects of attention affect patients' ability to persevere with tasks, and it links with the early onset of fatigue. This condition often results in participants' failing to complete the full battery of attention tests (Jongeng et al., 2014).

2.3.3 Memory Domain

Memory refers to the intentional access to knowledge reserves, which is central to all other cognitive abilities (Hanula et al., 2017). Memory influences how one can have a meaningful interaction with the world by providing for continuity with the past, present and future. Scientists propose several types of memory. On the one hand, there is the *declarative or explicit memory,* which is the conscious aspect of memory that enables people to possess facts about objects and events. It also involves the capacity to retain, revive, organize and recognize experiences (Hanula et al., 2017; Strauss et al., 2006). *Non-declarative memory* refers to the unconscious aspect of memory.

The three-stage model of memory is commonly used in clinical settings to investigate memory dysfunction. In this model, there are three broad subcomponents of memory. These sections consist of a working memory component involved in stimulus registration or sensory memory, a short-term memory component responsible for immediate recall of memory items and lasting about 30 seconds. The third one is the rehearsal and long-term memory component, which enables the acquisition and storage of new information (Hanula et al., 2017). Damage to the brain may disable aspects of long-term memory resulting in amnesia. This incapacity may involve a loss of memories of events that happened before the damage, that is, retrograde amnesia, or loss of the ability to form new memories after brain damage, as in anterograde amnesia. Patients with deficits in short-term memory may have problems such as forgetting names and appointments or forgetting to take their medication. They may also misplace objects around the house or have difficulty learning new skills. Consequently, poor drug compliance due to memory deficits can be a severe threat to recovery or survival amongst stroke suffers.

Most screening measures contain tests to assess memory functions using verbal stories in which participants are told a story and asked to provide both immediate and delayed recall of the story or to recall aspects of the testing situation or complex figures. A recently developed neurocognitive screen, Oxford Cognitive Screen (OCS; Demeyere et al., 2015) caters for these deficits by using tests that are designed to include patients with aphasia. (Demeyere et al., 2015 & Washida et al., 2017). The impact of memory deficits on patients' activities of daily living underscores the need to assess the memory integrity of stroke patients.

2.3.4 Visuospatial Processes

Visuospatial processes are a set of cognitive skills involved in the encoding and perception of the visual and spatial orientation of intra- or extra-personal space. These skills refer to how the body relates to itself and space, as well as spatial analysis and orientation of the body in relation to its surroundings in two or more dimensions (Dickerson & Atri, 2014). Visuospatial abilities include the systems that specialise in spatial analysis and orientation of shapes and patterns; that is, the visual ‘what’ type of information and the system commonly referred to as the dorsal ‘where’ pathway which specialises in the ‘where’ type of information. The other specialisations are the cortical integration of visuospatial experiences, such as perceptions of ‘bigger’ or ‘inside’. Visuospatial abilities facilitate movement, navigation and perception of depth in relation to the self and surroundings (Lezak et al., 2012).

Impairment of the visuospatial domain, usually following a right hemisphere lesion (right posterior cortical lesion), may result in the visuospatial inattention syndrome, which is also referred to as 'neglect'. A person may fail to scan left-sided stimuli; for instance, they may read from the middle of a sentence or may omit left-sided details of a drawing. In extreme cases, they may display inattention to the left side of the body (hemiasomatognosia) for example not using the left-side pocket, or they may fail to acknowledge left side disability (anosognosia), resulting in challenges with rehabilitation (Chelazi et al., 2018; Lezak et al., 2012). Other challenges include spatial disorientation, that is, challenges with perceptual or conceptual organisation. Such a person may fail to accurately identify the position, direction or movement of stimuli in space. Another syndrome is acalculia, whereby a person has difficulties in mentally manipulating numbers spatially, such as long, complex division, or mentally carrying numbers (Grimaldi & Jeanmonod, 2018). In spatial dyscalculia, a person experiences difficulty calculating written mathematical problems that require spatial organisation, in cases where the position of the figures affect the calculation (Kim & Cameron, 2016). Rare cases of left-sided lesions may result in constructional disorders, such as difficulties in drawing angles, oversimplifying or generally failing to execute movements needed for constructional activities such as grasping a pencil.

Consequently, impairment of the visuospatial domain may interfere with activities of daily living, including simple self-care tasks such as tying shoelaces and buttoning clothes (de Paula et al., 2016). Behaviourally, patients may bump into objects such as furniture or walls. Besides, driving a vehicle may also be a challenge because of the poor judgement of distance (Dickerson & Atri, 2014). Research shows that up to 50% of stroke victims suffer post-stroke visuospatial neglect during the acute phase of the condition.

Traditionally, visuospatial abilities are assessed using paper and pencil tests, such as the Cancellation Tests (Wilson et al., 1987; Lezak et al., 2012). Many cognitive tests also include an aspect of copying a visual object, such as the Rey Osterrieth Complex Figure (Osterrieth, 1944; Rey, 1941; Rey & Osterrieth, 1993) to assess for visuospatial deficits. However, during testing, patients with visuospatial neglect may perform poorly on cognitive tests because of their inability to attend to the other field of vision. For instance, unawareness of the other half of the page in arithmetic, reading or figure copying task may result in lower scores on these tasks even in cases in which the target cognitive processes are intact. However, most neuropsychological tests do not control for neglect, do not contain tests for detecting it, and also fail to isolate the different forms in which inattention manifests itself (Bickerton et al., 2011).

2.3.5 Executive Functions Domain

Executive functions can be defined as the cognitive processes that work to organise, plan, manage and execute goal-directed behaviours that are guided by self-appreciation, as well as by self, social and situational awareness (Oei et al., 2016 & Cardoso et al). The executive function, therefore, broadly constitutes higher cognitive functions which are crucial in making adaptive responses to cognitive, emotional and social stimuli, and are traditionally viewed as part of frontal-lobe functions. The executive function can be considered as comprising four components: 1) *Volition*: which refers to one's ability to conceptualise a goal and its end, self-initiate and execute the goal until completion. Volitional impairments display as decreased motivational capacity, poor insight, social disinhibition, withdrawal, passivity and, in its extremes, apathy (Oei et al., 2016).

Assessment for volitional defects can be conducted using personality change tests, social awareness and apathy scales. 2) *Planning and decision making*: this cognitive function involves abstract reasoning, judgment and intentional conceptualization of the steps required to achieve a goal, sequencing them, executing the plan, and following through with it, if there is any need to adjust (Oei et al., 2016). This process is usually assessed using brain teasers such as the Tower of London, (ToL; Culbertson & Zillmer, 2001) block designs, picture arrangement, Trail Making Test (TMT; Reitan 1985) and Complex Figure Test (ROCFT; Rey & Osterrieth, 1993) and the Hayling and Brixton tests (Burgess & Shallice, 1997). The systematic approaching of tasks shows intact planning and decision making. At the same time, impairment is displayed through perseveration, impulsivity, poor judgement and indecisiveness, which may cause huge losses of reasoning and judgement. 3) *Purposive action*: this practice can be thought of as some kind of programming in the execution of goal-directed behaviour. Intact function in this area is observed when intention and action are congruent. Impairment shows in the dissociation between verbal plans and actual actions, lack of persistence, goal neglect, perseveration, decreased or erratic productivity (Pallavicin et al., 2016; Lezak et al., 2012). 4) *Effective performance*: this cognitive function is characterised by personal inertia, self-monitoring, self-correction, rule detection, flexibility and shifting, sequencing and peak performance of goal-directed behaviour. Impairment in this function displays as impatience and a lack of insight. Studies show that dysfunction in other brain sites, such as damage to the frontal lobe, usually results in a broad range of the dysexecutive syndrome (Pallavicin et al., 2016).

2.3.6 Praxis Domain

Praxis refers to the purposeful expression of previously learned and mastered movements (Itabashi et al., 2016; Lezak et al., 2012). It is characterised by comprehension, formulation, initiation, sequencing, coordination and positioning of activities, leading to the implementation of goal-directed action. Brain injury in areas responsible for goal-directed action, planning and execution results in deficits in understanding and performing such tasks, a condition referred to as apraxia (Itabashi et al., 2016). Apraxia is mostly linked to lesions in the cerebral hemisphere and manifests itself in different forms, such as constructional agraphia, facial, dressing, gestural, ideomotor, ocular, optic, oral and ideokinetic apraxia (Party, 2012). Because of the numerous types of apraxia, there are also different ways to assess the integrity of this domain, including motoric tasks targeting the face, limbs and sometimes the body. For instance, the assessment may be conducted by asking participants to initiate and/or imitate gestures, pantomime object use or by asking them to action verbal commands, for instance, pretending to use a common tool (Itabashi et al., 2016). However, most clinicians seldom assess for apraxia, nor is this defect targeted for assessment in most cognitive batteries (Wu et al., 2014; Cullen et al., 2007). This deficit in praxis assessments occurs because there are limited validated praxis tests in most standard neuropsychological batteries. There are also no standardized ways of administering the few available praxis tests. Besides, the tests are usually scored qualitatively, and this subjective method requires expertise and training. Hence, there are a limited number of praxis tests with excellent psychometric properties (Hachinski et al., 2006; Nøkleby et al., 2008).

Given the rise in the burden of stroke, it is essential to make a dedicated effort to enhance the management of post-stroke disabilities to improve patient outcomes. Ideally, to assess the integrity of the functions mentioned above, a comprehensive neuropsychological battery is needed (Brainin et al., 2015). This battery should assess a minimum of five cognitive domains, including executive function, attention, memory, language and visuospatial abilities (Gorelick et al., 2016). An ideal instrument should be reliable, cost-effective and sensitive to the typical stroke impairment (Brainin et al., 2015).

2.4 Benefits of Neurocognitive Screening Following a Stroke

With the increase in people living with disabilities following a stroke, it is crucial to detect cognitive impairment early in order to facilitate treatment and rehabilitation. As mentioned in the previous chapter, there is evidence that most neurological consequences of a stroke (physical, emotional and behavioural) receive relatively reasonable attention in most clinical settings (Woodford & George, 2007). However, cognitive impairments are subtle and difficult to detect during routine clinical interviews. For instance, Harwood et al. (1997) assessed 201 randomly selected hospital patients in the United Kingdom (UK) on a cognitive screen and caregiver history and revealed that 46% of these patients were cognitively impaired. However, there was no record of cognitive impairment in their clinical notes. Patients are likely, therefore, to receive medical treatment for physical, emotional and behavioural symptoms while neglecting cognitive deficits (Zuo et al., 2016).

The National Institute for Health and Care Excellence (NICE) Guidelines recommend early screening for cognitive impairment in patients who suffer neurological change such as stroke patients (Godefroy et al., 2011; Fischer & Milfont, 2010). The NICE Guidelines for stroke patients urge that all stroke cases should be assumed to have a post-stroke cognitive impairment and, therefore, early screening should be conducted for all patients (Godefroy et al., 2011).

2.4.1 Role of Neurocognitive Tests in Diagnostic Formulation

Neurocognitive screening is an initial step that can detect neuropsychological deficits and help identify cases for management (Iracleous et al., 2010; Ismail et al., 2010; Mazzucco et al., 2017). Evidence shows that general practitioners are poor at detecting cognitive deficits, primarily when they rely exclusively on routine, non-cognitive interviews. In light of this situation, neuropsychological assessments are used for the diagnosis of different neurologic conditions and their severity. Such tests help to document spared and impaired cognitive abilities. Neuropsychological assessments complement data from brain imaging by providing behavioural data that helps localize areas of the brain lesion. While imaging can only show the site and severity of the brain lesion, neuropsychological assessments go further to identify residual behavioural strengths and deficits that can inform rehabilitation strategies and intervention (Leckman & Taylor, 2015). Screening for cognitive impairment can highlight the connection between the deficits and activity limitations, something that neuroimaging cannot precisely detect (Akbari et al., 2013).

2.4.2 The Prognostic Value of Neurocognitive Testing

The severity of post-stroke cognitive impairment informs prognosis. For instance, screening can detect post-stroke dementia, which is a significant predictor of functional incapacity and death (Banerjee et al., 2019). Early intervention may also improve prognosis because specific rehabilitation measures can be directed towards identified deficits. Unsatisfactory rehabilitation progress in patients may also be due to potential post-stroke cognitive impairment in which these cognitive impairments interfere with treatment. Patients indicating unsatisfactory progress require comprehensive cognitive assessment.

2.4.3 Role of Neurocognitive Tests in Aiding Professional Communication

A systematic review of the impact of patient outcome measures revealed that screening improves structured professional communication between the patient, caregivers and the clinical team (Etkind et al., 2015). Neuropsychological assessments profile a patient's cognitive status, personality and behavioural alterations. This data assists the treatment team to advise on adjustment using neurocognitive screening evidence-based information (Das et al., 2013). Most patients become frustrated when they do not understand their altered state and compromised functioning. Likewise, caregivers suffer burnout when they do not understand the consequences of the patient's poor functioning (Akbari et al., 2013).

Being aware of a patient's spared and impaired cognitive abilities informs programs for the reintegration of patients into the community. It enables the patients and their caregivers to develop realistic expectations around recovery. Screening results, therefore, can feed into the patient, family and community psycho-education information (Howitt et al., 2011; Das et al., 2013). Equipping patients with prognostic information, based on neurocognitive screening, has also been shown to significantly reduce the probability of patients developing post-injury neuropsychiatric disorders, such as apathy, depression and anxiety (Banerjee et al., 2019).

2.4.4 Role of Neurocognitive Tests in Treatment and Rehabilitation

Detection of cognitive deficits would consequently lead to improved treatment through various interventions, such as herbal, medical, psychosocial and computer-based neurocognitive training, among others (Farhana et al., 2016). It is critical to assess for cognitive impairment, even in poorly resourced countries, to set up appropriate rehabilitation interventions for stroke survivors. The detailed neuropsychological assessments can help clinicians choose appropriate treatment regimens and care plans that target specific deficits and ascertain re-training (Akinyemi et al., 2015). Clinicians can also use patients' cognitive profiles to evaluate treatment effectiveness, monitor disease prognosis, and predict implications for post-injury adjustment and community functioning (Karunaratne et al., 2011; Wright et al., 2011; Zhou & Jia, 2009). The purpose of screening, therefore, is to modify the personal impact of a stroke. If specific post-stroke cognitive impairments are identified through screening, some interventions can target these deficits. For instance, stroke survivors can be taught compensation skills so that the deficits do not severely affect their functional status. Simple interventions, such as visual scanning training to improve visuospatial processing, can produce positive outcomes and improve patients' functional outcomes (Akbari et al., 2013; Party, 2012).

2.4.5 Use of Neurocognitive Tests in Research

Neurocognitive tests are widely used for research purposes to assess brain activity and behaviour. Such research may involve developing, adapting, validating neuropsychological instruments and comparing their performance (Lezak et al., 2012).

2.4.6 Utility of Neurocognitive tests in Occupational and Forensic Settings

Neuropsychological assessments can be used to answer legal questions related to a patient's cognitive status. This information can assist in determining the cognitive capacity or extent of the cognitive damage for legal purposes. For instance, neuropsychological tests may be used in forensic cases as part of an expert witness to determine competency to stand trial, compensation claims, changes to work structure and evaluate patients involved in litigation. The NICE Guideline recommendations are that all stroke survivors should be screened to evaluate their cognitive competence before returning to work (Godefroy et al., 2011).

Given the benefits of cognitive screening, routine cognitive screening is crucial following acquired brain injury (Banerjee et al., 2019; Holsinger et al., 2012; Iracleous et al., 2010; Ismail et al., 2010; Teng & Manly, 2005; Wijedasa, 2012).

2.5 Cross-cultural Issues in Neuropsychological Assessment

The idea of testing for cognitive abilities is a cultural concept that was initially developed in western societies (Casaletto & Heaton, 2017). Cognition is influenced by variables such as culture, language and level of education. The utility of these psychological tests rests on their sensitivity to these variables and the robustness of their psychometric properties in different cultural contexts. Consequently, these tests are influenced by cultural biases if applied to different populations from the norm group in which they were developed.

Even though neuropsychological testing has flourished in certain countries, it is still mostly unfamiliar in developing countries. Below are some of the common cross-cultural factors that influence patients' performance on neurocognitive tests. In high-income countries, neuropsychological screening is a key part of clinical interventions following a stroke. This practice is not the case in developing countries (Oakland et al., 2013).

2.5.1 Influence of Cultural Beliefs on Neurocognitive Testing

Cultural beliefs influence people's appraisal of a situation and how they feel and act towards that situation. For this reason, people are bound to respond and preform on cognitive tests in a culture-specific way (Greif, 1994). Cross-cultural influences on test performance have been demonstrated in several studies. Such influences mean that patterns of cognitive test performance cannot be generalised from one culture to another. Most neuropsychological tests were developed and normed on primarily white, middle-class, educated individuals in western countries and, thus, do not usually perform well on individuals from other ethnic and socio-economic backgrounds (Oakland et al., 2013 & Yang et al., 2012).

2.5.2 The Impact of Personal Values on Test Performance

Psychological tests are developed based on some underlying principles, rules, values and reasons. For instance, in cognitive tests for evaluating an individual's speed of processing, participants have to value speed and fast reaction times to perform well (Cores et al., 2015). However, research shows that the principle of best performance, as indexed by the speed of performing a task, is embraced most positively by an individual from a culture that values competition (Nakling et al., 2017). Contrastingly, certain cultures may value a different competing aspect, for instance, accuracy, a fact that may hinder participants' good performance on the tests. Non-westernized cultural groups who are usually not ruled by the clock and lack the spirit of competition, due to communalism. They may present an unreliable picture of their cognitive functioning performing unhurriedly due to unfamiliarity with competition (Ardila et al., 2005). Consequently, an individual may perform poorly on an executive function test intended to assess the cerebral integrity of the 'white matter' because it is based on speed and not accuracy. This is because if a person has high regard for accuracy, they may perform poorly on the construct being measured, that is, speed, while they unhurriedly try to polish their performance. For example, the American culture teaches that 'faster is better', while the Hispanic culture teaches that 'thoughtful action and accuracy' produce the best outcome (Ardila et al., 2005; Dugbartey, 2014).

2.5.3 Bias in Neuropsychological Testing

Cultural bias in neurocognitive testing is defined by He and van de Vijver (2012) as any cultural factors altering outcomes when applied in different cultures. This practice, therefore, refers to any cultural confounding variables that hinder the accurate measurement of a construct. Van de Vijver and Tanzer (1997) outline three sources of bias in cross-cultural neurocognitive testing.

2.5.3.1 Construct Bias. Construct bias occurs when there is no universal definition for the cognitive process to be measured. For instance, there is a debate regarding the nature of intelligence and its different forms. Some researchers and theorists limit their definition of intelligence to scholastic abilities, while others include capacities involving social skills (Ang & Van Dyne, 2015; Kline, 2013). To minimise bias, a clear and consistent definition of a specific construct should be applied.

2.5.3.2 Method Bias. This form of bias refers to inconsistencies in the sample, instruments and response style flaws. Sampling method refers to how participants are drawn from the population. One way to minimise method-related bias is to use probability sampling through randomizing participants. Randomization involves giving each potential participant an equal probability of becoming involved. This process is achieved by selecting participants using procedures such as the lottery method, random table numbers or computer-generated numbers through a defined sampling frame (Acharya, 2013). Convenience/purposive sampling is commonly used in clinical research and involves recruiting participants who meet the research criteria merely because they are available. However, this approach is problematic in that it involves non-probability sampling and may not accurately represent the population and, therefore, the research results cannot be generalised. Where convenience sampling has been used, several methods are then applied to mediate for and reduce bias. For instance, using matched samples and/or controlling for demographic variables through statistically correcting for the confounders. Also instrument bias may be introduced due to the characteristics of the instrument. For example, the stimuli used, or the response style may not be appropriate for certain populations, such as computer-based responses in communities in which people are not familiar with computers (He & van de Vijver, 2012).

2.5.3.3 Test Administration Bias. This type of bias refers to partiality during the actual data collection process, including the size of the group, mode of instructions and the examiners.

One way to minimise test administration bias is through standardization of testing conditions. This practice includes thorough training of the research team and standardizing the recruitment, test environment and protocol for all data collection (He & van de Vijver, 2012).

2.5.4 Effects of Formal Education on Neuropsychological Test Performance

Most neurocognitive test designs are based on school-related skills. Education, therefore, influences an individual's performance in these tests in that the school environment exposes people to skills and abilities that are sampled by these tests. Formal education also improves the type of knowledge assessed in neurocognitive tests, for example, categorisation, problem-solving, application and generalisation of concepts. Studies show that the level and quality of education affects an individual's cognitive abilities. Therefore, education should be accounted for in evaluating neurocognitive tests (Ardilla et al., 2017; Cockroft et al., 2015; Heaton et al., 1996).

2.5.5 Effects of Age on Neurocognitive Test Performance

Age is one of the variables that contribute significantly to cognitive performance. A systematic review of 19 studies revealed that there is almost a universal decline of cognitive performance associated with an increase in age (Verhaeghen & Cerella et al., 2002; Park et al., 2003). The age-related decline in performance on psychological tests was also illustrated in all versions of the widely used Weschler Adult Intelligence Scale (WISC; Weschler, 1997). It was demonstrated that there is a significant decline in performance, especially on non-verbal subtests, from the mid-thirties onwards (Heaton et al., 1996). These findings highlight the importance of creating age-stratified normative data on which patient scores are compared accordingly to improve the utility of the test (Schneider et al., 2015).

2.5.6 Effects of Language in Neuropsychological Assessments

Language plays an important role in comprehension and expression in psychological tests. Tests are usually developed in English, making them inaccessible to people who cannot speak this language or those who use English as a second language. It is critical to adapt and translate tests to suit the target population.

2.5.7 Effects of Exposure to Test Taking in Neuropsychological Assessments

There is evidence that individuals in some cultures are exposed to test-taking from an early age, for example, Americans, while in some cultures, especially in developing countries, participants may be test-naïve (Heaton et al., 1996; Nell, 1999). Research has shown that some aspects of test-taking, such as the pressure for fast-paced performance, can be anxiety-provoking. This problem may be due to cultural differences in the perception of time, poor test-taking skills, low motivation and effort (Ardila et al., 2017). Besides, previous exposure to cognitively stimulating experiences has been shown to influence performance. Yang et al. (2012) compared the cognitive performance of men and women in a rural Chinese sample, in which male participants were more exposed to cognitive stimulation from their diverse work experiences outside the homes. The findings of this study indicated that the men performed significantly better than their female counterparts who were confined and less exposed to stimulation due to being in the home environment (Yang et al., 2012).

2.5.8 Impact of Socioeconomic Status on Neuropsychological Test Performance

There is strong evidence that shows that socio-economic status is an important predictor of performance on neurocognitive tests. One's socio-economic status has a complex and indirect relationship with other factors that also affect cognitive performance. For instance, socioeconomic status is also related to the brain nutrition and development, and level and quality of education a person receives, as well as access to health care (Piccolo et al., 2016; Heaton et al., 1996). Generally, individuals from low socio-economic backgrounds score relatively lower on the majority of neurocognitive tests compared to those from higher socio-economic backgrounds. Neurocognitive tests should consider one's background and ensure that the tests are culturally appropriate.

2.5.9 Gender Differences in Neuropsychological Performance

Generally, no gender differences have been found between males and females on most neurocognitive tests. However, gender differences have been noted on some subtests. For instance, females tend to perform better on verbal and memory skills while men tend to function relatively better on tests that tap on quantitative skills, physical strength and motor speed, for example, the Hand Dynamometer and Finger Tapping test (Díaz-Morales & Escribano 2015; Heaton et al., 1996). Likewise, consideration should be made to account for those differences.

2.5.10 Influence of Test Characteristics on Examinees Performance

Some characteristics of the test, such as unfamiliarity with test material, may negatively influence test performance. In a study by Serpell (1979), British and Zambian children were tasked with reproducing a model of a car using wire, pencil and paper and plasticine. Zambian children had experience making wire toys and did better on the wire figures, whereas British children performed better using pen and paper because of their familiarity with drawing. Both groups did equally well when using plasticine because neither of the groups had previous exposure to this medium (Serpell, 1979).

A study by Cockroft et al. (2015) compared the performance of predominantly white UK university students to that of a group of black South African (SA) university students from a diverse background, on various cognitive performances. The results indicated that the UK-based students performed better than the SA group on subtests that tapped into acquired knowledge. The SA group performed better than the UK group on subtests tapping into processing information. However, there was no significant difference in tests that were not language loaded (Cockroft et al., 2015).

Studies show that norms developed on English-speaking individuals are not always appropriate for use in populations where English is not the first language. Reduced performance may be attributed to high cultural loading on the tests, whereby individuals are assessed against the knowledge of foreign concepts rather than the cognitive domain being investigated (Dudley et al., 2014; Ardila et al., 2017; Yang et al., 2012).

There are various ways to address the effects of cross-cultural loading on psychological tests. These solutions include abandoning psychometric tests in other settings and confining cognitive tests only to the western societies where they were developed or, alternatively, using qualitative methods in other settings. Other researchers have suggested integrating cultural values in already developed tests or developing entirely new tests that are culturally and ecologically appropriate (Woodford & George, 2007). However, the implementation of this proposal is compounded by the high costs and complexity of test development, as well as the unavailability of expert personnel to administer the tests.

A seemingly more feasible and practical suggestion to the problem of cross-cultural loading on psychological tests is to obtain culturally appropriate normative data on the already established tests, namely having separate norms for different groups (Meiring et al., 2005; Matsumoto & Hwang, 2013; Byrne, 2016). Additionally, the adaptation and norming of tests will facilitate the cross-cultural comparison of test results and inform future research (Byrne, 2016). Test adaptation comprises analysing stimuli and establishing culturally-appropriate stimuli that maintain the integrity of the construct intended to be tested by the original test. Test adaptation aims to make a test that was developed on a different population, suitable for a different target population by minimising cross-cultural bias as much as possible (He & van de Vijver, 2012).

Screening for cognitive deficits post-stroke is essential, but the value of this screening is hinged upon the robustness of the screening instruments used. Such instruments need to have excellent psychometric properties such as the validity, reliability, responsiveness and interpretability of the instrument. Reliability assesses the level of freedom from error of the instrument. It refers to how much an instrument can give similar scores if administered elsewhere, under similar conditions. Test validity refers to whether an instrument measures the construct that it is intended to measure. Responsiveness evaluates the ability of an instrument to assess the slightest change in performance over time. Interpretability refers to the ease of administration and interpretation of the instrument (Tax et al., 2017). Furthermore, for all these psychometric aspects to be meaningful, they have to be evaluated in a population as close as possible to the target population sample. Also, the instruments should be sensitive to the domains that are affected by the condition in question.

Many instruments have been developed and validated to assess cognitive deficits in stroke patients. However, there has not been a comprehensive evaluation of the psychometric testing tools used in low- and middle-income countries to consolidate the collected data. To select an instrument that addresses the cultural issues mentioned above, we conducted a systematic review of the instruments used to assess neurocognitive deficits, specifically in stroke patients in low- and middle-income countries. Chapter 3 gives a detailed description of the systematic review.

Chapter 3: A Systematic Review of Neurocognitive Tools Used in Low and Middle-Income Countries

Abstract

Screening for cognitive deficits following acquired brain injury is essential for treatment and rehabilitation. However, there is a lack of the knowledge of neurocognitive instruments used on stroke patients, and their psychometric properties, in low- and middle-income countries. Our objectives for this study were two-fold: 1) to identify the neurocognitive instruments that have been used on stroke patients in low-and middle-income countries and 2) to select an ideal neurocognitive battery for validation in Zimbabwe. We conducted a systematic review searching five electronic databases (PubMed; PsycINFO; CINAHL; Web of Science and EbscoHost). We retrieved 1 290 studies and included 55 after applying the exclusion criteria. We identified 83 neurocognitive instruments that were used on 36 243 stroke patients from 1999 to 2018. The mean age of the participants was 61.1 years and the mean years of education of the sampled population were 9.3. Our findings indicated that the most frequently used cognitive screening tests are the Mini-Mental Status Examination which was used in 35/83 studies (42%) and the Montreal Cognitive Assessment in 12/83 studies (16%). All other instruments (56/83) were used only in one study each. We identified nine comprehensive neurocognitive batteries of excellent psychometric properties, of which the Birmingham Cognitive Screen is the only cognitive battery which was developed for post-stroke cognitive deficits. Of the retrieved studies, no study documented the development of a neurocognitive screen in many low- and middle-income countries. These findings are consistent with two previously systematic reviews. The findings of this review highlight the fact that there is limited use of cognitive instruments in low- and middle-income countries. Ultimately, based on our findings, we concluded that more work needs to be dedicated to training people to develop, translate, adapt, validate and use neurocognitive instruments in low- and middle-income countries.

Keywords: neurocognitive tests, systematic review, test battery, psychometric properties, stroke

3.1 Background

Though many instruments have been developed and validated to assess cognitive deficits in stroke patients, routine screening is not sufficiently performed in low- and middle-income countries as is done in high income countries (Pendlebury et al., 2015). The lack of a comprehensive evaluation of the tools used in these countries, together with the consolidation of this data, limits the researchers' understanding of why this deficit exists. Consolidation of such data is usually achieved through a systematic review. Systematic reviews gather and synthesize scientific evidence from multiple studies, using specific strategies that reduce bias (Surawan et al., 2017; Schlosser & Ralf, 2006). A systematic review helps in documenting available knowledge and identifying knowledge gaps, both of which are critical in making informed clinical decisions (Sauerland & Seiler, 2005).

An earlier systematic review evaluated the clinical utility and psychometric properties of instruments that are used to assess cognitive impairments due to stroke. This study identified 12 tools used to assess post-stroke cognitive impairments. However, most of these instruments were not developed specifically to assess post-stroke cognitive impairment (Burton & Tyson, 2015). A more recent systematic review evaluating the psychometric properties of instruments used for cognitive screening in patients with cerebrovascular diseases identified seven neurocognitive screens that were developed to evaluate cognitive deficits in stroke patients (Rodrigues et al., 2019). Of these seven screens, one instrument, the Birmingham Cognitive

Screen (Humphreys et al., 2012) was originally developed for stroke patients. In both systematic reviews, most of the tools used generic outcomes to assess global cognitive impairment and did not succinctly sample the most salient domains that characterize post-stroke sequelae. Considering the high rate of post-stroke cognitive impairment of 45-80% (Jokinen et al., 2015) and the high costs of neurocognitive tests, the careful selection of a robust tool for assessing post-stroke sequelae is essential for low- and middle-income countries.

To our knowledge, no review has been conducted to consolidate information on tools that assess post-stroke cognitive deficits or their psychometric properties in low- and middle-income countries. Consequently, the objectives of this particular systematic review were to:

1. Identify neurocognitive tests that have been used to assess post-stroke cognitive deficits in low- and middle-income countries.
2. Evaluate psychometric properties of neurocognitive batteries to select an ideal neurocognitive battery for norming and validating post-stroke sequelae in Zimbabwe.

3.2 Methods

3.2.1 Protocol and Registration

We conducted and reported the systematic review according to the Preferred Items Reporting for Systematic Review (PRISMA) Guidelines (Mokkink et al., 2018). The review protocol was registered on the International Prospective Register of Systematic Reviews (PROSPERO) database, registration number CRD42018068590.

3.2.2 Eligibility Criteria for Studies

We included all studies that have reported on neurocognitive assessments in stroke patients from the date of inception of each database to the search date. Studies were included if they satisfied the following criteria: (1) used a neurocognitive tool in their protocol, or described the development, adaptation, norming or psychometric properties of a neurocognitive tool, (2) included adult stroke patients ages 18 years or older (however, studies were also included if they had both patients with stroke and another brain injury if data regarding strokes was presented separately), (3) were conducted in a low- and middle-income countries according to the World Bank Country and Lending Groups' criteria, (World Bank Country & Lending Groups, 2017), (4) were written in English and published in a peer-reviewed journal. We excluded articles with abstracts only, and conference papers and reports because we were unable to follow up on these texts.

3.2.3 Data Sources and Searches

We searched five electronic bibliographic databases: PubMed, Web of Science, PsycINFO, CINAHL and Ebsco Host from 1999 to 2018. The search period was limited to studies within twenty years to include relatively recent studies that potentially utilize the gains that have been made due to advances in research and technology (Miller et al., 2017). Additional articles were obtained through backward and forward searches of the bibliographies of included studies. We identified search terms through previous systematic reviews on similar topics and a brainstorming session with a panel of experts, experienced in conducting systematic reviews and working clinically with stroke patients. These experts included Clinical and Research Psychologists, Occupational Therapists, Nurses and a Rehabilitation Technician. Controlled vocabulary words were adapted for each database. The search terms were peer-reviewed before searching.

3.2.4 Search Terms

The following key search terms were used: tool, stroke patient, neurocognitive, psychometric and low- and middle-income countries (see Table 3.1 for the detailed search strategy which was applied for the PubMed database).

Table 3.1
Search Strategy

Keyword	Alternative words
Tool	tool* OR assessment* OR screen* OR instrument OR measure* OR test OR questionnaire OR scale
Stroke patient	(Ischaemic infarction) OR (ischemic infarction) OR (cerebral infarction) OR (haemorrhagic stroke) OR (hemorrhagic stroke) OR (intracerebral hemorrhage) OR (intracerebral hemorrhage) OR stroke OR (cerebrovascular accident) OR (cerebral vascular event) OR (transient ischaemic attack) OR transient ischemic attack) OR tia OR (stroke survivor) OR (stroke patient*)
Neurocognitive	Neurocogniti* OR cognitive OR cognition
Psychometric	validate* OR adapt* OR evaluate* OR psychometric*
Low-income countries	Low-income countries OR Afghanistan OR Benin OR "Burkina Faso" OR Burundi OR "Central African Republic" OR Chad OR Comoros OR Congo OR Eritrea OR Ethiopia OR Gambia OR Guinea OR "Guinea-Bissau" OR Haiti OR "North Korea" OR "Democratic People's Republic of Korea" OR Liberia OR Madagascar OR Malawi OR Mali OR Mozambique OR Nepal OR Niger OR Rwanda OR Senegal OR "Sierra Leone" OR Somalia OR "South Sudan" OR Tanzania OR Togo OR Uganda OR Zimbabwe
NOT	child or CVA OR Europe OR adolescent OR adolescence OR USA OR Australia OR (New Zealand) OR (Continental Europe) OR Ireland OR UK OR children OR animal OR Canada OR (United States of America) OR rat OR mice OR (United Kingdom) OR (systematic review) OR meta-analysis OR (meta-analysis)

3.2.5 Study Selection

The principal investigator first removed duplicate studies. Two reviewers then independently screened the titles, abstracts and full texts for inclusion, while reconciling differences through discussion at each step. An adjudicator was then consulted to mediate on disputed articles. To answer the first part of the research question, we initially identified all the tools used to assess cognitive impairment in stroke patients and the cognitive domains these tools assessed. We then conducted a 'risk of bias' assessment on neurocognitive batteries that were validated on stroke patients. This practice was conducted to evaluate the measurement properties that the tools assess and to determine the methodological quality of the studies, based on the Cochrane checklist (Higgins & Green, 2011).

3.2.6 Data Extraction from Selected Studies

The Principal Investigator developed a data extraction codebook based on the Cochrane checklist and past systematic review papers (Higgins & Green, 2011; Burton & Tyson, 2015) (see Appendix A for the data extraction codebook). Two reviewers used the data extraction template to independently extract the following data and then met to synchronize their findings on the name of the instrument, country, sample characteristics (size, ages and gender), type of research, (study design/setting) cognitive domains assessed, duration of the test, duration of the post-stroke assessment, type of test and screen/battery. For this review, we adopted the definition from a previous study, whereby a battery shall refer to a constitution of cognitive tasks assessing at least three cognitive domains (Rodrigues et al., 2019). An adjudicator reconciled any differences that arose between members of the research team.

3.2.7 Data Items

For this systematic review, our primary outcome measure was the cognitive performance as assessed by neuropsychological tests. We considered the following psychometric properties: structural, internal, criterion and cross-cultural validity, reliability and responsiveness.

3.2.8 Risk of Bias Assessment

To assess the quality of neuropsychological tests used in the validated neurocognitive batteries, we used the Consensus-based Standard for the Selection of Health Measurement Instruments (COSMIN) checklist for risk of bias for assessing the methodological quality of the individual studies (Mokkink et al., 2017). The COSMIN checklist assesses the development of the outcome measures, content, structural, criterion, cross-cultural validity, as well as hypothesis testing, internal consistency, reliability and responsiveness (Mokkink et al., 2017).

The quality of each of these properties is assessed on a four-point scale rated as 'very good', 'adequate', 'doubtful' and 'inadequate'. These assessment criteria are critical to avoid selecting tools that were developed with inadequate rigour (Mokkink et al., 2017).

3.2.9 Assessment of Psychometric Properties of Stroke Tools

We assessed the psychometric properties of the validated neurocognitive batteries using the COSMIN methodology for systematic reviews of patient-reported outcome measures (PROMs) (Prinsen et al., 2018). This is a standardized tool that gives quality ratings of psychometric properties across nine domains (internal consistency, measurement error, reliability, content and face validity, construct validity, cross-cultural issues and hypothesis testing). The quality ratings of each measurement property are given as sufficient (+), insufficient (-) or indeterminable (?). Ideally, a tool should have positive ratings (Mokkink et al., 2017).

3.2.10 Best Evidence Synthesis

To ascertain the quality of the evidence for a tool, the methodological ratings and the quality of the psychometric properties were consolidated across studies for a particular tool. The rating scale used was 'high', 'moderate', 'low', 'very low' and 'unknown' (Prinsen et al., 2016).

3.3 Results

3.3.1 Database Search Results

Our search yielded 1 290 articles. After combining the searches, 229 duplicates were removed, 602 were excluded because they did not report on cognition, 327 were not related to post-stroke sequelae, 32 were not from low- and middle-income countries, 4 included children, and 27 were systematic reviews. Two studies were identified from hand searches; Chen et al. (2018) and Zuo et al. (2016). Sixteen studies were further excluded because they did not report on neurocognition, leaving 55 articles for full review and data extraction. Refer to Figure 3.1 for a summary of the retrieved studies.

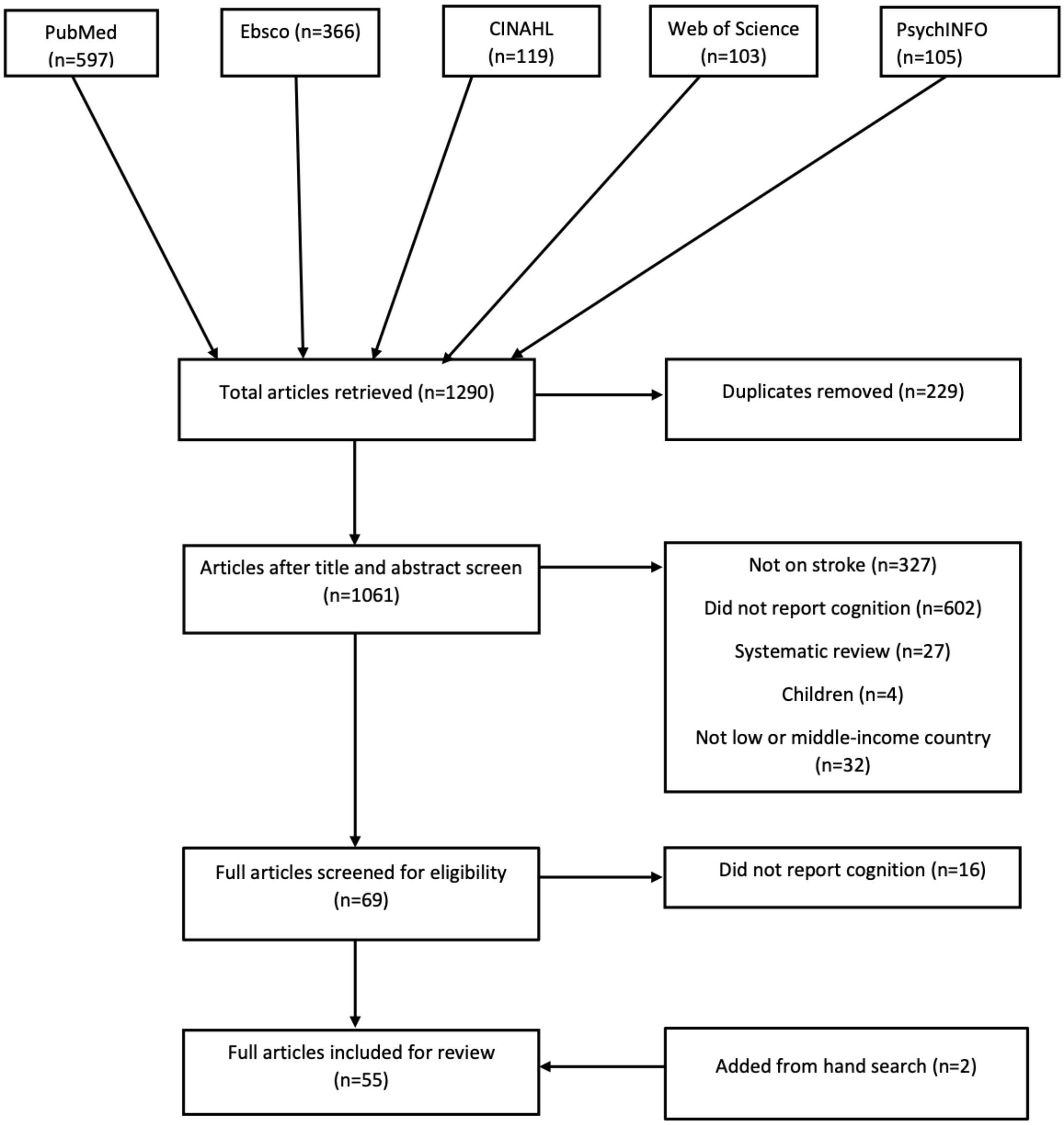

Figure 3.1. *Flow chart of the search process*

Characteristics of Retrieved Studies

3.3.2 Geographical Location of Selected Studies

Most of the reviewed studies – 25/55 (46%) were conducted in Asia, while 19/55 (35%) were conducted in Africa and 10/55 (18%) in South America and one in Europe. Half of the African studies were conducted in Nigeria, with only one study undertaken in Southern Africa, while in Asia most of the studies were performed in China and all but one of the studies executed in South America are from Brazil.

3.3.3 Types of Study Designs and Settings

About half of the studies – 28/55 (51%) involved Cross-sectional Survey Research designs. The other 20/55 (36%) studies were equally split between Prospective/Retrospective Cohort and Case-Control study designs. There were only three Randomized Control studies and three experimental/quasi-experimental ones. About 66% of all these studies were conducted with hospital patients, 18% were community surveys, while 11% recruited participants from both clinical and community settings. However, the rest of the studies (6%) did not report on the type of study design used (Elhan et al., 2005). Refer to Table 3.2 below for a detailed description of the studies.

3.3.4 Study Objectives

Only 11 (33%) of the studies included adaptation, translation and validation of tests (see Table 3.2 below). Seven of these validation studies were executed in China and the rest in Brazil, Turkey, Egypt and Malaysia (Carlesso et al., 2015; Chen et al., 2018; El-ella et al., 2013; Elhan et al., 2005; Gao et al., 2014; Pan et al., 2015; Sahathevan et al., 2018; Shen et al., 2016; Zuo et al., 2016). The validation studies included three comprehensive and domain-specific batteries, that is, the Chinese version of the Neuropsychiatry Unit Cognitive Assessment Tool (NUCOG) (Gao et al., 2014), the Birmingham Cognitive Screen, the National

Institute of Neurological Disorders and Stroke & Canadian Stroke Network (NINDS-CSN) Protocol (Hachinski et al., 2006).

The other five assessments were brief screens: the Montreal-Toulouse Language Assessment Battery – Brazilian version (Fonseca et al., 2008), the Arabic version of the Comprehensive Aphasia Test (Abou El-Ella et al., 2013), Six-Item-Screener, 5-minute NINDS-CNS test (Hachinski et al., 2006), Montreal Cognitive Assessment test (MOCA; Nasreddine et al., 2005) and the Mini-Mental Status Examination (MMSE; Folstein et al., 1975). The MOCA and MMSE tests were validated in three studies and the MMSE in two. The objectives of the majority of the studies were to evaluate the association of cognitive impairment on various conditions associated with a stroke, such as depression, ADLs, rehabilitation, risk factors, demographic features and quality of life (see Table 3.2 below).

Table 3.2

Description of Selected Studies

Author (Year)	Name of Tool	Study Design	Summary of Study Objectives
Akbari et al. (2013)	National Institute of Health Stroke Scale (NIHSS)	Cross-sectional study	Impact of cognitive impairment on ADLs
Carod et al. (2009a)	National Institute of Health Scale (NIHSS) Mini-Mental Status Examination (MMSE)	Cross-sectional	Prevalence of post-stroke depression and associated factors in Brazil
Chaiyawat and Kulkantrakom (2012)	National Institute of Health Scale (NIHSS)	Randomised Control Trial	Impact of rehabilitation on ADLs, depression and dementia
Akinyemi et al. (2013)	Community Screening Instrument for Dementia (CSI-D) protocol Mini-Mental State Examination (MMSE)	Case-control	Risk factors for post-stroke cognitive impairment in Nigeria
Akinyemi et al. (2015)	Vascular Neuropsychological Battery (V-NB)	Cross-sectional convenience sampling	Neuroimaging correlates of vascular cognitive impairment in Nigeria
Azad et al. (2017)	Mini-Mental State Examination (MMSE)	Methodological study	Validity and reliability of the Persian Katz Index in Iranian patients with acute stroke

Carod et al. (2009a)	Mini-Mental State Examination (MMSE)	Cross-sectional	Prevalence of post-stroke depression and associated factors in Brazil
Carod et al. (2009b)	Mini-Mental State Examination (MMSE)	Cross-sectional	Determine the health-related quality of life on stroke survivors
Chaiyawat and Kulkantrakorn (2012)	Mini-Mental State Examination (MMSE) Thai Version	Randomised Control Trial	Impact of rehabilitation on ADLs, depression and dementia
Bindawas et al. 2018	Functional Independence Measure (FIM)	Retrospective Cohort Study	Associations between the length of stay and functional outcomes among patients with stroke in Saudi Arabia
Bonini and Radanovic (2015)	Aphasia Examination (BDAE) Gesture Praxis Protocol (BDAE) Trail Making Test (TMT A and B) Consortium to Establish a Registry for Alzheimer's Disease Neuropsychological Battery (CERAD-NB)	Matched Cases Study	Comparison of performance of aphasic patients in cognitive tasks correlation with aphasia severity and post-stroke period
Cardoso et al. (2015)	Trail Making Test (TMT A and B)	Cross-sectional	The relationship between effective decision and "cold" executive components in patients with ischemic strokes
Campanholo et al. (2015)	Trail Making Test (TMT), Victoria version of the Stroop Test, Card 3 (Stroop Card 3), Symbol Digit Modalities Test (SDMT), Phonemic Verbal Fluency Task, Category Fluency Test (animals), Modified Wisconsin Card Sorting Test (MWCST), Wechsler Adult Intelligence Scale-Digit Span, Hopkins Verbal Learning Test-Revised (HVLT-R), Brief Visuospatial Memory Test-Revised (BVMT-R), Boston Naming Test (BNT), Visual Object and Space Perception Battery: Fragmented Letters and Position Discrimination	Matched pairs	Compare the cognitive statuses of patients with basilar artery occlusion disease
Cardoso et al. (2015)	Iowa Gambling Task (IGT) – computerised version Modified Wisconsin Card Sorting Task (M-WCST) Hayling Test Brief Neuropsychological Assessment Battery (NEUPSILIN) – Brazilian	Cross-Sectional	The relationship between effective decision and "cold" executive components in patients with ischemic strokes

Chen et al. (2015a)	Montreal Cognitive Assessment (MoCA) National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN) Neuropsychological Battery Mini-Mental State Examination (MMSE	Cross-sectional	Feasibility and validity of the telephone-based 5-minute NINDS-CSN protocol and SIS.
Chen et al. (2015b)	30-Minute National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN) Protocol 5-Minute National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN) Protocol 60-Minute National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN) Protocol Mini-Mental Status Examination (MMSE)	Case-control Study	Validity and reliability of the adapted Chinese versions of NINDS-CSN Neuropsychological Battery in Chinese stroke patients
Custodio et al. (2017)	Rey Auditory Verbal Learning Test (RAVLT) Clinical Dementia Rating (CDR) Addenbrooke's Cognitive Examination (ACE) Instituto de Neurología Cognitiva (INECO) Frontal Screening (IFS) Wechsler Memory Scale-Revised (WMS-R) Logical Memory subtest Trail Making (TMT) A & B Rey-Osterrieth Complex Figure Test (RCFT) Boston Naming Test (BNT) Wisconsin Card Sorting Test (WCST) Wechsler Adult Intelligence Scale III (WAIS-III) Logical Memory Letter Number and Cubes Test Copy of drawing	Prospective Cohort	Evolution of cognitive performance in patients with vascular cognitive impairment
Das et al. (2013)	Mini-Mental State Examination – Bengali version (BMSE) Kolkata Cognitive Screening Battery (KCSB) Clinical Dementia Rating (CDR)	Community-based Prospective Study	Prevalence of psMCI and psDem in an urban community cohort of stroke survivors (SS) in India

de Oliveira et al. (2015)	Mini-Mental State Examination (MMSE) Bells Test Montreal Communication Evaluation Battery – brief version (Brief MAC Battery)	Cross-Sectional, Quasi-Experimental and Comparative Between-Subjects	Communicative processing in adults with unilateral right hemisphere stroke
Abou El-Ella et al. (2013)	The Comprehensive Aphasia Test (CAT)	Case-control	Modification and standardisation of the Arabic version of the Comprehensive Aphasia Test
El-Han et al. (2005)	Mini-Mental State Examination (MMSE)	Cross-sectional	Psychometric properties of Mini-Mental State Examination (MMSE) in patients with acquired brain injury in Turkey
Ersoz et al. (2017)	Mini-Mental State Examination (MMSE)	Cross-Sectional	To compare the physical activity (PA) level between ambulatory stroke patients and a population of the same age. To investigate neuropsychological factors that could affect the PS level in the same group.
Farhana et al. (2015)	Montreal Cognitive Assessment-Indonesian version (MoCA-Ina)	Quasi-Experimental	Impact of gotukola (Centellaasiatica) and folic acid on patients with vascular cognitive impairment
Fatoye et al. (2009)	Mini-Mental State Examination –modified Mini-Mental State Examination (mMMSE)		Prevalence of post-stroke depression (PSD) and other associated factors.
Ferreira et al. (2015)	Weschler Adult Intelligence Scale (WAIS-III) Similarities Numbers	Cross-Sectional Design	Cognitive outcome of stroke outpatients
Ferreira et al. (2015)	Rey-Ossterieth Complex Figure Test (RCFT) Cancellation Task Semantic Verbal Fluency Test Boston Naming Test (BNT) Modified Wisconsin Card Sorting Test (M-WCST) Clock Drawing Test (CDT) Stroop Test Controlled Word Association Test (COWA) Phonemic Verbal Fluency Trail Making Test (TMT)	Cross-Sectional Design	Cognitive outcome of stroke outpatients

	Rey Auditory Verbal Learning Test (RAVLT) Weschler Token Test Memory Scale (WMS-III) Mental Control		
Gao et al. (2013)	Neuropsychiatry Unit Cognitive Assessment Tool (NUCOG) – Chinese version		Validation of translated NUCOG in Chinese patients with epilepsy, non-dementia neurological disease, and dementia.
Gao et al. (2013)	Mini-Mental State Examination (MMSE)		Validation of translated NUCOG in Chinese patients with epilepsy, non-dementia neurological disease, and dementia.
Gao et al. (2017)	Functional Independence Measure (FIM)	Single-Blind Randomised Control Trial	Effectiveness of treatments for post-ischemic stroke depression
Ghousal et al. (2014)	Mini-Mental State Examination – Bengali version (BMSE)	Community-based Prospective Study	Timeline and local factors associated with stroke outcome
Heikinheimo et al. (2015)	Newcastle Stroke-specific Quality of Life Measure (NEWSQOL)	Interview-based Cohort Study	QOL more than six months after the first-ever stroke in Malawi.
Holderbaum et al. (2016)	Boston Diagnostic Aphasia Examination – (BDAE) short version Token Test Pyramids and Palm Trees Brief Neuropsycholinguistic Evaluation for Expressive Aphasics – (NEUPSILIN-AF)	Case Series Study	Heterogeneity in semantic priming effect with a lexical decision task in patients after left hemisphere stroke
Howitt et al. (2011)	Community Screening Instrument for Dementia (CSI-D) protocol	Community-based Cohort Study	Quality of life in a community-based cohort of stroke survivors in rural northern Tanzania
Hua et al. (2014)	Mattis Dementia Rating Scale (MDRS) – Chinese version	Cross-sectional	Association of infarct location with post-stroke executive dysfunction
Jiang et al. (2013)	Montreal Cognitive Assessment (MoCA)	Case-control	Sleep quality and polysomnographic sleep structure features in patients with vascular cognitive impairment-no dementia
Jiang et al. (2014)	Montreal Cognitive Assessment (MoCA) Mini-Mental State Examination (MMSE)	Case-control	Effects of differences in serum total homocysteine, folate, and vitamin B12 on cognitive impairment in stroke patients

Kongkasuwan et al. (2015)	The Abbreviated Mental Test (AMT) Thai Quality of Life questionnaire - pictorial	Single-blind Randomised Controlled Trial	Efficacy of creative art therapy plus conventional physical therapy, compared with physical therapy only, in increasing cognitive ability, physical functions, psychological status and quality of life of stroke patients
Kumral et al. (1999)	Turkish Aphasia Test Mini-Mental State Examination (MMSE) - Turkish version Rey Auditory Verbal Learning Test (RAVLT) Benton Visual Retention Test (BVRT)	Cross-sectional	Demographic features, risk factors, clinical profiles, and behavioural abnormalities in patients with a caudate lesion, either with infarct or with haemorrhage involving the caudate nucleus.
Kumral et al. (2015)	Rey Auditory Verbal Learning Test (RAVLT) – Turkish Version Benton Visual Retention Test (BVRT) Rivermead Behavioural Test-II (RBMT-II) Location Learning Test (LTT) Serial Reaction Time Task (SRTT)	Cross-sectional	Clinical, anatomical, aetiological, and radiological features of isolated hippocampal infarcts by using MRI and neuropsychological evaluation
Kumral & Zirek (2016)	Mini-Mental State Examination Rey Auditory Verbal Learning Test (RAVLT) Wechsler Memory Scale-revised Rivermead Behavioural Test-III Location Learning Test (LTT-version A)	Cross-sectional	Correlation of neuropsychological and neurobiological findings of patients with acute isolated hippocampal ischemic lesions which can cause a specific clinical pattern of major cognitive disorder (MND)
Liu et al., (2014)	Montreal Cognitive Assessment (MoCA)		Functional alteration patterns of the default-mode network (DMN), its underlying mechanisms, and its functional implications in subcortical stroke patients
Mehrabi et al. (2015)	Mini-Mental State Examination (MMSE) Consortium to Establish a Registry for Alzheimer's Disease (CERAD) Neuropsychological Battery Trail Making Test (TMT) Isaacs Set Test (IST)	Prospective, Hospital-based Study	Neuropsychological and neuroimaging markers in prediction of cognitive impairment after ischemic stroke: a prospective follow-up study
Ojagbemi & Owolabi, (2013)	Mini-Mental State Examination (MMSE) – modified Token Test		Predictors of functional dependency after stroke

Ojagbemi et al. (2017)	Mini-Mental State Examination (MMSE) 10 Words List Learning and Delayed Recall Tests (10 WDRT) Animal Naming Test (ANT)	Longitudinal Observation	Prevalence, associated factors and 3-month outcome of delirium occurring within one week after a stroke.
Pagiarian et al. (2014)	Montreal-Toulouse Language Assessment Battery – Brazilian version (MTL-BR) Mini-Mental State Examination (MMSE)		Criterion-related validity of the Montreal-Toulouse Language Assessment Battery – Brazilian version
Pan et al. (2015)	Birmingham Cognitive Screen (BCoS) – Cantonese Montreal Cognitive Assessment (MoCA) Mini-Mental State Examination (MMSE) Albert's Cancellation Test Rey-Osterrieth Complex Figure Test (RCFT) Gesture Institution Tasks (Goldenberg)	Cross-Sectional	Reliability and validity of a Cantonese version of BCoS in patients with acute ischemic stroke.
Qu et al. 2014	Montreal Cognitive Assessment (MoCA) Mini-Mental State Examination (MMSE)	Community-based Cross-Sectional Study	Prevalence of post-stroke cognitive impairment in stroke survivors residing in rural and urban Chinese communities
Sahathevan et al. 2014	Montreal Cognitive Assessment (MoCA) – Bahasa Malaysia version	Validation Study	Development and validation of a Bahasa Malaysia version of the MoCA in a stroke population
Sarfo et al. (2017)	Montreal Cognitive Assessment (MoCA) Vascular Neuropsychological Battery (V-NB) – 60-minute protocol	Cross-Sectional Study	Determinants, and effects of vascular cognitive impairment on health-related quality of life in sub-Saharan Africa
Shen et al. (2016)	Montreal Cognitive Assessment (MoCA) – Chinese version Mini-Mental State Examination (MMSE) – Chinese version National Institute of Health Stroke Scale (NIHSS)	Cross-Sectional	Effectiveness of the MMSE and MoCA in screening cognitive impairments
Shi et al. (2015)	Mini-Mental State Examination (MMSE)	Cross-Sectional	Prevalence and predictors of post-stroke depression (PSD) in patients with minor ischaemic stroke
Sobreiri et al. 2014	Wechsler Adult Intelligence Scale-Revised (WAIS-R) – Brazilian version Digit Span Task The Verbal Fluency Test Victoria Stroop Test – Brazilian version	Cross-Sectional	Executive function and depressive symptoms of retardation in nonelderly stroke patients

Song et al. (2014)	Montreal Cognitive Assessment (MoCA) - Beijing version,	Cross-Sectional	Quantitative electroencephalography (qEEG) as a predictive biomarker for the development of cognitive impairment, post–cerebral infarct
Tu et al. 2013	Montreal Cognitive Assessment – Changsha version (MoCA-CS) Mini-Mental State Examination (MMSE) Frontal Assessment Battery – Changsha version (FAB-CS)	Cross-Sectional	Prevalence and effects of vascular cognitive impairment among ischemic stroke patients
Tu et al. 2013	Wechsler Memory Scale – Chinese version (WMS-RC) Logical Memory Clinical Dementia Rating (CDR)	Cross-Sectional	Prevalence and effects of vascular cognitive impairment among ischemic stroke patients
Vincentini et al. (2016)	Mini-Mental State Examination (MMSE) Montreal Cognitive Assessment (MoCA)	Cross-Sectional	Depression and anxiety symptoms are associated with disruption of default mode network in subacute ischemic stroke
Yang et al. (2017)	Mini-Mental State Examination (MMSE)	Prospective Cohort Study	Prevalence of post-stroke suicidal ideation and the associated risk factors in China
Zhou and Jia (2009)	Mini-Mental State Examination (MMSE) Wechsler Adult Intelligence Test (WAIS-RC) World Health Organisation-University of California-Los Angeles Auditory Verbal Learning Test (WHO-UCLA AVLT) Rey-Osterrieth Complex Figure (RCFT) Stroop Test – modified short form Semantic Category Verbal Fluency Test California Card Sorting Test (CCST) Clock Drawing Test (CDT)	Prospective Cohort Study	Cognitive impairment for patients with vascular cognitive impairment no dementia

3.3.5 Characteristics of Samples of the Selected Studies.

3.3.5.1 Study Sample Sizes and Participants' Ages. The total sample size of pooled studies was 36 243 stroke patients with the sample sizes of individual studies ranging from 17 - 9 522 participants. We noted, however, that 12 (22%) of these studies had small sample sizes of less than 50 participants. The minimum age of participants was 18 years, and the mean age was 61.1 years (see Table 3.3 below).

3.3.5.2 Post-Stroke Period. Most of the studies (31/55) were conducted with patients still in the acute phase of their index stroke, ranging from 3 hours to within three months post-stroke period. Follow up period for cohort studies ranged from 6 weeks to 5 years. It was difficult to determine the mean post-stroke period because of variations in reporting styles (see Table 3.3).

3.3.5.3 Level of Education of Participants. More than half the studies, 32/55 (58%) did not report education levels. For some of the studies, level of education was part of the inclusion criteria, described in different ways, such as a minimum of elementary school, literacy or one/two years of schooling (Bonini Radanovic, 2015; Cardoso et al., 2015; Ojagbemi & Owolabi, 2017). Several studies recruited participants with no education at all. The mean education level pooled for those that reported was 9.3 years of education (see Table 3.3).

Table 3.3
Sample Characteristics of the Selected Studies

Author	Who administered	Minimum education	Condition	Age	Sample size	Setting	Post Stroke Period
Abou El-Ella et al. (2013)	Not specified	1	Stroke	50.5	150	Hospital	6 months aphasia
Akbari et al. (2013)	Occupational Therapist- trained	Below 8	Stroke	51.7	27	Hospitals, Clinics, Community	1-6 months
Akinyemi et al. (2014)	Trained interviewers	None	Stroke	60.4	417	Hospital	3 months
Akinyemi et al. (2015)	Trained interviewer	Elementary	Stroke	60.1	143	Community	3 months
Azad et al. (2017)	Experienced rater	Not specified	Stroke	61	87	Hospital	1-30 days
Bindawas et al. (2018)	Not specified	Not reported	Stroke	60	409	Hospital	31-90 days
Bonini and Radanovic (2015)	Speech Therapist	2 years	Stroke	60.5	47	Hospital	> 2 months
Campanholo et al. (2015)	Neurologist	Not specified	Stroke	66.5	28	Hospital, Community	6 months
Cardoso et al. (2015)	Not specified	1 year	Stroke	58.5	99	Hospital	19-23 months
Carod et al. (2009a)	Neurologists and trained interviewers	8 years	Stroke	56.3	300	Hospital	
Carod et al. (2009b)	Trainee Neurologist	Not specified	Stroke	55.9	260	Community	20.7 months
Chaiyawat and Kulkantrakorn (2012)	Not specified	Elementary	Stroke	67	30	Hospital	6 months
Chen et al. (2015a)	Not specified	5 years	Acute Ischaemic stroke	62.9	89	Hospital	3 months
Chen et al. (2015b)	Not specified	Not specified	Ischaemic stroke	62.9	50	Hospital	3 months
Custodio et al. (2017)	Neuropsychologist	4 years	Stroke	69.12	152	Hospital	30 days

Das et al. (2013)	Graduate field workers, Neuropsychologist & Neurologist	Not Specified	Stroke	62.1	281	Hospital	1-5 years
de Oliveira et al. (2015)	Not specified	1 year	Stroke	56.48	100	Hospital	Not reported
El-Han et al. (2005)	Medical Doctors	Not Specified	Stroke	57.9	105	Hospitals, Clinics, Community	152 days
Ersoz et al. (2017)	Neurologist & Occupational Therapists	Not Specified	Stroke	64.7	85	Hospital	>3monthx
Farhana et al. (2015)	Researchers	Not Specified	Stroke	60.27	48	Community	Acute phase
Fatoye et al. (2009)	Consultant Psychiatrist & senior resident doctor	Not specified	Ischaemic stroke	58.4	118	Hospital	1 month- 2 years
Ferreira et al. (2015)	Psychologist, Neurologist, Public Health Specialist	> 3 years	Ischaemic stroke	59.96	45	Hospital	6-10 months
Gao et al. (2013)	Not specified	Not specified	Stroke	33.39	26	Hospital	Not reported
Gao et al. (2017)	Not specified	Not specified	Ischaemic stroke	67.2	274	Hospital, Community	3-6 months 6-9 months
Ghousal et al. (2014)	Field physicians	≥ 4 years	Stroke	64.27	283	Hospital	6 months plus
Heikinheimo et al. (2015)	Not specified	Not specified	Stroke	54	81	Hospital	6-8 weeks/ 6 months/ 12 months
Holderbaum et al. (2016)	Psychologist, Associate Professor	4 years	Stroke	57.9	17	Community	6/ 12 month
Howitt et al. (2011)	Physicians	Not specified	Stroke	67.1	58	Hospital	1-5 years
Hua et al. (2014)	Psychiatric specialist, Psychiatrist & neurologist	Not specified	Stroke	67.4	177	Hospital	7 days
Jiang et al. (2013)	Not specified	Not specified	Stroke	63	48	Hospital	≤ 3 months

Jiang B et al. (2014)	Not specified	Not specified	Stroke	62	80	Hospital	6 months
Jiang X et al. (2014)	Neurologist	Not specified	Stroke	67.2	329	Hospital	2-6 weeks
Kongkasuwan et al. (2015)	Researcher	Primary level	Stroke	56.5	118	Hospital	Not specified
Kumral & Zirek (2016)	Not specified	Not specified	Ischaemic Stroke	73	7200	Hospitals, Clinics, Community	7 days
Kumral et al. (1999)	Not specified	Not specified	Caudate stroke	62	3050	Hospital	7 days
Kumral et al. (2015) June	Not specified	Not specified	Ischaemic Stroke	63	6800	Community	7 days
Kumral et al. (2015) October	Neurologist	Not specified	Stroke	63	9522	Hospital	Not specified-follow-up 5 yrs.
Liu et al. (2014)	Neurologist	6 years	Ischaemic Stroke	55.7	18	Hospital	≥ 6 months
Mehrabi et al. (2015)	Neurologist and Neuropsychologist	Not specified	Ischaemic cerebral stroke	65.6	85	Hospital	3 days
Ojagbemi & Owolabi, (2013)	Psychiatrist	Illiterate	Stroke	59.77	128	Hospital, Community	3 months to 2 years
Ojagbemi et al. (2017)	Neuropsychologist, Neurologist & psychiatrist	1 Year	Ischaemic or haemorrhagic stroke	60.9	101	Hospital	7 days
Pagiarian et al. (2014)	Not specified	Not specified	Ischaemic Unilateral stroke	59.3	104	Hospital	6 months
Pan et al. (2015)	Not specified	≥ 6 years	Ischemic stroke	64.5	98	Community	≤ 2 weeks
Qu et al. (2014)	Neurologist, epidemiologists, physicians, general practitioners and students	Illiterate	Stroke	67.91	599	Hospital	Not clear
Sahathevan et al. (2014)	Researchers	Literacy	Stroke	57.2	40	Hospital	3 months

Sarfo et al. (2017)	Researchers	None	Stroke	59.9	147	Hospital	≥ 3 months
Shen et al. (2016)	Not specified	Elementary	Ischaemic Stroke	68.61	105	Hospital	≤ 2 weeks
Shi et al. (2015)	Not specified	High School	Ischaemic Stroke	61.14	1095	Hospital	≤ 3 weeks
Sobreiri et al. (2014)	Psychiatrist	Not specified	Ischaemic Stroke	50.7	87	Hospital	≤ 2 weeks
Song et al. (2014)	Not specified	Not specified	Cerebral infarcts	73.1	95	Hospitals, Clinics, Community	3-5 hours
Tu et al. (2013)	Not specified	Illiterate	Ischaemic Stroke	68.6	689	Hospital	≥ 3 months
Vincentini et al. (2016)	Psychologist, neuropsychologist	Not specified	Unilateral ischaemic stroke	63.8	34	Community	24 days, 26 days
Yang et al. (2017)	Not specified	High School	Stroke	61.9	1418	Hospital	≤ 14 days. Follow up 1 year
Zhou & Jia (2009)	Neuropsychologist	Elementary	Vascular cognitive impairment	65.85	160	Hospital	3 months
Zou et al. (2016)	Trained Neurologists	Elementary	Ischaemic mild stroke or TIA	53.9	102	Hospital	Within 14 days

3.3.5.4 Frequently used neurocognitive tools. We identified 83 neurocognitive tests that were used in the extracted studies (see Table 3.3 above). The MMSE and MoCA tools had the highest usage, used in 35/83 (42%) and 12/85 (16 %) respectively of all the studies. The next most widely used tests were the NHSS, RAVLT and TMT, used in five studies each. The RCFT was used in four studies. The CDR, Stroop, WAIS subtests and MWCST were used in three studies. The Clock Drawing Test (CDT), Location Learning Test (LLT), NINDS-CSN, Consortium to Establish a Registry for Alzheimer's Disease (CERAD) Neuropsychological Battery, Boston Naming Test (BNT), Benton Visual Retention Test (BVMT-R) and Goldenberg Imitation Test were used in two studies each. The rest of the tests were used only once. The tests were separated to indicate brief cognitive screens and diagnostic neuropsychological test (see Table 3.4 below and Appendix B for the author's list of articles).

Table 3.4

Frequency of Use of Neurocognitive Tools

Name of tool	**Domains assessed by the test**	**No. of domains assessed in study**	**Frequency of use**	**Article**	**Neuropsychological tests**	**Cognitive screening tests**
1. Abbreviated Mental Test (AMT)	Global Cognitive screen for delirium and dementia	Global score	1	33		✓
2. Addenbrooke's Cognitive Examination (ACE)	Attention, memory, verbal fluency, language and visuospatial abilities	5	1	14		✓
3. Albert's Cancellation Test	Visual cancellation	1	1	43	✓	
4. Animal Naming Fluency Test	Executive function/language/memory	1	1	13, 54, 55, 41	✓	
5. Bells Test	Visual neglect	1	1	17	✓	
6. Benton Visual Retention Test (BVMT-R)	Visual memory	1	2	8, 34, 35	✓	

7.	Benton Visual Retention Test (BVRT)	Executive functioning	1	2	34, 35	✓	
8.	Birmingham Cognitive Screen (BCoS) – Cantonese	Memory, orientation, executive function, praxis, number	5	1	43		✓
9.	Boston Diagnostic Aphasia Examination– (BDAE)	Aphasia	1	1	6	✓	
10.	Boston Naming Test (modified BNT)	Visual confrontation, naming ability	2	6	8, 13, 15, 22, 39, 55	✓	
11.	Brief Cognitive Battery (BCB-Edu)	Visual memory	1	1	6	✓	
12.	Brief Neuropsycholinguistic Evaluation for Expressive Aphasics – (NEUPSILIN-AF)	Temporal and spatial orientation, attention, perception, arithmetic abilities, language, memory, praxis and executive functions	7 with praxis	1	27	✓	
13.	Brief Neuropsychological Assessment Battery (NEUPSILIN) – Brazilian	Orientation, attention, visual perception, arithmetic abilities, language, verbal memory, apraxia, and executive functions	7	1	42		✓

14.	Brief Visuospatial Memory Test-Revised	Memory	1	1	8	✓	
15.	California Card Sorting Test (CCST)	Executive function	1	1	54	✓	
16.	Cancellation test	Hemineglect	1	1	22	✓	
17.	Category Fluency Test (animals)	Language/memory/executive function	1	1	8	✓	
18.	Clinical Dementia Rating	Verbal memory-dementia	1	3	14, 15, 51		✓
19.	Clock Drawing Test (CDT)	Executive function, Praxis	Global score	2	22, 54		✓
20.	Community Screening Instrument for Dementia (CSI-D) protocol	Global score: Attention, orientation, calculation, memory, language, praxis, abstract thinking.	Global score-dementia	3	3, 4, 28		✓
21.	Consortium to Establish a Registry for Alzheimer’s Disease (CERAD) Neuropsychological Battery	Memory subtest	5	2	6, 39		✓

22.	Controlled Word Association Test (COWA)	Verbal fluency	1	1	22	✓	
23.	Copy of drawing	Executive function	Global	1	15		✓
24.	Digit Span (forward and backwards)	Attention/auditory memory	2	1	6	✓	
25.	Figure copy-CERAD	Constructional praxis/executive function	2	1	39		✓
26.	Fragmented Letters and Position Discrimination	Visuospatial perception	1	1	8		✓
27.	Frontal Assessment Battery	Executive function	1	1	51		✓
28.	Functional Independence Measure- 5-item cognitive subscale	Language, executive function, memory	Global	3	6, 24		✓
29.	Gesture Imitation Tasks (Goldberg)	Praxis	1	1	43	✓	
30.	Gesture Praxis Protocol (BDAE)	Praxis	1	1	6	✓	
31.	Hayling Test	Executive function	1	1	9	✓	

32.	Hopkins Verbal Learning Test-Revised (HVLT-R)	Learning/memory	1	2	8, 13	✓	
33.	Iowa Gambling Test (IGT)	Executive function	1	1	9	✓	
34.	Isaacs Set Test (IST)	Verbal category/memory	1	1	39	✓	
35.	Kolkata Cognitive Screening Battery (KCSB)	Language, number abilities, memory, visuospatial abilities	Global	2	16, 25		✓
36.	Line Bisection Test	Visuospatial abilities	1	1	34	✓	
37.	Line cancellation Test	Visuospatial abilities	1	1	34	✓	
38.	Location Learning Test (LLT)	Object location memory	1	3	34, 35, 39	✓	
39.	Lowenstein Occupational Therapy Cognitive Assessment thinking process subtests	Hierarchy, classification	1	1	2	✓	
40.	Luria's conflicting tasks	Executive function, hierarchy, category	1	1	34	✓	
41.	Mattis Dementia Rating Scale	Initiation/perseveration	1	1	29		✓

(MDRS) – Chinese version						
42. Mini-Mental State Examination (MMSE)	Orientation, language, memory, calculation, visual construction	5	35	3, 4, 5, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 21, 23, 25, 32, 34, 36, 39, 40, 41, 42, 43, 44, 45, 47, 48, 51, 52, 53, 54, 55		✓
43. Montreal Cognitive Assessment Test (MoCA)	Attention, memory, visuospatial, language, executive function	5	12	13, 14, 20, 30, 31, 38, 43, 44, 45, 47, 50, 51,		✓
44. Montreal Communication Evaluation Battery	Language	1	1	17	✓	
45. Montreal-Toulouse Language Assessment Battery – Brazilian version (MTL-BR)	Language	1	1	40	✓	
46. National Institute of Health Stroke Scale (NIHSS)	Orientation, executive function, language, attention	Global score	5	2, 9, 10, 11, 47		✓
47. National Institute of Neurological Disorders and Stroke and Canadian						✓

Stroke Network (NINDS-CSN) 5 minute						
48. National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN)	Executive/activation, language, visuospatial, and memory	4	2	13, 14,		✓
49. Neuropsychiatry Unit Cognitive Assessment Tool (NUCOG) – Chinese version	Attention, memory, language, executive and visuospatial function	5	1	23		✓
50. Neurosciences (AIREN)	Memory and higher cognitive functions	2	1	36		✓
51. Newcastle Stroke-specific Quality of Life Measure (NEWSQOL)	Cognitive not clear which aspect of cognition	Could not ascertain	1	26		✓
52. Phonemic Verbal Fluency Task	Language	1	1	8	✓	
53. Pyramids and Palm Trees	Memory	1	1	27	✓	

54. Rey Auditory Verbal Learning Test (RAVLT)	Attention, memory	2	7	13, 15, 22, 34, 35, 33, 54	✓	
55. Rey-Osterrieth Complex Figure Test (RCFT)	Visuo-constructional skills and visual memory	1	6	14, 22, 43, 52, 54, 55	✓	
56. Rivermead Behavioural Test-II (RBMT-II)	Memory and executive function	1	2	33, 35	✓	
57. Semantic Category Verbal Fluency Test	Language	1	1	52	✓	
58. Sentence-word span	Executive function	1	1	9	✓	
59. Serial Reaction Time Task (SRTT)	Procedural memory	1	2	35, 39	✓	
60. Six-item-screener	Global	1	1	13		✓
61. Stick Design Test	Visuoconstructive	1	1	46	✓	
62. Stroop Test	Executive function	1	4	23, 34, 49, 54	✓	
63. Symbol Digit Modalities Test	Attention, information processing speed	2	1	8	✓	
64. Ten Words list learning	Memory	1	2	41, 46	✓	

65. Comprehensive Aphasia Test	Language	2	1	1	✓	
66. Token Test	Memory	1	5	13, 15, 22, 27, 40	✓	
67. Trail Making A & B (TMT)	Executive function	1	5	6, 9, 14, 23, 39	✓	
68. Turkish Aphasia Test	Language function – Aphasia	1	1	34	✓	
69. Vascular Neuropsychological Battery (V-NB) Animal naming test	Processing speed and executive function.	4	3	3,4, 46		✓
70. Verbal Fluency Test- Controlled Oral Word Association Test (FAS-COWA)	Working memory	1	2	7, 49	✓	
71. Victoria Stroop Test	Speed of processing	1	1	8	✓	
72. Visual Object and Space Perception Battery: Fragmented Letters and Position	Visuospatial ability	1	1	8	✓	
73. WAIS Picture sequencing	Planning, logistic, sequencing	1	1	54	✓	

74. WAIS Adult Intelligence Scale-Digit Span	Short-Term Memory	1	1	49	✓	
75. WAIS Block design	Visuoconstructional skills	1	1	54	✓	
76. WAIS Digit span forward subtest	Memory	1	1	54	✓	
77. WAIS-III Mental control test	Inhibition/executive function	1	1	22	✓	
78. WAIS-III Letter number & cubes test	Sequencing	1	1	15	✓	
79. WAIS-III Similarities Test	Abstract reasoning	1	2	22, 54	✓	
80. WAIS Logical Memory	Memory	1	1	51	✓	
81. WAIS Memory Scale – revised	Orientation/ memory	1	1	34	✓	
82. Weintraub and Mesulam	Motor neglect	1	1	34	✓	
83. Wisconsin Card Sorting Task (M-WCST)	Executive function	1	3	9, 15, 22	✓	

84. World Health Organisation-University of California-Los Angeles Auditory Verbal Learning Test (WHO-UCLA AVLT)	Memory/learning	1	1	54	✓	

3.3.5.5 Cognitive Domains Assessed by the Tests from Retrieved Studies. Most of the tools (n = 47) assess one cognitive domain. In contrast, six of the tools were not necessarily domain-specific; that is, the Abbreviated Mental Test (Kongkasuwan et al., 2015), Clock Drawing Test (Freedman et al., 1994), Functional Independence Measure − 5-item cognitive subscale (Bindawas et al., 2018), Kolkata Cognitive Screening Battery (Das et al., 2013), National Institute of Health Stroke Scale (Ortiz & Sacco, 2014), Six-item-screener (Callahan et al., 2002) and Community Screening Instrument for Dementia (Hall et al., 2000). These six screening tools all give a global score with a cut-off score to indicate either cognitive impairment or no cognitive impairment. For instance, with the CDT, scoring is presented as (1) mild cognitive impairment (MCI), (2) dementia, and (3) no dementia (Paula et al., 2013). Only 11 tools assessed more than three domains (see Table 3.4 above).

3.3.6 Cognitive Batteries Identified from Retrieved Studies

One of our main objectives was to identify a comprehensive battery that we could adapt for use in Zimbabwe. To fulfil this objective, we adopted the criteria set out in previous systematic reviews (Rodrigues et al., 2019). This criteria sets out that the battery has to: (1) assess at least three cognitive domains, (2) has been validated in low- and middle-income countries and reported excellent psychometric properties. The following instruments met our criteria for a cognitive battery according to Rodrigues et al. (2019): NINDS-CNS (Hachinski et al., 2006), NUCOG (Gao et al., 2014), MMSE (Folstein et al., 1975), MoCA (Nasreddine et al., 2005), BCoS (Humphreys et al., 2012) (see Table 3.5 below). A brief overview of the psychometric properties of the selected comprehensive neuropsychological batteries is given below.

Table 3.5

Characteristics of Validated Comprehensive Neurocognitive Batteries

Tool	Author and country	Orientation	Attention	Memory	Language	Numbers	ExecutiveFun	Praxis	Visuospatial	Processing	Aphasia	Neglect	Domain/ global score
Birmingham Cognitive Screen (BCoS)	Pan et al. (2015) China	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓	Domain
NINDS-CNS Battery x3	Chen et al. (2015b) China		✓	✓	✓		✓	✓	✓	✓			Domain
NUCOG (Neuropsychiatry Unit Cognitive Assessment)	Gao et al. (2014) China		✓	✓	✓		✓		✓				Domain
NINDS – 5 minutes	Chen et al. (2015) China	✓		✓	✓								Global
MMSE	El-Han et al. (2005), Turkey; Shen et al. (2016) China	✓		✓	✓	✓		✓					Domain/global
MOCA	Shen et al. (2016) China; Sahathevan et al. (2014) Malaysia; Zuo et al. (2016) China	✓		✓	✓	✓		✓					Domain/global

3.3.7 Assessment of Risk of Bias in Cognitive Batteries

We used the COSMIN checklist to assess for risk of bias of the validation studies (Mokkink et al., 2017). The methodological quality of most of the studies was poor because the studies assessed a few psychometric properties. Most of the validation studies were on hypothesis testing (5/9), assessing reliability (4/9) and responsiveness, (4/9). Other studies assessed internal consistency (3/9), cross-cultural validity (2/9) and content validity (3/9). No study evaluated both content validity and measurement error (Table 3.6 below).

Table 3.6

Risk of Bias of Validation Studies

Neurocognitive Battery	**Structural validity**	**Internal validity**	**Cross-cultural validity**	**Reliability**	**Criterion**	**Hypothesis testing**	**Responsiveness**
National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN) Neuropsychological Battery - 5 minutes (Chen et al. 2015b)				Adequate		Doubtful	
National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN)- 30 mins (Chen et al., 2015b)		Very good		Doubtful			Very good
Neuropsychiatry Unit Cognitive Assessment Tool (NUCOG) – Chinese version (Gao et al., 2013)		Very good			Very good	Very good	Very good
Mini-Mental State Examination (MMSE) (El-Han et al., 2005 & Shen et al., 2016)	Very good (El-Han et al., 2005)	Very good (El-Han et al., 2005)		Doubtful (El-Han et al., 2005)	Very good (Shen et al., 2016)	Inadequate (Shen et al., 2016)	Very good (El-Han et al., 2005)
Birmingham Cognitive Screen (BCoS) – Cantonese (Pan et al., 2015)			Very good	Doubtful		Inadequate	
Montreal Cognitive Assessment (MoCA) – (Sahathevan et al., 2014, Shen et al., 2016 & Zuo et al., 2016)			Inadequate (Sahathevan et al., 2014)		Very good (Shen et al., 2016 & Zuo et al., 2016)	Inadequate (Sahathevan et al., 2014 & Shen et al., 2016) Very Good (Zuo et al., 2016)	Very Good (Zuo et al., 2016)

3.3.8 Psychometric Properties of Individual Validated Neurocognitive Batteries

3.3.8.1 The Birmingham Cognitive Screen. The Birmingham Cognitive Screen (BCoS) was developed to profile post-stroke cognitive deficits (Humphreys et al., 2012). One study was identified, which was a validation of the Cantonese version of BCoS on stroke patients (Pan et al., 2015). The methodology used to assess cross-cultural validity, reliability and to test the hypothesis was good. However, there was no evidence provided for reliability because the level of patient stability and the testing interval were not reported. Evidence to support the hypothesis and cross-cultural validity was poor because the psychometrics of the comparator instruments were also not reported. As there was only one study using this tool (BCoS), the evidence for the psychometrics of this tool for cross-cultural validity, reliability and hypothesis testing for construct validity was thus rated as low.

3.3.8.2 Mini-Mental Status Examination. The MMSE (Folstein et al., 1975) is a widely used neurocognitive tool which was originally developed to screen for dementia in psychiatric settings. It has been translated into different languages and validated in different settings to screen for cognitive impairment. Two studies were retrieved, a Chinese MMSE version (Shen et al., 2016) and a modified Turkish MMSE version (Elhan et al., 2005). The methodological quality to assess responsiveness, structural criterion and internal validity were good. However, the reliability of the MMSE was weak because no evidence was provided for the level of stability of the patients when they were tested. The testing interval was also not reported. The evidence to support the hypothesis was also inadequate because no psychometrics for secondary outcome measures were provided; only constructs measured were presented. Evidence for reliability was questionable because the researchers did not use the recommended statistical analysis of intraclass correlation or weighted kappa (Mokkink et al., 2017).

3.3.8.3 The Neuropsychiatric Unit Cognitive Screen. The Neuropsychiatry Unit Cognitive Screening tool (NUCOG) (Gao et al., 2014) was developed to determine cognitive impairment among psychiatry and neurology patients. The NUCOG assesses five cognitive domains, including spatial and executive function. There was substantial evidence supporting the hypothesis. The study showed very good internal and criterion validity as well as very good responsiveness (Gao et al., 2014).

3.3.8.4 The Montreal Cognitive Assessment Screen. The Montreal Cognitive Assessment screen (MoCA) (Nasreddine et al., 2005) is a neuropsychological tool developed to assess mild cognitive impairment and Alzheimer's dementia. The MoCA has been validated and used widely for other neurologic and psychiatric conditions. We retrieved three studies that validated the MoCA on stroke patients; a Bahasa Malay version, a Chinese version and a modified MoCA Beijing version (Sahathevan et al., 2018; Shen et al., 2016; Zuo et al., 2016). There was strong evidence for criterion validity and responsiveness. Two of the studies were of good methodological quality. However, there was conflicting evidence on hypothesis testing. This variance was due to one of the studies using a sub-optimum sample size of 40 participants (Sahathevan et al., 2018).

3.3.8.5 The 5-minute National Institute of Neurological Disorders and Stroke and Canadian Stroke Network. The 5-minute National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN) (Hachinski et al., 2006) protocol is a telephone-based screening tool which was investigated as an alternative to face-face neurocognitive screening (Chen et al., 2018). It is a six-item screener based on the NINDS-CSN protocol. It comprises five subtests of the MoCA-Beijing version. The study was of adequate reliability. It was assumable that the patients were stable and that the testing conditions were the same for the comparison groups. However, the validity of the hypothesis is doubtful because the psychometric properties of the comparator instruments were not provided.

3.3.8.6 The National Institute of Neurological Disorders and Stroke and Canadian Stroke Network. The National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN) protocol is a battery of tests that were compiled to profile stroke-specific neurocognitive deficits (Chen et al., 2015). The protocol comprises of a 60-minute, 30-minute and 5-minute battery. The methodological quality for internal validity was very good. However, the reliability was poor because the level of patients' stability and the testing interval was not reported.

3.4 Quality of Psychometrics and Best Evidence Synthesis

For the quality of psychometrics, positive ratings were given for all categories for each tool, except for cross-cultural validity for both the BCoS and NINDS battery (see Table 3.7 below). In both instances, neither study used multiple group factor analysis or DIF analysis to determine whether there were any critical differences between the two language versions.

Table 3.7
Assessing Psychometric Properties of Identified Cognitive Batteries

Instrument	Sample size (n)	Methods of determining psychometric properties	Structural validity	Internal consistency	Cross-Cultural validity	Reliability	Criterion validity	Hypothesis testing	Responsiveness
Birmingham Cognitive Screen (BCoS) – Cantonese (Pan et al., 2015)	231	Test-retest reliability (temporal stability), interrater reliability (internal consistency), convergent validity (correlation with similar constructs)			?	+		+	
Mini-Mental State Examination (MMSE) (El-Han et al., 2005)	207	Internal consistency Reliability (person separation index) Internal & cross, cultural construct validity (group comparison) Convergence validity (correlation with similar constructs), responsiveness (El-Han et al., 2005) Sensitivity/specificity	+ (El-Han et al., 2005)	+ (El-Han et al., 2005)		?	+ (El-Han et al., 2005 & Shen et al., 2016)		+ (El-Han et al., 2005 & Shen et al., 2016)
Montreal Cognitive Assessment (MoCA) – Baha Malaysia version (Sahathevan et al., 2014, Shen et al., 2016 & Zuo et al., 2016)	40	Correlation of original and adapted version (Sahatven et al., 2014), Discriminant ability (group comparison) (Zuo et al., 2016), Sensitivity/specificity (Shen et al., 2016)					+ (Shen et al., 2016 & Zuo et al., 2016)	+ (Sahathevan et al., 2014, Shen et al., 2016 Zuo et al., 2016)	+ (Shen et al., 2016 & Zuo et al., 2016)

National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN) Protocol – 60, 30 and 5 minutes (Chen et al., 2015b)	100	Internal consistency, Interrater reliability, External validity (distinguishing patients from controls), Criterion validity (sensitivity & specificity)	+	+
Neuropsychiatry Unit Cognitive Assessment Tool (NUCOG) – Chinese version (Gao et al., 2013)	529	Convergence validity (correlation with similar constructs), Internal consistency , Criterion validity (sensitivity & specificity)	+	+

In terms of the overall synthesis of the psychometrics for the MMSE and NUCOG for internal consistency and the NUCOG for criterion validity, hypothesis testing for construct hypothesis and responsiveness demonstrated a high quality of evidence (see Table 3.8 below). Although in both cases, only one study was assessed, each study was of excellent quality with a total sample size of greater than 100 patients. Average ratings were assigned for the MMSE for structural validity and criterion validity, MoCA for criterion validity, NINDS battery for internal consistency, hypothesis testing and responsiveness because they were single studies that were of good quality and a sample size of above 50.

The BCoS rated low on all measures due to the high risk of bias. Similarly, the MMSE and NINDS were also rated low for reliability and the MoCA for responsiveness. The low ratings for hypothesis testing for construct validity for the MMSE and MoCA, and responsiveness for MMSE, were due to conflicting findings across two studies of fair quality. The MoCA had a very low sample size, and thus the results were rated as very low (Table 3.8).

Table 3.8
Best Evidence Synthesis

Tool	Structural Validity	Internal Consistency	Cross-Cultural Validity	Reliability	Measurement	Criterion Validity	Construct Validity	Responsiveness
Birmingham Cognitive Screen (BCoS) - Cantonese			Low	Low			Low	
Mini-Mental State Examination (MMSE)	Moderate	High		Low		Moderate	Low	Low
Montreal Cognitive Assessment (MoCA)			Very Low			Moderate	Low	Low

National Institute of Neurological Disorders and Stroke and Canadian Stroke Network (NINDS-CSN)	Moderate	Low		Moderate	Moderate
Neuropsychiatric and cognitive Assessment Tool (NUCOG) – Chinese v	High		High	High	High

3.5 Discussion

Our study captures cognitive tests that were used to assess cognitive deficits in stroke patients in low- and middle-income countries. These assessments ranged from single tests that evaluate one cognitive function to batteries that appraise several cognitive domains. For instance, the Animal Naming Fluency Test (Zhou & Jia, 2009) and the Bells Test (Cardoso et al., 2015) assess one domain each, that is verbal fluency and visuospatial neglect respectively. Some studies constituted batteries by selecting different known tests for a particular study. For instance, one study by Campanholo et al. (2015) constituted a neuropsychological battery by putting together 13 different tests such as the Trail Making Test (Army, 1944) and subtests from the Wechsler Adult Intelligence Scale (Wechsler, 2008). Other studies were based on complete batteries such as the Birmingham Cognitive Screen (Pan et al., 2015). In cases where different individual tests were combined to constitute a battery, we did not report on the battery because it is not a conventional battery but reported the single tests as presented. Constituting a battery from individual tests is useful in situations where specific domains are targeted. For instance, where there may not be a need to assess a patient on a whole battery, but rather to just select the desired tests.

There are some tests which have a cognitive component but are not primarily cognitive measures, such as the National Institute of Health Stroke Scale (NIHSS; Ortiz & Sacco, 2014) or Functional Independence Measure (FIM) (Bindawas et al., 2018). These instruments were used for determining stroke severity, (Ferreira et al., 2015), or capacity for carrying out activities of daily living (ADLs). In such cases, we excluded the instruments and only reported on them for studies where the cognitive subtests were reported separately.

The MMSE was the most widely used test and is popular for screening for dementia. The reason for the wide usage of the MMSE test could be because it is brief and also easy to administer and score. It should be noted that most of the studies had the determination of dementia as their primary outcome, which might explain why the MMSE was most commonly used because it is famous for its sensitivity to dementia. The MMSE was also frequently used as a screening tool, yielding a global score indicating possible cognitive impairment, but not necessarily offering comprehensive neuropsychological profiling of domain-specific deficits.

Overall, our review extracted a diverse range of studies that differed in terms of study objectives, instrument quality and sample size. This fact could be because our inclusion criteria were not stringent enough to be limited to studies evaluating psychometric properties; instead, it included any study that utilised a neurocognitive tool on a stroke sample to fulfil our first objective. As a result, not all studies reported the test's psychometric properties because that was not part of that study's objectives. Some studies were prevalence studies which aimed at evaluating a different hypothesis, such as, neuropsychiatric conditions or effectiveness of interventions. Other studies had smaller sample sizes compared to those recommended by Mitrushina et al. (2005). The small sample sizes could be because the studies were not for validation purposes and, therefore, did not require enormous numbers for statistical significance (Bridges et al., 2007). However, useful information was retrieved to identify and adapt a cognitive instrument that has been used for neurocognitive testing in low- and middle-income settings.

None of the studies that we reviewed was on the development of a neurocognitive test as a primary objective. As noted earlier, the validation studies were only aimed at translating and validating an already established cognitive tool. This indicates a research gap in test development, translation, adaptation and validation in low- to middle-income countries. This gap on test development might reflect a lack of capacity and/or resources in these countries. We also noted that there was only one test constituted specifically for post-stroke cognitive assessment, the NINDS-CNS, which comprises individual sub-tests that were selected to target stroke-specific cognitive deficits. However, because the batteries were constituted from different individual tests that were not necessarily developed to assess stroke patients, they do not wholly capture some of the nuances of post-stroke sequelae. For instance, the tests do not control for deficits such as aphasia or neglect that may influence the cognitive performance of stroke sufferers.

The NINDS-CNS battery also lacks tasks to profile executive functions. The Brief Neuropsycholinguistic Evaluation for Expressive Aphasics battery (NEUPSILIN-AF) (Holderbaum et al., 2016) has a praxis task and caters for patients with aphasia but not visuospatial neglect. Besides, most of the examined tools report global impairment and not individual cognitive domains. This fact is useful for indicating the presence of cognitive impairment. However, a score for global impairment is not sufficiently informative for detailed profiling, which is necessary for targeting domain-specific interventions and rehabilitation for stroke patients.

Most of the examined studies are designed to screen precisely for dementia, thus using tools aimed at detecting dementia-specific deficits such as the MMSE. While these instruments are sensitive to advanced cognitive deterioration, they may miss the mild and moderate deficits that are common to the acute and subacute phases of a stroke. For instance, when assessing dementia, there is a focus on determining premorbid function and the memory function. Some subtle and mild cognitive changes may be missed by such tools because of a greater focus on memory impairments, for example, neglect and apraxia. These findings correspond to previous studies. In a recent systematic review, Rodrigues et al. (2019) highlighted the issue of testing missing mild cognitive impairment.

Only one of the cognitive batteries that we retrieved, the BCoS, was specifically developed to assess post-stroke neurocognitive sequelae and is the only comprehensive battery that assesses all domains. Unlike the NINDS-CNS, it includes controls for aphasia and neglect and isolates their negative contribution to test performance on other domains. However, BCoS was developed and normed in the UK but has proved to be a reliable tool in other low- and middle-income countries' settings. Our systematic review identified BCoS as a suitable tool for our adoption because it assesses a broad range of cognitive domains commonly affected by a stroke. A more detailed narration of the merits of BCoS will be given in Chapter 4.

In this review, the challenge to consolidate the psychometric properties was that most of the tools were used in single studies. Although ratings were ascertained, determination of the reliability of these is limited because results may change given a different population. Deciding which tools best suit low income countries is further hampered by this difficulty of determining the quality of the evidence presented in studies. For example, the BCoS was identified as a suitable comprehensive tool for assessment of post-stroke impairment in Zimbabwe, but the study in which it was validated demonstrated a low quality of evidence. Determination of the usage of tools, therefore, is more dependent upon the utility of the tool to meet the needs of low resource settings.

3.6 Recommendations

These findings indicate that there is a lack of development or validation of neurocognitive instruments in low- and middle-income countries. There is a need to develop neurocognitive tests that are relevant to specific cultural contexts and also to specific neurological conditions in low- and middle-income countries (Rodrigues et al., 2019). Careful determination of sample size would be required, together with rigorous methodologies, to ensure robust instruments. Studies with samples higher than 100 patients offer more robust results, particularly when the general methodology is of high quality. Further emphasis needs to be made on the consideration of all psychometric properties, statistical analysis for cross-cultural validity needs to be conducted and reported on to ensure a better decision-making process about the utility of a translated tool by clinicians. Considering the limited resources available in low- to middle-income communities, it may not be possible to address all psychometric properties. Therefore, if only specific properties are assessed, it becomes even more essential to reduce or eliminate the risk of bias and, thus, improve the quality of evidence. Besides, there is a need to capacitate people to translate, adapt and validate cognitive tests to promote more use of these tests in low- and middle-income countries.

3.7 Limitations of this study

A weakness in this study is that the inclusion criteria were broad because we included any study that incorporated a cognitive tool for stroke patients. For the first part of the study, we did not place any limitations, such as the nature of the instrument (number of cognitive domains assessed, validation, version and others.) or the type of study (post-stroke period, validation and others). This lack of restrictions allowed a wider variety in the studies extracted, as well as in the range of cognitive domains used across studies. For instance, there were different versions of similar tests such as the Turkish version of MMSE which has 50 points, making it difficult to make any comparisons or contrasts with other versions of MMSE (Kumral et al., 1999), and, as a result, limited the kind of analysis that could be conducted on the collected data. Future reviews may target more specific issues. Another limitation of this study is that we could not follow up with the authors of some of the studies in terms of missing information. In addition, another limitation is that we only included articles written in English, missing out on other articles that would have been relevant but in other languages that we had no capacity to use. Also, a practical determination of the psychometric qualities of tools used in low-income countries is challenging because there is still little research undertaken in the field of neuropsychology. Perhaps due to limited resources and/or expertise, not all psychometric properties are assessed and addressed in validation studies. Therefore, based on the priorities of the study, not all statistical assessments are conducted or reported on sufficiently.

Chapter 4: An Overview of the Birmingham Cognitive Screen

4.1 Characteristics of the Birmingham Cognitive Screen

The Birmingham Cognitive Screen (BCoS; Humphreys et al., 2012) was designed to give specific information on each of the five cognitive domains that it assesses: attention/executive function, praxis, number abilities, language and memory domains. The screen comprises 22 main tasks with 32 sub-measures (Bickerton et al., 2015). These sub-measures allow a comprehensive analysis of cognitive performance in each of the domains. For instance, the praxis tasks give scores on limb and constructional apraxia separately, while on the reading tasks, the screen has unfamiliar, less frequently used words to give it more sensitivity to both surface and phonological dyslexia (Humphreys et al., 2012).

BCoS tasks are designed to be specifically sensitive to post-stroke deficits and to cater to common barriers that usually limit assessment, such as aphasia, neglect and hemiplegia (Bickerton et al., 2012). This makes the BCoS test inclusive to individuals who would typically be excluded from testing due to such deficits. This fact also controls for contamination on the performance of other tasks that would usually be disturbed by these deficits (Humphreys et al., 2012). For instance, test stimuli are centred on the page to control visuospatial neglect. Also, the inclusiveness of BCoS was illustrated in a study by Bickerton et al. (2015) on 635 stroke survivors. Up to 92.1% of these patients could be tested on at least one of the praxis tasks, despite having mild to moderate aphasia, which would typically hinder them from participating in many similar tests (Humphreys et al., 2012).

BCoS was also designed to be time-efficient in several ways. To begin with, a single task assesses multiple cognitive functions. For instance, the Story Recall task assesses encoding, retrieval/blocking and forgetting/consolidation, while the Auditory Attention task assesses three functions, namely working memory, selective and sustained attention. Furthermore, the tasks are designed with a ‘Stop’ criterion such that a task is discontinued when it is evident that a participant is not performing well. Accordingly, this action maximizes administration time and minimizes frustrating and exhausting the examinee (Humphreys et al., 2012).

BCoS takes about an hour to administer and gives specific detail of the attention and executive function domain which is not found in most neurocognitive tests. Most neurocognitive batteries lack praxis tasks. This deficit is because the tasks are difficult to standardize and score owing to their qualitative nature (Bickerton et al., 2012). Unlike most neurocognitive tests, BCoS contains five praxis tasks, all of which are particularly informative. One of the tasks is the Multi-step Object Use which incorporates real-life objects. This task helps to identify problems with action planning, sequencing and motor execution of plans (Humphreys et al., 2012). The wide range of praxis tasks included in BCoS enables it to capture all types of praxis impairment detail. For instance, the Multiple Object Use task has different demands; it relies on executive functions that include capacities for inhibition, sequencing and working memory (Bickerton et al., 2012). Information from this task has a practical application on ADLs.

One of the significant challenges in using neuropsychological tests is that they require expertise to develop, administer, score and interpret them. Such expertise is lacking, especially in low- and middle-income countries such as Zimbabwe where neuropsychology as a discipline is in its infancy. Given this fact, BCoS utilizes recent technology through online video training, electronic data entry and scoring. This electronic medium allows for virtual training and support for low-resourced settings. Most importantly, BCoS data is converted to a 'snapshot' of the cognitive function profile for each patient (see Figure 4.1 below). The snapshot shows the impaired and spared functions giving a simplified profile of the patient's performance. Also, BCoS shows domain-specific deficits allowing tailor-made interventions to target those specific deficits (Humphreys et al., 2012).

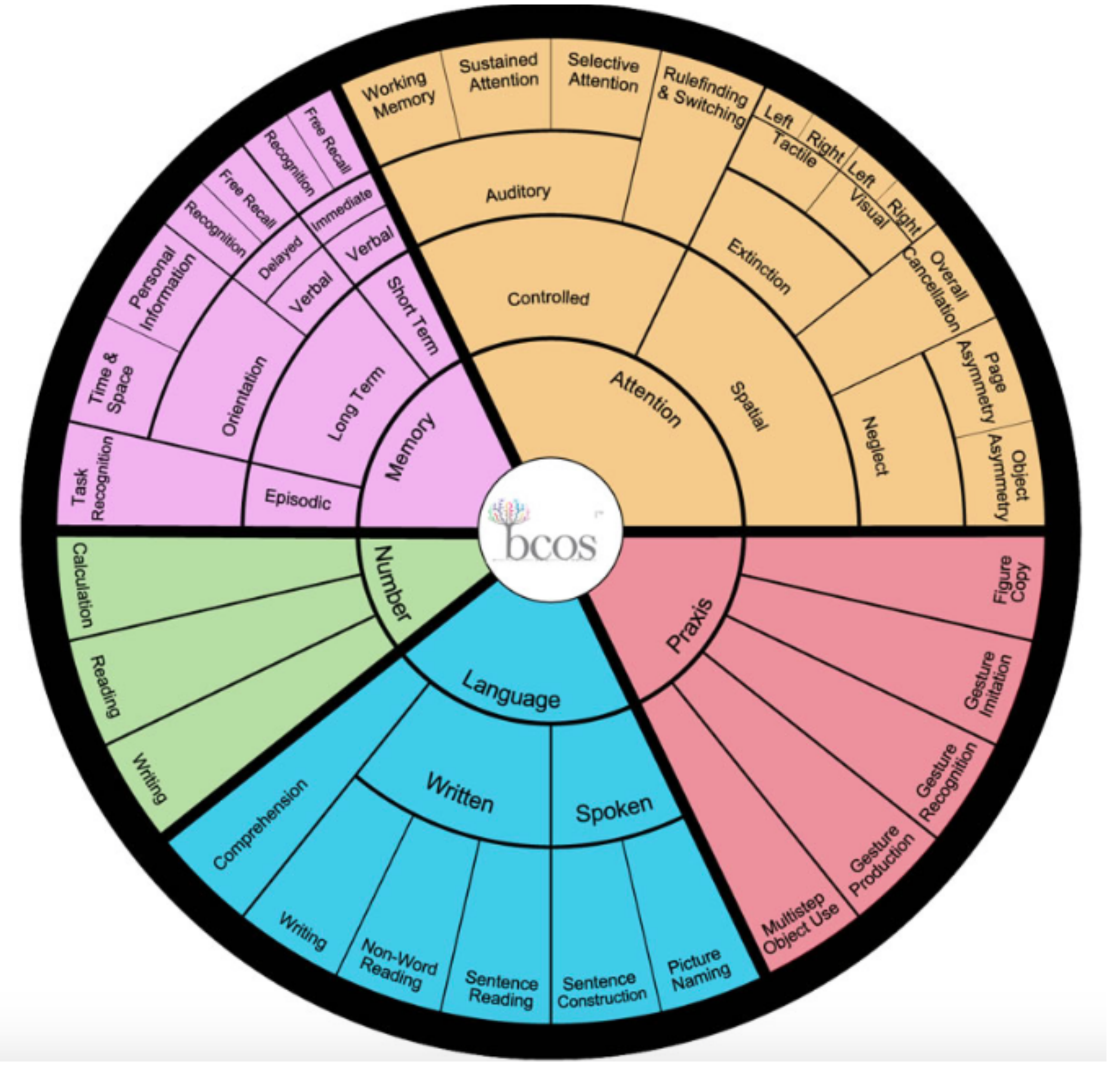

Figure 4.1. A ‘snapshot’ of the BCoS profile (Adopted from Humphreys et al., 2012)

The following section describes the BCoS tasks’ details that assess the five cognitive domains involving Attention/Executive Function, Language, Memory, Number Skills and Praxis which are summarised in Table 4. 1 below.

4.2 Attention and Executive Function Tasks

BCoS assesses a person's executive deficits in sequencing and mental set shifting (Humphreys et al., 2012). Following is a detailed description of the tasks for the Attention and Executive Function domain.

4.2.1 Auditory Attention Task

The BCoS auditory attention task is reported to be relatively culture-free (Pan et al., 2015). The task consists of six pre-recorded words made up of three target words and three distractors which are related to each other, e.g. "hello" vs "goodbye" and "no" vs "yes". These are short, simple high-frequency words which can be easily identified by people with aphasia. The examinee is asked to tap on the desk each time the recorded voice says the target word and ignore tapping on the distractors. This task assesses *selective attention* as the examinee selects target words only and ignores the distractor. An examinee with impaired selective attention will respond to distractors and/or miss tapping on target words. *Sustained attention* is assessed through an examinee's accurate, consistent and persistent performance across the entire three blocks. Poor sustained attention is observed when an examinee's performance drops across the blocks of the task. For *working memory*, the examinee is asked to recall the list of target words at the end of the task. Failure to recall indicates poor working memory (Humphreys et al., 2012).

4.2.2 Rule Finding and Concept Switching Task

This task consists of a grid of grey squares with two red and two green squares and a black dot on each of 20 pages. The black dot moves in a set pattern across the grey squares on each page. The examinee is tasked to observe and detect the rules governing the movement of the dot, then anticipate and tell the examiner where the dot is likely to move to on the next page. However, the rules governing the movement of the dot change and the examinee is supposed to detect that change, identify the new rule and predict the next move. The task assesses a person’s strength in detecting the rules. A person with an impaired executive function will be unable to detect the abstract rules governing the movement of the stimulus (Humphreys et al., 2012).

4.2.3 Apple Cancellation Task

The Apple Cancellation task assesses for visuospatial neglect. It consists of an A4 page evenly filled with the target stimuli (whole apples) and distractors (incomplete apples). The examinee is asked to cancel all the whole apples. The page with apples is demarcated into five invisible columns and two invisible rows. Scoring brings out any upper vs lower or right vs left visual neglect. The cancellation tests assess *Egocentric neglect* − shown when the examinee misses out target stimuli or *Allocentric neglect* − shown when the examinee crosses out the distractors, namely the incomplete apples which are false positives (Humphreys et al., 2012).

4.2.4 Visual Extinction Task

The visual extinction task is made up of 24 stimuli. These involve four left and right unilateral and eight bilateral double flicks of the forefinger by the examiner. To administer this test, the examiner positions herself centrally at a distance of one meter from the examinee. The examiner then positions her hands 20cm from either side of her head and takes turns to double flick the forefinger in a predetermined order. The examinee is required to point to the side of the head on which the examiner flicks her finger without moving her own eyes from the centre (Humphreys et al., 2012). Neglect is implicated where the examinee fails to perceive the movement of the examiner's finger flicks and extinction is suspected when the observations decline on one side when two stimuli relative to one stimulus are presented.

4.2.5 Tactile Extinction Task

To assess for tactile extinction, the examinee is asked to place both palms upside down on the table. With eyes closed, the examinee is asked to lift the hand that the examiner lightly taps. The test is scored the same as the test for visual extinction described in the section above (Humphreys et al., 2012).

4.3 The Language Domain

Tests targeting the language domain assess both the written and reading aspects of language. This domain is assessed by the following tests which are described below: Picture Naming, Sentence Construction, Sentence Reading, Word/Nonword Reading and Writing.

4.3.1 Picture Naming Task

The picture-naming task assesses semantic and conceptual knowledge. It consists of fourteen pictures of living and non-living things, which are hand-drawn in black and white. The examinee is asked to name each item. The depicted items range from animals, fruits and vegetables to kitchen equipment and household tools and are designed such that they are of a different range of difficulty. The relatively difficult items have long names to assess the examinee's word-finding and production difficulties (Humphreys et al., 2012).

4.3.2 Sentence Construction Task

This task assesses the examinee's syntactic and semantic processes. The examinee is consecutively shown two pictures each containing two words and asked to: (1) describe what the person is doing in the picture in one sentence and (2) include the two given words in the sentence. The sentence should be active with the correct use of the verb, object, subject and adverb (Humphreys et al., 2012). Again, the picture and two words are centred on the page to be sensitive to any visuospatial field neglect.

4.3.3 Sentence Reading Task

The reading task requires the examinee to read two sentences with a total of 42 words of different word classes; namely verbs, nouns, prepositions, adjectives and pronouns. These words include regular words such as "belong" and irregular words such as "daughter" or "viscount", suffixed words such as "impartial" and prefixed words such as "leisurely". The sentences are both centred in the middle of the page to be sensitive to patients with either left or right visual field neglect (Humphreys et al., 2012).

4.3.4 Word/Non-word Reading Task

To assess the correct use of phonological procedures, the examinee is required to read six items, each with at least five letters. These words do not mean anything but assess the examinee's language ability to correctly articulate the sounds (Humphreys et al., 2012).

4.3.5 Words/Non-word Writing

The examiner verbally presents sounds, and the examinee writes the words and non-words as presented. These words are of differing levels of difficulty. For instance, there is an abstract word – "although", an exception word – "scissors" and a non-word – "troom" among others (Humphreys et al., 2012).

4.4 The Memory Domain

Tasks in the memory domain assess different aspects of memory as outlined below:

4.4.1 Orientation Task

This task is divided into three sections; (1) the orientation to personal demographics assessing autobiographical semantic knowledge, (2) orientation to time and place, (3) nosognosia − namely awareness of personal deficits. There are templates with multiple-choice questions for those test-takers that may have aphasia (Humphreys et al., 2012).

4.4.2 Story Recall

This task assesses episodic memory. A simple story is read to the examinee who is required first to recall all the details of the story spontaneously and then from multiple-choice responses to assess immediate recall and recognition. The examinee is later prompted to perform a delayed recall of the story after completing some unrelated tasks. The second story task evaluates the examinee's encoding, retrieval and consolidation skills. Poor recognition indicates poor encoding. Poor performance on delayed recall indicates poor consolidation.

4.4.3 Task Recall

This part of the test is a delayed recall task which requires the examinee to elicit tasks covered earlier in the test that were not necessarily memorized (Humphreys et al., 2012).

4.5 Number Skills Domain

This task consists of complex numbers relating to mathematical figures, prices and times, which are embedded with zeros, decimal notation and also relating to prices and times. It also includes tasks on addition, subtraction, multiplication and division. The examinee is required to read and write given numbers, prices and clock times accordingly. The calculation tasks are relatively complex, with up to five figures. Some of the calculations require the examinee to mentally carry over some figures (Humphreys et al., 2012). This task assesses the examinee's ability to process numbers abstractly.

4.6 The Praxis Domain

The following tasks assess the Praxis Domain; Complex Figure Copy, Gesture Production, Gesture Recognition and Imitation tasks. The multiple praxis tests included in the BCoS make it one of the most sensitive screens for apraxia. Research has found that using only one praxis test results in under diagnosis of apraxia by about 30% (Bickerton et al., 2015). As mentioned earlier, the praxis tasks in BCoS were designed to be inclusive for patients with aphasia. For instance, the instructions are given in verbal, written and pictorial form, to cater for patients with deficits in any one of the three modalities.

4.6.1 Complex Figure Copy

This task is another relatively culture-free test (Pan et al., 2015). The complex figure has three major structures, to the left, right and centre. The examinee has to copy the given figure on a blank page. This task assesses possible constructional apraxia, visuospatial neglect as well as the organization of the figure. Scores are given for the presence of each specific feature, accurate positioning and accurate size (Humphreys et al., 2012).

4.6.2 Multi-step Object Use Task

This task assesses a person's skills in obeying commands. In this task, the target objects (parts of a torch) and three distractor objects are all arranged on the table in a row. The examinee is instructed to make the torch work using the objects on the table. The participant's planning and goal-directed behaviour are observed as s/he selects appropriate multiple objects (a torch and two batteries) and sequentially manipulates them to switch the torch on. The task also assesses the examinee's ability to identify and inhibit using distractor objects (Humphreys et al., 2012) as well as measuring steps that a participant is likely to meet in everyday life, which gives helpful insights for his/her rehabilitation.

4.6.3 Gesture Production task

This is another praxis task where the examinee is required to follow commands to produce six specific gestures: three intransitive (communication) gestures and three transitive (object-oriented) gestures. The actions require different forms of praxis. There are body-centred tasks, one of which includes producing the gesture of saluting. The other task involves producing a repetitive gesture of squeezing together the thumb and forefinger. In the other tasks, the examinee is asked to pantomime the gesture of a 'stop' sign as well as that of using a water glass (Humphreys et al., 2012).

4.6.4 Gesture Recognition task

The examiner produces a common gesture such as waving ‘good-bye’ and asks the examinee to identify the gesture spontaneously. The examinee is given forced choices as multiple choice to check if he knows the gesture but may simply be having word-finding difficulties. In one of the tasks, for instance, the choices include: 1) the name of the correct object (e.g. a cup), 2) the name of a semantically related object (e.g. a teapot), 3) the name of a visually related object (e.g. a glass), and 4) the name of an unrelated object (e.g. perfume).

4.6.5 Gesture Imitation Task

In the gesture imitation tasks, the examinee has to imitate four meaningless gestures produced by the examiner. Although this is another praxis test, it also assesses the person’s ability to comprehend and follow commands. For example, imitating two sequences of hand positions in relation to the face and head. This test is a useful task to evaluate a patient’s ability to follow commands which are closely related to their potential for rehabilitation (Humphreys et al., 2012). Patients with aphasia who successfully perform the Gesture Imitation tasks are likely benefit from non-verbal rehabilitation intervention (Bickerton et al., 2012).

During completion of the Gesture Recognition and Imitation tasks, the examinee is asked to identify and produce actions following the examiner’s instructions. These tasks assess the integrity of input coding, while the Gesture Production task assesses the examinee’s output coding of familiar and unfamiliar actions (Humphreys et al., 2012).

Table 4.1

A Summary of the Cognitive Domains Assessed in BCoS

Cognitive domain	**Sub-domains**
Attention and Executive Function	BCoS assesses spatial and controlled attention (selective, sustained & working memory).
Language	Written language-under this domain assesses for alexia, surface and phonological dyslexia-lexical and non-lexical deficits, agraphia, surface as well as phonological and peripheral dysgraphia. The sentence and word/non-word reading task assess syntactic, semantic and articulatory deficits.
Memory	Orientation: this subtask assesses an individual's awareness of time, place and person. Episodic memory evaluates recall vs recognition deficits in encoding, retrieval/blocking, consolidation/forgetting and intentional vs unintentional memory.
Number skills	Tasks in this domain assess for number recognition, reading, writing and checks for dyscalculia.
Praxis	Some tasks assess for constructional praxis, action praxis, organisation and sequencing skills. The other tasks assess for lexical and non-lexical aspects of gesture imitation, gesture recognition and production

Chapter 5: Zimbabwean Adaptation of the Birmingham Cognitive Screen

Abstract

Most neurocognitive tests used in low- and middle-income countries have been developed and normed on western populations with different demographic profiles. Consequently, the psychometric properties of these tests are weak when used in non-western settings. Through a systematic review, we identified the Birmingham Cognitive Screen (BCoS; Humphreys et al., 2012), a neurocognitive screening battery that assesses functioning across multiple cognitive domains as having potential for use in low- and middle-income countries. The screen was recently developed in the United Kingdom and has demonstrated good screening utility in other population groups in China, Hong Kong and Russia. We aimed to investigate the cross-cultural sensitivity of BCoS items and to adapt this screen as an initial step to norming it for research and clinical use in Zimbabwe. We used both qualitative and quantitative methodologies to investigate the cross-cultural performance of BCoS and enhance its applicability to adult neuropsychological assessment in Zimbabwe. The BCoS was administered to a convenience sample of neurologically intact participants (N = 105; mean age = 29.9yrs, SD = 9.24, range = 18 - 55yrs.). A difficulty index for each BCoS item was calculated to establish test item appropriateness. Items with an index value of $p \leq .35$ were considered difficult. We consulted an expert panel utilizing the Delphi technique to determine replacements for these culturally inappropriate and difficult items. Contextual and content changes were made to the original BCoS test items and instructions based on the expert panel's feedback. Cognitive interviewing was undertaken to determine participants and examiners' experience of the adapted test. Test-retest and interrater reliability of the adapted test, Zim-BCoS, was determined. The level of agreement between the original English and adapted Shona BCoS version was also calculated. The intraclass correlation coefficient between the three raters was .99, indicating excellent reliability. Test-retest reliability was excellent (r = .99). Qualitative feedback from the

cognitive debriefing indicated that the adapted Zim-BCoS is more culturally appropriate for clinical and research purposes in Zimbabwe.

Keywords: test adaptation, Birmingham Cognitive Screen, neurocognitive screening, cognitive test, cross-cultural

5.1 Cross Cultural Adaption

Neurocognitive screening is integral in holistic treatment intervention protocols following neurological change due to acquired brain damage such as stroke. However, in regular clinical practice, cognitive screening is not routinely undertaken due to lack of neurocognitive tests that are based on local normative data (Bonini & Radanovic, 2015, Pan et al., 2015). In Zimbabwe, no comprehensive neurocognitive screen has been locally designed to assess cognitive deficits in stroke and traumatic brain injury patients. This deficiency occurs because it is not only costly to construct these tests, but also requires specialised expertise and resources that are not usually available in low- and middle-income countries (Hambleton & Patsula, 1999).

Mate-Kole et al., 2013 highlight the importance of having culturally appropriate tests that cover areas that are peculiar to specific populations, and may not be covered in other cultures. This is particularly important because of different backgrounds and socio-economic status. Ideally, the African psychologists or neuropsychologists would develop original tests instead of adapting western developed tests (Mate-Kole et al., 2013). Like most cultures, African people have their own peculiar language, culture and ways of communication. For instance, they too have proverbs that could be used in evaluating executive function, similar to the proverbial interpretation used on evaluating executive function on the Mental Status Examination (Mate-Kole et al., 2013).

A practical and less costly way to address this challenge is to adapt a robust neurocognitive screen that is versatile for use on patients with acquired brain damage (Byrne, 2016). Through a systematic review of various neurocognitive screens, the Birmingham Cognitive Screen (BCoS; Humphreys et al., 2012) was the most recently developed neuropsychological screen. BCoS offers the best control of confounding variables in test performance on crucial cognitive abilities. For instance, the test relies less on language skills and in those instances in which language is used it comprises simple statements with high-frequency concrete words that do not impose a heavy cognitive and comprehension load on patients.

BCoS test items are constructed in such a way that controls for the influence of ancillary cognitive processes such as language comprehension and spatial attention that may affect performance on most test items (Humphreys et al., 2012) This level of control is achieved by the test's use of short, high-frequency words that are easy for a person with aphasia to comprehend. Furthermore, reading tasks are also centred on the page to control visual field impairments such as attentional neglect. More importantly, unlike most neurocognitive batteries, BCoS contains sub-tests to screen for apraxia (Humphreys et al., 2012; Pan et al., 2015).

The BCoS is accessible, affordable, and easy to administer by both clinicians and paraprofessionals (Humphreys et al., 2012). It takes about an hour and provides a broad and detailed neurocognitive profile. Unlike many cognitive batteries that only give extensive feedback, BCoS gives specific details of which aspect of the neurocognitive domain is impaired. For instance, the screen gives individual scores on controlled, selective and sustained attention; working memory, rule finding and switching (Bickerton et al., 2012; Humphreys et al., 2012; Pan et al., 2015; Kuzmina et al., 2017). For ease of use, BCoS is supported through an online video training service to assist clinicians with its administration, scoring and interpretation. This support is facilitated in such a way that scoring can also be conducted electronically, giving a graphic presentation of results across each of the cognitive domains that are relatively easy for clinicians, patients, and caregivers to interpret.

Although initially validated on stroke patients, BCoS is a universal measuring tool which can be used to assess cognitive deficits arising from different etiologies, and this fact increases its clinical and research utility (Bickerton et al., 2012; Humphreys et al., 2012). This flexible property makes the screen versatile and especially valuable for use in low and middle-income countries. BCoS, therefore, offers some potential advantages for screening patients in a low-income country such as Zimbabwe, where neurocognitive screening is scarce due to a lack of resources and clinical expertise. BCoS has been successfully translated and validated in Hong-Kong, Russia and China (Chan et al., 2013; Pan et al., 2015; Kuzmina et al., 2017), but it has not been validated in Zimbabwe, or any other part of the African Continent.

5.2 Aim

Our aim in this part of the study was to investigate the cross-cultural sensitivity of BCoS, translate and adapt the screen for clinical and research use on Zimbabwean patients. The adaptation process was an initial step to ensure that the BCoS battery was a workable tool before it was administered to a larger, normative sample (Byrne, 2016; Kuzmina et al., 2017). This practice is in line with the recommendation of the guidelines on neuropsychological test development International Test Commission (Muniz et al., 2013).

5.3 Study 1 Methods

We used guidelines by Borsa et al. (2012) for the cross-cultural adaptation process. This activity included both qualitative and quantitative methods to initially investigate the cross-cultural sensitivity of BCoS items, and then to adapt the screen into a Zimbabwean version. The process was carried out in two related studies. Study 1 involved the translation and evaluation of the cross-cultural sensitivity of BCoS. For the cross-cultural evaluation of BCoS, we initially gathered BCoS test items difficulty indices based on data obtained from a sample of healthy adult participants. In Study 2, we adapted and validated the BCoS test items identified through the difficult indices collected from Study 1.

5.3.1 Study 1 Design/Setting

The study was conducted at four disparate centres: two tertiary referral hospitals (Parirenyatwa and Harare hospitals), a Clinical Psychology Private Practice, and at the University of Zimbabwe. In the case of the hospitals, we targeted relatives accompanying patients for recruitment into the study. Under the country's pyramidal referral system, these hospitals receive referrals from both rural and urban areas across the country (Central Statistics Office, 1984; Kevany et al., 2012; Sanders et al., 1998). Targeting these four centres ensured that participants were drawn from diverse backgrounds.

5.3.2 Participants Inclusion/Exclusion Criteria

The inclusion and exclusion criteria were based on the absence of significant impairment on cognitive functioning or activities of daily living (ADLs) based on patients' responses to the screening questionnaire. In order to be able to respond to the test, participants had to have been born and grown up in Zimbabwe, be between 18 and 65 years old, and able to read and write in English and Shona. Participants were excluded if they had a history of any condition, pathology or disease that would compromise cognitive performance. These disorders included a history of mental illness, substance use, a current or lifetime diagnosis of a neurologic condition such as epilepsy, head injury, stroke, memory/thinking problems, motor neuron disease or a history of having experienced unconsciousness for more than 10 minutes (see Appendix B1 for the detailed screening tool).

Out of the 128 potential participants who were screened, a total of 105 participants took part in the study (Males = 56; Females = 49).Their age range was 18 to 65 years (mean age = 29.9 years; *SD* = 9.24). Most of the participants, (*n* = 95, 90.5%) were right-handed while 10 (9.5%) were left-handed. In terms of education, 6 (5.7%) of the participants had primary level education and 44 (41.9%) had secondary education, while 55 participants (52.4%) had tertiary education. The spread of these demographic variables is detailed in Table 5.1. The other 23 potential participants were ineligible and excluded for the following reasons: 1) failure to complete the test (*n* = 3), 2) a history of head injury (*n* = 9), 3) presence of epilepsy (*n* = 4), 4) a history of stroke (*n* = 5), 5) the inability to read or write (*n* = 2).

Table 5.1
Demographic Profile of Participants

Characteristic		**N (total = 105)**
Gender	Male	56 (53.3%)
	Female	49 (46.7%)
Age	18-24 years	22 (21.4%)
	25-34 years	37 (35.9%)
	35-44 years	29 (28.2%)
	45+ years	15 (14.6%)
Handedness	Right	95 (90.5%)
	Left	10 (9.5%)
Monthly income	<$100	53 (50.5%)
	$100-$500	37 (35.2%)
	$501<	15 (14.3%)
Years of education	≤ 7 years	0 6 (5.7%)
	8-13 years	44 (41.9%)
	14+ years	55 (52.4%)

5.3.3 Materials

5.2.3.1 Screening and Demographic Questionnaire. We adopted a screening questionnaire used in at least three other studies of this nature (Bickerton et al., 2012; Humphreys et al., 2012 & Pan et al., 2015) to exclude participants who did not meet our eligibility criteria (see Appendix B1). The questionnaire also sampled socio-demographic data on participants' age, gender, level of education, professional and employment status.

5.2.3.2 Birmingham Cognitive Screen (BCoS). The original BCoS version was administered following minor contextual modifications (Appendix D1). The BCoS gives a profile of five cognitive domains; Attention/Executive Function, Memory, Language, Number Abilities and Praxis (see Chapter 4 above a full description of BCoS). The screen exhibits good psychometric properties. For example, in a previous study, it demonstrated good inter-rater (0.99; $p < 0.001$) and test-retest reliability, with a sensitivity of .73 and specificity of .78 and good predictive validity (Bickerton et al., 2012).

*Contextual modifications of BCoS***.** Minor modifications were made on the instructions to make them more culturally relevant. Table 5.2 gives a summary of some contextual changes were made to the original BCoS before administration.

*Modification to the Orientation task***.** The orientation task requires participants to state the number and name of their residential street, yet some places in Zimbabwe do not have these details. Consequently, this item was substituted with a direct question: "What is your address?" which accommodates the above-stated reality. The original BCoS only has an educational option for diplomas, and these qualifications are becoming less common in Zimbabwe. We added an option for participants with university degrees under the domain of participant characteristics. We also substituted the four British city names in BCoS with four local city names. We made this exchange by matching the relative sizes of Zimbabwean cities to the ones in BCoS. The city name in the story for the Memory domain was changed from

Birmingham to Gweru, which is in the Midlands Province of Zimbabwe. We also updated the response choices on the time orientation task so that two of the three distracters included the previous and the following years in consistency with the original test.

Story recall task amendments. On the memory task, the name ‘Mrs. Davies’, a protagonist in the story recall for the memory test, was replaced by a local name with a wide national distribution, ‘Mrs. Moyo'. The term 'post office' was replaced with the term 'bank' because in Zimbabwe, monetary transactions take place at banks, and not at post offices.

Gesture Production and Recognition task amendments. This task required participants to produce and identify gestures. The word 'gesture' is unfamiliar to Zimbabweans. The pronunciation of the word also varies markedly depending on where people were educated. Some pronounce the 'g' as in 'get', while others pronounce it as 'j', as in 'jet'. We, therefore, substituted 'gesture' with 'sign', which is a more familiar word in Zimbabwe. Also, the word 'pantomime' is unfamiliar, and we substituted it with ‘demonstrate’.

On one of the praxis tasks, the participants must pretend to hold a glass. We specified a 'water glass' because, in Zimbabwe, a mirror is commonly referred to as a looking glass. We also replaced the term ‘salt-cellar' which is unfamiliar in Zimbabwe with ‘salt-shaker', which is a more commonly used local variation.

Non-word Writing task modification. The instruction to 'write a word that does not exist was potentially confusing to the participants. We modified this instruction to read as follows '… this is a word that I have made up if you were to write it, how would you write it down?'

Price Reading and Writing task modification. The British pound sign (£) was replaced with the dollar sign ($) and the word pound replaced with the word ‘dollar’ in line with

Zimbabwean currency. All the adaptations ensured that the participants understood they performed the same praxis action, as indicated in the original test.

Table 5.2

Summary of Contextual Changes

Item that needed modification	Comments	Alternative
What is the number and name of your street (question found on the orientation task)	Some places in Zimbabwe do not have house numbers.	What is your address?
University diploma (a response option for level of education)	BCoS has no option for a University degree, which is the most typical university qualification in Zimbabwe	We added an option: 'University degree.'
Birmingham, New Castle (UK cities in the story for the memory task)	These are UK cities.	Masvingo, Gweru, Harare, Bulawayo (Matched the cluster theme of the original test)
Multiple-choice options for the question 'What year are you in'?	The multiple-choice options in the original test were outdated	We provided up-to-date year options
The pound sterling sign (£) (a symbol on the number skills task)	Zimbabwe does not use the pound sterling	The pound sterling sign was substituted by the dollar sign ($)
Mrs. Davies (a protagonist in the story for the memory test)	The name Davies is not common in Zimbabwe	Mrs. Moyo (a familiar name to the major local languages in Zimbabwe)
Post office (item in the story recall task)	Money withdrawals are not transacted in post offices in Zimbabwe	Bank
Pantomime (part of the instructions on the praxis tasks)	Pantomime is an unfamiliar word for most Zimbabweans	Demonstrate
Gesture (part of the instructions on the praxis tasks)	The term 'gesture' is an unfamiliar word for most Zimbabweans	Sign
Glass (part of the instructions on the praxis tasks)	Zimbabweans commonly call a mirror a 'glass.'	The term was specified as 'water glass.'
Salt cellar (part of the instructions on the praxis tasks)	‘Salt cellar’ is an unfamiliar term in Zimbabwe	Saltshaker

A word that does not exist (part of the instructions on the language tasks)	The phrase 'a word that does not exist' was likely to confuse participants	A word that I made up

5.3.4 Procedures

Translation of the English version of BCoS test to Shona. A translation team was constituted, comprising a Linguist from a local university who is familiar with translation and adaption of tests, two Clinical Psychologists, two Social Science graduates and four Clinical Psychology interns. This team conducted the initial forward translation individually. They then met to compare their independently translated versions, discuss and agree on the best version. The final translated version was then given to two bilingual people, who were unfamiliar with neurocognitive testing for back-translation. These back-translators worked independently initially, and then jointly to produce a single version, and their final editions were then added to the original team's final translation.

5.3.4.1 Training of Research Team. The Principal Investigator, who is a Clinical Psychologist, trained the research team using videos and role-plays (four Clinical Psychology interns and a Psychology graduate with experience in neuropsychological tests). A Neuropsychologist, with expertise in the development and administration of the original BCoS test, then assessed the research team's administration and scoring skills.

5.3.4.2 Data Collection. We recruited a convenience sample of neurologically intact healthy adult participants from the four research sites mentioned above via word of mouth. The study procedures were explained to all potential participants in their preferred language, either English or Shona. An extensive self-report of personal and medical history was collected from potential participants to screen for neurocognitive normalcy using the screening and demographic questionnaire (see Appendix B1). Those potential participants not meeting the criteria for engaging in the study were thanked for their interest and informed as to why they could not participate in the study. Selected participants were invited to ask questions about the study and were also informed of their right to withdraw from the study at any time for any reason without any consequences. Willing participants who met the study criteria signed a consent form and completed the section of the questionnaire that captured their socio-demographic profiles (see Appendix B1). Each participant was then systematically assigned to one of four trained research assistants and individually tested on the original BCoS.

5.3.5 Ethical Considerations

The study was granted ethics approval from the University of Cape Town's Research Ethics Board, the Medical Research Council of Zimbabwe (MRCZ/A/2050) and the Institutional Review Boards of all the different research sites (see Appendix C). This study was performed in compliance with the Helsinki Declaration on the Code of Conduct in Research on Human Participants. The privacy of participants was ensured by conducting the testing in a quiet room at each of the study sites. Confidentiality of participant data was ensured by assigning participants numerical identity numbers to avoid collecting details that could identify them. Participants were given a subsistence allowance to cover transport and food costs. Data were captured using the de-identified participant identity numbers.

5.4 Data Analysis

Item difficulty indices for the BCoS were calculated to assess the cross-cultural sensitivity and appropriateness of the original BCoS items. The difficulty index is a description of the ease of test items and is based on the percentage (p) of people who give a correct response. The index ranges from 0-100% with lower percentages representing higher levels of difficulty and is calculated as $p = [(H+L/N)]$ x100; where H and L are the highest and lowest number of correct responses respectively, and N is the total number of participants in both groups. An acceptable difficulty is typically pegged at a cut off value of p-value of .3

(Hingorjo & Jaleel, 2012). For this study, items with a difficulty index value of $p \leq .35$ were considered difficult and recommended for an amendment to make the items more useful in detecting impairment. We targeted BCoS instructions and item content as these are the standard variables that impair cross-cultural transference of neurocognitive tests.

5.5 Study 1 Results

Our first aim in this study was to identify difficult items which were not culturally sensitive. To do this, we calculated difficulty indices for the BCoS items. Appendix E1 gives detail on all the tasks, including those that were completed successfully with a difficult index above 0.35. For instance, on the Non-word reading task, that is, a task which required reading of words that do not mean anything, all items were read correctly by all the participants, recording difficult indexes of at least .70 on the Attention and Executive function, Memory, Number Skills and Praxis domain. Only the Language domain had items that had a difficulty index below the cutoff score of .35. These items were from the Picture Naming task, that is, Raspberry (0.09), Colander (0.31), Leek (0.07), Stopwatch (0.15), Chisel (0.31) and Tiger (.32). On the sentence reading task from the Memory domain, there was one BCoS item that proved to be difficult for the participants; that is, the word "viscount". This item was correctly read by only 19% of the participants, which is a difficult index of .19. The word ‘viscount' was misread by participants who pronounced it as ‘vis-count' instead of ‘vi-count’. All other items on the sentence reading task had difficult indices of .75 and higher. There were graphic items that were modified as recommended by the expert panel. An artist who has experience in creating drawings for mental health research in Zimbabwe was tasked to draw alternative pictures and amend the other pictures.

5.6 Discussion

Initially, we made contextual modifications to BCoS. Similar modifications have been made to previous BCoS studies (Pan et al., 2017; Kuzmina et al., 2017). For instance, we changed the UK names of people and cities to Zimbabwean names. We also changed the pound sterling to the Zimbabwean dollar currency. We applied apriori procedures to identify BCoS items that had significant cultural loading and needed modification to improve our participants' understanding. All of the items that had a difficult index below the cutoff score of .35 occurred in the Language domain. This could be attributed to the fact that the test was conducted in English, which is a second language to all participants, and this highlights the influence of language loading on test performance, particularly in cross-cultural contexts (Vordenberg et al., 2014). Language is responsible for a significant part of cultural effects in psychological tests, particularly the language domains. There is strong evidence from previous studies of the negative impact of language on individuals who receive instruction and assessment in a second language (Makondo, 2012). A meta-analysis of 82 studies evaluating comprehension of material delivered in a second language highlighted that there are deficits in comprehension for individuals who use are bilingual when assessed in a second language (Melby-Lervåg & Lervåg, 2014). Other previous studies on BCoS have translated the whole battery (Pan et al., 2015) or test instructions only (Kuzmina et al., 2017) to allow individuals to be tested in their first language. We, therefore, recommend the translation of the whole battery in future to minimize the deficits that occur due to administering the test or parts of it in English to individuals who use English as a second language.

5.7 Study 2 Aim

The primary aim for Study 2 was to make cultural and linguistic adaptation to items with a difficult index score below the cutoff of .35, which were considered inappropriate for the Zimbabwean participants in Study 1. Implementation of these changes would yield the translated and adapted Zim-BCoS. The secondary aim was to determine the reliability of Zim-BCoS and the level of agreement between the original English and the translated Shona Zim-BCoS version.

5.8 Study 2 Methods

5.8.1 Participants for BCoS Items Amendments

A team of thirteen panelists was constituted through purposive sampling (Tongco, 2007). We solicited key informants with expertise in neuropsychological testing who were proficient in the source (United Kingdom) and target (Zimbabwe) languages and cultures to participate in the Delphi process (Hambleton & Patsula, 1999). This panel comprised two Clinical Psychologists, a Research Psychologist, a Consultant Psychiatrist, a Mental Health Nurse, an Occupational Therapist with experience in developing tests and working with people with acquired brain injury, a Professor in Linguistics from the University of Zimbabwe, two Social Science graduates, and four Clinical Psychology interns who were part of our original research team and have experience administering the original BCoS. Two of the panel members had also lived in the UK and had an appreciation of the circumstances under which the original test was developed. Table 5.3 gives a summary of the expert panel members' profiles.

Table 5.3

Expert Panel Profile

Panel member's profession	Expertise/qualities	No. of people
Research Psychologist	Familiarity with neurologic disorders and testing, also familiar with British and Zimbabwean cultures	1
Clinical Psychologists	Familiarity with the field of neuropsychology and neuropsychological research	2
Consultant Psychiatrist	Familiarity with cognitive testing and with both British and Zimbabwean cultures	1
Linguist	Familiarity with the translation and cultural adaptation of tests	1
Nurse	Familiarity with Zimbabwean culture	1
Social Science graduates	Familiar with psychological research	2
Intern Clinical Psychologists	Familiarity with neurologic disorders and BCoS administration	4
Occupational Therapist	Familiarity with neurological disorders and also experience with development, translation and cultural adaptation of neuropsychological tests	1

5.8.2 Participants for the Reliability Study

Based on previous studies, we recruited a convenience sample of 20 healthy participants and ten patients with stroke (Kuzmina et al., 2017). Each participant was re-tested by the same research assistant who had tested them in Study 1. The mean age of the healthy participants was 33.1 years (SD 10.8), mean years of education was 12.7 (SD 2.4). Men comprised 60% of the participants. The mean age for stroke patients was 49.3 years. The average age of education was 10.5 years, SD 2.8 (see Table 5.4).

Table 5.4

Demographic Profile of Participants

Demographic characteristics	***n* = 20** **Healthy participants**	***n* = 10** **Patients with stroke**
Mean Age	33.1(*SD* = 10.8)	49.3 (*SD* = 9.3)
Sex	60% of Males	30% Males
Mean Years of Education	12.7 (*SD* = 2.8)	10.5 (*SD* = 2.8)

5.8.3 Materials

5.8.3.1 Difficult Indices. Participants' difficult index scores on BCoS items that were collected from Study 1.

5.8.3.2 The Delphi Template for BCoS Test Adaptation. We adopted the Delphi approach to garner consensus on difficult (inappropriate) items in the original BCoS and substituted items through the expert panel. The Delphi approach is a method of brainstorming that is widely used for research. It involves the systematic collection of information on a subject area from a pool of experts for them to reach a consensus (Fish & Osborn, 1992; Vijayaraghavan et al., 2002). We designed a questionnaire template to facilitate the Delphi process (see Appendix D2). The questionnaire had multiple-choice questions, ratings, and a list of suggested alternatives to substitute culturally inappropriate items.

5.8.3.3 Cognitive Debriefing Interview Guide. The interview guide was a qualitative questionnaire asking the participant of their experiences of taking the test. It contained questions such as, 'How was it like taking the test? Which items were challenging and why?' Using this interview guide, the examiners also gave their impression of administering the test as well as their perception of participant experiences (see Appendix E for the cognitive debriefing interview guide). All this data was used for amending the BCoS to be culturally more sensitive.

5.8.4 Procedures

5.8.4.1 The Delphi Procedure. To conduct the Delphi technique, the PI identified and approached the expert panel members individually. The objectives of the Delphi expert panel process were explained through face-to-face or telephone call communication and an accompanying email to all panelists.

Initially, the task of the expert panel was to recommend alternatives to the identified culturally unfamiliar items by completing the Delphi template (see Appendix D) and to recommend simple, concise words and items suitable for use on Zimbabwean patients while considering participants' education, socioeconomic status, age and gender. To do that the expert panel took into consideration the meaning and context of the BCoS items in the original English culture and sought to find their semantic, cultural, and functional equivalents in the Shona culture. For instance, each panelist had to come up with four options to replace the word ‘hitchhiking’. Each member of the expert panel independently rated the four suggested items (number 1- 4) in terms of appropriateness, i.e. suitability and relevance. In the first two rounds, opinions on suggestions of alternative words, stimuli and wording were collected from the experts individually.

Feedback was given to the panel on each round, and again, panelists independently gave their ratings. Finally, an expert panel meeting was convened to discuss challenges identified in the items, iron out discrepancies on the amendments and agree upon the best options for substituting the culturally inappropriate items. A consensus threshold of 70% was used to determine the agreement of item choices (Ferguson et al., 2005), that is, an item was only accepted if it achieved a ≥ 70% agreement among the panelists for cultural relevance and appropriateness. Following the expert panel discussion, each member independently rated any disputed items again until consensus was reached

The amended BCoS was then evaluated for reliability. To determine the stability over time of the translated tests; test-retest reliability of BCoS, we tested a convenience sample of 20 healthy participants and ten stroke patients on the adapted BCoS in a quiet room. We conducted a repeated measure on 18 of these healthy participants that we could track and all the stroke patients. We used qualitative methods to gather participants’ perceptions and subjective experiences of taking the BCoS test (Beatty & Willis 2007; Hingorjo & Jaleel, 2012). To achieve this, we administered the interview guide to the healthy participants, patients with stroke and each examiner. Figure 5.1 shows the Delphi stages through which consensus on BCoS item appropriateness and replacements was arrived at.

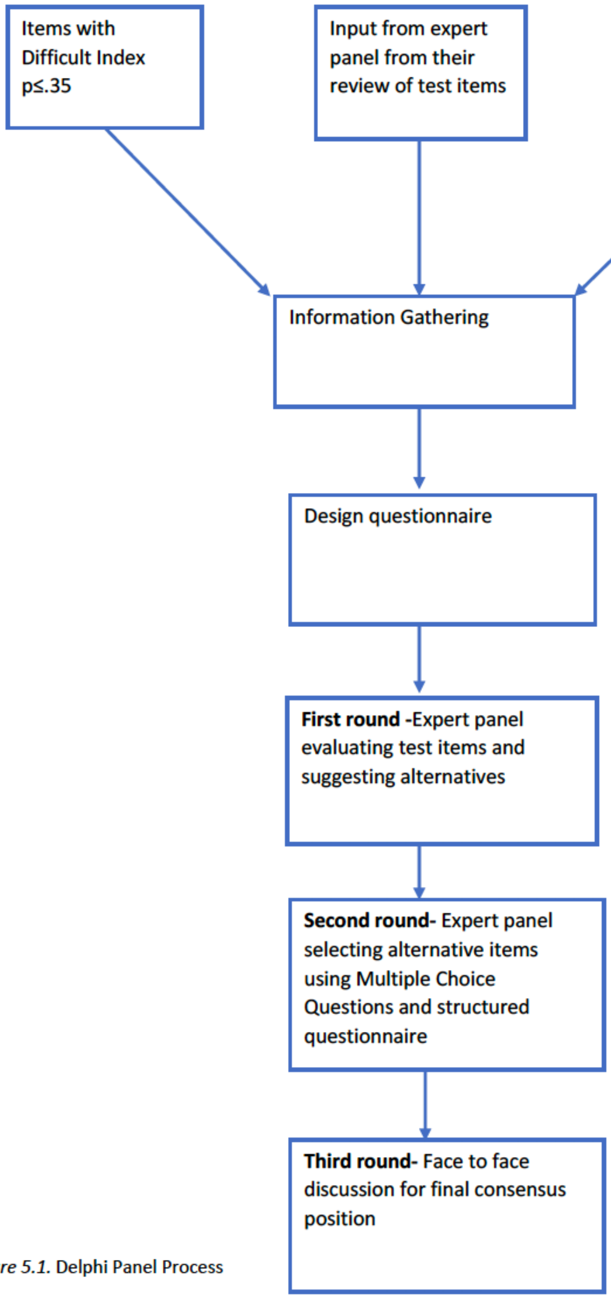

Figure 5.1. Delphi Panel Process

5.9 Data Analysis

We calculated the level of consensus from the Delphi expert panel for ratings of each BCoS item. We also calculated interrater reliability. Interrater reliability evaluates the agreement among raters which also indicates whether the dimensions evaluated by a test assess what they purport to assess (Fleiss et al., 1981). Perfect correlation is indicated by 1, and the higher the correlation, the closer the coefficient is to 1 and a p-value which is higher than .05. To determine interrater reliability, we used two qualitative BCoS tasks (the Sentence Construction and Figure Copy tasks) which required raters to make subjective judgements for their scoring. We randomly selected ten examinee scripts and asked three raters to independently score these two tasks using instructions from the BCoS test manual. The scores were compared against each other using Intraclass correlation analyses to assess the agreement of raters. Following the translation and amendment of some BCoS instructions and terms, we evaluated the agreement between the translated and adapted Zim-BCoS version with the original English BCoS version using Intraclass Correlation (ICC).

We also evaluated test-retest reliability, that is, the stability of the translated and amended BCoS test over time. To determine test-retest reliability, we compared the agreement between Zim-BCoS subtask score from Time 1 and Time 2 mean time for each task using Pearson's *r* correlation analyses. We used Bonferroni corrected p-values which are useful to control multiple analyses (see results section for specific details).

5.10 Study 2 Results

We used the results from the expert panel interviews to make the Zimbabwean version of BCoS. We named this cross-culturally adapted BCoS from the Delphi process, the Zim-BCoS. Feedback from the cognitive debriefing interview indicated that overall, the BCoS tasks were easily understood. However, we found that some items, particularly on language processing tasks were unfamiliar in Zimbabwe and required modifications. Figure 5.1 shows a summary of the Delphi process and the rest of the changes are presented in Table 5.5. The expert panel made the following changes to all items with difficulty indices below the cutoff score of .35.

Sentence Reading task word replacement. The word viscount is an old English word that had a difficulty index of 0.02. To replace the word 'viscount', the expert selected another irregular word, ‘lieutenant' to maintain that as one of the difficult items on the test. This replacement is in line with similar tests like the National Adult Reading Test (Bright et al., 2002) and the Wide Range Achievement Test-Word Reading which also contain phonetically irregular words of the different frequency of use to evaluate the premorbid function and reading level (wrat 3; Snelbaker et al., 2011).

Amendments to the Picture Naming task images. Five of the images on the picture naming task were replaced with local items of similar familiarity and/or use. The image of the chisel was elongated to modify its handle so that it resembles chisels commonly used in Zimbabwe. Raspberries are not a common fruit in Zimbabwe. The picture of raspberries was substituted with the picture of mulberries instead. The colander is also not a common kitchen utensil in Zimbabwe. The panel recommended the replacement of the picture of a colander with a ‘sieve’ instead. The expert panel also recommended the replacement of the unfamiliar leek with a more common vegetable in Zimbabwe, an onion, which are a local substitute with relatively the same difficulty level. The participants mistook the stopwatch for a scale. This is because the picture closely resembles scales that are used in local butcheries or infant clinics. The panel recommended that the picture be modified by adding features to make it look more like a watch, such as adding clock figures 12, 9, 6 and 3, an hour and a minute hand (see Table 5.5 for content changes). The picture of a tiger was inappropriate since Zimbabweans are not familiar with tigers. An image of a cheetah was used as a substitute instead.

Replacement of the Gesture Production task. There is a praxis task that requires participants to pantomime the gesture of hitchhiking. This is an unfamiliar activity in Zimbabwe. The task was replaced with the gesture for money (rubbing one's forefinger against the thumb).

Table 5.5
Summary of Content Changes and the Difficult Indices

Item	Comments	Alternative	Initial difficult index	Difficult index after amendments
Colander	Unfamiliar	Sieve/strainer	0.34	0.48
Leek	Not a common vegetable in Zimbabwe.	Onion	0.03	0.89
Stopwatch	Confused with baby weighing scale and butchery scale	Scale	0.13	0.86
Tiger	Unfamiliar, too many varied responses including cheetah, lion, leopard, hyena	Cheetah	0.32	100
Chisel	Too varied responses including knife and potato peeler	Shovel	0.31	0.97
Raspberry	Unfamiliar	Mulberry	0.09	0.4
Viscount	Unfamiliar	Colonel	0.19	0.48

Inter-rater reliability. We checked interrater reliability by comparing individual ratings of three independent raters on the ratings that they did on two qualitative BCoS tasks. The intraclass correlation coefficient between the three raters was 0.999, indicating excellent reliability. There was a statistically significant positive correlation between each raters' ratings (see Table 5.6).

Table 5.6

Interrater Reliability

	Rater 1	**Rater 2**	**Rater 3**
Rater 1	1.00	0.999	0.997
Rater 2		1.00	0.997
Rater 3			1.00

Note. Data presented are Pearson's r correlation coefficients. All *p*-values < .001.

Test-retest reliability of BCoS Test

To determine the stability of the test over time, we conducted repeat measures on 18 healthy participants and 10 patients with stroke that we could follow up. We pooled the scores of these two groups to increase power. We calculated Pearson's Product-moment correlation to determine the strength of the correlation between the initial and follow up scores of the combined group. There were statistically significant correlations between scores at initial testing and follow up scores for 21/28 (75%) of Zim-BCoS tasks.

Attention and Executive Function subtests. Auditory Attention (Auditory Attention $r(26) = .58$, $p < .003$, Rule Finding $r(26) = .62$, $p < .002$, Apple Cancellation $r(26) = .90$, $p < .001$, Visual $r(26) = 51$, $p < .007$ and Tactile Extinction $r(26) = .42$, $p < .034$). The only task that was not statistically significant was the unilateral and bilateral visual extinction test $r(26) = -.56$, $p < .783$.

Performance on the Language domain

All the Language domain subtests had statistically significant correlations between the initial and follow up test. The Picture Naming task was $r(26) = .68$, $p < .001$, the Sentence Construction task $r(26) = .54$, $p < .004$, Sentence Reading $r(26) = .85$, $p < .001$, Nonword Reading $r(26) = .51$, $p < .006$ and the Writing Word/nonword was $r(26) = .50$, $p < .007$.

Performance on the Memory domain

On the Memory domain, the following tasks had statistically significant correlations between the initial and follow up test; Orientation to Personal Information was $r(26) = .62$, $p < .001$and the and Immediate Recall task was $r(26) = .68$, $p < .001$. There was no variation on the Orientation to Personal Information task. However, the correlation was not statistically significant for both the delayed recall tasks, that is, the Delayed Recall task, $r(26) = .27$, $p < .17$ and Task Recall test was $r(26) = .25$, $p < .19$.

Performance on the Number Skills Domain

The Number Writing and Reading tests were well correlated between the initial and follow up time; Number Price/time Reading was $r(26) = .48$, $p < .012$ and Number/Price Writing was $r(26) = .4$, $p < .028$. However, the Calculation scores were not statistically significant $r(26) = .27$, $p < .181$.

Performance on the Praxis and Action Domain

On the Praxis domain, scores for the two out of five tasks, that is, the Figure Copy and the Gesture Imitation Tasks were well correlated between the initial and follow up tests: Complex Figure Copy was $r(26) = .46$, $p < .0.20$ and Gesture Imitation was $r(26) = .69$, $p < .001$. The other three tasks were not statistically significant: The Multiple-step Object Use task was $r(26) = .25$, $p < .227$, Gesture production was $r(26) = -.01$, $p < .95$ and the Gesture recognition task was $r(26) = .22$, $p < .27$. (see Table 5.7 below).

Table 5.7

Test-Retest Reliability of BCoS test

BCoS Test			***Patients and Controls combined***	
			r	*p*
Attention and Executive Functioning				
	Auditory Attention		.577	.003*
	Rule Finding		.623	.002*
	Apple Cancelation		.904	< .001**
	Visual Extinction			
		Left U	.952	< .001**
		Right U	-.055	.783
		Left B	.510	.007*
		Right B	.605	.001**
	Tactile Extinction			
		Left U	.970	< .001**
		Right U	.554	.003*
		Left B	.992	< .001**
		Right B	.418	.034*
Language				
	Picture Naming		.678	< .001**
	Sentence Construction		.537	.004*
	Sentence Reading		.849	< .001**
	Reading Word/nonword		.512	.006*
	Writing Word/nonword		.504	.007*
Memory				
	Orientation Personal Information		-	-
	Orientation Time and Space		.621	.001**
	Immediate Recall		.681	< .001**
	Delayed Recall		.273	.168
	Task Recall		.254	.192
Number Skill				
	Reading Number Price/Time		.476	.012*

	Writing Number/Price	.424	.028*
	Calculation	.265	.181
Praxis and Action			
	Complex Figure Copy	.462	.020*
	Multiple-step Object Use	.251	.227
	Gesture Production	-.013	.950
	Gesture Recognition	.215	.272
	Gesture Imitation	.686	<.001**

Note. *p < 0.05 at conventional level of significance. **p < 0.002, significant at the Bonferroni corrected level.

Internal consistency reliability BCoS

Shona/English version agreement. The level of agreement between the Shona and the English version was very high with kappa exact score percentage agreement ranging from 74.1% to 100% at 95% confidence interval (see Table 5.8). Specifically, there was perfect agreement on both versions for the following tasks: Orientation to personal information, time and nosognosia, Visual extinction left and right unilateral, as well as bilateral and on Number Writing tasks. There was an excellent correlation on the Auditory task. There was moderate correlation on the following tasks: Picture Naming, Non-word Reading, Rule Finding, Gesture Production, Meaningless Gesture Imitation, Task Recall, Word Writing, Number Reading and Complex Figure Copy.

We then used the Wilcoxon sign test to evaluate the within-subject design. The Wilcoxon signed-rank test indicates that there was no statistically significant difference between the English version and the Shona version of the BCoS for all tasks except two, the multiple-step object and the Visual Extinction Right Bilateral tasks both with values of .04.

Table 5.8
BCoS English/Shona version agreement

BCoS tasks	Pearson Correlation- r	p-value	Wilcoxon z-value	p-value	Exact score agreement (Kappa)
Orientation personal	Ceiling		.	.	100
Orientation Time	100		.	.	100
Orientation Nosognosia	Ceiling		.	.	100
Picture Naming	.59	.01*	-1.010	.31	86.1
Sentence construction	-0.16	.53	.87	.39	80.6
Sentence Reading	.26	.29	.33	.75	86.1
Nonword reading	.49	.03*	.71	.48	63.7
Immediate recall	.23	.35	.93	.35	76.7
Apple Cancellation	-0.03	.9	.88	.38	75.0
Visual Extinction left Unilateral	Ceiling	Ceiling	1.000	.32	94.4
Visual Extinction Right	Ceiling	Ceiling	Ceiling	Ceiling	100
Visual Extinction left Bilateral	Ceiling	Ceiling	.51	.61	88.9
Visual Extinction Right Bilateral	Ceiling	Ceiling	.04	.98	94.4
Tactile Extinction left Unilateral	Ceiling	Ceiling	.58	0.56	83.33
Tactile Extinction Right Unilateral	Ceiling	Ceiling	-1.731	0.08*	86.1
Left Extinction left Bilateral	Ceiling	Ceiling	1.414	.158	88.9
Tactile Extinction Right Bilateral	Ceiling	Ceiling	-1.414	.61	88.9
Rule finding	.67	.00**	.42	0.68	78.2
Auditory	.98	.00**	-1.59	.11	87.8
Delayed recall	-.10	.07	.69	.49	77
Multiple step	.40	.09	.04	.97	63.4
Gesture production	.51	.03*	-1.73	.08*	90.7
Gesture recognition	.33	.17	-1.134	.26	81.5
Meaningless gesture	.73	.00**	.22	.83	85.6
Task recall	.71	.00**	.50	.62	88.9

Word writing	.74	.00**	3.57	.00**	94
Number reading	.52	.02*	3.755	.00**	87.0
Number writing	Ceiling	Ceiling	-1.000	.32	94.4
Calculation	-0.10	.68	.57	.57	74.1
Figure copy	.51	.03*	-0.2	.84	79.9

Note. **p* < 0.05at conventional level of significance. ***p* < 0.002, significant at the Bonferroni corrected level

5.11 Discussion

The primary aim was to amend BCoS items to make them more culturally suitable. We constituted an expert panel and used the Delphi approach to suggest culturally appropriate alternatives. We calculated consensus percentages to determine expert agreement on each proposed amendment and accepted items when they had > 70% consensus. The secondary aim was to determine the test-retest and inter-rater reliability of the adapted Zim-BCoS and to evaluate the agreement of the Shona translation and original English version.

All culturally inappropriate items were from the Language domain. These unfamiliar items, for instance, terms such as 'hitchhiking' and Picture Naming images such as the picture of a colander and tiger were similarly replaced in the Chinese study (Pan et al., 2015).

The interrater reliability was excellent, meaning that there was no significant difference among the three raters who rated the two qualitative BCoS subtests. This finding is consistent with previous BCoS validation studies where there was good agreement among multiple raters (Pan et al., 2015; Kuzmina et al., 2017).

The overall correlation of the test-retest reliability was good. Out of the 29 tasks assessed, 23 of them (79%) showed stability of the retest period. The level of agreement between the English and adapted Shona versions was good meaning that the adaptation and translation were closely matching the original version. Both these findings are similar to those of previous studies on a Chinese sample (Pan et al., 2017). However, six of the tasks which had weak correlation may be explained by possible changes in the patients' cognitive abilities. It is possible that since patients were initially tested in the acute phase, they may have regained their function. The weak correlation may, therefore, be attributed to the resolution of cognitive deficit, and not to the flaws in the test.

These findings demonstrated that although the BCoS is overall a robust neurocognitive screen, some modifications are crucial when administering it cross-culturally. However, we note that most of these amendments were largely contextual and minor content changes. These findings could be attributed to the fact that BCoS has little language loading (Humphreys et al., 2012; Vordenberg et al., 2014).

Cognitive debriefing indicated that all items in the adapted version were understood and culturally acceptable. Our findings support previous indications that BCoS is a promising tool for detecting neurocognitive deficits for patients with neurologic conditions (Bickerton, et al., 2012; Humphreys et al., 2012; Chan et al., 2013; Kuzmina et al., 2017; Pan et al., 2015).

5.12 Conclusion

In this study, we evaluate the cross-cultural robustness of the BCoS. The output of this study is that we offer a culturally adapted BCoS version, which can be used to assess cognitive deficits for clinic and research purposes on neurological patients in Zimbabwe. Besides, we describe ways of translating and evaluating cross-cultural sensitivity as well as the cross-cultural adaptation of research and clinical tests. Hopefully, it will inspire more work in test adaptation and development. We also improved test instructions and made contextual alterations to some BCoS items to enable us to administer the screen on a Zimbabwean sample. Our findings are consistent with previous studies (Pan et al., 2015; Kuzmina et al., 2017. Currently, there is no culturally relevant test for assessing cognitive impairment in Zimbabwe. To our knowledge, this is the first cross-cultural adaptation of a neurocognitive instrument in Zimbabwe.

5.13 Limitations of this study

The major weakness of this part of the study is that we only translated test instructions and not the whole test. The complete translation of the test would require evaluation of psychometric properties for each test item which was beyond the scope of this thesis. The other shortcoming was that we used non-probability convenience sampling for recruiting participants. While convenience sampling is useful in limited-resource settings, it may introduce sampling bias (Eitikan et al., 2016). Future studies can utilise more rigorous methods such as Randomized Control Trials.

Another limitation is that the sample size was very small. Similar sample sizes have been used for this aspect in previous studies (Pan et al., 2015 & Kuzmina et al., 2017). In addition, it was noted that the there is very little variability on this cognitive task, especially among healthy participants. This is likely to be the explanation to the poor reliability on the retest. A larger sample size should be used in future studies.

Chapter 6: Regression-based norms for Zim-BCoS

"Robust normative standards simply refer to the use of as neurologically normal individuals as possible to provide standards of comparison": (Casaletto, & Heaton, 2017p.3).

Abstract

In neuropsychology, normative data is useful for putting a numerical score into a contextual perspective so that it can be interpreted meaningfully. Norming can be done using either mean based or regression-based methods. Our objective was to generate regression-based normative data on the translated and adapted Zim-BCoS instrument. We administered the Zim-BCoS on a sample of 412 cognitively intact community-dwelling individuals. We evaluated the effects of demographic variables on each of the Zim-BCoS task scores using multiple linear regression analyses. We computed normative data for each Zim-BCoS task and compared this data against previously published BCoS data. Our findings indicate that all the tasks under the language domain (Picture Naming, Sentence Construction/Reading, Word/Non-Word Reading/Writing & Instruction Comprehension & Sentence Construction) were affected by the demographic factors that were factored in (age, gender and level of education) while the Praxis domain was least affected. Zim-BCoS participants had on average relatively lower performance scores compared to the other published BCoS scores in other countries on most tasks, although the difference in performance was in some cases not statistically significant. Zim-BCoS participants performed higher than published norms on two tasks, (Sentence reading & Immediate Story Recall) compared to Russian and Cantonese BCoS participants respectively. Overall, Zim-BCoS participants performed lower than the previously published norms on 83.5% of the tasks. The differences in performance in the various samples highlight the need to generate normative scores that are specific to the population being assessed.

Keywords: Birmingham Cognitive Screen, Normative scores, Regression-based norms, Zimbabwe

6.1 Introduction to normative data

Neurocognitive tests are used to make important decisions about people. For instance, they are useful in determining whether or not a person has impaired cognitive function (Aart & Oosterhuis, 2017). However, a person's score on a test is meaningless unless it is compared against some standard so that the interpretation becomes meaningful. The normative approach helps put an individual's performance into perspective by comparing that performance against fellow individuals with similar demographic profiles. The normative approach assumes that performance on most cognitive domains conforms to the bell-shaped curve, also known as the Glaussian normal distribution (see Figure 6.1). In this curve, the position of any obtained score indicates whether the performance is close to the centre where the majority of scores in a normal distribution fall or is abnormal and falls at one of the two extreme tails of the bell shape (Strauss et al., 2006).

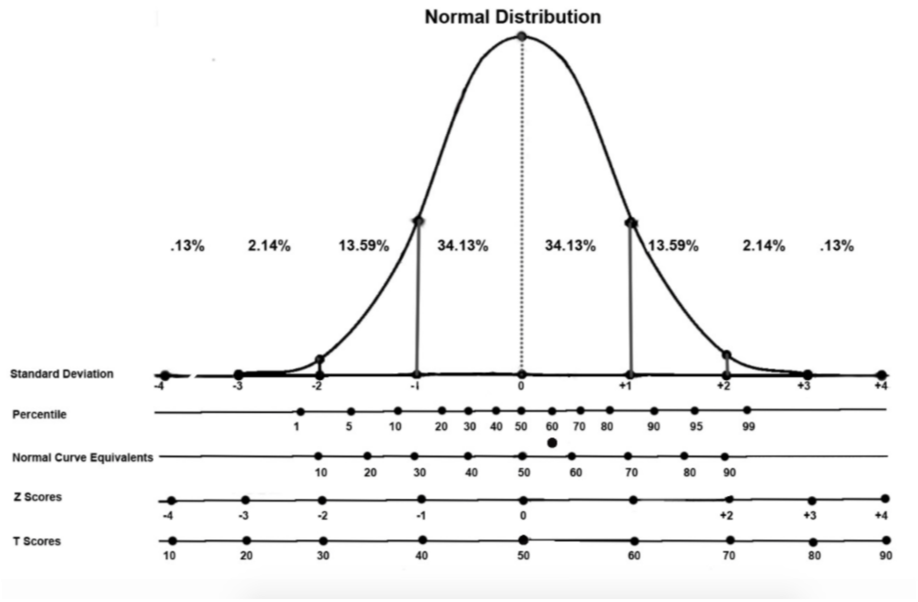

Figure 6.1. The normal distribution curve.

For neurocognitive data to be informative, the scores need to be judged against normative scores that are representative of the target population (Kline, 2000). Key demographic variables that are known to affect performance on the cognitive domain under analysis should be accounted for. In neurocognitive testing, the primary demographic variables that are usually controlled for are age, gender and level of education (Crawford & Allan, 1997). Currently, there are two standard methods of generating normative data, that is, using the traditional mean-based norms or the regression-based norms.

6.2 The Traditional Mean-Based Method of Generating Norms

The traditional method of norming entails generating norms using raw scores, means and standard deviations and considering one or two demographic variables. For continuous data such as age and number of years of education, the data is categorised into different strata such as age bands. The advantage of the traditional means based normative method is that it is simple. However, there are challenges to using these traditional mean-based norms (Aart & Oosterhuis, 2017). For example, the performance of individuals at each end of the same age-band may be different. For instance, in two age bands (e.g., 0 to 5 years and 6 to 10 years) individuals aged 5 and 6 years may have many similar characteristics even though they belong to different age bands. Likewise, a 6-year-old individual and a 10-year-old individual may have very different performance profiles even though they are in the same age band. Another challenge in using this method is that information is not useful in situations where data is not normally distributed or where there is variation between the normative sample mean/standard deviation and the true population (Parmenter, Testa & Schretlen, 2010). Besides, this method requires that each cell have a minimum sample size; hence the normative sample has to be reasonably large, which requires more resources.

6.3 The Regression-Based Method of Generating Norms

An alternative to the mean-based norms model is to derive continuous norms using the regression equation-based normative method (Parmenteret al., 2010). Here the continuous variable is not categorised into cells. Instead, data is treated individually as continuous norms. The magnitude of the effect of each predictor variable (mostly demographic) is assessed first, and predictors with non-significant effects are deleted from the regression equation. In this method, variables with a quadratic effect (where a variable interacts with itself) can also be assessed. This approach minimizes the bias that may introduced by demographic variables such as age, education and gender (Crawford & Allan, 1997).

Overall, regression-based norms are more robust compared to mean-based norms. While mean-based methods are simple, they are limited in that data is stratified into categories (for example, into age bands). These norms are more robust than mean-based norms. For instance, they are better at controlling generational effects. In this study, we aimed to develop regression-based norms for Zim-BCoS, a version of the BCoS (Humphreys et al., 2012) that we adapted for use in Zimbabwe. We aimed to answer the following research questions:

1. Which demographic variables have a significant influence on cognitive performance on Zim-BCoS?

2. What are the regression-based norms for Zim-BCoS on a Zimbabwean population when adjusted for age, gender and education level?

3. Is there a significant difference between the previously published UK, Cantonese, Rus-BCoS and Zim-BCoS means?

6.4 Methods

6.4.1 Research Design

We adopted a quantitative research paradigm utilizing the multi-centre cross-sectional research design which has been used widely for normative studies (see De Vos et al., 2011).

6.4.1.1 Sample size calculation. To determine the appropriate sample size, we used the classical estimation, where we assumed massive population sizes (Arrufat, Guàrdia-Olmos, & Blanxart, 1999). Here, we assumed maximum uncertainty ($\pi = 0.5$) at a confidence interval of 95%:

$$n = \frac{Z_{\frac{\alpha}{2}}^{2} \cdot \pi \cdot (1 - \pi)}{e^{2}}$$

The range of the maximum error (e) of sample sizes was from 0.001 (n = 960,400) to 0.060 (n = 267). Table 6.1 shows the calculated maximum error (*e*) and levels of accuracy for the different sample sizes. For our normative study, we selected a sample size with an e = .05, accuracy level = 95%, and a confidence interval of 95% (*N* = 384). We oversampled slightly and collected data from 412 participants. We used non-proportionate quota sampling and looked for a symmetrical distribution for strata of age, gender and education level.

Table 6.1
Sample Size Calculation

Maximum error(e)	**Accuracy level**	n_i **(Approx.)**
0.001	99.9%	960,400
0.020	98.0%	2,401
0.030	97.0%	1,067
0.040	96.0%	600
0.050	95.0%	384
0.055	94.5%	317
0.056	94.4%	306
0.060	94.0%	267

6.4.1.2 Participants. The sample comprised of 412 healthy individuals (Females = 177(43%), Males = 235(57%), age range = 18 - 75 years, Mean age = 36.9 (*SD* = 14.4), who met the inclusion criteria for the study after being screened for conditions that might influence cognitive performance (see Appendix C1). Participants were recruited from four research sites, two tertiary referral hospitals (Parirenyatwa and Harare Hospitals), a local university (University of Zimbabwe) and a Private Clinical Psychology Practice. Participants were normal 'care-givers' accompanying patients to the hospital. Participants' levels of education were determined by the number of years in formal education. Hence the participants were stratified into Low level of education (0 -7 years), Average level of education (8 - 13 years) and High level of education (more than 13 years). There were 44 participants (12.9%) with primary level education, the majority (60.1%) with a high school education, and 26.0% with a tertiary education. Data frequencies and proportions were reported for ordinal and nominal categorical variables (age, gender, education, language & handedness). See Table 6.2 below.

Table 6.2
Sample Distribution by Age, Gender and Education Level

		Mean	***SD***
Age		36.9	14.4
Years of Education		12	3.4
		Frequency	**%**
Education Level	0 to 7	44	13.9%
	8 to 13	251	60.1%
	> 13	117	28.4%
Gender	Female	177	43%
	Male	235	57%
Language	Shona	406	98.5%
	Ndebele	6	1.5%
Handedness	Right	395	95.9%

	Left	17	4.1%

6.4.2 Materials

6.4.2.1 Screening Form. We used a comprehensive self-reporting questionnaire to exclude potential participants with a history of conditions that would compromise cognitive functioning. These conditions included individuals with a history of a head injury, brain tumour, previous stroke or being unconscious for more than 10 minutes at any one time, memory or thinking problems, dependence on ADLs, meningitis, Asperger's syndrome, motor neuron disease, Huntington's or Parkinson's disease, Encephalitis, psychiatric conditions such as Schizophrenia, Dementia or substance abuse. This form included a section to collect participants' demographic characteristics, including age, gender, education level and handedness.

6.4.2.2 Consent Form. The consent form (Appendix D) contained a brief description of the study, the procedures, its duration and gave potential benefits or possible harm that could arise from taking part in the study. We clarified that the study was voluntary and that participants could opt-out at any point if they decided to discontinue.

6.4.2.3 Zim-BCoS. We used our version of BCoS (Zim-BCoS) to assess participants' cognitive capacities. A full description of the screen was given in Chapter Five. During performance on the screen, the examiner administers the test, and the participant gives verbal, written and gesturing responses depending on test demands. Each cognitive task is scored separately in the examiner and examinee booklets (Appendix G2)

6.4.3 Procedures

6.4.3.1 Data collection. We explained the procedures of the research to potential participants and screened them for inclusion using the socio-demographic form. Those people who agreed to participate signed the Informed Consent form (Appendix D). Neuropsychological testing of each participant was conducted individually in a quiet room at the various research sites.

6.4.3.2 Ethics. Consideration of ethics procedures was in line with the provisions from the Helsinki declaration on the ethics standards for human research. Other ethical considerations were detailed in the previous chapters. Data were de-identified by using only the anonymous participant identity number (ID), and the data manuscripts were kept in a locked room in the Psychology Department at the University of Zimbabwe to maintain confidentiality and anonymity. Electronic data was stored on computers encrypted with passwords which were only accessible to members of the research team.

6.4.4 Statistical Analyses

6.4.4.1 Preliminary Analysis. We scrutinized the data and removed outliers which constituted 0.001% to avoid the risk of skewing the data. These outliers could have been due to errors or variability in the data (Broeck et al., 2005). We also screened out cases lacking crucial data. For instance, two participants were excluded because of insufficient demographic data that was critical for the analysis.

6.4.4.2 Descriptive Statistics for Demographic and Zim-BCoS Variables. We calculated means and standard deviations for continuous variables (age, years of education and all Zim-BCoS subtask variables). Frequencies and proportions were calculated for ordinal and nominal categorical variables (gender, education, language and handedness).

6.4.4.3 Inferential Analyses. The Zim-BCoS task scores were computed separately to evaluate the effects of sociodemographic variables on cognitive performance. We used multiple linear regression analyses to evaluate the effect of demographic variables on each of the Zim-BCoS task scores. The full regression models included as predictors were; age, age^2, level of education, gender, and all two-way interactions between these variables. Age was centred (= Age – average age of the sample ≅ 36.9) before computing the quadratic age term to avoid multicollinearity (Rivera et al., 2019). Multicollinearity means that the predictors in a regression model are highly correlated, which leads to inflated standard errors for the regression weights and erroneous p-values. Level of education was dummy coded with two dummies, average Level of Education, High Level of Education and Low Education as the reference category (LE average, LE high and LE low). Gender was dummy coded as man = 1 and women = 0. The full regression model can be formally described as:

$$Y_i = B_0 + B_1 \cdot \left(Age - \bar{X}_{Age}\right)_i + B_2 \cdot \left(Age - \bar{X}_{Age}\right)_i^2 + B_3 \cdot LEmiddle_i + B_4 \cdot LEhigh_i + B_5 \cdot Gender_i + B_k \\ \cdot Interactions_i + \varepsilon_i.$$

In this case, the term ‘interactions’ refers to all two-way relationships/interactions between the fixed effects. The model assumes that the residuals ε_i are typically distributed with mean 0 and variance σ_ε^2, i.e., $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$. Independent variables that were not statistically significant in the multiple regression model were removed from the model, and the reduced model was fitted again. A Bonferroni-corrected alpha-level of 0.005 ($=0.05/10$) was used. In the stepwise model-building procedure, no predictor was removed as long as it was also included in a higher-order term in the model (Aiken &West, 1991).

6.4.4.4 Assumptions. For all multiple linear regression models, the following assumptions were evaluated:

a) Multicollinearity: multicollinearity was assessed by checking that the Variance Inflation Factor (VIF) was not greater than 10 and the collinearity tolerance values were not greater than 1 (Kutner et al., 2005)

b) Homoscedasticity: homoscedasticity was evaluated by grouping the participants into quartiles of the predicted scores and applying the Levene test on the residuals

c) Normality: we tested for normality of the standardized residuals by using Kolmogorov–Smirnov (KS) test (an alpha level of 0.01 was used in Levene and KS analyses)

d) Influential values: we tested for the existence of influential values by calculating the maximum Cook's distance in the sample. The maximum Cook's distance value was subsequently related to an $F(p, n-p)$ distribution, where p is the number of regression parameters (including the intercept) and *n* is the sample size. Influential values were considered when the obtained percentile value was equal to or higher than 50 (Kutner et al., 2005).

Using the final regression model obtained at the end of the stepwise procedure, normative data that were adjusted for demographic variables were established using a four-step procedure (Van Breukelen & Vlaeyen, 2005; Van der Elst et al., 2006a; Van der Elst et al., 2006b):

1. The expected test score $(Y^{\wedge}{}_{i})$ was computed based on the fixed effect parameter estimates of the established final regression model: $Y^{\wedge}{}_{i} = B_0 + B_1X_{1i} + B_2X_{2i} + \cdots + B_KX_{Ki}$.

2. To obtain the residual value (e_i), a subtraction between the raw score of the Zim-BCoS task (Y_i) and the predicted value previously calculated was performed $(Y^{\wedge}{}_{i})$, as shown in the formula: $e_i = Y_i - Y^{\wedge}{}_{i}$.

3. Using the residual standard deviation (SD_e) value provided by the regression model, residuals were standardized: $z_i = e_i / SD_e$.

4. Finally, the exact percentile corresponding to the z-score previously calculated was obtained using the standard normal cumulative distribution function (if the model assumption of normality of the residuals was met in the normative sample), or via the empirical cumulative distribution function of the standardized residuals (if the standardized residuals were not normally distributed in the normative sample). This four-step process was applied to the scores separately for each task. All analyses were performed using SPSS version 23 (IBM Corp., Armonk, NY).

6.4.4.5 Comparison of the Performance of Zim-BCoS against Previously Published Norms. To evaluate the performance of the BCoS across different cultures, we evaluated the Zim-BCoS normative data against the original UK BCoS norms and normative data derived from Russian and Cantonese translation and adaptation studies for the same screen. Means for the different samples were compared using independent sample t-tests (Kuzmina et al., 2017; Pan et al., 2015).

6.5 Results

Our main aim in this study was to determine the influence of socio-demographic characteristics on performance on BCoS-Zim. To do this, we evaluated the effects of demographic variables on each of the Zim-BCoS task scores using multiple linear regression analyses. We computed each of the Zim-BCoS task scores separately.

6.5.1 Descriptive statistics for Zim-BCoS subdomains

Means and standard deviations for all Zim-BCoS tasks were calculated separately. A summary of the descriptive analysis by score for all the BCoS subtasks is given in Table 6.3 below.

Table 6.3

Descriptive Analysis by Score

Zim-BCoS Test	**Minimum**	**Maximum**	**Range**	**Mean (*SD*)**
Auditory Attention	0.0	54.0	54.0	44.6 (13.8)
Rule Finding	0.0	38.0	38.0	9.4 (4.9)
Apple Cancellation	0.0	50.0	50.0	45.9 (7.7)
Visual Extinction	0.0	24.0	24.0	23.8 (1.7)
Tactile Extinction	0.0	24.0	24.0	23.8 (1.8)
Picture Naming	3.0	14.0	11.0	8.7 (2.2)
Sentence Construction	1.0	8.0	7.0	7.1 (1.5)
Sentence Reading	2.0	42.0	40.0	38.3 (5.3)
Sentence Reading Time	1.2	120.8	119.6	20.2 (12.3)
Reading Nonword	0.0	6.0	6.0	4.3 (1.8)
Nonword Reading- Time	1.7	68.0	66.3	8.7 (6.2)
Writing Word and Nonword	0.0	5.0	5.0	2.9 (1.6)
Instruction Compression	2.0	4.0	2.0	3.0 (0.2)
Orientation Personal Information	1.0	8.0	7.0	8.0 (0.4)
Orientation Time and Space	3.0	6.0	3.0	6.0 (0.3)
Immediate Recall	0.0	15.0	15.0	11.6 (3.0)
Task Recall	2.0	10.0	8.0	8.8 (1.5)
Number Price/Time Reading	0.0	9.0	9.0	8.3 (1.8)
Number/Price Writing	0.0	5.0	5.0	4.3 (1.4)
Calculation	0.0	4.0	4.0	2.8 (1.3)
Complex Figure Copy	7.0	47.0	40.0	41.8 (7.0)
Multiple-Step Object Use	1.0	12.0	11.0	11.7 (1.4)
Gesture Production	4.0	12.0	8.0	9.7 (1.9)
Gesture Recognition	1.0	6.0	5.0	5.4 (0.8)
Gesture Imitation	0.0	12.0	12.0	9.4 (2.5)
Anosognosia	2.0	3.0	1.0	3.0 (3.0)
Delay Recall	1.0	15.0	14.0	12.9 (2.4)

6.5.2 Generating Normative Data for Zim-BCoS

The assumptions of multiple linear regression analysis were met for all final models. There was no multicollinearity (the VIF values in all models were at most 9.940, and thus well below the threshold value = 10 that is indicative of multicollinearity; collinearity tolerance values did not exceed the value of 1) or influential cases (the maximum Cook's distance value was 0.764; relating this value to an $F_{(3, 376)}$ distribution yields percentile value of 49, which is below the threshold percentile value = 50 that is indicative for the presence of influential cases). The Levene test suggested that all models were heterogeneous except for the Rule Finding, Picture Naming, Gesture Imitation and Gesture Production subtests (see Table 6.4 below).

Table 6.4

Homoscedasticity, Normality, and Influential Values by Score

		Homoscedasticity		**Normality**		**Influential values**	
		Levene	*p*-value	K-S	*p*-value	Cook	Percentile
Attention & Executive Function	Auditory	7,715	<.001	2,839	<.001	0,116	0,01
	Rule Finding	1,659	.176	1,773	.004	0,043	0,00
	Apple Cancelation	7,284	<.001	2,994	0,000	0,764	0,49
Language	Picture Naming	1,536	.217	1,980	.001	0,042	0,01
	Sentence Reading	14,010	<.001	3,902	<.001	0,201	0,10
	Sentence Reading Time	5,598	0,001	2,389	<.001	0,177	0,05
	Reading Nonword	17,208	<.001	2,898	<.001	0,053	0,00
	Reading Nonword-Time	6,723	<.001	3,094	<.001	0,129	0,01
	Writing Word & Nonword	9,252	<.001	2,232	<.001	0,124	0,01
	Instruction Comprehension	44,677	<.001	5,018	<.001	0,135	0,06

Memory	Task Recall	9,828	<.001	3,619	<.001	0,081	0,01
Number Skill	Number/Price Writing	57,967	<.001	6,794	<.001	0,043	0,01
	Calculation	7,486	.001	3,571	<.001	0,027	0,01
Praxis & Action	Complex Figure Copy	7,311	.001	2,354	<.001	0,093	0,04
	Gesture Imitation	1,267	.283	2,321	<.001	0,052	0,02
	Gesture Production	0,951	.416	1,180	.123	0,050	0,00

The effect of gender, age and education level was evaluated. Table 6.5 (below) shows the final regression model. Table 6.6 (below) gives a summary of the effect of sociodemographic variables on each subtask of Zim-BCoS' five cognitive domains.

Table 6.5

Summary of Demographic Predictor Variables

Zim-BCoS Task		**Regression equation**
Attention & Executive Function	Auditory	41.727 – (0.236 x Age) – (0.013 x Age^2) + (5.699 x L.E. Average) + (7.283 x L.E. High)
	Rule Finding	9.305 – (0.092 x Age)
	Apple Cancelation	47.150 – (0.053 x Age) – (0.006 x Age^2)
Language	Picture Naming	7.195 + (1.261 x L.E. Average) + (2.454 x L.E. High)
	Sentence Reading	35.733 + (2.467 x L.E. Average) + (3.432 x L.E. High)
	Sentence Reading Time	21.031 + (0.457 x Age) – (0.68 x Sex) + (0.278 x Age*Sex)
	Reading Nonword	2.091 + (2.618 x L.E. Average) + (2.862 x L.E. High) + (1.659 x Sex) - (2.17 x L.E. Average*Sex) - (2.178 x L.E. High*Sex)
	Reading Nonword-Time	7.777 + (0.171 x Age) + (0.004 x Age^2) + (0.390 x Sex) – (0.180 x Age*Sex)
	Writing Word & Nonword	1.735 – (0.027 x Age) + (1.452 x L.E. Average) + (1.928 x L.E. High) – (0.396 x Sex)
	Instruction Comprehension	2.816 – (0.004 x Age) + (0.153 x L.E. Average) + (0.164 x L.E. High)

Memory	Task Recall	8.143 + (1.012 x L.E. Average) + (1.373 x L.E. High) – (0.555 x Sex)
Number Skill	Number/Price Writing	2.951 + (1.366 x L.E. Average) + (1.758 x L.E. High)
	Calculation	1.780 + (1.100 x L.E. Average) + (1.365 x L.E. High)
Praxis & action	Complex Figure Copy	41.846 – (0.159 x Age)
	Gesture Imitation	4.829 + (0.623 x L.E. Average) + (0.820 x L.E. High)

Notes: L.E. Average and L.E. High refer to llow and high level of education respectively

The effects of the demographic variables, age, gender and level of education on each of the BCoS tasks are summarized in Table 6.6. below.

Table 6.6

Summary of Demographic Effects on Zim-BCoS Tasks

Zim-BCoS Domain	Task by domain	Age	Age2	LEAverage	LE High	Sex	Age x sex	L.E. A. X-Sex	L.E. H. X Sex
Attention & Executive Function	Auditory	*	*	*	*				
	Rule Finding	*							
	Apple Cancellation	*	*						
	Visual Extinction								
	Tactile Extinction								
Language	Picture Naming			*	*				
	Sentence Construction								
	Sentence Reading			*	*				
	Sentence Reading- Time	*				*	*		
	Reading Nonword					*	*	*	*
	Reading Nonword- Time	*	*			*	*		
	Writing Word & Nonword	*		*	*	*			

	Instruction Comprehension	*		*	*
Memory	Orientation				
	Story Recall				
	Task Recall		*	*	*
Number Skill	Number Price/Time Reading				
	Number/Price Writing		*	*	
	Calculation		*	*	
Praxis & Action	Complex Figure Copy	*			
	Multi-Step Object Use				
	Gesture Production				
	Gesture Recognition				
	Imitation		*	*	

Notes: L.E. Average and L.E. High refer to llow and high level of education respectively

6.5.3 Effects of Demographic Variables on Zim-BCoS Attention and Executive Function Domain

The Attention and Executive Function domain was assessed by the Auditory, Apple Cancellation and Rule Finding tasks. The final multiple linear regression models for Attention and Executive Function were significant (see Table 6.7 below). The predicted values for Age negatively influenced all scores. The Auditory and Apple Cancellation scores were affected by a quadratic age effect while the Rule Finding scores decreased linearly as a function of age. Level of education also positively influenced Auditory and Rule Finding scores, such that those with a high level of education scored higher compared to people with a low level of education. The amount of variance explained by these predictors in the Attention and Executive Function scores ranged from 7.7% (Rule Finding) to 31.8% (Auditory).

Table 6.7

Final Multiple Linear Regression Models for Zim-BCoS for the Attention Domain

Score		B	Std. Error	β	*t*	Sig.	R^2
Auditory	(Constant)	41.727	2.247		18.570	<.001	0. 318
	Age	-0.236	0.055	-0.244	-4.302	<.001	
	Age^2	-0.013	0.003	-0.282	-5.022	<.001	
	L.E. Average	5.699	2.214	0.201	2.574	.010	
	L.E. High	7.283	2.420	0.238	3.009	.003	
Rule Finding	(Constant)	9.305	0.257		36.174	<.001	0.077
	Age	-0.092	0.018	-0.278	-5.254	<.001	
Apple Cancelation	(Constant)	47.150	0.495		95.264	<.001	0.094
	Age	-0.053	0.034	-0.099	-1.566	.118	
	Age^2	-0.006	0.002	-0.233	-3.705	<.001	

Note. Low education: Primary school, which is 0-7 years. Medium: Secondary/High school, which is 8-13 Years High: Tertiary which is +13years.

The Visual and Tactile Extinction tasks had a ceiling effect, with most people getting the highest score. It was not possible to generate the normative data for Visual Extinction and Tactile Extinction scores because of the lack of variability in the scores of the two tasks. The standard deviation (residual) for the final multiple linear regression models to Attention and Executive Function are shown in Table 6.8 below.

Table 6.8

Standard Deviation for Final Multiple Linear Regression Models to Attention

Score	Predicted value $(Y^{\wedge}{}_{i})$	SD_e (residual)
Auditory	≤44.647	14.89
	44.648 to 47.825	13.79
	47.826 to 48.457	7.73
	≥48.458	5.82
Rule Finding	All values	4.67
Apple Cancellation	≤46.309	10.40
	46.310 to 46.820	6.55
	46.821 to 47.138	2.82
	≥47.139	7.38

The multiple linear regression for the Auditory Attention task showed statistically significant effects of level of education on cognitive performance. Following the multiple linear regression, normative data for the Auditory Attention task was stratified by age and education levels (low, average and high) (see Table 6.9 below).

Table 6.9

Normative Data for the Auditory Attention Task

	Z	Percentile	Age (Yrs.)											
			20	25	30	35	40	45	50	55	60	65	70	75
High Education	0.95	**95**	54	54	54	54	54	54	54	54	50.6	46.1	40.8	34.9
	0.74	**85**	53.5	54	54	53.7	53.9	54	54	51.4	47.5	42.9	37.7	31.8
	0.66	**75**	53.0	53.8	53.8	53.2	53.3	55.3	53.5	50.2	46.3	41.7	36.5	30.6
	0.35	**50**	51.3	52.0	52.1	51.5	50.9	51.1	48.9	45.7	41.8	37.2	32.0	26.0
	-0.37	**25**	47.1	47.8	47.9	47.3	45.3	41.2	38.2	35.0	31.0	26.5	21.2	15.3

	-0.95	**15**	43.6	44.4	44.5	43.9	40.8	33.1	29.4	26.2	22.3	17.7	12.5	6.6
	-1.81	**5**	38.7	39.4	39.5	38.9	34.2	21.3	16.7	13.5	9.5	5.0	--	--
Average Education	0.95	**95**	54	54	54	54	54	54	54	53.0	49.1	44.5	39.2	33.3
	0.74	**85**	54	54	54	53.5	54	54	53.1	49.8	45.9	41.3	36.1	30.2
	0.66	**75**	54	53.4	53.5	52.9	54	53.7	51.9	48.6	44.7	40.1	34.9	29.0
	0.35	**50**	52.5	51.1	51.2	50.6	51.5	49.5	47.3	44.1	40.2	35.6	30.4	24.5
	-0.37	**25**	42.6	45.5	45.6	45.0	41.5	39.6	36.6	33.4	29.5	24.9	19.6	13.7
	-0.95	**15**	34.5	41.0	41.0	40.5	33.4	31.5	27.9	24.6	20.7	16.1	10.9	5.0
	-1.81	**5**	22.7	34.4	34.4	33.8	21.6	19.7	15.1	11.9	8.0	3.4	--	--
Low Education	0.95	**95**	54	54	54	54	54	53.1	50.5	47.3	43.4	38.8	33.5	27.6
	0.74	**85**	52.9	53.7	53.7	53.1	51.9	50.0	47.4	44.1	40.2	35.6	30.4	24.5
	0.66	**75**	51.7	52.5	52.5	51.9	50.7	48.8	46.2	42.9	39.0	34.4	29.2	23.3
	0.35	**50**	47.2	47.9	48.0	47.4	46.2	44.2	41.6	38.4	34.5	29.9	24.7	18.8
	-0.37	**25**	36.5	37.2	37.3	36.7	35.4	33.5	30.9	27.7	23.8	19.2	13.9	8.0
	-0.95	**15**	27.7	28.4	28.5	27.9	26.7	24.7	22.2	18.9	15.0	10.4	5.2	--
	-1.81	**5**	15.0	15.7	15.8	15.2	13.9	12.0	9.4	6.2	2.3	--	--	--

The multiple linear regression for the Rule Finding task showed statistically significant effects of age. Following the multiple linear regression, normative data for the Rule Finding task was stratified by age only (see Table 6.10 below).

Table 6.10

Normative Data for the Rule Finding

Z	Percentile	Age (Yrs.)											
		20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**
1.64	**95**	18	18	17.6	17.1	16.7	16.2	15.8	15.3	14.8	14.4	13.9	13.4
1.04	**85**	15.7	15.3	14.8	14.3	13.9	13.4	12.9	12.5	12.0	11.6	11.1	10.6
0.66	**75**	13.9	13.5	13.0	12.6	12.1	11.6	11.2	10.7	10.3	9.8	9.3	8.9
0	**50**	10.9	10.4	9.9	9.5	9.0	8.6	8.1	7.6	7.2	6.7	6.2	5.8
-0.66	**25**	7.8	7.3	6.9	6.4	5.9	5.5	5.0	4.6	4.1	3.6	3.2	2.7
-1.04	**15**	6.0	5.6	5.1	4.6	4.2	3.7	3.2	2.8	2.3	1.9	1.4	0.9
-1.64	**5**	3.2	2.7	2.3	1.8	1.4	0.9	0.4	0.0	--	--	--	--

Following the multiple linear regression, normative data for the Apple Cancellation task was stratified by age only (see Table 6.11 below).

Table 6.11

Normative Data for the Apple Cancellation

Z	Percentile	Age (Yrs.)											
		20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**
1.07	**95**	50	49.9	50	50	49.9	50	50	50	50	50	49.9	47.4
0.64	**85**	50	48.7	51.9	51.9	48.7	50	50	50	49.3	47.5	45.4	43.0
0.43	**75**	49.1	48.1	50	50	48.1	49.1	49.8	48.6	47.1	45.3	43.2	40.8
0.25	**50**	48.0	47.6	49.1	49.1	47.6	48.0	48.1	46.9	45.4	43.5	41.4	39.0
-0.09	**25**	45.7	46.7	46.5	46.5	46.7	45.7	44.4	43.2	41.7	39.9	37.8	35.4
-0.40	**15**	43.7	45.8	44.3	44.3	45.8	43.7	41.3	40.1	38.6	36.8	34.6	32.2
-1.64	**5**	35.6	42.3	35.2	35.2	42.3	35.6	28.4	27.2	25.7	23.9	21.8	19.3

6.5.4 Effects of Demographic Variables on Zim-BCoS Language Domain

In the Language domain, we analyzed scores on Picture Naming, Sentence Construction, Sentence Reading and Sentence Writing, Reading and Writing Words and Non-words as well as Instruction Comprehension. The final multiple linear regression models for subtests under the Language domain were significant (Table 6.12). Age adversely influenced scores on all the subtests. Time taken to complete tasks and instruction comprehension scores were affected by a quadratic age effect. Level of education positively influenced all the reading and writing tasks. Participants with a higher level of education scored better than those with lower levels of education. The degree of variance explained by these predictors in the Language function ranged from 6.8% (Sentence Reading) to 26.7% (Non-word Writing).

Table 6.12

Final Multiple Linear Regression Models for the Language Domain

Score		**B**	**Std. Error**	***β***	***t***	**Sig.**	**R^2**
Picture Naming	(Constant)	7.195	0.317		22.679	<.001	0.113
	L.E. Average	1.261	0.342	0.286	3.687	<.001	
	L.E. High	2.454	0.369	0.516	6.657	<.001	
Sentence Reading	(Constant)	35.733	0.964		37.059	<.001	0.068
	L.E. Average	2.467	1.020	0.223	2.417	.016	
	L.E. High	3.432	1.083	0.293	3.170	.002	
Sentence Reading Time	(Constant)	21.031	0.914		23.016	<.001	0.137
	Age	0.457	0.064	0.510	7.189	<.001	
	Sex	-0.680	1.190	-0.027	-0.572	.568	
	Age X Sex	-0.278	0.085	-0.229	-3.254	.001	
Reading Word/Nonword	(Constant)	2.091	0.351		5.952	<.001	0.126
	L.E. Average	2.618	0.394	0.727	6.651	<.001	

	L.E. High	2.862	0.407	0.741	7.028	<.001	
	Sex	1.659	0.541	0.469	3.064	.002	
	L.E. A. X Sex	-2.170	0.584	-0.610	-3.715	<.001	
	L.E. H. X Sex	-2.178	0.622	-0.419	-3.502	.001	
Reading Nonword- Time	(Constant)	7.777	0.568		13.681	<.001	0.141
	Age	0.171	0.036	0.377	4.691	<.001	
	Age^2	0.004	0.001	0.194	3.169	.002	
	Sex	0.390	0.613	0.031	0.637	.525	
	Age X Sex	-0.180	0.044	-0.293	-4.137	<.001	
Writing Word/Nonword	(Constant)	1.735	0.240		7.231	<.001	0.267
	Age	-0.027	0.005	-0.248	-5.094	<.001	
	L.E. Average	1.452	0.256	0.450	5.671	<.001	
	L.E. High	1.928	0.280	0.554	6.886	<.001	
	Sex	-0.396	0.139	-0.125	-2.851	.005	
Instruction Comprehension	(Constant)	2.816	0.038		73.947	<.001	0.140
	Age	-0.004	0.001	-0.229	-4.233	<.001	
	L.E. Average	0.153	0.041	0.328	3.775	<.001	
	L.E. High	0.164	0.045	0.325	3.628	<.001	

It was not possible to generate the normative data for Sentence Construction scores because there was a ceiling effect which resulted in a lack of variability in the scores, with most participants getting the highest score. The standard deviation (residual) for the final multiple linear regression models to Language is shown in Table 6.13 below.

Table 6.13

Standard Deviation for Final Multiple Linear Regression Models to Language

	Predicted value $(Y^{\wedge}{}_{i})$	SD_e (residual)
Picture Naming	All values	2.02
Sentence Reading	All values	5.26
Sentence Reading Time	≤17.687	7.30
	17.688 to 19.705	10.45
	19.706 to 22.445	9.48
	22.446	17.09
Reading Word/Nonword	≤4.198	2.17
	4.199 to 4.433	1.74
	4.434 to 4.952	1.47
	4.953	1.37
Reading Nonword- Time	≤7.318	3.31
	7.319 to 8.380	5.30
	8.381 to 9.211	4.91
	9.212	8.78
Writing Word/Nonword	≤2.678	1.37
	2.679 to 3.057	1.42
	3.058 to 3.535	1.56
	3.536	0.99
Instruction Comprehension	≤2.939	0.34
	2.940 to 2.982	0.23
	2.983 to 3.015	0.01
	3.016	0.10

Multiple linear regression showed statistically significant effects of education levels on the BCoS Picture Naming task. Normative data for the Picture Naming task was stratified by education levels to correct for the effect of demographic variables. Table 6.14 below presents the normative data for the Picture Naming task.

Table 6.14

Normative Data for the Picture Naming task

Z	Percentile	Level of Education		
		Low	Average	High
1.75	**95**	13.2	12.0	10.7
1.16	**85**	12.0	10.8	9.5
0.76	**75**	11.2	10.0	8.7
-0.10	**50**	9.5	8.3	7.0
-0.72	**25**	8.2	7.0	5.7
-1.08	**15**	7.5	6.3	5.0
-1.71	**5**	6.2	5.0	3.7

Multiple linear regression showed statistically significant effects of gender and education levels on the BCoS Word/Nonword reading task. To correct for the effect of demographic variables, normative data for the Reading Word/Nonword reading task was stratified by gender and education levels (see Table 6.15 below).

Table 6.15

Normative Data for the Word/Nonword Reading task

	z	Percentile	Level of Education		
			High	**Average**	**Low**
	1.07	**95**	6.0	6.1	6.1
	1.04	**85**	6.0	6.0	6.0
	0.76	**75**	5.6	5.5	5.4
Men	0.20	**50**	4.7	4.5	4.2
	-0.49	**25**	3.7	3.4	2.7
	-0.98	**15**	3.0	2.5	1.6
	-2.40	**5**	0.9	0.0	-1.5
	1.07	**95**	6.0	6.1	6.1
	1.04	**85**	6.0	6.0	6.0
	0.76	**75**	5.6	5.5	5.4
Women	0.20	**50**	4.7	4.5	4.2
	-0.49	**25**	3.7	3.4	2.7
	-0.98	**15**	3.0	2.5	1.6
	-2.40	**5**	0.9	0.0	--

Multiple linear regression also showed statistically significant effects of gender and education levels on the BCoS Word/Nonword writing task. To correct for the effect of demographic variables, normative data for the Word/Nonword Writing task was stratified by education levels and gender (see Table 6.16 below).

Table 6.16

Normative Data for the Non-word Writing task for Men

	Z	Percentile	Age (Yrs.)											
			20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**
High	1.64	**95**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	1.04	**85**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.9	5.7	5.6
	0.66	**75**	6.0	6.0	6.0	6.0	6.0	6.0	5.9	5.8	5.6	5.5	5.4	5.2
	0	**50**	6.0	5.9	5.8	5.6	5.5	5.4	5.2	5.1	5.0	4.8	4.7	4.6
	-0.66	**25**	5.4	5.3	5.1	5.0	4.9	4.7	4.6	4.4	4.3	4.2	4.0	3.9
	-1.04	**15**	5.0	4.9	4.7	4.6	4.5	4.3	4.2	4.1	3.9	3.8	3.7	3.5
	-1.64	**5**	4.4	4.3	4.2	4.0	3.9	3.7	3.6	3.5	3.3	3.2	3.1	2.9
Average	1.64	**95**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.8	5.7
	1.04	**85**	6.0	6.0	6.0	6.0	6.0	5.9	5.8	5.7	5.5	5.4	5.2	5.1
	0.66	**75**	6.0	6.0	6.0	5.8	5.7	5.5	5.4	5.3	5.1	5.0	4.9	4.7
	0	**50**	5.6	5.4	5.3	5.2	5.0	4.9	4.8	4.6	4.5	4.4	4.2	4.1
	-0.66	**25**	4.9	4.8	4.6	4.5	4.4	4.2	4.1	4.0	3.8	3.7	3.6	3.4
	-1.04	**15**	4.5	4.4	4.3	4.1	4.0	3.9	3.7	3.6	3.5	3.3	3.2	3.1
	-1.64	**5**	3.9	3.8	3.7	3.5	3.4	3.3	3.1	3.0	2.9	2.7	2.6	2.5
Low	1.64	**95**	5.7	5.6	5.5	5.3	5.2	6.0	5.9	5.7	5.4	5.2	5.1	4.9
	1.04	**85**	5.2	5.0	4.9	4.7	4.6	5.1	4.9	4.8	4.5	4.4	4.2	4.1
	0.66	**75**	4.8	4.6	4.5	4.4	4.2	4.5	4.3	4.2	4.0	3.8	3.7	3.5

0	**50**	4.1	4.0	3.9	3.7	3.6	3.4	3.3	3.2	3.0	2.9	2.8	2.6
-0.66	**25**	3.5	3.3	3.2	3.1	2.9	2.4	2.3	2.1	2.1	2.0	1.8	1.7
-1.04	**15**	3.1	3.0	2.8	2.7	2.6	1.8	1.7	1.6	1.6	1.4	1.3	1.2
-1.64	**5**	2.5	2.4	2.2	2.1	2.0	0.9	0.8	0.6	0.7	0.6	0.4	0.4

Multiple linear regression showed statistically significant effects of gender and education levels on the BCoS Word/Nonword writing task. To correct for the effect of demographic variables, normative data for the Word/Non-word Writing task for women was stratified gender and by education levels (see Table 6.17 below).

Table 6.17

Normative Data for the Word/Nonword Writing for Women

	Z	**Percentile**	**Age (Yrs.)**											
			20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**
High	1.64	**95**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	1.04	**85**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.9	5.7	5.6
	0.66	**75**	6.0	6.0	6.0	6.0	6.0	6.0	5.9	5.8	5.6	5.5	5.4	5.2
	0	**50**	6.0	5.9	5.8	5.6	5.5	5.4	5.2	5.1	5.0	4.8	4.7	4.6
	-0.66	**25**	5.4	5.3	5.1	5.0	4.9	4.7	4.6	4.4	4.3	4.2	4.0	3.9
	-1.04	**15**	5.0	4.9	4.7	4.6	4.5	4.3	4.2	4.1	3.9	3.8	3.7	3.5
	-1.64	**5**	4.4	4.3	4.2	4.0	3.9	3.7	3.6	3.5	3.3	3.2	3.1	2.9
Average	1.64	**95**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.8	5.7
	1.04	**85**	6.0	6.0	6.0	6.0	6.0	5.9	5.8	5.7	5.5	5.4	5.2	5.1
	0.66	**75**	6.0	6.0	6.0	5.8	5.7	5.5	5.4	5.3	5.1	5.0	4.9	4.7
	0	**50**	5.6	5.4	5.3	5.2	5.0	4.9	4.8	4.6	4.5	4.4	4.2	4.1
	-0.66	**25**	4.9	4.8	4.6	4.5	4.4	4.2	4.1	4.0	3.8	3.7	3.6	3.4
	-1.04	**15**	4.5	4.4	4.3	4.1	4.0	3.9	3.7	3.6	3.5	3.3	3.2	3.1

	-1.64	**5**	3.9	3.8	3.7	3.5	3.4	3.3	3.1	3.0	2.9	2.7	2.6	2.5
Low	1.64	**95**	5.7	5.6	5.5	5.3	5.2	6.0	5.9	5.7	5.4	5.2	5.1	4.9
	1.04	**85**	5.2	5.0	4.9	4.7	4.6	5.1	4.9	4.8	4.5	4.4	4.2	4.1
	0.66	**75**	4.8	4.6	4.5	4.4	4.2	4.5	4.3	4.2	4.0	3.8	3.7	3.5
	0	**50**	4.1	4.0	3.9	3.7	3.6	3.4	3.3	3.2	3.0	2.9	2.8	2.6
	-0.66	**25**	3.5	3.3	3.2	3.1	2.9	2.4	2.3	2.1	2.1	2.0	1.8	1.7
	-1.04	**15**	3.1	3.0	2.8	2.7	2.6	1.8	1.7	1.6	1.6	1.4	1.3	1.2
	-1.64	**5**	2.5	2.4	2.2	2.1	2.0	0.9	0.8	0.6	0.7	0.6	0.4	0.4

6.5.5 Effects of Demographic Variables on Zim-BCoS Memory Domain

The Memory domain was assessed using the Task Recall subtest. The final multiple linear regression models for scores on the subtest were significant (see Table 6.18 below). Gender negatively influenced all scores. Task Recall decreased linearly as a function of gender. Level of education also positively influenced the Task Recall scores such that those with a high level of education scored higher compared to participants with a low level of education. The amount of variance explained by these predictors in the Memory Function was 10.5% (Task Recall).

Table 6.18

Final Multiple Linear Regression Models for the Memory Domain

Score		**B**	**Std. Error**	***β***	***t***	**Sig.**	**R^2**
Task Recall	(Constant)	8.143	0.235		34.709	<.001	0.105
	L.E. Average	1.012	0.248	0.324	4.075	<.001	
	L.E. High	1.373	0.264	0.408	5.195	<.001	
	Gender	-0.555	0.149	-0.181	-3.725	<.001	

It was not possible to generate the normative data for Orientation and Story Recall scores because of the lack of variability in the scores. Table 6.19 below shows the Standard Deviation (residual) for multiple linear regression models to the Memory domain.

Table 6.19

Standard Deviation for Final Multiple Linear Regression Models to Memory

	Predicted value $(Y^{\wedge}_{i})$	SD_e **(residual)**
Task Recall	≤8.599	1.89
	8.600 to 8.960	1.56
	8.961 to 9.515	1.23
	≥9.516	1.29

Multiple linear regression showed statistically significant effects of gender and education on the Task Recall task. Normative data for the Task Recall task were stratified by participants' gender and level of education to correct for the demographical variable (Table 6.20).

Table 6.20

Normative Data for the Task Recall

	Z	**Percentile**	**Level of education**		
			High	**Average**	**Low**
Men	0.90	**95**	10.0	10.0	9.3
	0.90	**85**	10.0	10.0	9.3
	0.69	**75**	9.8	9.7	8.9
	0.26	**50**	9.3	9.0	8.1
	-0.38	**25**	8.5	8.0	6.9
	-1.03	**15**	7.7	7.0	5.6
	-1.91	**5**	6.6	5.6	4.0

Women	0.90	**95**	10.0	10.0	9.3
	0.90	**85**	10.0	10.0	9.3
	0.69	**75**	9.8	9.7	8.9
	0.26	**50**	9.3	9.0	8.1
	-0.38	**25**	8.5	8.0	6.9
	-1.03	**15**	7.7	7.0	5.6
	-1.91	**5**	6.6	5.6	4.0

6.5.6 Effects of Demographic Variables on the Number Skills Domain

The final multiple linear regression models for the Number Skills domain were significant (Table 6.21 below). Again, level of education also positively influenced the Number/Price Writing and Calculation scores. Those with a high level of education scored higher compared to participants with a low level of education. The scope of variance explained by these predictors in the Number Skills domain ranged from 8.6% (Calculation) to 11.5% (Number/Price Writing).

Table 6.21

Final Multiple Linear Regression Models for the Number Skill Domain

Score		**B**	**Std. Error**	***β***	**t**	**Sig.**	**R^2**
Number/Price Writing	(Constant)	2.951	0.208		14.162	<.001	0.115
	L.E. Average	1.366	0.225	0.470	6.080	<.001	
	L.E. High	1.758	0.242	0.562	7.260	<.001	
Calculation	(Constant)	1.780	0.191		9.343	<.001	0.086
	L.E. Average	1.100	0.205	0.421	5.356	<.001	
	L.E. High	1.365	0.221	0.485	6.163	<.001	

It was not possible to generate the normative data for Number Price/Time Reading scores because of the lack of variability in the scores. The standard deviation (residual) for the final multiple linear regression models to number skills is shown in Table 6.22 below.

Table 6.22
Standard Deviation for Final Multiple Linear Regression Models to Number Skills

	Predicted value $(Y^{\wedge}_{i})$	***SD_e* (residual)**
Number/Price Writing	≤ 4.316	2.07
	4.317 to 4.708	1.33
	≥4.709	0.97
Calculation	≤ 2.880	1.51
	2.881 to 3.144	1.24
	≥3.145	1.06

Multiple linear regression showed statistically significant effects of education on the Number Skills Domain. Data for Number Skills Domain that is, Number Writing, was stratified by level of education to correct for the effect of the demographic variable (Table 6.23).

Table 6.23
Normative Data for the Number/Price Writing task

Raw Score	**Level of education**		
	High	**Average**	**Low**
5	24.0	50.0	100.0
4	17.0	23.0	49.0
3	6.0	16.0	23.0
2	3.0	11.0	17.0
1	1.0	3.0	16.0

Data for number skills, that is, the Calculation task, was stratified by level of education to correct for the effect of the demographic variable (see Table 6.24 below).

Table 6.24

Normative Data for the Number Calculation task

Raw Score	Level of education		
	High	Average	Low
4	61	74	100
3	36	39	61
2	17	26	58
1	4	10	28

6.5.7 Effects of Demographic Variables on the Praxis and Action Domain

The final multiple linear regression models for the Praxis and Action domain were significant (see Table 6.25 below). Both Age and Level of Education positively influenced the Praxis and Action functions, meaning performance on the Praxis and Action increased linearly as a function of both these variables. Those with a high level of education scored higher compared to participants with a low level of education. The amount of variance explained by these predictors in the Attention and Executive Function scores ranged from 3.8% (Gesture Production) to 10.6% (Figure Copy).

Table 6.25

Final Multiple Linear Regression Models for the Praxis Domain

		B	Std. Error	β	T	Sig.	R^2
Complex Figure Copy	(Constant)	41.846	0.330		126.944	<0.001	0.106
	Age	-0.159	0.023	-0.326	-6.937	<0.001	
Gesture Imitation	(Constant)	4.829	0.118		40.881	<0.001	0.038
	L.E. Average	0.623	0.127	0.386	4.892	<0.001	
	L.E. High	0.820	0.137	0.471	5.976	<0.001	

Table 6.26 below shows the standard deviation (residual) for the final multiple linear regression models to Praxis & Action domain.

Table 6.26

Standard Deviation for Final Multiple Linear Regression Models to Praxis Domain

	Predicted value $(Y^{\wedge}_{i})$	***SD$_e$*** **(residual)**
Complex Figure Copy	≤40.718	9.98
	40.719 to 42.464	6.06
	42.465 to 43.734	4.58
	≥43.735	4.42
Gesture Imitation	≤5.451	1.28
	5.452 to 5.649	0.70
	≥5.650	0.61

Multiple linear regression showed statistically significant effects of age. The normative data for the Praxis tasks; that is, the Complex Figure Copy, was stratified by age to control for the effect of the demographic variable (see Table 6.27 below).

Table 6.27

Normative Data for Praxis Domain- Complex Figure task

z	**Percentile**	**Age (Yrs.)**											
		20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**
1.07	**95**	47	47	47	47	47	47	47	47	47	47	46.7	45.9
1.01	**85**	47	47	47	47	46.9	47	47	47	47	46.9	46.1	45.3
0.85	**75**	47	47	47	46.8	46.0	47	47	46.9	46.1	45.3	44.5	43.7
0.19	**50**	44.8	44.0	43.5	42.7	41.9	41.9	41.1	40.3	39.5	38.7	37.9	37.1
-0.62	**25**	41.2	40.4	38.6	37.9	37.1	33.9	33.1	32.3	31.5	30.7	29.9	29.1
-1.06	**15**	39.3	38.3	36.0	35.2	34.4	29.4	28.6	27.8	27.0	26.3	25.5	24.7
-2.02	**5**	35.0	33.9	30.1	29.4	28.6	19.8	19.1	18.3	17.5	16.7	15.9	15.1

It was not possible to generate the normative data for the Multi-step Object Use task scores because of the ceiling effect and resultant lack of variability. The normative data for the Praxis tasks, that is, the Gesture Imitation task, was stratified by age (see Table 6.28 below).

Table 6.28

Normative Data for the Praxis Domain -Gesture Imitation task

Z	Percentile	Level of education		
		High	Average	Low
0.78	**95**	--	--	--
0.78	**85**	6.0	6.0	5.8
0.78	**75**	6.0	6.0	5.8
0.58	**50**	6.0	5.9	5.6
-0.65	**25**	5.3	5.0	4.0
-1.08	**15**	5.0	4.7	3.4
-2.07	**5**	4.4	4.0	2.2

6.6 A Comparison of Zim-BCoS against UK, Rus-BCoS and Cantonese-BCoS Means

The fourth aim in this part of the to compare Zim-BCoS scores and scores on other published versions of BCoS. In doing so we wanted gain insight into how BCoS performs across cultures. To do this, we compared the Zim-BCoS scores to standard scores on the original UK-BCoS (Humphreys et al.,2012) as well as to scores from studies on other populations; Russia (Rus-BCoS; Pan et al., 2015) and China (Cantonese-BCoS; Kuzmina et al., 2017). We performed One-sample t-tests to compare scores across the three BCoS versions because we did not have access to raw data. This approach was used because one-sample t-test is one of the most frequently used ways of comparing the means between two different samples on a similar measure in the absence of raw data. In this approach, the means of one data set are compared against that of a known population mean (Jankowski et al., 2018). One of the assumptions of the One-sample t-test is that data is normally distributed. To correct for non-normality, we conducted 'bootstrapping', which is a way of resampling through selecting thousands of mini random samples from the dataset (Field, 2009).

We divided the dataset into two groups based on the age groups that were previously used for the UK-BCoS (Humphreys et al., 2012). These two groups were made up of a group of younger participants 50 - 64 years and another group of older participants 65 - 75 years.

For the Cantonese version, the younger group was made of participants with a 50 – 69 yrs. age range, and the older group had participants whose ages ranged from 70 – 75 (Pan et al., 2015). For the Russ-BCoS, the group had a 32 - 74yrs age range (Kuzmina et al., 2017). Table 6.29 (below) gives a summary of results from comparison of Zim-BCoS scores against scores from previous BCoS validation studies. A detailed narration of the results from these comparisons across each of the screen subtests is presented in the paragraphs below.

Table 6.29

Summary of comparison results of Zim-BCoS scores against previously published BCoS validation studies

BCoS Cognitive Domain	**BCoS Cognitive Task**	**UK-BCoS**	**UK-BCoS**	**Cantonese-BCoS**	**Cantonese-BCoS**	**Rus-BCoS**
Attention	Apple Cancellation	x	*	*	*	*
	Visual Extinction	x	-	x	*	*
	Tactile Extinction	x	-	*	*	x
	Auditory Attention	*	*	*	*	*
	Rule Finding	*	*	*	*	*
Language	Picture Naming	*	*	*	*	*
	Sentence Construction	*	*	*	*	*
	Non-Word Reading	*	*	*	*	*
	Sentence Reading	*	*	*	*	✓
	Word/Non-Word Writing	*	*	*	*	*
Memory	Personal	*	*	x	x	x
	Time and Space	*	*	x	x	*
	Immediate Story- Recall	*	*	*	✓	*
	Delayed Story Recall	*	*	x	x	*
	Task Recall	x	x	x	x	*
Number Skills	Reading	*	*	x	x	*
	Writing	*	*	*	*	*
	Calculation	*	*	*	*	*
Praxis	Figure Copy	*	*	*	*	*
	Multi-Step Object Use	x	x	*	*	*
	Gesture Production	*	*	*	*	*
	Gesture Recognition	*	*	*	*	*
	Imitation	*	*	*	*	*

Notes: Asterisk (*) indicates where Zim-BCoS means were significantly lower than the three comparative studies, while an (x) indicates where Zim-BCoS was lower but the difference is not statistically significant, a tick (✓) indicates where Zim-BCoS means were significantly higher than the comparative study and a dash (-) indicates where there was no difference between Zim-BCoS scores and scores on the comparative study.

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6.6.1 Attention Domain

6.6.1.1 Comparison of Zim-BCoS to UK-BCoS on Apple Cancellation Task. This test for visuospatial attention required the participants to cross out target stimuli (all complete apples) and ignore distracter items (incomplete apples). On average the younger Zim-BCoS participants (Ages 50-64years), (*M* = 45.02, *SD* = 10.14) identified and crossed out fewer target stimuli compared to the UK-BCoS mean (*M* = 48.0). However, the difference was not statistically significant *t*(41) = -1.9, p = .064, *d* = -2.9 with a very large effect size (see Table 6.30).

Table 6.30

Comparison of UK-BCoS to Zim-BCoS Means (Ages 50-64years)

BCoS Task	**Score range**	**UK-BCoS *M***	**Zim-BCoS *M***	**Mean Difference**	***SD***	***df***	***t***	***p*-value**	**Cohen's *d***
Spatial Attention									
Apple Cancellation (Accuracy)	0-50	48.0	45.02	-2.976	10.137	41	-1.903	.064	90.26
Visual Extinction	0-24	24	23. 02	-.976	3.751	41	-1.686	.099	90.26
Tactile Extinction	0-24	23.9	23.79	-.114	0.813	41	-0.911	.367	-0.14
Attention-Controlled									
Auditory Attention	**0-54**	**53.2**	**42.62**	**-10.581**	**17074**	**41**	**-4.016**	**.000***	**-0.001**
Rule Finding	**0-18**	**11.9**	**8.12**	**-3.779**	**4.484**	**32**	**-4841**	**.000***	**-0.842**
Language- Spoken									
Instruction Comprehension	1-3	3.0	2.93	-.073	0.264	40	-1.777	.083	-0.276
Picture Naming	0-14	13.1	8.64	-4.457	2.173	40	-13.29	.000	-2.051
Sentence Construction	0-8	8.0	7.05	-.952	1.637	41	-3.770	.001	-0.581
Language-Written									
Non-word Reading- Accuracy	**0-6**	**5.8**	**4.15**	**-1.654**	**1.811**	**40**	**-4.787**	**.000***	**-0.913**

Sentence Reading-Accuracy	**0-42**	**41.9**	**36.341**	**28.345**	**9.2347**	**40**	**19651**	**.000***	**3.069**
Word/ non-word Writing	**0-5**	**4.4**	**2.4**	**-1.995**	**1.197**	**41**	**-7.618**	**.000***	**-1.667**
Memory-Orientation									
Personal	**0-8**	**8.0**	**7.98**	**.176**	**.154**	**41**	**7.400**	**.000***	**1.142**
Time and space (MC)	0-6	6.0	6.0	-	0		no difference	**	**
Memory- Episodic									
Immediate Story Recall	**0-15**	**14.3**	**11,3**	**-3.038**	**3.794**	**41**	**-5.190**	**.000***	**-0.801**
Delayed Story Recall	**0-15**	**14.6**	**12.2**	**12.457**	**3.411**	**41**	**-4.668**	**.000***	**3.652**
Task Recall	**0-10**	**9.8**	**8.8**	**-9.67**	**1.695**	**41**	**-3.695**	**.001***	**-5.705**
Number									
Reading	**0-9**	**8.8**	**8.17**	**-.633**	**1.847**	**41**	**-2.223**	**.032***	**-0.342**
Writing	**0-5**	**4.9**	**4.36**	**-.543**	**1.340**	**41**	**-2.625**	**.012***	**-0.405**
Calculation	**0-4**	**3.6**	**3.14**	**-.457**	**1.117**	**41**	**-2.653**	**.011***	**-0.409**
Praxis- action									
Figure copy	**0-47**	**45.1**	**40.98**	**-4.124**	**7.710**	**41**	**-2.571**	**.014***	**-0.534**
Multi-step Object Use	**0-12**	**11.6**	**9.86**	**-1.743**	**4.393**	**41**	**-2.571**	**.014***	**-0.396**
Gesture Production	**0-12**	**11.5**	**9.67**	**-1.833**	**2.486**	**41**	**-4.780**	**.000***	**-0.737**
Gesture Recognition	**0-6**	**5.8**	**5.14**	**-.657**	**1.117**	**41**	**-3.813**	**.000***	**-0.588**
Imitation	**0-12**	**11.1**	**9.95**	**-1.148**	**1.899**	**41**	**-3.92**	**.000***	**-0.604**

Notes: The asterisks (*) and a bold font shows correlations where Zim-BCoS scores are significantly lower than UK-BCoS, Font that is bold and in italics shows where Zim-BCoS scores are significantly higher than the UK-BCoS mean, two asterisks (**) indicate where there is no difference between Zim-BCoS and UK-BCoS, font that is not bold shows a non- significant difference between Zim-BCoS mean and UK-BCoS mean

The older Zim-BCoS participants (Ages 65-75years), also cancelled out fewer target apples (*M* = 38.53, *SD* = 12.19) than the UK-BCoS cutoff score (*M* = 47.60). The difference was statistically significant *t*(31) = -4.21, *p* < .001, *d* = .74 and the effect size for this analysis was large (See Table 6.31).

Table 6.31

Comparison of UK-BCoS to Zim-BCoS Means (Ages 65-75years)

BCoS Task	Score range	UK-BCoS *M*	Zim-BCoS *M*	Mean Difference	*SD*	*df*	*t*	*p*-value	Cohen's *d*
Attention Spatial							**-**		
Apple Cancellation	**0-50**	**47.6**	**38.53**	**12.19**	**-9.069**	**31**	**-4.206**	**.000***	**-0.743**
Visual Extinction	0-24	23.8	24.0	0		-	**		
Tactile Extinction	0-24	24	24.0	0		-	**		
Auditory Attention	**0-54**	**52.7**	**19.38**	**17.27**	**-18.02**	**31**	**-5.902**	**.000***	**-1.047**
Rule Finding	**0-18**	**11**	**7.22**	**3.004**	**-3.778**	**26**	**-6.534**	**.000***	**-1.257**
Language- Spoken									
Instruction Comprehension	**1-3**	**3**	**2.61**	**.659**	**-.394**	**32**	**-3.436**	**.002***	**-0.597**
Picture Naming	**0-14**	**13**	**7.94**	**2.290**	**-5.061**	**32**	**-12.69**	**.000***	**-2.212**
Sentence Construction	**0-8**	**8**	**6.24**	**2.332**	**-1.758**	**32**	**-4.329**	**.000***	**-0.753**
Language-Written									
Non-word reading	**0-6**	**5.8**	**3.13**	**2.37**	**-2.675**	**31**	**-6.61**	**.000***	**-1.128**
Sentence Reading-Accuracy	0-42	41.9	32.889	13.33	-9.011		-2.52		-0.676
Word/ non-word Writing	**0-5**	**4.1**	**.91**	**1.04**	**-3.191**	**32**	**-12.58**	**.000***	**-3.068**
Memory-Orientation									
Personal	0-8	8	7.64	1.270	-.364	32	-1.644	.110	-0.286
Time and space	**0-6**	**6**	**5.76**	**.663**	**-.242**	**32**	**-2.101**	**.004***	**-0.365**

Memory- Episodic									
Immediate Story Recall	**0-15**	**14.1**	**11.42**	**3.437**	**-2.676**	**32**	**-4.472**	**.000***	**-0.778**
Delayed Story Recall	**0-15**	**14.8**	**12.73**	**3.31**	**-2.073**	**32**	**-3.60**	**,001***	**-0.626**
Task Recall	**0-10**	**9.6**	**8.45**	**1.91**	**-1.145**	**32**	**-3.45**	**.002***	**-0.599**
Number									
Reading	**0-9**	**8.9**	**6.67**	**3.47**	**-2.233**	**32**	**-3.69**	**.001***	**-0.643**
Writing	**0-5**	**5.0**	**2.91**	**2.14**	**-2.091**	**32**	**-5.61**	**.000***	**-0.977**
Calculation	**0-4**	**3.8**	**1.52**	**1.64**	**-2285**	**32**	**-7.99**	**.000***	**-1.393**
Praxis- Action									
Figure Copy	**0-47**	**45.3**	**33.06**	**11.1**	**-10.23**	**32**	**-5.30**	**.000***	**-0.922**
Multi-step Object Use	0-12	11.5	10.18	4.10	-1.318	32	-1.85	.074	-0.321
Gesture Production	**0-12**	**11.5**	**10.03**	**1.57**	**-1.47**	**32f**	**-5.37**	**.000***	**-0.936**
Gesture Recognition	**0-6**	**5.8**	**5.24**	**1.00**	**-.558**	**32**	**-3.20**	**.003***	**-0.558**
Imitation	**0-12**	**11.0**	**9.55**	**2.88**	**-1.455**	**32**	**-2.90**	**.007***	**-0.505**

Notes: The asterisks (*) and a bold font shows correlations where Zim-BCoS scores are significantly lower than UK-BCoS, Font that is bold and in italics shows where Zim-BCoS scores are significantly higher than the UK-BCoS mean, two asterisks (**) indicate where there is no difference between Zim-BCoS and UK-BCoS, font that is not bold shows a non- significant difference between Zim-BCoS mean and UK-BCoS mean

6.6.1.2 Comparison of Zim-BCoS to Cantonese-BCoS on Apple Cancellation Task. The younger Zim-BCoS participants (Ages 50-69years), cancelled fewer of the target stimuli (*M* = 44.55, *SD* = 9.35) than the Cantonese-BCoS score *(M* = 46.60). The difference between the scores was statistically not significant *t*(55) = -1.64, p = 0.11, *d* = 0.22 and the effect size was small (See Table 6.32).

Table 6.32

Comparison of Cantonese-BCoS to Zim-BCoS Means (Ages 50-69years)

Zim-BCoS Task	Score range	Cantonese-BCoS *M*	Zim-BCoS *M*	Mean Difference	*SD*	*df*	*t*	*p*	Cohen's *d*
Attention Spatial									
Apple Cancellation (Accuracy)	0-50	46.6	44.55	-2.046	9.350	55	-1.638	.107	-0.218
Visual Extinction	0-24	23.94	23.28	-.659	3.239	56	-1.537	.130	-0.203
Tactile Extinction	**0-24**	**23.1**	**23.84**	**.742**	**.702**	**56**	**7.984**	**.000**	**1.056**
Attention-Controlled									
Auditory Attention	**0-54**	**50.82**	**37.42**	**-13.399**	**19.73**	**56**	**-5.125**	**.000**	**-0.678**
Rule Finding	**0-18**	**11.96**	**7.8**	**-4.160**	**4.19**	**44**	**-6.657**	**.000**	**-0.992**
Language-Spoken									
Instruction Comprehension	**1-3**	**3**	**2.84**	**-.161**	**.371**	**55**	**-3.245**	**.002**	**-0.433**
Picture Naming	**0-14**	**13.29**	**8.32**	**-4.884**	**2.205**	**57**	**-16.72**	**.000**	**-2.214**
Sentence Construction	**0-8**	**7.8**	**6.88**	**-.923**	**1.794**	**57**	**-3.885**	**.000**	**-0.514**
Language-Written									
Non-word Reading-Accuracy	**0-6**	**5.84**	**3.75**	**-2.090**	**2.134**	**56**	**7.329**	**.000**	**-0.979**
Sentence Reading-Accuracy	**0-42**	**39.27**	**36.717**	**-2.553**	**8.263**	**53**	**-2.249**	**.029**	**-0.308**
Word/Non-word Writing	0-5	3.38	1.96	-1.415	2.13	56	1.3	.20	-0.664
Memory-Orientation									
Personal	0-8	7.94	7.84	-.098	.94	56	-.79	.44	-0.104
Time and Space	0-6	5.99	5.96	-.025	.86	16	-1.07	.302	-0.029
Memory-Episodic									
Story Recall 1	0-15	12.45	11.04	-1.415	2.83	16	1.07	.301	-0.5

Delayed Recall	0-15	14.22	12.35	-1.869	3.76	16	-1.04	.313	-0.497
Task Recall	0-10	9.43	8.65	-7.81	1.22	16	-.92	.371	-6.401
Number									
Reading	0-9	8.78	7.75	-1.026	3.60	16	1.897	.076	-0.28
Writing	0-5	6.84	3.91	-2.928	2.31	16	-2.08	.054	-1.267
Calculation	**0-4**	**3.71**	**2.74**	**-.973**	**1.70**	**16**	**-4.85**	**.000**	**-0.572**
Praxis- Action									
Figure Copy	**0-47**	**43.24**	**40.28**	**-2.959**	**12.48**	**16**	**-3.39**	**.004**	**-0.237**
Multi-step Object	0-12	11.86	9.81	-2.053	3.97	16	-1.28	.220	-0.517
Gesture Production	0-12	11.2	9.63	-1.568	.775	16	.29	.079	-2.023
Recognition	**0-6**	**5.96**	**5.26**	**.046**	**1.173**	**16**	**-3.24**	**.005**	**0.039**
Imitation	0-12	10.3	9.77	-.528	3.20	16	.23	.822	-0.165

Notes: The asterisk (*) and a bold font shows correlations where Zim-BCoS scores are significantly lower than Cantonese-BCoS, Font that is bold and in italics shows where Zim-BCoS scores are significantly higher than the Cantonese-BCoS mean, two asterisks (**) indicate where there is no difference between Zim-BCoS and Cantonese-BCoS, font that is not bold shows a non- significant difference between Zim-BCoS mean and Cantonese-BCoS mean

The older Zim-BCoS participants (Ages 70-75years), performed lower (*M* = 34.29, *SD* = 14.56) than the Cantonese-BCoS mean (*M* = 45.79). The difference between the older Zim-BCoS and Cantonese-BCoS participants was statistically significant*, t*(16) = -3.25, *p* = 0.005, *d* = .78 with a big effect size (See Table 6.33).

Table 6.33

Comparison of Cantonese-BCoS to Zim-BCoS Means (Ages 70-75years)

Zim-BCoS Task	**Score range**	**Cantonese-BCoS *M***	**Zim-BCoS *M***	**Mean Difference**	***SD***	***df***	***t***	***p***	**Cohen's *d***
Attention Spatial									
Apple Cancellation	**0-50**	**45.79**	**34.29**	**-11.49**	**14.568**	**16**	**-3.254**	**.005**	**-0.788**
Visual Extinction	**0-24**	**23. 97**	**24.0**	**No difference**	**2.32**	**220**	**-1.99**	**.047****	
Tactile Extinction	**0-24**	**23.86**	**24.0**	**No difference**	**2.42**	**220**	**-2.08**	**.038****	
Attention-Controlled									
Auditory Attention	**0-54**	**48.92**	**14.3**	**-34.608**	**12.360**	**15**	**-11.200**	**.000**	**-2.8**

Rule Finding	**0-18**	**11.13**	**7.4**	**-3.701**	**2.980**	**13**	**-4.648**	**.000**	**-1.241**
Language- Spoken									
Instruction Comprehension	1-3	2.84	2.59	-2.52	.795	16	-1.305	.210	-3.169
Picture Naming	**0-14**	**12.03**	**8.41**	**-3.618**	**2.476**	**16**	**-6.024**	**.000**	**-1.461**
Sentence Construction	**0-8**	**7.82**	**6.24**	**-1.585**	**2.538**	**16**	**-2.574**	**.020**	**-0.624**
Language- Written									
Word Reading- Accuracy	**0-6**	**5.89**	**3.63**	**2.156**	**2.16**	**15**	**-4.20**	**.001**	**0.998**
Sentence Reading	**0-42**	**39.36**	**28.63**	**17.398**	**17.39**	**13**	**-2.30**	**.038**	**1.0004**
Word/Non-word Writing	***0-5***	***3.19***	***3.29***	***.104***	***1.17***	***16***	***-7.33***	***.000***	***0.088***
Memory- Orientation									
Personal	0-8	7.94-7.90	7.76	-1.75	.56	16	-1.29	.217	-3.125
Time and Space	0-6	5.87	5.65	-.223	.86	16	-1.07	.302	-0.259
Memory- Episodic									
Story	0-15	11.62	12.35	.733	2.83	16	1.07	.301	0.259
Delayed Story Recall	0-15	13.42	12.47	-.949	3.76	16	-1.09	.294	-0.252
Task Recall	0-10	8.92	8.65	-2.73	1.22	16	-.92	.371	-2.237
Number									
Reading	0-9	8.42	6.76	-1.655	3.59	16	-1.89	.076	-0.461
Writing	0-5	4.46	3.29	-1.166	2.31	16	-2.01	.062	-0.504
Calculation	**0-4**	**3.47**	**1.47**	**-1.999**	**1.70**	**16**	**-4.85**	**.000**	**-1.175**
Praxis- Action									
Figure Copy	**0-47**	**41.92**	**31.65**	**-10.273**	**12.48**	**16**	**-3.39**	**.004**	**-0.823**
Multi-step Object	0-12	11.76	10.53	-1.231	3.97	16	-1.28	.220	-0.311
Gesture Production	0-12	10.45	10.53	.079	1.13	16	.29	.079	0.069
Gesture Recognition	**0-6**	**5.92**	**5.00**	**-.920**	**1.17**	**16**	**-3.24**	**.005**	**-0.786**
Imitation	0-12	9.47	9.65	.177	3.20	16	.23	.822	0.055

Notes: The asterisks (*) and a bold font shows correlations where Zim-BCoS scores are significantly lower than Cantonese-BCoS, Font that is bold and in italics shows where Zim-BCoS scores are significantly higher than the Cantonese-BCoS mean, two asterisks (**) indicate where there is no difference between Zim-BCoS and Cantonese-BCoS, font that is not bold shows a non- significant difference between Zim-BCoS mean and Cantonese-BCoS mean

6.6.1.3 Comparison of Zim-BCoS to Rus-BCoS on Apple Cancellation Task. On average Zim-BCoS participants performed lower on the Apple Cancellation task. The Zim-BCoS participants crossed out fewer target stimuli, the complete apples (*M* = 45.4, *SD* = 8.76) than the Rus-BCoS mean (*M* = 46.94). The difference was statistically significant, *t*(218) = -2.59, *p* = .010, *d* = 0.79 and the effect size for this analysis was large (see Table 6.34).

Table 6.34

Comparison of Rus-BCoS to Zim-BCoS Means (Ages 32-74 years)

Zim-BCoS Task	**Score range**	**Zim-BCoS *M***	**Rus-BCoS *M***	**Mean Difference**	***SD***	***df***	***t***	***p***	**Cohen's *d***
Attention Spatial									
Apple Cancellation (Accuracy)	**0-50**	**45.4**	**46.94**	**-1.538**	**8.761**	**218**	**-2.598**	**.010***	**-0.788**
Visual Extinction	**0-24**	**23.7**	**24**		**2.32**	**220**	**-1.99**	**.047***	
Tactile Extinction	**0-24**	**23.7**	**24**		**2.42**	**220**	**-2.08**	**.038***	
Attention-Controlled									
Auditory Attention	**0-54**	**41.01**	**53.17**	**-12.161**	**16.30**	**219**	**-11.06**	**.000***	**-2.8**
Rule Finding	**0-18**	**7.92**	**10.57**	**-2.653**	**4.34**	**167**	**-7.918**	**.000***	**-1.241**
Language-Spoken									
Instruction Comprehension	**1-3**	**2.9**	**3**		**2.91**	**211**	**-3.91**	**.000***	**-3.169**
Picture Naming	**0-14**	**8.43**	**12.84**	**-4.415**	**2.09**	**220**	**-31.45**	**.000***	**-1.461**
Sentence Construction	**0-8**	**6.78**	**7.9**	**-1.122**	**1.95**	**220**	**-8.55**	**.000***	**-0.624**
Language-Written									
Non-word Reading-Accuracy	**0-6**	**4.11**	**5.57**	**-1.464**	**1.84**	**217**	**-11.79**	**.000***	**0.998**

Sentence Reading-Accuracy	**0-42**	**36.9**	**39.35**	**-2.44**	**8.01**	**213**	**-4.47**	**.000***	**1.00**
Word/Non-word Writing	0-5	4.1	3.94		1.84	217	1.33	.184	0.088
Memory-Orientation									
Personal	0-8	7.95	8	-.054	.50	220	-1.61	.109	-3.125
Time and Space (MC)	**0-6**	**5.9**	**6**	**.059**	**.35**	**220**	**-2.53**	**.012***	**-0.259**
Memory-Episodic									
Immediate Story Recall	***0-15***	***11.61***	***10.84***	***.771***	***2.99***	***220***	***3.82***	***.000****	***0.259***
Delayed Story Recall	**0-15**	**12.78**	**14.14**	**-1.359**	**2.57**	**220**	**-7.87**	**.000***	**-0.252**
Task Recall	**0-10**	**8.7**	**9.83**	**-1.13**	**1.56**	**221**	**-10.77**	**.000***	**-2.237**
Number									
Reading	**0-9**	**8.26**	**9**	**-.742**	**1.82**	**221**	**-6.06**	**.000***	**-0.461**
Writing	**0-5**	**4.12**	**5**	**-.878**	**1.54**	**220**	**-8.47**	**.000***	**-0.504**
Calculation	**0-4**	**2.74**	**4**	**-1.26**	**1.37**	**220**	**-13.70**	**.000***	**-1.175**
Praxis- Action									
Figure Copy	**0-47**	**40.24**	**44.84**	**-4.605**	**8.66**	**220**	**-7.91**	**.000***	**-0.823**
Multi-step Object Use	**0-12**	**10.76**	**11.73**	**-.970**	**3.44**	**220**	**-4.19**	**.000***	**-0.311**
Gesture Production	**0-12**	**9.63**	**11.68**	**-2.051**	**1,96**	**221**	**-15.57**	**.000***	**0.069**
Gesture Recognition	**0-6**	**5.33**	**5.94**	**-.614**	**.87**	**220**	**-10.49**	**.000***	**-0.78**
Imitation	**0-12**	**8.99**	**11.56**	**-2.594**	**2.62**	**220**	**-14.73**	**.000***	**0.055**

Notes: The asterisks (*) and a bold font shows correlations where Zim-BCoS scores are significantly lower than Rus-BCoS, Font that is bold and in italics shows where Zim-BCoS scores are significantly higher than the Rus-BCoS mean, two asterisks (**) indicate where there is no difference between Zim-BCoS and Rus-BCoS, font that is not bold shows a non-significant difference between Zim-BCoS mean and Rus-BCoS mean

Visual Extinction

6.6.1.4 Comparison of Zim-BCoS to UK-BCoS on Visual Extinction Task. Here the participants were required to respond to the examiner's finger flicks to demonstrate attention to stimuli. The results show that the younger Zim-BCoS participants were sensitive to a lower number of the examiner's finger flicks (*M* = 23.02, *SD* = 3.75) compared to UK-BCoS participants (*M* = 24). The difference was not statistically significant *t*(41) = -1.69, *p* = 0.099, *d* = -0.26 and the effect size was also very small. Although the older Zim-BCoS participants scored (*M* = 24, *SD* = 0) which is slightly higher than the UK-BCoS cutoff score (*M* = 23.80), there was no statistical difference and a t-test could not be performed.

6.6.1.5 Comparison of Zim-BCoS to Cantonese on Visual Extinction Task. The younger Zim-BCoS participants scored lower (*M* = 23.28, *SD* = 3.24) than the Cantonese-BCoS mean (*M* = 23.94) on the Visual Extinction task. The difference was not statistically significant *t*(56) = -1.54, *p* = 0.13, *d* = 0.20. The older Zim-BCoS participants also responded to fewer of the examiner's finger wiggles (*M* = 23.97, *SD* = 2.32) than the older Cantonese cutoff score (*M* = 24). The difference was statistically significant, *t*(220) = -1.99, *p* = .047.

6.6.1.6 Comparison of Zim-BCoS to Rus-BCoS on Visual Extinction Task. The Zim-BCoS participants scored lower on responding to the examiner's finger flicks (*M* = 23.70, *SD* = 2.32) than the Rus-BCoS cutoff score (*M* = 24). The difference was statistically significant, *t*(220) = -1.99, *p* = .047.

Tactile Extinction Task

6.6.1.7 Comparison of Zim-BCoS to UK-BCoS on Tactile Extinction Task. This test assesses the participant's sensitivity to touch. The examinees lift their hands in response to the examiner's tap. The younger Zim-BCoS participants' response to the sense of touch stimuli was lower (*M* = 23.79, *SD* = .81) than the UK-BCoS mean (*M* = 23.9). These findings were not statistically insignificant *t*(41) = -.91, *p* = 0.36, *d* = -.14 with a very small effect size. The older Zim-BCoS sample mean score was (*M* = 24, *SD* = 0) which is comparable to the UK-BCoS (*M* = 24). A t-test could not be performed because of the lack of variation between scores.

6.6.1.8 Comparison of Zim-BCoS to Cantonese on Tactile Extinction Task. The younger Zim-BCoS participants were more responsive to the touch stimuli (*M* = 23.84, *SD* = .702) than the Cantonese-BCoS mean (*M* = 23.10). The test was statistically significant *t*(56) = 7.98, *p* < .001, *d* = 1.06 and the effect size was large. Similarly, the older Zim-BCoS sample were also more sensitive (*M* = 24) than the Cantonese-BCoS sample (*M* = 24, *SD* = 2.42) which is higher than the Cantonese-BCoS mean (*M* = 23.86). The difference was also statistically significant, *t*(22.0) = -2.08, *p* = 0.038.

6.6.1.9 Comparison of Zim-BCoS to Rus-BCoS on Tactile Extinction Task. The results indicated that the Zim-BCoS participants were less responsive to the touch stimuli (*M* = 23.70, *SD* = 2.42) than the Rus-BCoS mean (*M* = 24). The difference was not statistically significant, *t*(220) = -2.08, *p* = .038.

Auditory Attention Task

6.6.1.10 Comparison of Zim-BCoS to UK-BCoS on Auditory Attention Task. This task assesses selective and sustained attention. The participant is instructed to tap on the table in response to target words: 'Hello', 'Please' and 'No', and to ignore all distracters. On the Auditory Attention task, the results indicated that younger Zim-BCoS participants, ages 50 - 64 years tapped fewer times in response to the target words (*M* = 42.62, *SD* = 17.07)

than the UK-BCoS sample (*M* = 53.2). The older Zim-BCoS participants (65 - 75 years age group) also had lower auditory attention (*M* = 19.38, *SD* = 17.27) than the UK-BCoS mean (*M* = 52.7). The difference was statistically significant *t*(31) = -5.90, *p* < .001, *d* = -1.04 with a very large effect size.

6.6.1.11 Comparison of Zim-BCoS to Cantonese-BCoS on Auditory Attention Task. The younger Zim-BCoS participants tapped fewer times in response to the target words (*M* = 37.42; *SD* = 19.74) which is lower than the Cantonese-BCoS mean (*M* = 50.82). The test was statistically significant *t*(56) = -5.13, *p* < .001, *d* = 0.68 and effect size was moderate. The older sample of Zim-BCoS also had lower selective attention (*M* = 14.3, *SD* = 16.30) than the Cantonese-BCoS mean (*M* = 48.92). This test was statistically significant, *t*(15) = -11.20, *p* < .001, *d* = -2.8 and the effect size was very large.

6.6.1.12 Comparison of Zim-BCoS to Rus-BCoS on Auditory Attention Task. The Zim-BCoS tapped fewer times in response to the target words (*M* = 41.01, *SD* = 16.30) than the Rus-BCoS mean (*M* = 53.17). The t-test comparison results were statistically significant, *t*(219) = -11.06, *p* < .001, *d* = 2.8. However, the effect size was very large.

Rule Finding and Concept Switching

6.6.1.13 Comparison of Zim-BCoS to UK-BCoS on Rule Finding and Concept Switching. To assess Executive Function, participants were supposed to identify rules guiding the movement of a dot on different pages. The younger Zim-BCoS participants identified fewer rules on this task (*M* = 8.12, *SD* = 4.48) than the UK-BCoS cutoff score (*M* = 11.9). The difference between the scores was statistically significant *t*(32) = -4.84, *p* < .001, *d* = -0.84 with a large effect size. The older participants also performed lower (*M* = 7.22, *SD* = 3.00) than the UK-BCoS means (*M* = 11.00). This test was statistically significant *t*(26) = -6.53, *p* < 0.001, *d* = 1.26 and the effect size was very large.

6.6.1.14 Comparison of Zim-BCoS to Cantonese-BCoS on Rule Finding and Concept Switching. The younger Zim-BCoS participants identified fewer rules (*M* = 7.8, *SD* = 4.19) which is lower than the Cantonese-BCoS mean (*M* = 11.96). The test was statistically significant *t*(44) = -6.66, *p* < .001, *d* = .99 with a very large effect size. The older sample of Zim-BCoS also identified fewer rules (*M* = 7.40, *SD* = 2.98) than the Cantonese-BCoS mean (*M* = 11.13). The difference was statistically significant *t*(13) = 4.64, p <.001, *d* = -1.24 and the effect size for the analysis was large.

6.6.1.15 Comparison of Zim-BCoS to Rus-BCoS on Rule Finding and Concept Switching. The Zim-BCoS participants identified fewer rules and, hence, scored lower (*M* = 7.92, *SD* = 4.34) than the Rus-BCoS mean (*M* = 10.57). The difference was statistically significant *t*(167) = -7.92, *p* < .001, *d* = 1.24 with a large effect size.

6.6.2 Language Domain

6.6.2.1 Comparison of Zim-BCoS to UK-BCoS on Picture Naming Task. This task assesses verbal fluency through naming a set of pictures. The results indicate that the younger Zim-BCoS participants could correctly name fewer pictures ($M = 8.64$, $SD = 2.17$) compared to UK-BCoS participants ($M = 13.1$). Further t-tests performed on this difference indicated that the difference was statistically significant with a $t(39) = -13.29$, $p < 0.001$, $d = -2.05$ with a large effect size. Likewise, the older participants also named fewer pictures ($M = 7.94$, $SD = 2.29$) than the UK-BCoS mean ($M = 13$). The difference was statistically significant, $t(32) = -12.69$, $p < .001$, $d = 2.21$ with a very large effect size.

6.6.2.2 Comparison of Zim-BCoS to Cantonese-BCoS on Picture Naming Task. The younger Zim-BCoS participants correctly identified fewer pictures ($M = 8.32$) compared to the Cantonese participants ($M = 13.29$). The difference was statistically significant, $t(57) = -16.72$, $p < .001$, $d = -2.21$. The older participants also performed lower ($M = 8.41$, $SD = 2.47$) than the Cantonese-BCoS mean ($M = 12.03$). The difference was statistically significant, $t(16) = 6.02$, $p = 0.00$, $d = -1.46$ and the effect size was very small.

6.6.2.3 Comparison of Zim-BCoS to Rus-BCoS on Picture Naming Task. The results showed that the Zim-BCoS participants managed to identify fewer pictures ($M = 8.4$, $SD = 2.09$) than the Rus-BCoS mean ($M = 12.54$). The difference was statistically significant, $t(220) = -31.45$, $p < .001$, $d = 1.46$. However, the effect size was very small.

Sentence Construction

6.6.2.4 Comparison of Zim-BCoS to UK-BCoS on Sentence Construction. The task requires the participant to construct a sentence describing the action in a picture to assess verbal fluency. The younger Zim-BCoS sample had challenges constructing correct sentences (*M* = 7.05, *SD* = 1.64), compared to the UK-BCoS cutoff score (*M* = 8.0). The test was statistically significant *t*(41) = -3.77, *p* < .001, *d* = 0.58 with a moderate effect size. Similarly, the older Zim-BCoS participants also performed lower on Sentence Construction (*M* = 6.24, *SD* = 2.33) which is lower than the UK-BCoS cutoff score (*M* = 8). The difference was statistically significant *t*(32) = -4.33, *p* < .001, *d* = 0.75 with a large effect size.

6.6.2.5 Comparison of Zim-BCoS to Cantonese-BCoS on Sentence Construction. The younger Zim-BCoS participants constructed fewer correct sentences (*M* = 6.88, *SD* = 1.79) which is lower than the Cantonese-BCoS mean (M = 7.80). The test was statistically significant *t*(57) = -3.88, *p* < .001, *d* = 0.51. The effect size was moderate. The older Zim-BCoS participants scored lower (*M* = 6.24, *SD* = 2.53) than the Cantonese-BCoS mean (*M* = 7.82). The difference was statistically significant *t*(16) = -8.55, *p* = 0.020, *d* = -0.62 with a moderate effect size.

6.6.2.6 Comparison of Zim-BCoS to Rus-BCoS on Sentence Construction. The Zim-BCoS participants performed lower on sentence construction (*M* = 6.78, *SD* = 1.95) than the Rus-BCoS cutoff score (*M* = 7.90). The difference was statistically significant *t*(220) = -8.55, *p* < .001, *d* = 0.62 with a moderate effect size.

Word/Nonword Reading Task

6.6.2.7 Comparison of Zim-BCoS to UK-BCoS on Word/Nonword Reading Task. This task assesses phonological skills through reading actual and made-up words. The Zim-BCoS participants read fewer words accurately (*M* = 4.15, SD = 1.81) than the UK-BCoS mean (*M* = 5.8). The difference was statistically significant t(40) = -4.79, *p* = 0.00, *d* = -0.91 with a very large effect size. The older participants also read fewer words correctly (*M* = 3.13, *SD* = 2.37) which is lower than the cutoff score (*M* = 5.80). This test was statistically significant *t*(31) = -6.61, *p* < .001, *d* = 1.13 and the effect size for this analysis was very high.

6.6.2.8 Comparison of Zim-BCoS to Cantonese-BCoS on the Word/Nonword Reading Task. The Zim-BCoS participants read less words accurately (*M* = 3.75, *SD* = 2.13) which is lower than the Cantonese-BCoS mean (*M* = 5.84). The test was statistically significant *t*(56) = 7.33, *p* < .001, *d* = -.98 and the effect size was large. The older population of the Zim-BCoS participants scored lower than the Cantonese-BCoS mean with Zim-BCoS scoring (*M* = 3.63, *SD* = 2.16) while the Cantonese-BCoS mean was (*M* = 5.89). The test was statistically significant *t*(15) = -420, *p* = 0.001, *d* = 0.99 and the effect size for the analysis was small.

6.6.2.9 Comparison of Zim-BCoS to Rus-BCoS Word/Nonword Reading Task. The Zim-BCoS participants could correctly read fewer words (*M* = 4.11; *SD* = 1.84) than the Rus-BCoS cutoff score (*M* = 5.57). The test was statistically significant *t*(217) = -11.79, *p* < .001 , *d* = 0.99. The effect size for analysis was small.

Sentence Reading task

6.6.2.10 Comparison of Zim-BCoS to UK-BCoS on Sentence Reading. This task assesses reading *fluency. The younger Zim-BCoS participants could read fewer words accurately (M = 36.34, SD* = 9.23) than the UK-BCoS cutoff score (*M* = 41.90). The test was statistically significant *t*(40) = 1.97 *p* = 0.00, *d* = 3.07. The effect size of this analysis was statistically large. The older participants also read fewer words correctly (*M* = 32.89, *SD* = 13.33) than the UK-BCoS mean (*M* = 41.90). The difference was statistically significant t(32) = -2.52, *p* < .001, *d* = -0.68 and the effect size was moderate.

6.6.2.11 Comparison of Zim-BCoS to Cantonese-BCoS on Sentence Reading. The younger Zim-BCoS participants could read fewer words accurately (*M* = 36.72, *SD* = -255) than the Cantonese-BCoS cutoff score (*M* = 39.27). The test was statistically significant *t*(53) = -2.25, *p* = 0.029, *d* = -.31. The effect size of this analysis was statistically large. The older participants also read fewer words correctly (*M* = 28.63, *SD* = 17.40) than the Cantonese mean (M = 39.36). The difference was statistically significant *t*(13) = -2.30, *p* < .001, *d* = 1.00 and the effect size was very large.

6.6.2.12 Comparison of Zim-BCoS to Rus-BCoS on Sentence Reading. The Zim-BCoS participants could read more words correctly in the Sentence Reading section (*M* = 36.90, *SD* = 8.01) than the Rus-BCoS cutoff score (*M* = 39.35). The test was statistically significant **t**(213) = -4.47, *p* < .001, *d* = 1.00 and the effect size for this analysis was large.

Word/Nonword Writing

6.6.2.13 Comparison of Zim-BCoS to UK-BCoS on Word/Nonword Writing. Participants wrote fewer words correctly (*M* = 2.4, SD = 1.20) than the standard UK-BCoS mean (*M* = 4.0). This result was statistically significant, *t*(41) = -7.62, *p* < .00; *d* = -1.67, with a very large effect. The older participants also wrote fewer words correctly (*M* = 3.91, SD = 1.04) than UK-BCoS mean (*M* = 4.1). The difference was statistically significant *t*(32) = -12.58, *p* < .000, *d* = -3.07 with a moderate effect size.

6.6.*2*.14 Comparison of Zim-BCoS to Cantonese-BCoS on Word/Nonword Writing. The younger Zim-BCoS participants wrote the required words less accurately (*M* = 1.96, *SD* = 2.13) which is lower than the Cantonese-BCoS mean score (*M* = 3.38). The test was statistically not significant *t*(56) = 1.3, *p* = .20, *d* = 0.66. The effect size was moderate. The older population of Zim-BCoS participants scored (*M* = 3.29, *SD* = 1.17) which is higher than the Cantonese-BCoS score (*M* = 3.19). The test was statistically significant *t*(16) = -7.33, *p* <.001, *d* = .09 with a large effect size.

6.6.2.15 Comparison of Zim-BCoS to Rus-BCoS on Word/Nonword Writing. Participants for the Zim-BCoS scored higher on writing words correctly (M = 4.1, SD = 1.84) than the Rus-BCoS cutoff score (M=3.94). However, the difference was not statistically significant t(217) = 1.33, p = .184; d = 0.09 and the effect size was small.

6.6.3 Memory Domain

Orientation to Personal Information

6.6.3.1 Comparison of Zim-BCoS to UK-BCoS on Orientation to Personal Information. This part of the test assesses participants' orientation to their personal information, including age, years of education and home address. The results show that the younger Zim-BCoS sample scored a mean of (*M* = 7.98, *SD* = .15) which is lower than the cutoff score (*M* = 8.0). The test was statistically significant *t* (41) = 7.40, *p* < .001, *d* =1.14 with a very large effect size. The older Zim-BCoS sample scored a mean of (*M* = 7.95, *SD* = .50), this is lower than the cutoff score (*M* = 8.0). The test was statistically significant *t* (220) = -1.61, *p* < .109, *d* = -3.13 with a very large effect size.

6.6.3.2 Comparison of Zim-BCoS to Cantonese-BCoS on Orientation to Personal Information. The younger Zim-BCoS participants mean was (*M* = 7.84, *SD* = .94) which is lower than the Cantonese-BCoS mean (*M* = 7.94). The test was statistically not significant *t*(56) = -.79, *p* = .44, *d* = -.10 and the effect size for this task was moderate. The older population for

Zim-BCoS also scored lower (*M* = 7.76, *SD* = .56) than the Cantonese-BCoS mean (*M* = 7.90). The result was not statistically significant *t*(16) = -1.29, *p* = .217, *d* = -3.13 and the effect size was very large.

6.6.3.3 Comparison of Zim-BCoS to Rus-BCoS on Orientation to Personal Information. Zim-BCoS participants scored lower (*M* = 7.95, *SD* = .56) than the Rus-BCoS cutoff score (*M* = 8) on their orientation to Personal Information. However, the difference was not statistically significant t(22) = -1.61, *p* = .109, *d* = -3.13 and the effect size was very large.

Orientation to Time and Space

6.6.3.4 Comparison of Zim-BCoS to UK-BCoS on Orientation to Time and Space. Participants were assessed on their orientation to time and space to assess their long term and immediate memory. On the memory task, there was no significant difference in performance between the younger Zim-BCoS participants and UK-BCoS mean. A t-test was not performed because of the lack of variation. Overall, the older participants performed lower (*M* = 5.76, *SD* = 0.66) than the UK-BCoS mean (*M* = 6). The difference was statistically significant *t*(32) = -2.101, *p* = 0.004, *d* = -0.37 with a small effect size.

6.6.3.5 Comparison of Zim-BCoS to Cantonese-BCoS on Orientation to Time and Space. The Zim-BCoS participants were less oriented to Time and Space information (*M* = 5.96, *SD* = 0.86) which is lower than the Cantonese-BCoS mean of (*M* = 5.99). The test was statistically not significant *t*(16) = -1.07, *p* = 0.302, *d* = 0.03 and the effect size for this task was moderate. The older population also scored lower than the Cantonese-BCoS mean, with Zim-BCoS participants scoring (*M* = 5.65, *SD* = 0.86) against the Cantonese-BCoS score (*M* = 5.87) on the Memory task. The results were not statistically significant *t*(16) = -107, *p* =.302, *d* = -0.26. The effect size for this analysis was small.

6.6.3.6 Comparison of Zim-BCoS to Rus-BCoS on Orientation to Time and Space. The Zim-BCoS participants were less oriented to Time and pace (*M* = 5.9; *SD* =.35) than the

Rus-BCoS cutoff score (*M* = 6). The results were statistically significant *t*(220) = -2.53, *p* = .012, *d* = .26 with a small effect size.

Immediate Story Recall

6.6.3.7 Comparison of Zim-BCoS to UK-BCoS on Immediate Story Recall. To assess short-term memory, participants were required to immediately state specific details of a story that they were told. The results show that the younger Zim-BCoS participants scored lower (*M* = 11.3, *SD* = 3.79) than the UK-BCoS mean cutoff score (*M* = 14.3). The test was statistically significant *t*(41) = -5.19, *p* < .00, *d* = 0.80 with a very large effect size. Similarly, the older participants could recall fewer details of the story (*M* =11.42, *SD* = 3.44) compared to the UK-BCoS mean (*M* = 14.1). The difference was statistically significant, *t*(32) = -4.47; *p* < .001, *d* = 0.78 with a large effect size.

6.6.3.8 Comparison of Zim-BCoS to Cantonese-BCoS on Immediate Story Recall. The Zim-BCoS participants recalled fewer details of the story (M = 11.04, *SD* = 2.83) which is lower than the Cantonese-BCoS mean (*M* = 12.45). The test was statistically not significant *t*(16) = 1.07, *p* = 0.301, *d* = 0.51. The effect size for this task was moderate. However, the older population of Zim-BCoS recalled more details of the story (*M* = 12.35, *SD* = 2.83) than the Cantonese-BCoS mean score (*M* = 11.62). The difference was statistically not significant, *t*(16) = -1.07, *p* = .301, *d* = 0.26 with a small effect size.

6.6.3.9 Comparison of Zim-BCoS to Rus-BCoS on Immediate Story Recall. The Zim-BCoS participants recalled fewer details of the story (*M* = 12.78, *SD* = 2.57) than the Rus-BCoS cutoff score (*M* = 14.14.) The difference was statistically significant, *t*(220) = -7.87, *p* < .001, *d* = 0.25 but the effect size for this analysis was very small.

Delayed Story Recall task

6.6.3.10 Comparison of Zim-BCoS to UK-BCoS on the Delayed Story Recall task. Delayed Recall was assessed by checking the details of the story that each participant could recall after about 25 minutes. The younger participants could recall fewer details of the story (*M* = 12.2, *SD* = 3.41) than the original UK-BCoS mean (*M* = 14.6). The test was statistically significant *t*(41) = -4.67, *p* = 0.00, *d* = 3.65 and the effect size was very large. The older participants scored a mean of (*M* = 12.73, *SD* = 3.31) which is also lower than the UK-BCoS cutoff score (*M* = 14.8). This test was statistically significant *t*(32) = -3.60, *p* < 0.001, *d* = 0.63 with a moderate effect size.

6.6.3.11 Comparison of Zim-BCoS to Cantonese-BCoS on the Delayed Story Recall task. The Zim-BCoS participants recalled fewer details of the story on the Delayed Recall task (*M* = 12.35, *SD* = 3.76) which is lower than the Cantonese-BCoS mean (*M* = 14.22). The test was not statistically significant *t*(16) = -1.04, *p* = 0.313, *d* = .5. The effect size for this task was moderate. The older Zim-BCoS participants scored lower (*M* = 12.47, *SD* = 3.76) than the Cantonese-BCoS mean score (*M* = 13.42). The difference was not statistically significant, *t*(16) = -109, *p* = 0.29, *d* = -0.25. The effect size was very small.

6.6.3.12 Comparison of Zim-BCoS to Rus-BCoS on the Delayed Story Recall. The Zim-BCoS participants recalled more details of the story (*M* = 11.61, *SD* = 2.99) than the Rus-BCoS (*M* = 10.84). The difference was statistically significant, *t*(220) = -3.82, *p* < .001, *d* = 0.26 but the effect size for this analysis was small.

Task Recall

6.6.3.13 Comparison of Zim-BCoS to UK-BCoS on Task Recall. Participants' long-term memory was assessed by identifying tasks that they had encountered during the testing period. The Zim-BCoS participants recalled fewer details of the test on the Task Recall (*M* = 8.8, *SD* = 1.69) than the UK-BCoS mean (*M* = 9.8). The test was statistically significant *t*(41) = 3.69, *p* < .001, *d* = -5.7. The effect size for this task was very large. The older population for Zim-BCoS also scored lower than the UK-BCoS mean on Task Recall (*M* = 8.45, *SD* = 1.91) which is lower than the Cantonese-BCoS score (*M* = 9.6). The difference was not statistically significant, *t*(31) = -3.45, *p* = .002, *d* = .599. The effect size was large.

6.6.3.14 Comparison of Zim-BCoS to Cantonese-BCoS on Task Recall. The Zim-BCoS participants recalled fewer details of the test on the Task Recall (*M* = 8.65, *SD* = 1.22) than the Cantonese-BCoS mean (*M* = 9.43). The test was not statistically significant *t*(16) = -0.92, *p* = 0.317, *d* = -6.40. The effect size for this task was very large. The older population for Zim-BCoS also scored lower than the Cantonese-BCoS mean on Task Recall (*M* = 8.65, *SD* = 1.22) which is lower than the Cantonese-BCoS score (*M* = 8.92). The difference was not statistically significant, *t*(16) = -.92, *p* = .371, *d* = -2.24. The effect size was very large.

6.6.3.15 Comparison of Zim-BCoS to Rus-BCoS on Task Recall. The Zim-BCoS participants could recall fewer tasks correctly (*M* = 8.7, *SD* = 1.56) than the Rus-BCoS mean (*M* = 9.83). The difference was statistically significant, *t*(221) = -10.77, *p* < .001, *d* = 2.24 and the effect size was large.

6.6.4 Number Skills Domain

Number/Price/Time Reading

6.6.4.1 Comparison of Zim-BCoS to UK-BCoS on Number/Price/Time Reading. This task assesses participants' enumeration skills through reading complex figures, prices and clock times. The results indicated that the younger Zim-BCoS participants scored a mean of (*M* = 8.17, *SD* = 1.85) compared to UK-BCoS cutoff score of (*M* = 8.8). The test was statistically significant *t*(41) = -2.22, *p* = 0.032, *d* = -0.34 and the effect size of this analysis was large. The older participants read fewer numbers correctly (*M* = 6.67, *SD* = 3.47) than the UK-BCoS mean (*M* = 8.9). The difference was statistically significant *t*(32) = -3.69, *p* = .001, *d* = -.64 and the effect size was moderate.

6.6.4.2 Comparison of Zim-BCoS to Cantonese-BCoS on Number/Price/Time Reading. The Zim-BCoS participants read less accurately (*M* = 7.75, *SD* = 3.60) compared to the Cantonese-BCoS mean (*M* = 8.78). The test result was not statistically significant *t*(16) = 1.90, *p* = 0.076, *d* = 0.29 with a moderate effect size. The older Zim-BCoS participants scored (*M* = 6.76, *SD* = 3.59) which is lower than the Cantonese-BCoS mean (*M* = 8.42). The difference was not statistically significant, *t*(16) = -1.89, *p* = 0.076, *d* = -0.46 and the effect size was very moderate.

6.6.4.3 Comparison of Zim-BCoS to Rus-BCoS on Number/Price/Time Reading. The Zim-BCoS participants could read fewer numbers correctly (*M* = 8.26; *SD* = 1.82) than Rus-BCoS cutoff score (*M* = 9). The difference was statistically significant, *t*(221) = -6.06, *p* < .001, *d* = 0.46 but the effect size was moderate.

Number/Price/Time Writing

6.6.4.4 Comparison of Zim-BCoS to UK-BCoS on Number/Price/Time Writing. The Zim-BCoS participants wrote fewer numbers correctly (*M* = 4.36, *SD* = 1.34) compared to the UK-BCoS mean (*M* = 4.9). The difference was statistically significant *t*(41) = -2.63, *p* = 0.012, *d* = -0.41 with a moderate effect size. The older participants also wrote fewer numbers correctly (*M* = 2.91, *SD* = 5.0) than the UK-BCoS mean (*M* = 5.0). The test was statistically significant *t*(32) = -5.61, *p* < .001, *d* = .98 with a very large effect size.

6.6.4.5 Comparison of Zim-BCoS to Rus-BCoS on Number/Price/Time Writing. The results showed that the Zim-BCoS participants faced challenges writing numbers correctly (*M* = 4.12, *SD* = 1.54) compared to the BCoS mean (*M* = 5). The difference was statistically significant, *t*(220) = -8.47, *p* < .001, *d* = -.50 but the effect size for this analysis was moderate.

Number Calculations

6.6.4.6 Comparison of Zim-BCoS to UK-BCoS on the Number Calculations task. The results indicated that the Zim-BCoS participants made fewer correct calculations (*M* = 3.14, *SD* = 1.12) which is lower than the cutoff score of (*M* = 3.6). The test was statistically significant *t*(41) = -2.65, *p* = 0.011, *d* = 0.41 with a moderate effect size. The older participants calculated fewer problems correctly (*M* = 1.52, *SD* = 1.64) compared to the UK-BCoS mean (*M* = 3.8). The difference was statistically significant *t*(32) = -7.99, *p* < .001, *d* = -1.39 with a very large effect size.

6.6.4.7 Comparison of Zim-BCoS to Cantonese-BCoS on the Number Calculations task. The younger Zim-BCoS participants were less accurate on the calculations (*M* = 2.74, *SD* = 1.70) which is lower than the Cantonese-BCoS mean (*M* = 3.71). The test was statistically significant *t*(16) = -4.85, *p* < .001, *d* = 0.57 with a moderate effect size. The older Zim-BCoS participants scored (*M* =1.47, *SD* = 1.70) which is lower than the Cantonese-BCoS score (*M* = 3.47). This test was statistically significant, and the effect size was large *t*(16) = -4.85, *p* < .001, *d* = -1.18.

6.6.4.8 Comparison of Zim-BCoS to Rus-BCoS on the Number Calculations task. The Zim-BCoS participants faced more challenges with calculations (*M* = 2.74, *SD* = 1.37) than the Rus-BCoS mean (*M* = 4). The difference was statistically significant *t*(220) = -13.70, *p* < .001; *d* = -1.17 with a small effect size.

6.6.5 Praxis Domain

Complex Figure Copy task

6.6.5.1 Comparison of Zim-BCoS to UK-BCoS on the Complex Figure Copy task. The participants were less accurate when drawing the complex figures (*M* = 40.98, *SD* = 7.71) than the UK-BCoS mean (*M* = 45.1). The difference was statistically significant *t*(41) = -2.57, *p* = 0.014, *d* = 0.53 with a moderate effect size. The older participants also scored lower (*M* = 33.06, *SD* = 11.1) than the UK-BCoS cutoff (*M* = 45.3). The test was statistically significant *t*(32) = -5.30, *p* < .001 with a very large effect size (*d* = 0.92).

6.6.5.2 Comparison of Zim-BCoS to Cantonese-BCoS on the Complex Figure Copy task. The younger Zim-BCoS participants were less accurate on the Complex Figure Copy task (*M* = 40.28, *SD* =12.48) than the Cantonese-BCoS mean (*M* = 43.24). The test was statistically significant *t*(16) =-3.39, *p* = 0.004, *d* = 0.24 and the effect size for this analysis was small. The older Zim-BCoS participants scored (*M* = 31.65, *SD* = 12.48) lower than the Cantonese-BCoS mean score (*M* = 41.92). The difference was statistically significant *t* (16) = 3.39, *p* = .004, *d* = -0.82 and the effect size was large.

6.6.5.2 Comparison of Zim-BCoS to Rus-BCoS on the Complex Figure Copy task. The Zim-BCoS participants performed lower (*M* = 40.24, *SD* = 8.66) than the Rus-BCoS mean (*M* = 44.84). The difference was statistically significant t(220) = 7.91, *p* < .001, *d* = -0.82 and the effect size for this analysis was large.

Multi-step Object Use

6.6.5.3 Comparison of Zim-BCoS to UK-BCoS on the Multi-step Object Use task. The younger Zim-BCoS participants were less articulate (*M* = 9.86, *SD* = -1.74) than the UK-BCoS mean (*M* = 11.6) on the Multiple Step Object Use task of manipulating the torch. The difference was not statistically significant *t*(41) = -2.57, *p* = .014, *d* = -.39 and the effect size was moderate.

Although the Zim-BCoS older participants also scored lower (*M* = 10.18, *SD* = 4.10) than the BCoS mean (*M* = 11.5) on the Multiple Step Object Use task of manipulating the torch, the difference was not statistically significant *t*(32) = -1.85, *p* = 0.074, *d* = 0.32 and the effect size was small.

6.6.5.4 Comparison of Zim-BCoS to Cantonese-BCoS on the Multi-step Object Use task. The younger Zim-BCoS participants were less articulate in manipulating the torch on the Multiple Step Object Use (*M* = 9.81, *SD* = 3.97) than the Cantonese-BCoS score (*M* =11.86). The test was statistically significant *t*(220) = -1.28, *p* = 0.220, *d* = 0.52 with a moderate effect size. The older Zim-BCoS participants scored (*M* = 10.53, *SD* = 3.97) which is lower than the Cantonese-BCoS mean score (*M* = 11.76). The difference was not statistically significant, *t*(16) = -1.28, *p* = .220, *d* = -0.31 and the effect size was small.

6.6.5.5 Comparison of Zim-BCoS to Rus-BCoS on the Multi-step Object Use task. The Zim-BCoS participants scored lower on manipulating the torch (*M* = 10.76, *SD* = 3.44) compared to the Rus-BCoS cutoff score (*M* = 11.73). The difference was statistically significant, *t*(220) = -4.19, *p* < .001, *d* = -0.31 but the effect size was small.

Gesture Production

6.6.5.6 Comparison of Zim-BCoS to UK-BCoS on Gesture Production task. On average, younger Zim-BCoS participants had challenges producing the required gestures (*M* = 9.67, *SD* = 2.49) which is lower than the UK-BCoS mean (*M* = 11.5). The difference was statistically significant *t*(41) = -4.78, *p* = < .001, *d* = 0.74). The effect size for this analysis was moderate. Similarly, the older participants performed lower (*M* =10.03, *SD* = 1.57) than UK-BCoS (*M* = 11.5). The difference was also statistically significant *t*(32) = -5.37, *p* = 0.000, *d* = 0.94 with a very large effect size.

6.6.5.7 Comparison of Zim-BCoS to Cantonese-BCoS on Gesture Production task. The Zim-BCoS participants scored (*M* = 9.63, *SD* = 0.77) which is lower than the Cantonese-BCoS mean (*M* = 11.2). The test was statistically significant *t*(16) = 0.29, *p* = 0.079, *d* = 2.02 and the effect size for this task was large. The older Zim-BCoS participants produced more accurate gestures (*M* = 10.53, *SD* = 1.13) which is higher than the Cantonese-BCoS mean score (*M*=10.45). However, the difference was not statistically significant, *t*(16) = 0.29, *p* =.079, *d* = 0.07 and the effect size was small.

6.6.5.8 Comparison of Zim-BCoS to Rus-BCoS on Gesture Production task. The results indicate that the Zim-BCoS participants produced fewer accurate gestures (*M* = 9.63; *SD* =1.96) than the Rus-BCoS cutoff score (*M* = 11.68). The difference was statistically significant, *t*(221) = -15.57, *p* < .001, *d* = 0.07 but the effect size for this analysis was small.

Gesture Recognition Task

6.6.5.9 Comparison of Zim-BCoS to UK-BCoS on the Gesture Recognition task. Younger Zim-BCoS participants could identify fewer gestures accurately (*M* = 5.14, *SD* = 1.12) compared to the standard UK-BCoS mean (*M* = 5.8). The test was statistically significant, *t*(41) = -3.81, *p* <.00, *d* = .59. Likewise, the older participants identified fewer gestures accurately (*M* = 5.24, *SD* = 1) The difference was statistically significant, *t*(32) = -3.20, *p* =.003, *d* = 0.55 with a very large effect size.

6.6.5.10 Comparison of Zim-BCoS to Cantonese-BCoS on the Gesture Recognition task. Participants for the Zim-BCoS could identify fewer gestures correctly (*M* = 5.33, *SD* =.87) which is less than the Rus-BCoS mean (*M* = 5.94). The difference was statistically significant, *t*(220) = -10.49, *p* < .001, *d* = -0.79, however, the effect size was very large.

Gesture Imitation

6.6.5.11 Comparison of Zim-BCoS to UK-BCoS on the Gesture Imitation task. On average the Zim-BCoS participants scored lower (*M* = 9.95, *SD* = 1.90) than the UK-BCoS mean (*M* = 11.1). The difference was statistically significant *t*(41) = -3.92, *p* < .001, *d* = 0.60 with a moderate effect size. The older participants also had a lower mean score (*M* = 9.55, *SD* = 2.88) than the BCoS mean (*M* = 11.0). Likewise, the difference was statistically significant *t*(32)= -2.90, *p* = 0.007, *d* = 0.51 while the effect size for this task was moderate .

6.6.5.12 Comparison of Zim-BCoS to Cantonese-BCoS on the Gesture Imitation task. The Zim-BCoS participants were less accurate when imitating gestures (*M* = 9.77, *SD* = 3.20) which is lower than the Cantonese-BCoS mean (*M* = 10.3). The test was statistically significant *t*(16) = 0.2,3 *p* = 0.822, *d* = 0.17 and the effect size for this task was moderate. The older Zim-BCoS participants were more accurate when imitating gestures (*M* = 9.65, *SD* 3.20) which was higher than the Cantonese-BCoS mean score (*M* = 9.47). The difference is not statistically significant *t*(16) =.23, *p* = 0.822, *d* = 0.06 and the effect size for this analysis was low.

6.6.5.13 Comparison of Zim-BCoS to Rus-BCoS on the Gesture Imitation task.

The Zim-BCoS participants had lower scores on imitating gestures (*M* = 8.99, *SD* 2.62) and this was below the Rus-BCoS cutoff score of (*M* = 11.56). The difference is statistically significant *t*(220) = -14.73, *p* < .001, *d* = 0.06 with a small effect size.

6.7 Discussion

The broad objective for this part of the study was to generate Zimbabwean regression-based normative data for the Zimbabwean version of the BCoS, which we called Zim-BCoS. To achieve this objective, we administered Zim-BCoS to a sample of cognitively intact community-dwelling adults in Zimbabwe. We made regression models account for the influence of demographic variables on Zim-BCoS performance. Subsequently, the effects of the demographic variables on each of the Zim-BCoS task scores were evaluated using multiple linear regression analyses from which the normative data for each Zim-BCoS task were determined.

The menag age of the normative was lower than that of most stroke patients. This could be attributed to that fact that globally, stroke incidents of the ages between 20-64 has increased by 25% (Feigin et al., 204). This is more in Low and middle income countries where he number of younger people who suffer stroke is more than three times compared to high income countries (Feigin et al., 2014). While this might be so, the regression based norms that were generated in this study give age specific normative data catering for all demographic variables.

The age ranges for the Zim-BCoS sample 18-75 years, while the comparative samples are: the UK-BCoS 50-75 years, Cantonese BCoS sample was 50-75 years and Rus-BCoS 32-75 years. The Zim-BCoS generated norms to include younger ages because of the trend of increase in stroke among younger people (Feigin et al., 2014)Broadly, all Language domain tasks were influenced by demographic variables, (age, education level and gender). The Praxis domain tasks were least affected by the influence of these demographic variables. Overall, 83.5% of Zim-BCoS participants performed lower than the three sets of participants (UK, China and Russia). However, most of the differences were statistically insignificant. Zim-BCoS participants performed higher on two tasks, that is, the Sentence reading & Immediate Story Recall compared to Russian and Cantonese BCoS participants respectively. This disparity in performance among the three different participant groups of different cultural backgrounds highlights the need to generate demographically corrected norms that are specific to a population. This is useful to ensure that the normative data is relevant to the particular population. The specific results for performance on each Zim-BCoS domain are discussed in the sections below

Overall, all subtests under the language domain (Picture Naming, Sentence Construction/Reading, Word/Non-Word Reading/Writing & Instruction Comprehension) of the Zim-BCoS test, except performance on the Sentence Construction, were significantly affected by all demographic variables; age, level of education and sex. These findings concur with numerous previous studies. For instance, a meta-analysis of 82 studies demonstrated that performance is negatively affected in bilingual participants when they are assessed in their second language (Melby-Lervåg & Lervåg, 2014). Another study on Zimbabwean students indicated that bilingual students performed poorly when they received instructions in a second language compared to their native language (Makondo, 2012).

Broadly, there was also a significant gender difference in performance between males and females on all of the language sub-tasks except the Sentence Construction task. For instance, in the Sentence Construction task, women outperformed men. Our findings are consistent with previous studies where gender differences have also been found mainly on the language domain in favour of women (Díaz-Morales & Escribano 2015; Heaton et al., 1996).

This underscores the need to create sex-specific strata when generating normative data on those language subtasks.

Tasks on Sentence reading and Writing words and non-words showed a quadratic effect of age. This means that performance on these language tasks increased with increasing age to a certain point, and then decreased as age continued to increase thereafter. The quadratic effect of age on the Language domain as well as the general deterioration of cognitive performance with age especially on aspects of memory is well documented (Hoogendam et al., 2014; Ashaie & Obler, 2014). For instance, in a study of 3000 non-demented adults assessing ageing and cognitive function, there was a general decline in all the domains that were assessed in that study: Language, Speed of Processing and Memory (Hoogendam et al., 2014).

Tasks on the Attention and Executive Function domain were mostly affected by age and the quadratic effects of age. A general decline in performance was observed with increasing age. These findings are consistent with previous studies (Hoogendam et al., 2014; Park et al., 2003; Verhaeghen & Cerella et al., 2002). A quadratic effect of age was also observed on the Auditory and Apple Cancellation test, meaning that performance initially improved with age to a certain point but declined after that. The normative data was hence stratified by age to correct for the age effect on the affected subtasks. No gender differences were observed in the performance of all the different tasks in the Attention and Executive Function domain. Previous studies have found no gender difference in tests of Attention and Executive Function (Díaz-Morales & Escribano 2015).

In the Memory domain, males performed comparatively similar to their female counterparts in all tasks except the Delayed Recall task. On the Delayed Recall task, there was variability in performance in favour of females. This finding of gender differences in performance on the Memory domain is inconsistent with previous studies which have found no gender differences in this cognitive domain (Díaz-Morales & Escribano, 2015). It is not clear why this difference occurred in this study. No statistically significant effect of age was observed on the Memory cognitive domains.

The Number Skills domain was only affected by the participants' level of education. There was an improved performance with increased education. This finding is not surprising considering that number skills are a core part of most education systems. It is likely that participants' knowledge of number reading, writing and calculation was transferred to these tasks on the BCoS. This finding is also consistent with previous studies which have indicated that education generally increases an individual's Cognitive Executive Function. Also, there is strong evidence that the brain activation associated with academic learning taps into similar neurobiological mechanisms necessary for tackling neurocognitive tasks (Baker et al., 2015). No statistically significant effect of age was observed on the Number Skills cognitive domains tasks. Men and women performed comparably on the Number Skills domain, meaning that there were no statistically significant gender differences in their performance.

The Praxis and Action domain was least affected by the demographic variables we targeted in this study. Three of the praxis tests were not affected by any of the three demographic variables (age, gender and level of education) that were assessed, that is, the Multiple-step Object Use, the Gesture Imitation and Production tasks. This result could be because these three tasks have minimal language loading (Kuzmina et al., 2017; Pan et al., 2015). However, there was a general decline in performance with age on one task in the Praxis domain, the Complex Figure Copy, meaning that individuals' performance in this area declined with age.

Overall, 9/22 (41%) of the Zim-BCoS task results presented as being relatively 'culture-free', that is, they did not show a statistically significant effect from any of the demographic variables that were assessed (Visual & Tactile Extinction, Sentence construction, Orientation, Story Recall, Number Reading/Writing, Multi-Step Object Use and Gesture Production). This could be attributed to the minimal language loading of BCoS (Kuzmina et al., 2017). There was at least one task from each of the BCoS cognitive domains, which was not significantly affected by demographic variables. For instance, the following tasks showed no variability based on age, gender and level of education; on the Attention and Executive Function (Visual and Tactile Extinction tasks), Language domain (Sentence Construction task), Memory domain (Orientation and Story Recall), Number abilities (Number/Price/Time Reading) and on the Praxis domain (Multiple-step Object Use, Gesture Production and Recognition). There was no significant effect on performance by age, gender or level of education on the Visual Extinction task. Instead, there was a ceiling effect on performance, with most people achieving the highest score on the Visual Extinction task. These findings have been observed in previous studies and could be attributed to the fact that BCoS has minimal language loading (Humphreys et al., 2012 and Pan et al., 2015) which makes BCoS a viable tool to use in cross-cultural settings.

Our secondary objective was to compare Zim-BCoS normative data against previously published versions of BCoS (i.e. UK-BCoS, Cantonese-BCoS and Rus-BCoS). The purpose of this part of the study was to determine whether there is a significant difference in the cognitive performance among the different populations on BCoS performance because any such differences would justify the need for contextualised normative data.

The findings on the comparison of performance of Zim-BCoS participants against previously published norms on the Attention and Executive Function Domain indicated differences in perfomance. Both younger and older Zim-BCoS participants' performance was significantly lower compared to all the other three sets of participants (UK, China and Russia) on the Auditory Attention and Rule Finding tasks. The difference in performance on the Rule Finding task may be attributed to differences in exposure. The UK-BCoS sample may have more exposure to the nature and rules of games and puzzles that resemble these tasks compared to Zim-BCoS participants. It is likely that the BCoS test material mimics the types of activities that constitute common games and quizzes in other parts of the world like China Russia and the UK, thereby giving a performance advantage for participants from those cultures compared to your sample. In addition, the Auditory Attention task comprises a pre-recorded audio that the examinee responds to for selecting target words from distracters. Zim-BCoS participants' performance on this task may have been affected by the examiner's British accent of the voice actor. Future tasks may evaluate the use of an audio-recorded voice with a local accent which is likely to be more easily understood. For both tasks, the Zim-BCoS participants may also have been affected by test anxiety as most of the participants were community-dwelling individuals who have very little or no exposure to tests in formal settings (Sommer & Arendasy, 2014). Besides, most participants are involved in informal trading such as street vending, which involves very little or no paperwork (Rogerson, 2016). Although Zim-BCoS participants’ scores were lower on three out of five Attention tasks (Apple Cancellation, Visual and Tactile Extinction), the performance difference was not statistically significant among the Cantonese and Russian samples. This non-significant difference could be because the tasks have minimal language loading (Humphreys et al., 2012), making it easy for participants from any culture to understand them. However, the Zim-BCoS participants’ performance on Visual and Tactile Extinction was comparable with the UK-BCoS sample. This lack of variation in the performance between Zim-BCoS and UK-BCoS could be attributed to the fact that there is no prior exposure or experience needed for paying attention to and performing these tasks. For instance, the Tactile Extinction task requires the examinees to lift their hand when it is tapped by the examiner or to point to the finger that is moved by the examiner. The tactile and visual sensations are universal languages. As long as the participants can see and feel clearly, they should be able to perform the required tasks.

On the comparison of performance of Zim-BCoS participants against previously published norms on the Language Domain, participants scores were low on all but one of the eight tasks, Word Writing. Again, the issue of the negative influence of using a second language on cognitive tests is highlighted. The Zim-BCoS participants may have been compromised because the test was not fully translated into Shona, the local language, whereas in the other three previous studies, participants were using their first language. This result also may be supported by the fact that there was no statistically significant difference in Instruction Comprehension since the instructions were translated into Shona. This result may also imply that the instructions are relatively simple and that they were well adapted to suit the participants. While some of the stimuli for the Picture Naming task were amended to suit Zim-BCoS participants, they still performed significantly lower than the UK-BCoS norms. However, as the stimuli for the Sentence Construction task were not replaced; this could imply a cultural difference in the remaining pictures.

On the Language domain, although there was no significant difference in instruction comprehension, Zim-BCoS participants still performed lower than UK-BCoS norms. This result implies that there were some residual effects of language on the tasks, hence the need for demographically corrected norms. UK-BCoS participants also have more exposure to the English language as it is their native tongue. First language English speakers, even with limited education, are more proficient than second-language speakers of low educational backgrounds.

Overall, performance on the Memory D domain was mixed, but generally, Zim-BCoS performance was the best in this domain. The performance was significantly lower on half the tasks (50%), and the other 50% was not statistically significant. The Memory domain includes immediate and delayed recall of a story that is read out by the examiner. In the adaptation of the Zim-BCoS, the original story was not translated; it is still in English. The language barrier might have had a bearing on participants' lower performance. The way an individual comprehends and understands a story impacts on their ability to code, store and retrieve the information. This fact is supported by substantial evidence from a meta-analysis evaluating the impact of a second language on working memory (Linck et al., 2014). Information is efficiently coded and assimilated if the individual has prior similar information. It is, therefore, possible that the story used in the Zim-BCoS still has a Eurocentric flare to it. Ideally, a story that matches the day to day experience of Zimbabwean people should be designed and evaluated for improvement in performance on the Memory domain.

There was no significant difference in performance on the Task Recall test on all groups except the Rus-BCoS. Knowledge of personal information, space and time is general information which is not dependent on the participants' age, gender and level of education; it was least affected by cultural differences.

Generally, the performance of Zim-BCoS participants on the Number Skills Domain was significantly lower than the five age groups except for Cantonese-BCoS, where it was not statistically significant. It is likely that the UK-BCoS participants are more exposed to the digital world and, therefore, are more familiar with reading and writing in English. Test anxiety could also have been at play (Sommer & Arendasy, 2014). The low exposure to test situations is also applicable to the participants' performance on number reading/writing and mental calculations. This result could be attributed to varying cultural aspects such as the different sociodemographic profiles (level of education and background). In Zimbabwe, most informally engaged people have little exposure to writing and reading; hence their capacity for and confidence in handling text are low. This deficiency occurs because many people in Zimbabwe mainly engage with texts during their formal schooling and will not use their education very much once they leave school because of the focus on informal trading in Zimbabwe. Hence, many Zimbabweans lose their reading and writing skill proficiency over time. The higher performance of Rus-BCoS in this area may be attributed to the culture of prioritizing Science and Mathematics in Russia (Gasparyan & Smirnova et al., 2015).

Zim-BCoS scores were significantly lower on all Praxis tasks except for UK-BCoS where the difference was not statistically significant. The Multiple Object Use task involves sequential steps that culminate in the lighting of a torch. Lower performance on the Multi-step Object Use task may be attributed to the participants' lack of exposure. Torches are usually used for camping activities, which is not a very familiar activity in Zimbabwe.

Additionally, skill in the general manipulation of electronic gadgets is lower with some people, especially those from rural settings and, thus, few people are sufficiently educated to know how to connect the positive and negative battery terminals. Although participants may have had some exposure to using torches, it was a trial and error process getting the torch to work.

The Gesture Production/Imitation Tasks may have appeared nonsensical to participants, and so they may not have seen the relevance of committing themselves to produce accurate gestures. This indifference may be attributed to the fact that Zim-BCoS participants are less exposed to adult games compared to UK-BCoS adults because playing games is more common in the UK than in developing countries.

Similarly, in Zimbabwe there is less exposure to pencil and paper tasks, which might have compromised the Zim-BCoS participants' performance on the Figure Copy task (Sommer & Arendasy, 2014). Generally, there is less exposure to the use of stationary and fewer people are familiar with the use of puzzles and art. Such activities are not as common in the culture or education system of developing countries as they are likely to be in developed countries such as the UK. There is also a possibility that there could be some residual cultural issues on the Praxis tasks which need further modification. This highlights the importance of developing and using regression-based norms which correct for demographic variables and give normative data that is specific to a particular population.

6.8 Limitations of the normative study

This study had shortcomings in that raw data from the previously published norms were not available. We were not able to perform some comparative tests such as a t-test to evaluate group differences among the three different versions of BCoS. This appraisal would have allowed for the determination of the statistical significance of the similarities and differences in participants' performance on the different versions.

The BCoS items could not be fully translated into the local languages without compromising the psychometric properties of the test, thus impacting the participants' expected performance. Implementing such changes would have required resources and expertise that were beyond the scope of this study. We recommend that BCoS type psychometric tests be designed from scratch, using culturally appropriate stimuli wherever resources permit. Ideally, neuropsychological tests can be developed in African languages to provide culturally and linguistically good data that is collected in the first language use in practice and future studies.

Chapter 7: Validation of Zim-BCoS on patients with stroke

"When a test user makes a substantial change in test format, mode of administration, instructions, language, or content, the user should revalidate the use of the test for the changed conditions": (American Educational Research Association, American Psychological Association & National Council on Measurement in Education, 1985 p.41).

Abstract

The translation and adaptation of cognitive tests can potentially alter their psychometric properties and compromise their robustness. Whenever a test is modified, there is a need to investigate its psychometric properties in order to ensure the test's utility. We translated and adapted the BCoS for use in Zimbabwe. Our aim in this part of the study was to evaluate the convergent and predictive validity of Zim-BCoS. Our secondary aim was to determine the inclusivity of Zim-BCoS on assessing patients with aphasia, determine how well Zim-BCoS could relate to post-stroke functional outcome as well as determining the prevalence of cognitive deficits (global cognitive impairment, visuospatial abilities & impairment on executive function) and how these relate to other post-stroke conditions (depression, generalized anxiety, apathy and impairment to quality of life and activities of daily life). We validated the modified Zimbabwean version of BCoS (Zim-BCoS) on a sample of patients with stroke. To check the correlation of Zim-BCoS with commonly used cognitive tests, we checked convergence validity by comparing the performance of patients with stroke (*N*=103) and matched controls (*N*=103) on Zim-BCoS cognitive domains alongside other tests that assess similar cognitive domains. For instance, we compared performance on the Zim-BCoS Apple Cancellation task against the Star Cancellation test (Halligan et al., 1990), Zim-BCoS Auditory Attention task against the MoCA Attention task (MoCA; Nasreddine et al., 2005), Zim-BCoS Rule Finding task against the Brixton Spatial Anticipation Test (BSAT; Burgess & Shallice, 1999), Zim-BCoS Picture Naming test against MoCA and Mini-Mental Status Examination (MMSE; Folstein et al., 1975) Picture Naming tasks, Zim-BCoS Orientation tasks to the MoCA Orientation task, Zim-BCoS Memory tests to the MoCA Word Recall task, Zim-BCoS Number

Calculation task against MoCA Serial Sevens Calculations as well as Zim-BCoS Complex Figure Copy to MoCA Figure Copy task. To ascertain correlation of Zim-BCoS with other post-stroke measures, we determined predictive validity by comparing the performance of the same patient cohort on each Zim-BCoS task against the following post-stroke measures; 1) neurobehavioral outcomes; the Patient Health Questionnaire-9 (PHQ-9; Kroenke & Spitzer, 2002), the Generalised Anxiety Disorder-7 (GAD-7; Kroenke & Spitzer, 2006), Apathy Evaluation Scale (AES; Marin et al., 1991), 2) Quality of Life measure, the Stroke Form Health Questionnaire (SF-36; Burholt & Nash, 2011); 3) Functional independence measures Barthel Index (BI; Mahoney & Barthel, 1965), and Stroke Impact Scale (SIS; Duncan et al., 2003). To determine ability of Zim-BCoS to predict functional outcome, we compared the performance of patients with stroke on Zim-BCoS praxis subtests and the Barthel Index at initial and six-months follow up. We investigated the inclusivity of Zim-BCoS on patients with aphasia and also documented the prevalence of cognitive deficits and other post-stroke sequelae that we gathered from the neurobehavioral, quality of life and functional independence measures. Our findings indicate that Zim-BCoS tasks all had statistically significant convergence and predictive validity, could predict functional outcome at six-months follow up and is inclusive of assessing patients with aphasia. We conclude that Zim-BCoS shows excellent psychometric properties and offers a less costly and easy to use neurocognitive screen for Zimbabwe.

Keywords: convergence, predictive validity and inclusivity

7.1 Validation of Zim-BCoS

Translating and adapting psychological tests has numerous benefits; for instance, it makes a test more robust and relevant to the target population. Test adaptation is also practical and less costly in low resourced settings in which financial and technical resources are scarce. However, the adaptation process introduces changes in the psychometric properties of tests which may lead to the production of unreliable or invalid test results (Borsa et al., 2012; Byrne, 2016). It is crucial, therefore, to validate the modified test to minimise inconsistencies that might have been brought about by translation and validation. Validation is an essential and continuous process of interrogating the utility of a test and refining its contents through empirical evidence (Anastasi, 1986; Mokkink et al., 2017).

There are various methods for validating tests. Several boards, including the American Psychological Association and International Test Commission, have made recommendations on gathering evidence to evaluate the reliability and validity of tests. These key recommendations include the evaluation of the test's temporal stability, as assessed in test-retest reliability to determine the test's consistency over time (Mokkink et al., 2017). Another method of testing is to determine convergence validity by comparing the test in question with established comparison tests that measure similar constructs or are related to that construct (Borsa et al., 2012). Convergence validity is a form of criterion validity that refers to how two different instruments measuring the same construct should be highly correlated. For instance, if Zim-BCoS has good convergence validity, it should converge and show good interrelations with the comparison tests that index similar underlying cognitive functions (Wood et al, 2002).

We selected patients with stroke as an initial condition to test Zim-BCoS because the original BCoS was also evaluated on a similar patient sample. It was therefore important to assess the predictive validity of Zim-BCoS subtest scores by evaluating how they relate to functional outcomes of common post-stroke sequalae, and then evaluate it on other conditions in future studies. Ideally, performance on certain Zim-BCoS subtests would be able to show negative or positive interrelations with a patient’s post stroke profile (Bertua et al., 2005). For instance, increased impairment on certain Zim-BCoS subtests would predict positive association with increased neurobehavioural consequences, while high performance on Zim-

BCoS tasks would be positively associated with increased functional independence and increased scores on a patient's quality of life outcome measure.

Previous studies indicate that the BCoS screen praxis tests can be used to determine functional outcome at initial assessment and recovery after a period (Bickerton et al., 2012). This information which gives insight to a patient's prognosis is critical in planning and determining healthcare costs. It was important to assess the utility of the translated Zim-BCoS version praxis subtests to see if they could predetermine functional outcome and recovery.

Previous studies have also demonstrated that BCoS is inclusive, that is, it was developed to minimize contamination from aphasia and neglect and to accommodate patients with those deficits, which are a typical result of strokes (Bickerton et al., 2012; Pan et al., 2015; Kuzmina et al., 2017). Inclusivity in this study refers to the extent to which an instrument is designed in such a way that it accommodates participants with specific deficits that would typically hinder them from taking a test or influence their performance. In this case, common hindering deficits in patients with stroke include aphasia, apraxia and neglect. This characteristics of including patients with aphasia is lacking in most neurocognitive tests, yet aphasia is a common post-stroke outcome that interferes with patients' cognitive performance (Bickerton et al., 2012). We sought to assess the capacity of Zim-BCoS to facilitate test-taking among patients with aphasia in the various subtests.

Another way of assessing the objectivity or robustness of a psychological test is to determine if the prevalence of condition that are picked up by the instrument are within the range that is common for such a condition. If the prevalence are too high, there could be a possibility that the instrument is detecting false positives and too low prevalence may be due to the instrument's poor detection of the condition. Inaccurate results on cognitive tests are a waste of resources and have negative psychological consequences including people experiencing unnecessary negative emotions, inaccurate diagnosis leading to inappropriate treatment and rehabilitation among other things (van der Velde et al., 2017).

Following the translation and adaptation of Zim-BCoS, it was therefore necessary to evaluate the utility of the test on an actual patient sample. The primary objective of this part of the study was to evaluate the validity of Zim-BCoS. The secondary objectives were to determine the prevalence of cognitive impairment and other post-stroke sequelae using the Zim-BCoS and other standardized tests that assess for post-stroke sequelae. We sought to answer the following research questions:

1. What is the convergence validity of Zim-BCoS subtests against tests that measure similar cognitive constructs such as Mini-Mental Status Examination (MMSE; Folstein et al., 1975), Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005), Trail Making Test (TMT; Army, U. S., 1944), Star Cancellation Test (Halligan et al., 1990) and the BSAT; Burgess & Shallice, 1999)?

2. What is the predictive validity of Zim-BCoS against the following measures of post-stroke sequelae?

    i. Neurobehavioural outcome measures based on scores on the Patient Health Questionnaire-9 (PHQ-9; Kroenke & Spitzer, 2002); the Generalised Anxiety Disorder-7 (GAD-7; Kroenke & Spitzer, 2006) and the Apathy Evaluation Scale (AES; Marin et al., 1991),

    ii. Quality of Life outcome measure based on scores on the Short-Form Health Questionnaire-36 (SF-36; Burholt & Nash, 2011),

    iii. Functional Independence and disability based on scores on the Barthel Index (BI; Mahoney & Barthel, 1965) and the Stroke Impact Scale (SIS; Duncan et al., 2003)?

3. What is the association of Zim-BCoS praxis scores in determining functional outcome and recovery based on the Barthel Index?
4. What is the inclusivity of Zim-BCoS on patients with aphasia?
5. What is the prevalence of cognitive impairment in the patient sample based on assessments using Zim-BCoS cutoffs and other measures of post-stroke sequelae?

For the convergence validity, we hypothesize that there will be positive correlations between Zim-BCoS subtests and other cognitive tests assessing similar cognitive domains (see Table 7.1 for the parallel comparisons). For this reason, we hypothesize that the following neurocognitive tests will show positive correlations:

i) Zim-BCoS Apple Cancellation against Star Cancellation test,
ii) Zim-BCoS Auditory Attention task against MoCA attention task,
iii) Zim-BCoS Rule Finding task against the Brixton Spatial Anticipation Test,
iv) Zim-BCoS Picture Naming test against MoCA and MMSE Picture Naming task,
v) Zim-BCoS Orientation task to MoCA Orientation task,
vi) Zim-BCoS Memory test to MoCA Word Recall task,
vii) Zim-BCoS Number Calculation against MoCA Serial Sevens task,
viii) Zim-BCoS Complex Figure Copy to MoCA Figure Copy task.

For predictive validity of Zim-BCoS with neurobehavioral outcomes, we hypothesize that there will be a positive correlation on the functional independence measure, the Barthel Index but negative correlation on the following tests:

i) Zim-BCoS and PHQ-9 scores,
ii) Zim-BCoS and GAD-7 scores,
iii)Zim-BCoS and AES scores, Quality of Life measure, the SF-36,
iv) Stroke Impact Scale

Table 7.1
BCoS tasks correlations with other cognitive tasks

Zim-BCoS Domain	Zim-BCoS Tasks	Parallel task
Orientation	Orientation to time and person	MMSE orientation task MoCA orientation task
Praxis	Figure copy	MMSE Figure copy task MoCA figure copy task
	Gesture production	MMSE obeying command
Visuospatial	Visual extinction	MMSE Figure copy task MoCA figure copy task
Memory (immediate recall)	Story recall 1	MMSE Word recall test
Delayed memory	Delayed story recall	MMSE Delayed Word recall
	Task recognition	MoCA Delayed Word recall
Calculation	Calculation	MMSE Serial Sevens test
Language	Picture naming	MoCA language task MMSE item naming task
	Word writing	MMSE sentence writing task
Visuospatial	Apple cancellation task	Star Cancellation Test
Attention/Executive function	Rule finding	Brixton Spatial Anticipation Test MMSE command obey task
Attention	Auditory task	MoCA Attention task

7.2 Methods

7.2.1 Participants

Patients with a clinical diagnosis of a first-ever stroke were recruited from referral hospitals, rehabilitation centres and the community in Harare and Chitungwiza. Patients were included if they were aged 18-75 years and could read and write in English (see Appendix C1 for the patient screening questionnaire). We excluded participants with a history of conditions that would compromise their cognitive function such as a history of head injury, brain tumour, previous stroke or history of unconsciousness that lasted for more than 10 minutes at any one time, memory problems, meningitis, Asperger's syndrome, motor neuron disease, Huntington's or Parkinson's disease, Encephalitis, a psychiatric condition such as Schizophrenia, dementia or substance abuse. Out of the 408 patients screened, we recruited adults with a first-ever stroke (*N*=103) of within the three months post-stroke period who met our criteria (Males = 45; Females = 58). Most of the participants were right-handed (94.2%). Their mean age was 49.4 (*SD* 10.7) and mean education period was 11.1 years (*SD* 3.8). We then matched these patients with cognitively healthy participants *(N=103)* for our analysis. The inclusion and exclusion criteria for this study were based on the absence of significant impairment on cognitive functioning or activities of daily living (ADLs) based on patients' responses to the screening questionnaire. In order to be able to respond to the test, participants had to have been born and grown up in Zimbabwe, be between 18 and 65 years old, and able to read and write in English and Shona. Participants were excluded if they had a history of any condition, pathology or disease that would compromise cognitive performance. These disorders included a history of mental illness, substance use, a current or lifetime diagnosis of neurologic condition such as epilepsy, head injury, stroke, memory/thinking problems, motor neuron disease or a history of having experienced unconsciousness for more than 10 minutes performance (see Appendix C1).

The matched healthy participants (N=103) were recruited from the normative sample through matching the demographic variables. The matched sample consisted of 40.8% of male participants. Most of the participants (96.9%) were right-handed. Their mean age was 49.3 (*SD* 11.3) and mean education period was 11.1 years (*SD* 3.1). A series of independent sample t-test for continuous variables and chi-square for categorical variables assessed baseline differences between patients and controls. There were no statistically significant differences between the groups of patients and matched participants in terms of their demographic characteristics. Table 7.2 below gives a detailed demographic profile of these participants.

Table 7.2
Demographic Profiles for Patients with Stroke and Matched Healthy Participants

Outcome variable		Controls (*N* = 103)	Patients (*N* = 103)	*t/χ2*	*p*	ESE
Demographic Details	Age (years)	49.26 (11.28)	M=49.38 SD(10.69)	-0.08	.939	0.01
	Education (years)	11.10 (3.02)	M=11.08 SD(3.79)	0.04	.968	0.01
	Gender (Male)	42 (40.8%)	45 (43.7%)	0.18	.672	0.03

	Handedness (Right)	95 (96.9%)	97 (94.2%)	0.90	.344	0.07
Language	English	6 (7.4%)	3 (2.9%)	-	-	-
	Shona	75 (92.6%)	99 (96.1%)	-	-	-
	Other	0	1 (1%)	-	-	-
Affected Side	Left	51	52.6%	-	-	-
	Right	45	46.4%	-	-	-
Diagnosis	Stroke	50	52.6%	-	-	-
	Head Injury	4	4.2%	-	-	-
	*POCS	13	13.7%	-	-	-
	*PACS	2	2.1%	-	-	-
	*CVA	19	20%	-	-	-
	*TACS	7	7.4%	-	-	-
Risk Factors	Hypertension	35	34.3%	-	-	-
	Diabetes	5	4.9%	-	-	-
	Hypertension & Diabetes	9	8.8%	-	-	-
	HIV	6	5.9%	-	-	-
	Unknown	48	46.1%	-	-	-
Post-stroke Period	No of Days	51	52.6	-	-	-

*Note**. ESE = Effect Size Estimate. For Age and Education, it is Cohen's *d,* for all other variables Cramer's *PACS=Partial Anterior Circulation Stroke Syndrome PACS= Posterior Circulation Stroke Syndrome, TACS=Total Anterior Circulation Stroke Syndrome, CVA=Cerebrovascular Accident

We conducted a 6+months follow up after the initial testing on 53 patients that we could trace. We evaluated the demographics of the 53 patients who were subjected to follow up tests at six months post stroke. The mean age for these patients was 48.98 (*SD*=11.08); their mean years of education was 11.49 (*SD*=3.50). The mean age for patients who were lost to follow up was 49.8 (*SD*=10.35); their mean years of education was 10.64 (*SD*=4.07). There were no statistically significant differences between patients who were lost to follow-up and those retested on any of the demographic variables, or on initial scores on the PHQ-9, GAD-7, Barthel assessments (see Table 7.3 below).

Table 7.3

Demographic Profiles of Patients with Stroke who were Lost to Follow Up and those Retested

Outcome variable	LTFU (*N* = 50)	Retested (*N* = 53)	$t/\chi2$	*P*	ESE
Age (Years)	49.8 (10.35)	48.98 (11.08)	0.39	.700	0.02
Education (Years)	10.64 (4.07)	11.49 (3.50)	-1.14	.257	0.22
Stroke Period	32.58 (30.74)^{45}	40.78 (33.48)^{49}	-1.23	.221	0.25
PHQ-9	9.86 (5.66)^{28}	9.19 (5.20)^{32}	0.48	.635	0.12
GAD-7	6.61 (5.40)^{28}	6.79 (5.10)^{34}	-0.14	.889	0.03
Barthel Index	62.22 (31.49)^{45}	63.44 (31.66)^{48}	-0.19	.853	0.04
Affected Side (Right)	22 (46.8%)^{47}	23 (46.9%)^{49}	0	.990	<0.01
Handedness (Right)	48 (96%)	49 (92.5%)	0.59	.442	0.08
PHQ9 (Impaired)	10 (35.7%)^{28}	14 (43.8%)^{32}	0.40	.526	0.08
GAD (Impaired)	7 (25%)^{28}	8 (23.5%)^{34}	0.02	.893	0.02
Barthel (Impaired)	35 (77.8%)^{45}	36 (75%)^{48}	0.10	.753	0.03

Note. Continuous variables – means are presented with standard deviations in parentheses. ESE = Effect Size Estimate. For continuous variables, it is Cohen's *d,* for all other variables Cramer's *V,* the subscripts are sample sizes for pre and post-tests.

7.3 Materials

7.3.1 Patient Screening Form

We used a self-reported questionnaire to exclude patients who had other conditions besides suffering from a stroke that might compromise cognitive function. This questionnaire also sampled participants' demographical data such as age, gender, level of education and handedness (see Appendix C1).

7.3.2 Consent Form

In the consent form, we gave a brief description of the study, the procedures, duration and any beneficial or potentially harmful effects of participating in the study to the participants. We indicated that the study was voluntary and that participants could opt-out at any point if they decided to discontinue their involvement (see Appendix D).

7.3.3 The Birmingham Cognitive Screen

The original BCoS is a neurocognitive battery that assesses participants' cognitive function on five domains: Attention and Executive Function, Language, Memory, Number Abilities and Praxis (Humphreys et al., 2012). The BCoS screen was earlier described in detail in Chapter 4. For this phase of the study, we used the BCoS version that we adapted and translated in the previous study, Zim-BCoS (see Appendix G3). The examiner administers the Zim-BCoS screen, and the participant gives verbal, written and gesturing responses accordingly. Each task is scored separately in the examiner and examinee booklet (Appendix G2).

7.3.4 Mini-Mental Status Examination

Subtests in the Mini-Mental Status Examination (MMSE) (Folstein et al., 1975) were to assess convergence validity against corresponding domains of the Zim-BCoS test. The MMSE is a neurocognitive screen that comprises 11 items which assess five cognitive domains: Executive Function, Serial Subtraction, Language, Memory, Orientation and Visuospatial Abilities (Folstein et al., 1975). It is one of the most widely used scales to assess cognitive impairment and consciousness (see Appendix J1). The MMSE is administered by a clinician asking patients different questions on their everyday mental abilities. The participant responds verbally to some parts of the exam and in writing to the other parts of the scale (Folstein et al., 1975). The maximum score is 30 which is interpreted as follows; cutoff scores of <10 indicate severe impairment; 10-20 indicate moderate impairment, 21-24, mild cognitive impairment and a score of 25-30 is considered a normal score, with no impairment (Holzer et al., 1984; Mitolo et al., 2013; Tombaugh & McIntyre, 1992).

7.3.5 The Montreal Cognitive Assessment

Some of the MoCA subtest scores (Nasreddine et al., 2012) were used to evaluate convergence validity against corresponding Zim-BCoS cognitive domains. The MoCA is a rapid screening tool to assess cognitive impairment (see Appendix J2). The test is administered by a trained professional and takes about 10-15 minutes. A score below 26 signals cognitive impairment. The MoCA gives a cognitive profile of the following domains: Attention and Concentration, Memory, Executive Functions, Language, Visuospatial Abilities, Calculation, Conceptual Thinking and Orientation.

7.3.6 Star Cancellation Test

Scores on the Star Cancellation test (Halligan et al., 1990) were used to evaluate the convergence validity of the Apple Cancellation task in Zim-BCoS. The Star Cancellation test is a measure for assessing attention disorder involving unilateral or bilateral neglect (see Appendix J3). The stimulus consists of a page (298 mm x 208mm) scattered with ten short words, ten letters, 56 small and 52 large star shapes. The participant is asked to cross out the target stimulus (all the small stars) and to ignore the distracters (the rest of the stimuli). When giving the instruction, the examiner provides a demonstration by crossing out two small stars on the page. The maximum score for this test is 54, excluding the two small stars crossed out by the examiner. A cutoff score of <44 signals impairment (Halligan et al., 1990).

7.3.7 The Brixton Spatial Anticipation Test (BSAT)

We evaluated the convergence validity of Zim-BCoS Rule-Finding task, an Executive Function task, against the BSAT (Burgess & Shallice, 1999). The BSAT was selected because it has little language loading and is suitable for cross-cultural assessment (Vordenberg et al., 2014). The test assesses one's ability to detect and follow rules in solving sequences of stimuli.

The test consists of a 'rule' identification and switching task. The stimulus consists of a page with a grid with one dot that moves to a different position on each page using a specific pattern. The participant is asked to follow the pattern and then use the pattern to anticipate the position of where the dot will move to next. Responses do not have to be verbal (see Appendix J4).

7.3.8 Trail Making Test (TMT)

The Trail Making Test (TMT) (Army, U. S., 1944) was selected because it has little language loading; therefore, has minimal cross-cultural issues (Vordenberg et al., 2014). The TMT is a measure of the Executive Function, which assesses complex cognitive functions including abstraction, flexibility/switching, visual scanning, motor functioning and processing speed (Tombaugh, 2004). The stimulus consists of encircled numbers (Trails A), then a combination of letters and numbers (Trails B). These stimuli are randomly scattered across a page. In Trails A, the participant is required to connect the numbers in ascending order as quickly as possible. In Trails B, the participant is required to do the same, but this time switching between number and letter, again in ascending order of each. The maximum time for completing the task is 5 minutes. There are two ways of scoring, either by recording the time taken or the number of errors made. Performance is interpreted as follows: Trail A: Average performance >29 seconds, Deficient performance >79 seconds, Trail B: Average performance >78 seconds, Deficient performance >273 seconds. We used the cutoff on time taken to complete each task to determine impairment and compared that to Zim-BCoS scores on measures of Executive Function and Rule Finding test (see Appendix J5).

7.3.9 Patient Health Questionnaire-9 (PHQ-9)

The PHQ-9 (Kroenke & Spitzer, 2002) was to determine depression levels and to assess predictive validity by comparing with participants' performance on Zim-BCoS. For purposes of this study, we adopted the version of the PHQ-9 previously validated in Zimbabwe

(Chibanda et al., 2016). The PHQ-9 is a self-administered diagnostic tool for detecting and determining the severity of depression according to the DSM-IV criteria. The PHQ-9 is a 9-item Likert scale with four options ranging from 0 (not at all) to 3 (nearly every day). Scoring is interpreted as follows; 0-4 minimal depression, 5-9 mild depression, 10-14 moderate depression, 15-19 moderately severe depression and 20-27 severe depression (Kroenke et al., 2001). For this study, the clinicians rated the responses by the patients to maximise on administration time and to improve accuracy, although it can be self-administered in other settings (see Appendix K1).

7.3.10 Generalised Anxiety Disorder-7 (GAD-7)

The GAD-7 (Spitzer et al., 2006) was used to assess predictive validity, comparing level of anxiety against patients' performance Zim-BCoS level of cognitive impairment (see Appendix K2). For this study, we adopted a version that was validated in Zimbabwe (Chibanda et al., 2016). The GAD-7 is a screening tool which was originally developed to assess for the presence and severity of generalised anxiety disorder symptoms. It is a 7-item Likert scale with four options ranging from 0 (not at all) to 3 (nearly every day). Scoring of the level of anxiety is interpreted as follows: 0-4 minimal anxiety, 5-9 mild anxiety, 10-14 moderate anxiety and 15-21 severe anxiety.

7.3.11 Perceived Stress Scale

The Perceived Stress Scale (PSS) (Levenstein, 1993) was used to determine levels of perceived stress and to compare predictive validity against Zim-BCoS level of impairment. The PSS is a 30-item scale used to evaluate individuals' self-perception of their experiences post a traumatic life event such as a stroke (see Appendix K3). The PSS requires the participants to report if they have experienced any negative anxiety-like symptoms, how they are coping with these issues, and how much they feel in control of these situations. We recorded the presence of symptoms as reported by the participants.

7.3.12 Neuropsychiatric Inventory Questionnaire (NPI-Q)

We administered the Neuropsychiatric Inventory Questionnaire (NPI-Q) (Cummings et al., 1994) to access patient neuropsychiatric symptoms and compared the presence of these symptoms with the performance on some Zim-BCoS cognitive tasks for convergence validity (see Appendix K4). The NPI-Q is a widely used caregiver measure which was developed to assess for the presence of psychiatric symptoms in 12 subdomains: hallucinations, aggression and euphoria. Although there are 12 subdomains, the informant only proceeds to score if the said symptom is present. If the symptoms are present, the severity of the symptoms is rated 1-3, 3 being most severe and similarly, the distress, caused by the symptoms to the caregiver is scored from 1 to 3. The sum of the severity scores ranges from 0-36 (Cummings et al., 1997).

7.3.13 Apathy Evaluation Scale (AES)

We assessed the presence of apathy using the AES (Marin et al., 1991) and compared the participant's level of apathy with their performance on Zim-BCoS cognitive tasks for predictive validity (see Appendix K5). The AES is an 18-item psychiatric instrument for assessing levels of apathy symptoms secondary to brain-related pathology such as a stroke. The scoring is simply an addition of individual scores. However, three items are asked in a positive syntax which has to be reverse scored. The interpretation of the scale is that the higher the score, the higher the level of apathy. The suggested cutoff score is 39-41 when using a criterion of +/- 2 Standard Deviations (Marin, 1991).

7.3.14 Short Form- 36 (SF-36)

We determined patients' mental health status using the Short Form- 36 (SF-36) (Burholt & Nash, 2011). We then determined predictive validity by comparing the participant’s health status on the SF-36 with their performance on Zim-BCoS cognitive tasks. The SF-36 is a 36-item measure which is widely used and easy to administer instrument for gauging patients' health status when planning and evaluating interventions (Burholt & Nash, 2011). The SF-36 is scored through summing obtained scores on each of the eight domains: physical function, emotional and physical role limitation, bodily pain, general health function, energy, social function and mental health domains (see Appendix L1).

7.3.15 Stroke Impact Scale (SIS)

We used the SIS (Duncan et al., 2003) to check predictive validity by comparing the severity of stroke on SIS against performance on the Zim-BCoS subtests. The SIS was developed to assess the broad consequences of suffering from a stroke (see Appendix L2). It is a patient-rated self-report measure with 64 items that assess outcomes in eight domains (strength, hand function, activities of daily living, mobility, communication, emotion, memory and participation). It is scored on a 5-point Likert scale and takes 15-20 minutes to complete. There is a single additional question that assesses a person's perception of how much they have recovered that is scored from 0 to 100, zero being no recovery and 100 completely recovered (Duncan et al., 2003).

7.3.16 The Barthel Index (BI)

The Barthel Index (Mahoney & Barthel, 1965) is a widely used measure which was originally developed to assess for ADLs, functional mobility and gait on patients with acquired brain injury; stroke, neuromuscular or musculoskeletal disorders. It comprises ten ADLs, namely feeding, bathing, grooming, dressing, bowel control, bladder control, toileting, chair transfer, ambulation and stair climbing. It is a self-report test which takes less than 5 minutes to administer. The scores are rated according to the level of nursing care required and to evaluate whether an individual is completely independent, needs some assistance or is completely dependent (10, 5, 0, respectively) (Finch et al., 2002). The BI has a total score of 100 yielded by simply adding all the patient’s scores (McDowell & Newell, 1996; Uyttenboogaart et al., 2005). We used this for our baseline assessment to obtain an impression of a patient’s functioning and then functional recovery after a six-months period. We compared patient's performance Zim-BCoS against functional outcomes and functional recovery to determine Zim-BCoS' capacity to predict functional outcome (see Appendix M).

7.4 Procedures

7.4.1 Data collection

We screened patients with stroke from two hospital stroke registers, rehabilitation centre records, social media and word of mouth (see Appendix C for screening questionnaire). Those who agreed to participate signed the informed consent form (Appendix D) and were assigned to one of the six clinicians for testing. Neuropsychological testing of patients was done individually in a dedicated space at each of the research sites, or at bedsides in the hospital wards. Curtains were drawn whenever possible to allow the patients to focus and minimise interruptions in the hospital ward. We had to conduct home visits for some patients who were discharged before they could be tested and for those who had mobilization problems. We also scheduled two sessions on different days for some patients who experienced fatigue and were unable to complete the whole test battery in one sitting, in order to attain their best performance.

7.4.2 Ethical considerations

Ethical procedures for this study were in line with the provisions from the Helsinki declaration on the Ethics Standards for Human Research. Patients meeting the inclusion criteria for our study were informed of the procedures of the research. Other considerations around patient informed consent and confidentiality of their data were detailed in the previous chapters.

7.5 Statistical Analysis

We performed independent sample t-tests to determine whether patient-participants differed significantly to the study controls on age and years of education. Chi-square tests of independence were performed on measures that yielded categorical data. Participants were defined as cognitively impaired if their score was below the predicted scores (based on the regression generated norms described in the previous chapter).

To determine the convergence validity of Zim-BCoS subtests against commonly used cognitive tests that measure similar constructs on the MMSE; the MoCA; the TMT; the Star Cancellation and the BSAT we performed Pearson's *r* correlation analysis.

We used Pearson's *r* correlation analyses to assess predictive validity, that is, the correlation of Zim-BCoS with functional outcomes typical of post-stroke sequelae.

To determine Zim-BCoS capacity to predict functional outcome and recovery after six months in patients with stroke (by comparing pre- and post-scores of ADLs against Zim-BCoS subtasks of praxis), we used Pearson's *r* correlation analyses, comparing Barthel Index scores against Zim-BCoS subtasks.

We assessed the Zim-BCoS' level of inclusivity by determining the number of patients who were able to complete tasks, retain scores and pass subtests, despite suffering from aphasia.

To determine the prevalence of cognitive impairment among the patient sample, we documented all the performances that were below the Zim-BCoS cutoffs. We also documented impairment based upon the standard cutoffs for each instrument described earlier to determine the prevalence of other post-stroke sequelae among the patients.

7.6 Results

7.6.1 Evaluation of Convergence Validity of the Zim-BCoS against other Cognitive Measures

The study's second objective was to evaluate Zim-BCoS' convergence validity with other tests that measure similar cognitive functions. On the cognitive tests for which we could find approximate equivalents, we computed a Pearson Product-moment correlation coefficient to evaluate the relationship between Zim-BCoS tasks and the other cognitive tests assessing similar cognitive domains. The convergence validity of each Zim-BCoS task is presented below according to the cognitive domains (see Table 7.4 below).

7.6.1.1 Convergence Validity of the Attention/Executive Function Domain. On the Attention/Executive Function domain, Pearson Product-moment correlation analyses showed significant positive correlations between the Apple Cancellation task and Star Cancellation test, r(78) = .796, p <.001, the Visual Extinction task and MOCA Visuospatial test, r(90) = .43, p <.001, the Auditory Attention task and MoCA Attention Tapping Task test, r(80) = .37, p = .001. However, there was a non-significant positive correlation between the following; the Visual Extinction task and the MMSE Figure Copy test, r(92) = .234, p = . 28, the Rule Finding task and MMSE Command Obey test, r(112) = .11,p = .29 as well as the Rule Finding task and the BSAT, r(52) = .22, p = .13. These findings mean that the performance on the Zim-BCoS tasks was comparable to the other identified tests that assess similar cognitive skills.

7.6.1.2 Convergence Validity of the Zim-BCoS Memory Domain. Results of the Pearson Product-moment correlation indicated that there was a significant positive association between the Zim-BCoS Orientation to Time and Space task and MMSE Orientation test, r(94) = .60, p <.001 as well as between the Zim-BCoS Orientation to Time and Space task and MoCA Orientation test, r(90) = .496, p <.001.

7.6.1.3 Convergence Validity of the Zim-BCoS Language Domain. On the Zim-BCoS Language Domain, there was a significant positive association between the Zim-BCoS Picture Naming task and the MMSE Language test, r(94) = .27, p =.008, the Zim-BCoS Picture Naming task and the MoCA Language test, r(102) = .53, p <.001as well as the Zim-BCoS Picture Naming task and the MoCA Item Naming test, r(90) = .50, p <.001. These findings indicate that patients who performed well on the Zim-BCoS task also performed well on the comparative test, implying that they tap into similar cognitive skills.

7.6.1.4 Convergence Validity of the Zim-BCoS Memory Domain. Zim-BCoS Memory Domain results from the Pearson Product-moment correlation indicated there was a significant positive association between: the Zim-BCoS Personal Information task and MMSE Orientation test, r(94) = .44, p <.001, the Zim-BCoS Personal Information task and MoCA Orientation test, r(90) = .50, p <.001, the Zim-BCoS Immediate Story Recall task and the MoCA Word Recall test, r(90) = .46, p =.02, the Zim-BCoS Delayed Story Recall and MMSE Delayed Word Recall test, r(93) = .46, p <.001 as well as the Zim-BCoS Delayed Story Recall task and the MoCA Delayed Word Recall test, r(90) = .47, p <.001. These results imply that participants performed comparably between Zim-BCoS tests and other commonly used memory tests.

7.6.1.5 Convergence Validity of the Zim-BCoS Numbers Skills Domain. Results of the Pearson Product-moment correlation indicated that there was a significant positive association between the Zim-BCoS Calculation task and MMSE Serial 7's Calculation test, r(112) = .41, p <.001 and between the Zim-BCoS Figure Copy task and MMSE Figure Copy test, r(91) = .29, p =.011. These results imply that the Numbers Abilities tests of Zim-BCoS were comparable to other tests that tap into similar cognitive skills.

7.6.1.6 Convergence Validity of the Zim-BCoS Praxis Domain. On this domain, results of the Pearson Product-moment correlation indicated that there was a significant positive association between the Zim-BCoS Figure Copy task and MoCA Figure Copy test, r(112) = .50, p <.001 as well as between the Zim-BCoS Gesture Production task and the MMSE Obeying Command test, r(112) = .37, p <.001. These findings indicate that the Zim-BCoS praxis tests are comparable to other commonly used praxis tests.

Table 7.4

Zim-BCoS Convergence Validity/Correlation with other Cognitive Tasks

Zim-BCoS task	Standardised test	n	p-value	r
Attention Spatial				

Apple Cancellation (Accuracy)	Star Cancellation Task	78	p <.001**	.796
Visual Extinction	MMSE Figure Copy	92	.28*	.234
	MoCA Figure Copy		<.001**	.428
Attention -controlled				
Auditory Attention	MoCA attention Tapping Task	80	.001**	.369
Rule Finding	MMSE Command Obey	52	.298	.113
	Brixton Spatial Anticipation	83	.128	.216
Language -spoken				
Picture Naming	MMSE Language	102	.008*	.271
	MoCA Language	90	<.001**	.528
	MoCA Naming	94	<.001**	.498
Memory -Orientation				
Personal Information	MMSE Orientation	90	<.001**	.440
	MoCA Orientation	94	<.001**	.497
Time and Space	MMSE Orientation	90	<.001**	.601
	MoCA Orientation	95	<.001**	.677
Memory - Episodic				
Immediate Story Recall	MMSE Word Recall	90	.678	.085
	MoCA Word Recall	97	.022*	.455
Delayed Story Recall	MMSE Delayed Word Recall	90	<.001**	.460
	MoCA Delayed Word Recall	91	<.001**	.467
Calculation	MMSE Serial 7's		<.001**	.413
Praxis-Action				
Figure Copy	MMSE Figure Copy		.011*	.287
	MoCA Figure Copy		<.001**	.502
Gesture Production	MMSE Obeying Command		<.001**	.371

7.6.2 Evaluation of Zim-BCoS Predictive Validity

To assess predictive validity, we computed a Pearson Product-moment correlation coefficient to assess how well Zim-BCoS tasks correlated with other tests for post-stroke sequelae. The following 15 Zim-BCoS tests were significantly correlated:

7.6.2.1 Predictive Validity of Zim-BCoS Attention and Executive Function Domain.

7.6.2.1.1 Predictive Validity of Zim-BCoS the Apple Cancellation test. This test was significantly negatively correlated to the PHQ-9 scores, r(92) = .-30, p = .005. High levels of depression indicated by high scores on the PHQ-9 were associated with lower cancellation of the target stimulus. Results of the Pearson Product-moment correlation indicated that there was a significant negative association between Apple Cancellation task and GAD-7 score, r(92) = .-32, p = .004. High levels of anxiety indicated by a high score on the GAD-7 were associated with lower scores on the Apple Cancellation test. Similarly, the results of the Pearson Product-moment correlation indicated that there was a significant negative association between the Apple Cancellation task and Perceived Stress, r(85) = .-31, p = .005. An increase in levels of stress was associated with decreased performance on the Apple Cancellation test. Results of the Pearson Product-moment correlation indicated that there was a significant negative association between Apple Cancellation task and the SIS, r(60) = .45, p = <.001. High levels of disability due to stroke were associated with lower performance on the Apple Cancellation test (see Table 7.5). Results of the Pearson Product-moment correlation also indicated that there was a significant positive association between the Apple Cancellation task and the BI, r(92) = .46, p = <.001. An increase in the number of Activities of Daily Living was associated with high performance on the Apple Cancellation test.

7.6.2.1.2 Predictive Validity of Zim-BCoS Visual/Tactile Extinction test with post-stroke measures. Results of the Pearson Product-moment correlation indicated that there was a significant negative association between the Visual Extinction task and GAD-7 Score, r(92) = -.308, p = .004. High levels of depression were associated with lower levels of attention to the stimuli. Likewise, there was a significant negative association between the Visual Extinction task and the AES, r(92) = -.295, p = .005 as well as between the Visual Extinction task and the SIS, r(60) = .402, p = .002. High levels of disability by the patients were associated with their lower levels of attention to target stimuli. Also, there was a significant positive association between the Tactile Extinction task and the SIS, r(60) = .34, p = .010. High levels of disability were associated with lower sensitivity to the touch stimuli (see Table 7.5 below).

7.6.2.1.3 Predictive Validity of Zim-BCoS Attention Domain with post-stroke measures There was a significant positive association between Visual Extinction task and BI, r(92) = .38, p = <.001. An increase in the number of Activities of Daily Living was associated with an increase in the number of target stimuli identified by the patient. Similarly, there was a significant positive association between Tactile Extinction task and BI, r(92) = .39, p = <.001. Increased activities of daily living were associated with an increase in sensitivity to the touch stimuli. Likewise, there was a significant positive association between Rule Finding task and BI, r(92) = .37, p = .001. An increase in ADLs was associated with the ability to identify more rules on the Zim-BCoS Rule Finding test (see Table 7.5 below).

7.6.2.1.4 Predictive Validity of Zim-BCoS Praxis tasks with post-stroke measures. There was a significant negative association between Multi-Step Object Use task and AES scores, r(92) = -.29, p = .005. High levels of apathy were associated with decreased ability to plan and follow through the sequence of lighting a torch. Likewise, increased apathy was associated with a decreased number of correct gestures produced by the patients r(92) = -.35, p = .001. Likewise, there was a significant negative association between Gesture Recognition task and AES scores, r(92) = -.28, p = .007). High levels of apathy were associated with a decreased number of gestures identified correctly by the patients. Also, there was a significant positive association between Complex Figure task and SF-36 Total, r(82) = .39, p = .001. Decreased quality of life was associated with poor constructional abilities. Similarly, there was a significant positive association between Complex Figure task and SIS, r(60) = .46, p = <.001. High levels of disability were associated with poor constructional abilities; also, there was a significant positive association between Meaningless Gesture task and BI, r(92) = .29, p = .005. Decreased independence on Activities of Daily Living was associated with fewer accurate gestures. Likewise, the results of the Pearson Product-moment correlation indicated that there was a significant positive association between Complex Figure task and BI, r(92) = .45, p = <.001 (see Table 7.5 below).

7.6.2.1.5 Predictive Validity of Zim-BCoS Language tasks with post-stroke measures. There was a significant positive association between Picture Naming task and BI, r(92) = .31, p = .003. Patients with increased independence on Activities of Daily Living could correctly identify more pictures. Likewise, there was a significant positive association between Sentence Construction task and BI, r(92) = .29, p = .005. More independence on daily functions was associated with constructing more correct sentences. Similarly, there was a significant positive association between Sentence Reading task and BI, r(92) = .29, p = .007. There was a significant positive association between Sentence Construction task and SIS, r(60) = .39, p = .003. Increased disability on the patient was associated with poor sentence construction. Similarly, the increase in levels of apathy was associated with poor sentence construction. Also, there was a significant positive association between Sentence Construction task and AES, r(92) = -.33, p = .002 (see Table 7.5).

7.6.2.1.6 Predictive Validity of Zim-BCoS Memory against post-stroke measures. There was a significant positive association between Orientation to Time task and BI, r(92) = .28, p = .007. Increased independence in Activities of Daily Living was associated with increased awareness of time.

Table 7.5

Predictive Validity of Zim-BCoS subtests Against Other Measures of Post-stroke Sequelae

Zim-BCoS Task	**Comparative Test**	N	**p-Value**	***r***

Attention	Apple Cancellation	PHQ-9 Score	92	.005	-.303
		GAD-7 Score	92	.004	-.315
		Perceived Stress	85	.005	-.313
		Barthel Index	92	< .001	.460
		Stoke Impact Scale	60	< .001	.454
	Visual Extinction	GAD-7 Score	92	.004	-.308
		Apathy Evaluation Scale	92	.005	-.295
		Barthel Index	92	< .001	.377
		Stroke Impact Scale	60	.002	.402
	Rule Finding	Barthel Index	92	.001	.366
	Tactile Extinction	Barthel Index	92	< .001	.390
		Stroke Impact Scale	60	.010	.340
Praxis	Multi-Step Object Use	Apathy Evaluation Scale	92	.005	-.295
	Gesture Production	Apathy Evaluation Scale	92	.001	-.351
	Recognition	Apathy Evaluation Scale	92	.007	-.284
	Meaningless Gesture	Barthel Index	92	.005	.293
		Barthel Index	92	.004	.306
	Complex Figure	Sf-36 Total	82	.001	.395
		Barthel Index	92	< .001	.447
		Stroke Impact Scale	60	< .001	.465
Language	Orientation to Time	Barthel Index	92	.007	.278
	Picture Naming	Barthel Index	92	.003	.311
	Sentence Construction	Barthel Index	92	.005	.294
		Stroke Impact Scale	60	.003	.385
	Sentence Construction	Apathy Evaluation Scale	92	.002	-.328
	Sentence Reading	Barthel Index	92	.007	.288

7.6.3 Zim-BCoS Prediction of Functional Outcome and Recovery

To determine Zim-BCoS' ability to predict functional outcome and recovery, we compared the performance of patients on the Zim-BCoS and their functioning on the BI scale six months after being tested. Initially, 71 of 93 patients (76.3%) were impaired on the BI. Patients who recovered (based on BI) were significantly less likely to be impaired on Picture Naming, Auditory and Word Writing, as well as on the Number domain, but more likely to be impaired on Immediate Recall (see Table 7.6 below).

A 'chi-square' test of independence was performed to examine the relationship between impairment on the Zim-BCoS tasks and recovery, according to BI. There was a statistically positive correlation between these variables, $\chi2$ (2, n = 70) = 4.58, p < .032, meaning an increase in functional independence on the BI was related to increased Zim-BCoS scores. The patients who recovered (based on BI) were significantly less likely to be impaired on Picture Naming. The relationship between the Zim-BCoS Memory domain, Immediate Recall task and BI were also significant, $\chi2$ (2, n = 66 = 5.56, p <. 018. Patients who recovered (based on BI) were significantly less likely to be impaired on the Immediate Recall task. Likewise, the relationship between the Zim-BCoS Language domain, Word Writing task and BI was also significant, $\chi2$ (2, n = 57) = 5.79, p <. 016. The relationship between the Zim-BCoS Number Skills domain, Immediate Recall task and BI was similarly significant, $\chi2$ (2, n = 54) = 8.29, p < .004. These results indicate that patients who performed badly on Memory Recall and Number Skills were also more likely to have problems executing Activities of Daily Living six months after their initial stroke (see Table 7.6 below for details of these associations).

Table 7.6
Zim-BCoS Prediction of Functional Outcomes Against Functional Independence Measures

	Barthel Index				
Outcome variable	Recovered (N = 22)	Impaired (N = 71)	$t/\chi2$	p	ESE
BCoS Tasks					
Picture Naming (Impaired)	5 (22.7%)	34 (48.6%)^{70}	4.58	.032	0.22

Immediate Recall (Impaired)	8 (36.4%)	7 (9.9%)	8.72	.003	0.31
Auditory (Impaired)	2 (11.1%)^{18}	27 (40.9%)^{66}	5.56	.018	0.26s
Word-writing (Impaired)	2 (11.1%)^{18}	26 (45.6%)^{57}	5.79	.016	0.28
BCoS Domains					
Number	15 (78.9%)^{19}	54 (98.2%)^{54}	8.29	.004	0.34

7.6.4 BCoS Inclusivity for Patients with Aphasia and Neglect

Previous studies have demonstrated that BCoS screen is useful for accommodating patients with aphasia. Our fifth objective was to assess the Zim-BCoS level of inclusivity by determining the number of patients who were able to complete tasks, retain scores and pass Praxis subtests, despite suffering from aphasia. Forty-four patients had aphasia, and 55 did not have aphasia, relevant data for some patients was missing. The patients with aphasia completed 12/19 (63%) tasks at almost 100% level. Of those who completed tasks, at least 28/44 (67%) retained a non-zero score on each of the tasks, except on the Writing task, which was 29.5% (see Table 7.7 below).

Table 7.7

Performance of Patients with Aphasia on the Zim-BCoS Tasks

BCoS Test	No. who completed a Praxis test (n = 44)	No. who retained a Non-zero Score
Attention and Executive Functioning		
Auditory Attention	44 (100%)	29/44 (65.9%)
Rule Finding	44 (100%)	44/44 (100%)
Apple Cancellation	44 (100%)	43/44 (97.7%)
Language		
Picture Naming	43 (97.7%)	40/43 (93%)
Sentence Reading	43 (97.7%)	38/43 (88.4%)
Nonword Reading	43 (97.7%)	33/43 (76.7%)
Word/Non-word Writing	44 (100%)	13/44 (29.5%)
Memory		
Orientation Personal Information	44 (100%)	43/44 (97.7%)
Immediate Story Recall	44 (100%)	44/44 (100%)
Delayed Story Recall	44 (100%)	39/44 (88.6%)
Task Recall	44 (100%)	42/44 (95.5%)
Number Skill		
Number/Price/Time Reading	44 (100%)	37/44 (84.1%)

Number/Price Writing	44 (100%)	28/44 (63.6%)
Calculation	41 (93.3%)	31/41 (75.6%)
Praxis and Action		
Complex Figure Copy	43 (97.7%)	43/43 (100%)
Multiple-step Object Use	42 (95.5%)	37/42 (88.1%)
Gesture Production	43 (97.7%)	43/43 (100)
Gesture Recognition	44 (100%)	44/44 (100%)
Gesture Imitation	44 (100%)	42/44 (95.5%)

7.6.5 Prevalence of Impairments Among Patients with Stroke

Our secondary objectives were to determine the frequencies of impairment among patients with stroke using the Zim-BCoS and the measures of post-stroke sequelae. We used the regression-based generated cutoff scores for Zim-BCoS and published cutoff scores for the other measures of post-stroke sequelae to determine the prevalence of impairment among patients with stroke (see Table 7.8 below).

7.6.5.1 Prevalence of Global Cognitive Impairment. We assessed for global cognitive impairment using the MMSE (*n* = 94) and MoCA (*n* = 90) respectively. Using a cutoff score of 24 on the MMSE, 94 patients completed the test, and approximately half (48%) showed global cognitive impairment. On the MoCA, 92% of the 90 participants showed global cognitive impairment (see Table 7.8).

7.6.5.2 Prevalence of Depression. The prevalence of depression was 41% based on the cutoff score of PHQ-9 ≥11 among the patients (*n* = 93) who were able to take part.

7.6.5.3 Prevalence of Generalised Anxiety. Amongst the patients who were assessed on the GAD-7 (*n* = 93), the prevalence of generalised anxiety was 26% based on the cutoff score GAD-7 ≥ 10.

7.6.5.4 Prevalence of Impairment of the Executive Function. Almost half of the patients (*n* = 52) were assessed with the BSAT. About half (43%) of these showed impairments of the Executive Function, based on the cutoff score of 19 on the BSAT.

7.6.5.5 Prevalence of Impairment of Visuospatial Abilities. On the Star Cancellation task, a cutoff score of $\geq$ 11showed that 19% of the participants assessed had visuospatial impairment (*n* = 78).

7.6.5.6 Impairment on the Perceived Stress Scale. Of the patients who took the PSS test (*n* = 86), 67% showed low perceived stress and 14% showed high levels of perceived stress.

7.6.5.7 Impairment on the Trail Making Test. On the TMT (A), 51 patients took part, and 65% showed an impaired speed of processing at a cutoff score of TMT > 79. Fewer patients *(n* = 41) could proceed to TMT (B), and of them, 24% showed an impaired speed of processing at a cutoff score of 273 seconds.

7.6.5.8 Prevalence of Apathy. A third (31.2%) of the patients (*n* = 93) showed apathy symptoms based on a cutoff score of the Apathy Evaluation Scale > 38.

7.6.5.9 Frequencies of Impairment on ADLs. Using a cutoff score of 95 on the BI, 95% of the participants (*n* = 14) had impaired Functional Independence (see Table 7.8 below).

Table 7.8

Frequency of Impairment on Neurocognitive Tests

	Outcome measure	**n**	**M**	**SD**	**Range**	**Cutoff**	**% impaired**
Neurocognitive tests	MMSE	94	22.3	5.8	2-30	24	48.9
	MoCA	90	16.7	7.2	0-30	26	92.2
	Brixton	52	36.3	15.9	0-55	19	43.9
	Star Cancellation	78	48.2	10.7	3-54	<44	19.2
	TMT A	51	119.2	90.8	15-480	79	64.7
	TMT B	41	183.5	112.6	27-480	273	24.4

Neurobehavioural consequences	PHQ-9	93	9.6	5.2	0-19	≥11	41.4
	GAD-7	93	7.0	5.2	0-18	≥10	25.8
	Perceived Stress	86	20.8	6.3	8-40	Low 14-26	67.5
						High 27-40	14
	Apathy Evaluation Scale	93	34.9	11.9	14-89	>38	31.2
Functional Independence	Barthel Index	14	85	20.9	40-100	95	57.14

7.7 Discussion

Our primary objective for this part of the study was to investigate the convergency and predictive validity of Zim-BCoS on a sample of patients with stroke. We evaluated the Zim-BCoS tasks against commonly used neurocognitive tests that assess similar functions to ascertain if there would be correlations as evidence of convergence validity. Our findings indicate significant positive correlations between Zim-BCoS subtests and other tests commonly used for the same cognitive functions. This demonstrates that Zim-BCoS has good convergence validity (Borsa et al., 2012). However, on the Attention and Executive Function domain, only one task, the Auditory Attention task, had a statistically significant correlation against the MoCA Tapping Attention task. The rest of the tests showed a weak correlation, namely the Zim-BCoS Rule Finding against the MMSE Command Obeying tasks, as well as the BSAT task. On the memory domain, there were no statistically significant correlations on the Zim-BCoS Story Recall test vs the MMSE Word Recall tasks. The weak correlations may be attributed to the differences in the nature of the tasks that were compared, such as the type of stimuli, length and difficulty of the task. For instance, the Zim-BCoS Auditory Attention task is longer and more complex because the person has to respond to 54 meaningful words. In contrast, the comparative MoCA Tapping task is brief with the stimuli being just 29 letters, not even words. The same task differences can also explain the non-significant relationship between the Zim-BCoS Story Recall, which involves recalling 15 story details, compared to the MMSE Word Recall task which requires recalling three words after 3 minutes. It is much easier to recall three words over a brief period, compared to trying to recall details of a long story over a much longer duration of about 25 minutes. The Zim-BCoS Rule Finding task is also much more complex and demands higher levels of concentration and complex Executive Function compared to obeying the simple MMSE command. We, therefore, infer that these may not be the best set of tasks for comparison and as an alternative, more similar tests should be found for comparisons of that domain. On the convergence validity study, fifteen Zim-BCoS subtests that were compared against measures of other post-stroke sequelae (PHQ-9, GAD-7, BI, SIS, AES), showed statistically significant correlations between Zim-BCoS and all post-stroke sequelae measures, demonstrating convergent validity between each set of comparisons (Paap & Sawi, 2014). However, the correlations ranged from weak to powerful relationships. There were statistically significant correlations on all cognitive domains except the Attention and Executive Function domain.

Only one task from this domain had a statistically significant correlation, that is the Auditory Attention task against the MoCA Tapping Attention task. This correlation is an indication that the cognitive deficits being assessed by Zim-BCoS are related to the constructs being assessed by the comparative tests, which are evidence for convergent validity. However, it is not clear why the correlations were weak, ranging from $r = .27$ to $r = .46$. This result may be attributed to the fact that the tests were not adapted and validated in Zimbabwe. Nevertheless, given the lack of validated instruments in Zimbabwe, we had to start somewhere by using available instruments. Further exploration of this concept is recommended using validated instruments.

Our secondary goal was to determine the prevalence of cognitive impairment among the patient sample using Zim-BCoS as well as other instruments measuring similar constructs. This information has not been documented before in Zimbabwe. The MMSE and MoCA both assess for cognitive impairment. Our findings on the prevalence of cognitive impairment using the two instruments were 48.9% on the MMSE and 92.2% on the MoCA, respectively. The difference in prevalence between the two measures of cognitive impairment was such that the MoCA detected twice as much impairment compared to the MMSE. These differences between these two measuring instruments are consistent with previous studies where the MoCA is more sensitive to detecting cognitive impairment than the MMSE (Dong et al., 2010). Previous studies put the prevalence of global cognitive deficits between 20-80% (Makin et al., 2013; Sun et al., 2014). Our findings concur with these previous findings, although they appear to be on the high side. This fact could be because the patients were still in the acute stage of post-stroke sequelae when cognitive deficits will not have been resolved. Prevalence of cognitive impairment likely becomes lesser as the cognitive deficits resolve with time. Other differences in prevalence may be due to the types of instruments used, the post-stroke duration periods, the nature of patients, among other factors.

Our study findings indicate that 19% of the patients showed visuospatial impairment. These findings concur with previous studies which put the prevalence of visuospatial impairment between 23% - 65% in the acute stage of recovery (Lisa et al., 2013). Among the participants who undertook the TMT (A), 64.7% showed an impaired speed of processing information, and 24.4% of those who proceeded to complete the more complex TMT (B), also performed below cutoff score. These findings confirm prior investigations which demonstrated that patients with stroke were prone to a slower speed of processing information following a stroke (Pihlaja et al., 2014).

We also documented the prevalence of neuropsychiatric consequences for patients with stroke**.** Our findings indicate that the prevalence of depression was 32.3% among the stroke patient sample. These findings fall within the ranges documented in previous studies of depression among similar populations, where the prevalence of depression ranged from 25-

79% (Ayerbe et al., 2013; Gillen et al., 2001). The wide ranges in the prevalence of depression may be attributed to differences in the study characteristics, for instance, different settings, post-stroke periods and variations in the instruments used. For instance, our patient sample was still in the acute phase of recovery, and there are chances that depression is likely to increase with time as patients experience increased limitations due to the effects of the stroke (Hackett & Pickles, 2014).

The prevalence of anxiety in our sample was 25.8%. These findings concur with previous studies of anxiety among patients with stroke. For instance, a systematic review of 44 studies reported a prevalence of anxiety that was around 20% (Burton et al., 2013). The slightly higher figure from our findings may also be attributed to the fact that the patients were still in the acute phase of recovery. They had not yet fully comprehended how they would handle their compromised condition and were still anxious about adjusting to their limited functions. Prevalence of dysexecutive function was 43.9% as assessed by the BSAT test. Again, this result is in line with previously published data, in which prevalence was reported to be around 55% (Roussel et al., 2016). The slight difference in percentages may be accounted for by other factors such as disparities in measures, post-stroke duration and demographic profiles. Our findings indicate that the prevalence of apathy in our sample was 31.2%. This figure is in line with reports from other similar studies. For instance, an earlier systematic review reported that the prevalence of apathy ranged from 15-70% (Caeiro et al., 2013).

Visual and Tactile Extinction could not be assessed because of ceiling effects. However, these two tasks have previously shown excellent reliability and validity in other studies. Since these tasks have minimal language loading, we assume that they will also be valid as screening tools in a Zimbabwean population (Kuzmina et al., 2017; Vordenberg et al., 2014). Zim-BCoS yielded favourable psychometric properties in the validation studies. These findings highlight the importance of investigating post-stroke sequelae and addressing them because they interfere with the rehabilitation of patients with stroke. While this study narrowed down to post-stroke cognitive deficits as was done in the original study, future work can evaluate the performance of Zim-BCoS on other acquired brain injuries to increase the robustness of Zim-BCoS.

7.8 Limitations of the validation study

The major limitation of the validation study is that we could not secure equivalent cognitive tests for comparison against Zim-BCoS. This is because these tests are costly. Future validation studies can ensure they secure equivalent comparative tests as was done in previous studies (Humphreys et al., 2012; Kuzmina et al., 2015; Pan et al., 2017). One of the challenges of the validation study was recruiting adequate numbers of stroke patient meeting the criteria. Ideally, it would have been best to uses randomised control trial. However, that was not possible because of the nature of the stroke patients and sensitivity nature of the study. We ended up using convenience sampling (a non-probability sampling method) to recruit statistically significant numbers within the timeframe of the study (Eitikan et al., 2016). When using the convenience sampling method, you recruit all available participants meeting the criteria without considering the various demographic variables such as gender or level of education. While this has potential of introducing sampling bias, we mitigated for this by using a matched sample for comparison. Matched sample design is useful for comparisons in validation studies where randomization may be difficulty (Batchelor et al., 2015; Weinstein et al., 2014).

Another challenge was that there was a lot of missing data from the stroke patients sample. This was partly because most of the patients were easily fatigued and irritable. There was also high loss to follow up due to some patients deceasing, relocating or could not be traced. The loss to follow up among stroke patients is inevitable among stroke patients due to severe physical and cognitive impairment. For instance, most patients will have mobilization challenges and require special transportation, and sometimes several caregivers to move from one place to the other. We resorted to doing home visits though this was not always possible for long distances.

The other challenge was the 6-months period of the follow up assessment. While there is some recovery between three to six months, it will not be complete. Resolution of cognitive impairments continues for over a year (Rasquin et al., 2004; Serano et al., 207). We recommend follow up assessments at longer post-stroke durations such as at the 12th, 18th and 24-months period in order to capture the recovery process to assess Zim-BCoS' capacity to predict functional recovery.

Chapter 8: General Discussion and Conclusion

When a person experiences a brain injury, they need neurocognitive screening to determine the extent and location of the injury, and identify the cognitive deficits for purposes of treatment, rehabilitation and adjustment to their compromised functions (Akinyemi et al., 2015). In high-income countries, cognitive deficits are routinely screened for following an acquired brain injury (Pendlebury et al., 2015). This is not the case in low- and middle-income countries because of a lack of locally developed neuropsychological tests as well as a lack of expertise and finance data (Bonini & Radanovic, 2015, Pan et al., 2015). Applying tests developed in different settings weakens the psychometric properties of the tests, resulting in the collection of uninformative data. For these neurocognitive tests to be meaningful, they need to be undertaken with an instrument with robust psychometric properties that are culturally appropriate for the target population (Byrne, 2016).

Given the constraints of developing neuropsychological tests in low-resourced countries, it is best to translate and adapt existing tests so that they are more culturally sensitive (Byrne, 2016). To date, there has not been a culturally appropriate neurocognitive screen available in Zimbabwe. The purpose of this study was to identify neurocognitive instruments that have been used in low- and middle-income countries, and from these select, a robust neurocognitive battery for adaptation, norming and validation.

The first phase for this project was to identify an appropriate neurocognitive screen for use on patients with acquired brain injury in a low- and middle-income country, like Zimbabwe. We used a systematic review to identify an appropriate cognitive screen for adaptation. Systematic reviews are useful in that they use a methodological way of consolidating existing researches, giving an overview of a scientific position (Denyer et al., 2009). Through a systematic review, we identified neurocognitive instruments that have been used on patients with stroke in low- and middle-income countries. We noted that out of the 83 identified studies, ten studies had been conducted in Africa, while 11 assessed psychometric properties. It was remarkable to note from the systematic review that there is no test developed in low- and middle-income countries for neurocognitive assessment. While we identified 83 tests that have been used in low- and middle-income countries, it was of concern to discover that most of these tests had just been used in a solitary study or on a few occasions only, and also that these were single-domain tests. These findings indicate a lack of uptake for neuropsychological screens and made test development and use seem out of reach. Through the systematic review, we thus highlight a gap in neurocognitive testing in low- and middle-income countries.

It is important to evaluate psychometric properties of psychological tests (Rodrigues et al., 2018). We therefore evaluated the psychometric properties of batteries assessing at least three cognitive domains and selected the BCoS as a robust screen which is designed mainly for patients with stroke. The BCoS presented numerous advantages over other instruments in that while it was developed specifically for patients with stroke, it is not necessarily disease-specific but can be used on cognitive conditions from other aetiologies (Pan et al., 2017). As mentioned earlier in this study, Zimbabwe is a low-income country and neuropsychology is still in its infancy there. The fact that BCoS is not disease-specific makes it an ideal instrument in that it is versatile enough to be used on other neurologic conditions. It is both relatively modern and brief, considering that it yields a cognitive profile for five domains in about an hour. It is designed to be inclusive of patients with aphasia and visuospatial neglect, conditions common amongst post-patients with stroke. Besides, the BCoS includes tests for Praxis which are missing in most other neurocognitive batteries (Bickerton et al., 2012).

The second phase of the study focused on culturally adapting and translating the identified BCoS screen. The cultural adaptation entailed identifying and substituting all BCoS items that were not culturally appropriate, based on a low Difficult Index (<.35). A panel of 13 multidisciplinary experts used the Delphi technique to amend or replace the problematic items systematically. Contextual changes were made to the BCoS test content. For instance, the task to produce gestures for a word such as 'hitchhiking' was replaced with a more familiar gesture, such as the gesture for money (i.e. rubbing the thumb against the forefinger). The translation process followed recommendations by Borsa et al (2012), and the International Test Commission Guidelines. The translation and cultural adaptation team of experts was very well constituted in terms of exposure, access to both languages, culture and knowledge of the subject and we used the rigorous Delphi method to assess the proposed changes. However, we simply translated the story task and adapted a few facts of the story; therefore, while the story was improved in its relevancy to the local context, it still had a Eurocentric flair. In future, we recommend the development of full batteries from local resources, such as a story based in a local context of events to improve indigenous participants' encoding and recollection. We could not translate the whole test because it was beyond the scope of this thesis. Besides, a full translation of the whole test would alter the psychometric properties of the test and, in turn, would require an investigation of the translated test. It was also challenging to find appropriate and equal translations of specific English terms in the local language. A close equivalent would be a description of the English word as opposed to using a local language equivalent. The partial translation might have compromised the performance of Zim-BCoS participants when compared to previous studies which were conducted in the home languages of the target populations. Further work should aim to translate the whole test as has been the case in previous BCoS studies in China and Russia (Kuzmina et al., 2017; Pan et al., 2015).

Following the adaptation and translation process, we administered the test to a sample of healthy participants to check the psychometric properties of the Zim-BCoS screen. The test had good inter-rater, test-retest reliability and the agreement between the original UK-BCoS English and Zim-BCoS Shona version was excellent. The major limitation of this part of the study was the convenience sampling method that we used. While convenience sampling is used in studies with limited resources, it is less rigorous than other forms of sampling (Emerson et al., 2015). Instead, randomization during recruitment would be a more robust approach, ensuring that sample bias is minimized (Hilgers et al., 2017). For the screening of healthy participants, we used self-report measures to test for normalcy. While self-report medical and psychological history is useful, it would have been advantageous if we could also have screened precisely for mild cognitive impairment. We recommend the use of a scientific instrument such as the MMSE, to improve the rigour in the recruitment process (Bickerton et al., 2015; Olmos et al., 2015).

The third phase of this study was to generate regression-based normative data using community-dwelling, cognitively intact healthy participants. Regression based normative data is more robust in that it mediates for the effects of certain variables that would potentially introduce bias, such as age, gender and level of education (Parmenter et al., 2010; Crawford & Allan, 1997). On evaluating the effects of age, gender and level of education on these participants, there is a difference in the extent to which demographic variables influence a cognitive domain. For instance, the Language domain was affected by all three variables (age, gender and level of education) while the Praxis domain was least affected. Normative data, consequently, was generated using regression-based methods to correct for any variables that might affect individuals' cognitive performance. This method makes the norms more robust than mean-based ones. The output is the composition of normative tables that have been corrected for age, gender and level of education. The collected normative data was then evaluated against previously published data from the UK, Russian and Chinese populations (UK-BCoS, Russ-BCoS and Cantonese-BCoS).

In Phase Four, we validated the Zim-BCoS on a sample of patients with stroke and documented the prevalence of cognitive impairment, as well as other post-stroke sequelae conditions. The practice of validating psychological tests is recommended to evaluate robustness, that is, the reliability and validity of the modified instrument (Anastasi, 1986; Borsa et al., 2012; Byrne, 2016; Mokkink et al., 2017). The Zim-BCoS showed statistically significant correlations with tests commonly used to assess similar cognitive profiles and those that assess post-stroke sequelae. However, there was a considerable amount of missing data. Some patients were too unwell and easily fatigued to complete the whole battery. Besides, loss to follow up was high on our stroke cohort for the retest. Some of the patients had relocated, deteriorated or deceased. Loss to follow up is common among stroke patients (Bour et al., 2007). The follow-up period of six months was too short to bring about much change in cognition. We recommend following up patients for retest after at least nine to twelve months when patients are likely to have recovered more in terms of function and cognitive resolution.

The greatest strength of our validation study was that we targeted the stroke population for which the BCoS was developed. This practice is consistent with previous studies (Kuzmina et al., 2017; Pan et al., 2015; Humphreys et al., 2012). However, on the validation study, despite the careful adaptation and translation, Zim-BCoS participants still performed lower than other participants on most of the published norms. This might be due to the language used in the tests, in which only the instructions and not content details were translated into the participants' home language (Shona). Further investigations may work on the full translation of both content and instructions, as recommended earlier in this thesis. The previous BCoS validation studies used more comprehensive tests, such as the WAIS (Kuzmina et al., 2017; Pan et al., 2015; Humphreys et al., 2012). However, some of these tests are costly, and due to constrained resources, we only used those that were readily available. We resorted to using sub-sections of comparative tests that assess for the specific cognitive functions that we wanted to compare to the Zim-BCoS, as opposed to using tests of global function. Some of the tests were disparate in terms of length and difficulty of the task. This inequality in test structure could have been the reason for the poor specificity and sensitivity in the test results. It is recommended that future studies focus on securing tests that are closer matches to ensure fair comparisons.

The output of this thesis includes detailed documentation of how to conduct a systematic review, to translate, adapt, generate regression-based normative data and validate a psychological test according to the recommended procedures. It also makes available normative data for a culturally adapted neurocognitive test with instructions written in the local language.

In conclusion, we identified a comprehensive neurocognitive screen using rigorous systematic review methods. This is the first study to avail the regression-based norms of an adapted and translated version of that neurocognitive screen. The findings of this thesis is essential for future clinical practice and research. From this study, we note that more effort needs to be made to create awareness of advantageous objective assessments to increase the use of tests and, eventually, the initiation of test development.

References

Abdallah, A., Chang, J. L., O'Carroll, C. B., Musubire, A., Chow, F. C., Wilson, A. L., & Siedner, M. J. (2018). Stroke in human immunodeficiency virus-infected individuals in Sub-Saharan Africa (SSA): a systematic review. *Journal of Stroke and Cerebrovascular Diseases*, *27*(7), 1828-1836.

Abou El-Ella, M. Y., T. K. Alloush, A. M. El-Shobary, N. G. El-Dien Hafez, A. I. Abd EL-Halim, and I. M. El-Rouby. "Modification and standardisation of Arabic version of the Comprehensive Aphasia Test." *Aphasiology* 27, no. 5 (2013): 599-614.

Acharya, A. S., Prakash, A., Saxena, P., & Nigam, A. (2013). Sampling: Why and how of it. *Indian Journal of Medical Specialties*, *4*(2), 330-333

Adeloye, D. (2014). An estimate of the incidence and prevalence of stroke in Africa: a systematic review and meta-analysis. *PLoS One*, *9*(6), e100724.

Adjorlolo, S. (2018). Diagnostic accuracy, sensitivity, and specificity of executive function tests in moderate traumatic brain injury in Ghana. *Assessment*, *25*(4), 498-512.

Albert, M. L. (1973). A simple test of visual neglect. Neurology.

Aharon-Peretz, J., Daskovski, E., Mashiach, T., & Tomer, R. (2002). Natural history of dementia associated with lacunar infarctions. *Journal of the neurological sciences*, *203*, 53-55.

Akbari, S., Lyden, P. D., Kamali, M., & Akbarfahimi, M. (2013). Correlations among impairment, daily activities and thinking operations after stroke. *NeuroRehabilitation*, *33*(1), 153-160

Akinyemi, R. O., Allan, L., Owolabi, M. O., Akinyemi, J. O., Ogbole, G., Ajani, A., ... & Kalaria, R. N. (2014). Profile and determinants of vascular cognitive impairment in African stroke survivors: the CogFAST Nigeria Study. *Journal of the neurological sciences*, *346*(1-2), 241-249.

Akinyemi, R. O., Firbank, M., Ogbole, G. I., Allan, L. M., Owolabi, M. O., Akinyemi, J. O., ... & Kalaria, R. N. (2015). Medial temporal lobe atrophy, white matter hyperintensities and cognitive impairment among Nigerian African stroke survivors. *BMC research notes*, *8*(1), 625.

Akinyemi, R., ... & Lackland, D. (2015). The burden of stroke in Africa: a glance at the present and a glimpse into the future: review article. *Cardiovascular journal of Africa*, *26*(Supplement 1), 27-38.

Albert, M. L. (1973). A simple test of visual neglect. *Neurology.* PMID: 473631

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (1985). *Standards for educational and psychological testing. Wash- ington, DC: American Psychological Association.*

Anastasi, A. (1986). Evolving concepts of test validation. *Annual Review of Psychology*, *37*(1), 1-16.

Anderson, C., Laubscher, S., & Burns, R. (1996). Validation of the Short Form 36 (SF-36) health survey questionnaire among stroke patients. *Stroke*, *27*(10), 1812-1816.

Ang, S., & Van Dyne, L. (2015). Conceptualization of cultural intelligence: Definition, distinctiveness, and nomological network. In *Handbook of cultural intelligence* (pp. 21-33). Routledge.

Appelros, P., Karlsson, G.M., Seiger, Å., & Nydevik, I. (2002). Neglect and anosognosia after first-ever stroke: incidence and relationship to disability. Journal of rehabilitation medicine, 34 5, 215-20. Aarts, E. H. L., & Oosterhuis, H. E. M. Regression-Based Norming for Psychological Tests and Questionnaires.

Arafat, S. Y., Chowdhury, H. R., Qusar, M. S., & Hafez, M. A. (2016). Cross Cultural Adaptation & Psychometric Validation of Research Instruments: a Methodological Review. *J Behav Health*, *5*, 129-136.

Ardila, A. (2017). *Historical development of human cognition: A cultural-historical neuropsychological perspective* (Vol. 3). Springer.

Ashaie, S., & Obler, L. (2014). Effect of age, education, and bilingualism on confrontation naming in older illiterate and low-educated populations. *Behavioural neurology*, *2014*.

Ayerbe, L., Ayis, S., Wolfe, C. D., & Rudd, A. G. (2013). Natural history, predictors and outcomes of depression after stroke: systematic review and meta-analysis. *The British Journal of Psychiatry*, *202*(1), 14-21.

Azad, A., Mohammadinezhad, T., Taghizadeh, G., & Lajevardi, L. (2017). Clinical assessment of activities of daily living in acute stroke: Validation of the Persian version of Katz Index. *Medical journal of the Islamic Republic of Iran*, *31*, 30.

Babatunde, G. B., van Rensburg, A. J., Bhana, A., & Petersen, I. (2019). Barriers and facilitators to child and adolescent mental health services in low-and-middle-income countries: A scoping review. *Global Social Welfare*, 1-18.

Batchelor, F. A., Williams, S. B., Wijeratne, T., Said, C. M., & Petty, S. (2015). Balance and gait impairment in transient ischemic attack and minor stroke. *Journal of stroke and cerebrovascular diseases*, *24*(10), 2291-2297.

Baker, D. P., Eslinger, P. J., Benavides, M., Peters, E., Dieckmann, N. F., & Leon, J. (2015). The cognitive impact of the education revolution: A possible cause of the Flynn Effect on population IQ. *Intelligence*, *49*, 144-158.

Balchin, R. (2008). The Genesis and Development of the Groote Schuur Neurocognitive Screening Battery: A Neurocognitive Screening Tool for the South African Context (Doctoral dissertation, University of Cape Town).

Banerjee, N., McIntosh, R. C., & Ironson, G. (2019). Impaired Neurocognitive Performance and Mortality in HIV: Assessing the Prognostic Value of the HIV-Dementia Scale. *AIDS and Behavior*, *23*(12), 3482-3492.

Battery, A. I. T. (1944). Manual of directions and scoring Washington, DC, War Department, Adjutant General's Office, 1944

Barba, R., Martínez-Espinosa, S., Rodríguez-García, E., Pondal, M., Vivancos, J., & Del Ser, T. (2000). Poststroke dementia: clinical features and risk factors. *Stroke*, *31*(7), 1494-1501.

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). %Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*, *25*(24), 3186-3191.

Beatty, P. C., & Willis, G. B. (2007). Research synthesis: The practice of cognitive interviewing. *Public opinion quarterly*, *71*(2), 287-311.

Bertua, C., Anderson, N., & Salgado, J. F. (2005). The predictive validity of cognitive ability tests: A UK meta-analysis. *Journal of Occupational and Organizational Psychology*, *78*(3), 387-409.

Beaumont, J. G. (2008). Introduction to neuropsychology. Guilford Press.

Bethlehem, D., De Picciotto, J., & Watt, N. (2003). Assessment of verbal fluency in bilingual Zulu-English speakers. South African Journal of Psychology, 33(4), 236-240.

Bickerton, W. L., Demeyere, N., Francis, D., Kumar, V., Remoundou, M., Balani, A., ... & Riddoch, M. J. (2015). The BCoS cognitive profile screen: Utility and predictive value for stroke. *Neuropsychology*, *29*(4), 638.

Bickerton, W. L., Riddoch, M. J., Samson, D., Balani, A. B., Mistry, B., & Humphreys, G. W. (2012). Systematic assessment of apraxia and functional predictions from the Birmingham Cognitive Screen. *J Neurol Neurosurg Psychiatry*, *83*(5), 513-521.

Bickerton, W. L., Samson, D., Williamson, J., & Humphreys, G. W. (2011). Separating forms of neglect using the Apples Test: Validation and functional prediction in chronic and acute stroke. *Neuropsychology*, *25*(5), 567.

Bickerton, W.-L., Riddoch, M. J., Samson, D., Balani, A. B., Mistry, B., & Humphreys, G. W. (2012). Systematic assessment of apraxia and functional predictions from the Birmingham Cognitive Screen. *Journal of Neurology, Neurosurgery & Psychiatry*, *83*, 513–521. https://doi.org/10.1136/jnnp-2011-300968

Bindawas, S. M., Vennu, V., Mawajdeh, H., Alhaidary, H. M., & Moftah, E. (2018). Length of Stay and Functional Outcomes Among Patients with Stroke Discharged from an Inpatient Rehabilitation Facility in Saudi Arabia. *Medical science monitor: international medical journal of experimental and clinical research*, *24*, 207.

Blake, H., McKinney, M., Treece, K., Lee, E., & Lincoln, N. B. (2002). An evaluation of screening measures for cognitive impairment after stroke. Age and Ageing, 31(6), 451–6. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12446291

Bobba, U., Munivenkatappa, A., & Agrawal, A. (2019). Speech and language dysfunctions in patients with cerebrocortical disorders admitted in a neurosurgical unit. *Asian journal of neurosurgery*, *14*(1), 87.

Bonini, M. V., & Radanovic, M. (2015). Cognitive deficits in post-stroke aphasia. *Arquivos de neuro-psiquiatria*, *73*(10), 840-847.

Boon, M., & Steel, H. R. (2005). The internal consistency, predictive validity and norms of the Paper and Pencil Games for a group of isiXhosa-speaking learners. *South African Journal of Psychology*, *35*(2), 163-174.

Boone, K. B., Victor, T. L., Wen, J., Razani, J., & Pontón, M. (2007). The association between neuropsychological scores and ethnicity, language, and acculturation variables in a large patient population. Archives of Clinical Neuropsychology, 22(3), 355-365.

Borsa, J. C., Damásio, B. F., & Bandeira, D. R. (2012). Cross-cultural adaptation and validation of psychological instruments: Some considerations. *Paidéia (Ribeirão Preto)*, *22*(53), 423-432.

Borsa, Juliane Callegaro, Bruno Figueiredo Damásio, and Denise Ruschel Bandeira. "Cross-cultural adaptation and validation of psychological instruments: some considerations." *Paidéia (Ribeirão Preto)* 22, no. 53 (2012): 423-43

Bour, A., Rasquin, S., Boreas, A., Limburg, M., & Verhey, F. (2010). How predictive is the MMSE for cognitive performance after stroke?. *Journal of neurology*, *257*(4), 630-637.

Brainin, M., Tuomilehto, J., Heiss, W. D., Bornstein, N. M., Bath, P. M. W., Teuschl, Y., ... & Post Stroke Cognition Study Group. (2015). Post-stroke cognitive decline: an update and perspectives for clinical research. *European journal of neurology*, *22*(2), 229-e16..

Bridges, A. J., & Holler, K. A. (2007). How many is enough? Determining optimal sample sizes for normative studies in pediatric neuropsychology. *Child Neuropsychology*, *13*(6), 528-538.

Bright, P., Jaldow, E. L. I., & Kopelman, M. D. (2002). The National Adult Reading Test as a measure of premorbid intelligence: a comparison with estimates derived from demographic variables. *Journal of the International Neuropsychological Society*, *8*(6), 847-854.

Burgess, P. W., & Shallice, T. (1997). The hayling and brixton tests.

Burholt, V., & Nash, P. (2011). Short form 36 (SF-36) health survey questionnaire: normative data for wales. *Journal of Public Health*, *33*(4), 587-603.

Burton, C. A. C., Murray, J., Holmes, J., Astin, F., Greenwood, D., & Knapp, P. (2013). Frequency of anxiety after stroke: a systematic review and meta-analysis of observational studies. *International Journal of Stroke*, *8*(7), 545-559

Byrne, B. M. (2016). Adaptation of assessment scales in cross-national research: Issues, guidelines, and caveats. *International Perspectives in Psychology: Research, Practice, Consultation*, *5*(1), 51.

Caeiro, L., Ferro, J. M., & Costa, J. (2013). Apathy secondary to stroke: a systematic review and meta-analysis. *Cerebrovascular diseases*, *35*(1), 23-39

Callahan, C. M., Unverzagt, F. W., Hui, S. L., Perkins, A. J., & Hendrie, H. C. (2002). Six-item screener to identify cognitive impairment among potential subjects for clinical research. *Medical care*, 771-781.

Cameron, J., Worrall-Carter, L., Page, K., Riegel, B., Lo, S. K., & Stewart, S. (2010). Does cognitive impairment predict poor self-care in patients with heart failure?. *European Journal of Heart Failure*, *12*(5), 508-515.

Campanholo, K. R., Conforto, A. B., Rimkus, C. M., & Miotto, E. C. (2015). Cognitive and functional impairment in stroke survivors with basilar artery occlusive disease. *Behavioural Neurology*, *2015*.

Cardoso, C. D. O., Branco, L. D., Cotrena, C., & Fonseca, R. P. (2015). Correlational analysis of performance in executive function tasks after stroke. *Psychology & Neuroscience*, *8*(1), 56.

Carreker, S. H. (2010). *Effects of preservice and inservice teacher knowledge on the analysis of spelling errors and choice of appropriate instructional activities* (Doctoral dissertation, Texas A & M University).

Casaletto, K. B., & Heaton, R. K. (2017). Neuropsychological assessment: Past and future. *Journal of the International Neuropsychological Society*, *23*(9-10), 778-790.

Cavé, J., & Grieve, K. (2009). Quality of education and neuropsychological test performance. *New Voices in Psychology*, *5*(1), 29-48.

Central Statistics Office, (CSO), Government of Zimbabwe and Institute Research Development (IRD), 1989 Zimbabwe Demographic Survey, 1988, Preliminary Report, Harare, Zimbabwe & Columbia, MD, USA

Chaiyawat, P., & Kulkantrakorn, K. (2012). Randomized controlled trial of home rehabilitation for patients with ischemic stroke: impact upon disability and elderly depression. *Psychogeriatrics*, *12*(3), 193-199.

Champion, A. J. (2006). Neuropsychological rehabilitation: a resource for group-based education and intervention. John Wiley & Sons. Charbonneau, S., Whitehead, V., & Collin, I. (2005).

Chan, J., Kong, A., Weekes, B. S., Humphreys, G. W., Riddoch, J., Bickerton, W. L., & Lau, J. (2013). A validation of the Cantonese version of the Birmingham Cognitive Screen (BCoS) for stroke survivors in Hong Kong. *Procedia: Social and Behavioral Sciences*.

Chelazzi, L., Bisley, J. W., & Bartolomeo, P. (2018). The unconscious guidance of attention. *Cortex*, *102*, 1-5.

Chibanda, D., Weiss, H. A., Verhey, R., Simms, V., Munjoma, R., Rusakaniko, S., ... & Abas, M. (2016). Effect of a primary care–based psychological intervention on symptoms of common mental disorders in Zimbabwe: a randomized clinical trial. *Jama*, *316*(24), 2618-2626

Chibanda, D., Verhey, R., Gibson, L. J., Munetsi, E., Machando, D., Rusakaniko, S., ... & Abas, M. (2016). Validation of screening tools for depression and anxiety disorders in a primary care population with high HIV prevalence in Zimbabwe. *Journal of affective disorders*, *198*, 50-55.

Chikanda, A. (2006). Skilled health professionals' migration and its impact on health delivery in Zimbabwe. *Journal of ethnic and migration studies*, *32*(04), 667-680.

Cicerone, K. D., Dahlberg, C., Malec, J. F., Langenbahn, D. M., Felicetti, T., Kneipp, S., ... & Laatsch, L. (2005). Evidence-based cognitive rehabilitation: updated review of the literature from 1998 through 2002. *Archives of physical medicine and rehabilitation*, *86*(8), 1681-1692.

Ciesielska, N., Sokolowski, R., Mazur, E., Podhorecka, M., Polak-Szabela, A., & Kedziora-Kornatowska, K. (2016). Is the Montreal Cognitive Assessment (MoCA) test better suited than the Mini-Mental State Examination (MMSE) in mild cognitive impairment (MCI) detection among people aged over 60? Meta-analysis. *Psychiatr Pol*, *50*(5), 1039-1052.and management. *Annals of translational medicine*, *2*(8).

Claassen, N. C. W., Krynauw, A. H., Holtzhausen, H., & Mathe, M. (2001). Wechsler Adult Intelligence Scale-: performance of South African reference groups. *Pretoria: Human Sciences Research Council.*

Cockcroft, K., Alloway, T., Copello, E., & Milligan, R. (2015). A cross-cultural comparison between south african and british students on the wechsler adult intelligence scales third edition (WAIS-III). *Frontiers in psychology*, *6*, 297.

Coetzer, R., Balchin, R., Salas, C., & Webster, J. (2017). *Addressing Brain Injury in Under-Resourced Settings: A Practical Guide to Community-Centred Approaches*. Psychology Press.

Cofresí, N. I., & Gorman, A. A. (2004). Testing and Assessment Issues With Spanish-English Bilingual Latinos. *Journal of Counseling & Development*, *82*(1), 99-10

Cohen, R. A., Malloy, P., Jenkins, M., & Paul, R. (2014). Disorders of attention.

Cole, M., Levitin, K., & Luria, A. R. (2014). *The autobiography of Alexander Luria: A dialogue with the making of mind*. Psychology Press.

Collins A. F. (2006). An intimate connection: Oliver Zangwill and the emergence of neuropsychology in Britain. *History of psychology*, *9*(2), 89–112. https://doi.org/10.1037/1093-4510.9.2.89

Commander, S., Kangasniemi, M., & Winters, L. A. (2004). The brain drain: curse or boon? A survey of the literature. In Challenges to Globalization: Analyzing the Economics (pp. 235-278). University of Chicago Press.

Corbyn, Z. (2014). A growing global burden. Nature, 510 (7506), S2-S2.

Cores, E. V., Vanotti, S., Eizaguirre, B., Fiorentini, L., Garcea, O., Benedict, R. H., & Cáceres, F. (2015). The effect of culture on two information-processing speed tests. *Applied Neuropsychology: Adult*, *22*(4), 241-245.

Correia, H., Pérez, B., Arnold, B., Wong, A. W., Lai, J. S., Kallen, M., & Cella, D. (2015). Spanish translation and linguistic validation of the quality of life in neurological disorders (Neuro-QoL) measurement system. *Quality of Life Research*, *24*(3), 753-756.

Corrigan, J. D., Selassie, A. W., & Orman, J. A. L. (2010). The epidemiology of traumatic brain injury. The Journal of head trauma rehabilitation, 25(2), 72-80.

Crawford, J. R., & Allan, K. M. (1997). Estimating premorbid WAIS-R IQ with demographic variables: Regression equations derived from a UK sample. *The Clinical Neuropsychologist*, *11*(2), 192-197

Culbertson, W. C., & Zillmer, E. A. (2001). Tower of London. *Drexel University. TOLDX. North Tonawanda, NY: Multi-Health Systems*.

Cullen, B., O'Neill, B., Evans, J. J., Coen, R. F., & Lawlor, B. A. (2007). A review of screening tests for cognitive impairment. Journal of Neurology, Neurosurgery & Psychiatry, 78(8), 790-799.

Cummings, J. L. (1997). The Neuropsychiatric Inventory Assessing psychopathology in dementia patients. *Neurology*, *48*(5 Suppl 6), 10S-16S.

Cummings, J. L., Ketchel, P., Ed, M., Shelley, T., Lopez, O. L., & Dekosky, S. T. (2000). Validation of the NPI-Q, a Brief Clinical Form of the Neuropsychiatric Inventory, 233–239.

Cummings, J. L., Mega, M., Gray, K., Rosenberg-Thompson, S., Carusi, D. A., & Gornbein, J. (1994). The Neuropsychiatric Inventory comprehensive assessment of psychopathology in dementia. Neurology, 44(12), 2308-2308.

Custodio, N., Montesinos, R., Lira, D., Herrera-Perez, E., Bardales, Y., & Valeriano-Lorenzo, L. (2017). Evolution of short cognitive test performance in stroke patients with vascular cognitive impairment and vascular dementia: Baseline evaluation and follow-up. *Dementia & neuropsychologia*, *11*(4), 381-388.

Das, S., Paul, N., Hazra, A., Ghosal, M., Ray, B. K., Banerjee, T. K., ... & Das, S. K. (2013). Cognitive dysfunction in stroke survivors: a community-based prospective study from Kolkata, India. *Journal of Stroke and Cerebrovascular Diseases*, *22*(8), 1233-1242.

de Paula, J. J., Albuquerque, M. R., Lage, G. M., Bicalho, M. A., Romano-Silva, M. A., & Malloy-Diniz, L. F. (2016). Impairment of fine motor dexterity in mild cognitive impairment and Alzheimer's disease dementia: association with activities of daily living. *Brazilian Journal of Psychiatry*, *38*(3), 235-238.

De Vos, A. S., Delport, C. S. L., Fouché, C. B., &Strydom, H. (2011). Research at grass roots: A primer for the social science and human professions. Van Schaik Publishers

Demeter, E., & Woldorff, M. G. (2016). Transient distraction and attentional control during a sustained selective attention task. *Journal of cognitive neuroscience*, *28*(7), 935-947.

Denyer, D., & Tranfield, D. (2009). Producing a systematic review.

Díaz-Morales, J. F., & Escribano, C. (2015). Social jetlag, academic achievement and cognitive performance: Understanding gender/sex differences. *Chronobiology international*, *32*(6), 822-831.

Dickerson, B. C., & Atri, A. (Eds.). (2014). *Dementia: comprehensive principles and practice*. Oxford University Press, USA.

Dictionary, M. W. S. C. (1996). Merriam-Webster. *Incorporated, 10th edition edition*.

Dong, Y., Sharma, V. K., Chan, B. P. L., Venketasubramanian, N., Teoh, H. L., Seet, R. C. S., ... & Chen, C. (2010). The Montreal Cognitive Assessment (MoCA) is superior to the Mini-Mental State Examination (MMSE) for the detection of vascular cognitive impairment after acute stroke. *Journal of the neurological sciences*, *299*(1-2), 15-18.

Dudley, M., Wilson, D., & Barker-Collo, S. (2014). Cultural invisibility: Māori people with traumatic brain injury and their experiences of neuropsychological assessments. *New Zealand Journal of Psychology*, *43*(3).

Duffy, L., Gajree, S., Langhorne, P., Stott, D. J., & Quinn, T. J. (2013). Reliability (inter-rater agreement) of the Barthel Index for assessment of stroke survivors: systematic review and meta-analysis. *Stroke*, *44*(2), 462-468.

Dugbartey, A. T. (2014). Ethical Considerations in Neuropsychological Assessment of Asian Heritage Clients. In Neuropsychology of Asians and Asian-Americans (pp. 17-25). Springer New York.

Dugbartey, A. T., Townes, B. D., &Mahurin, R. K. (2000). Equivalence of the color trails test and trail making test in nonnative English-speakers. Archives of Clinical Neuropsychology, 15(5), 425-431.

Duncan, P. W., Lai, S. M., Bode, R. K., Perera, S., DeRosa, J., & GAIN Americas Investigators. (2003). Stroke Impact Scale-16 A brief assessment of physical function. *Neurology*, *60*(2), 291-296.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics*, *5*(1), 1-4.

Elhan Tesio, L., & Tennant, A. (2005). Psychometric properties of the Mini-Mental State Examination in patients with acquired brain injury in Turkey. *Journal of Rehabilitation Medicine*, *37*, 306-311.

Elliot, C., Murray, D., & Pearson, L. (1983). British abilities scales. National Foundation for Educational Research-Nelson: Windsor, UK.

Elosua, P., & Hambleton, R. K. (2013). International Test Commission Guidelines for test translation and adaptation. *Psicothema*, *25*(2), 151-157. Snelbaker, A. J., Wilkinson, G. S., Robertson, G. J., & Glutting, J. J. (2001). Wide range achievement test 3 (wrat3). In *Understanding psychological assessment* (pp. 259-274). Springer, Boston, MA

EMBASE, C. (2015). Screening for cognitive impairment after stroke: a systematic review of psychometric properties and clinical utility. *J Rehabil Med*, *47*, 00-00.

Emerson, R. W. (2015). Convenience sampling, random sampling, and snowball sampling: How does sampling affect the validity of research?. *Journal of Visual Impairment & Blindness*, *109*(2), 164-168.

Ersöz Hüseyinsinoğlu, B., Kuran Aslan, G., Tarakci, D., Razak Özdinçler, A., Küçükoğlu, H., & Baybaş, S. (2017). Physical Activity Level of Ambulatory Stroke Patients: Is it Related to Neuropsychological Factors?. *Archives of Neuropsychiatry/Noropsikiatri Arsivi*, *54*(2)

Farhana, K. M., Malueka, R. G., Wibowo, S., & Gofir, A. (2016). Effectiveness of gotu kola extract 750 mg and 1000 mg compared with folic acid 3 mg in improving vascular cognitive impairment after stroke. *Evidence-Based Complementary and Alternative Medicine*, *2016*.

Fatoye, F. O., Mosaku, S. K., Komolafe, M. A., Eegunranti, B. A., Adebayo, R. A., Komolafe, E. O., & Fatoye, G. K. (2009). Depressive symptoms and associated factors following cerebrovascular accident among Nigerians. *Journal of Mental Health*, *18*(3), 224-232.

Feigin, V. L., Forouzanfar, M. H., Krishnamurthi, R., Mensah, G. A., Connor, M., Bennett, D. A., ... & O'Donnell, M. (2014). Global and regional burden of stroke during 1990–2010: findings from the Global Burden of Disease Study 2010. *The Lancet*, *383*(9913), 245-255.

Feigin, V. L., Roth, G. A., Naghavi, M., Parmar, P., Krishnamurthi, R., Chugh, S., ... & Estep, K. (2016). Global burden of stroke and risk factors in 188 countries, during

1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet Neurology*, *15*(9), 913-924.

Ferrett, H. L., Thomas, K. G., Tapert, S. F., Carey, P. D., Conradie, S., Cuzen, N. L., ... & Fein, G. (2014). The cross-cultural utility of foreign-and locally-derived normative data for three WHO-endorsed neuropsychological tests for South African adolescents. *Metabolic brain disease*, *29*(2), 395-408.

Ferguson, N. D., Davis, A. M., Slutsky, A. S., & Stewart, T. E. (2005). Development of a clinical definition for acute respiratory distress syndrome using the Delphi technique. *Journal of critical care*, *20*(2), 147-154.

Finch, E., Brooks, D., Stratford, P. W., & Mayo, N. E. (2002). Motor assessment scale, 6-minute walk test, berg balance scale, barthel ADL index. *Physical rehabilitation outcome measures*, 4-253.

Fish, L. S., & Osborn, J. L. (1992). Therapists' views of family life: A Delphi study. *Family Relations*, 409-416.

Fleiss, J. L., Levin, B., & Paik, M. C. (1981). The measurement of interrater agreement. *Statistical methods for rates and proportions*, *2*(212-236), 22-23.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). “Mini-mental state”: a practical method for grading the cognitive state of patients for the clinician. *Journal of psychiatric research*, *12*(3), 189-198.

Fonseca, R. P., Salles, J. F. D., & Parente, M. A. D. M. P. (2008). Development and content validity of the Brazilian brief neuropsychological assessment battery Neupsilin. *Psychology & Neuroscience*, *1*(1), 55-62.

Ford, C. B., Kim, H. Y., Brown, L., Aber, J. L., & Sheridan, M. A. (2019). A cognitive assessment tool designed for data collection in the field in low-and middle-income countries. *Research in Comparative and International Education*, *14*(1), 141-157.

Frances, A., First, M. B., & Pincus, H. A. (1995). *DSM-IV guidebook*. American Psychiatric Association.

Freedman, M., Leach, L., Kaplan, E., Delis, D., Shulman, K. and Winocur, G. (1994). *Clock Drawing: A Neuropsychological Analysis*. NewYork: Oxford University Press

Field, C. A., & Welsh, A. H. (2009). Bootstrapping clustered data. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, *69*(3), 369-390.

Frost, M. H., Reeve, B. B., Liepa, A. M., Stauffer, J. W., & Hays, R. D. (2007). What Is Sufficient Evidence for the Reliability and Validity of Patient-Reported Outcome Measures?. *Value in Health*, *10*(s2), S94-S105.

Gao, L., Li, S. C., Xia, L., Pan, S., Velakoulis, D., & Walterfang, M. (2014). Validation of the Chinese version of the NUCOG cognitive screening tool in patients with epilepsy, dementia and other neurological disorders. *Journal of Clinical Neuroscience*, *21*(6), 980-987.

Gasparyan, M. V., & Smirnova, N. B. (2015). Role of mathematics in modern economy of Russia. In *Culture and society: history and present* (pp. 183-187).

Gerein, N., Green, A., & Pearson, S. (2006). The implications of shortages of health professionals for maternal health in sub-Saharan Africa. *Reproductive health matters*, *14*(27), 40-50.

Ghosal, M. K., Burman, P., Singh, V., Das, S., Paul, N., Ray, B. K., ... & Das, S. K. (2014). Correlates of functional outcome among stroke survivors in a developing country–a prospective community-based study from India. *Journal of Stroke and Cerebrovascular Diseases*, *23*(10), 2614-2621

Gillen, R., Tennen, H., McKee, T. E., Gernert-Dott, P., & Affleck, G. (2001). Depressive symptoms and history of depression predict rehabilitation efficiency in stroke patients. *Archives of physical medicine and rehabilitation*, *82*(12), 1645-1649

Gladman, J. R. F., Lincoln, N. B., & Adams, S. A. (1993). Use of the extended ADL scale with stroke patients. *Age and Ageing*, *22*(6), 419-424.

Godefroy, O., Fickl, A., Roussel, M., Auribault, C., Bugnicourt, J. M., Lamy, C., ... & Petitnicolas, G. (2011). Is the Montreal Cognitive Assessment superior to the Mini-Mental State Examination to detect poststroke cognitive impairment? A study with neuropsychological evaluation. *Stroke*, *42*(6), 1712-1716.

Golicki, D., Niewada, M., Karlińska, A., Buczek, J., Kobayashi, A., Janssen, M. F., & Pickard, A. S. (2015). Comparing responsiveness of the EQ-5D-5L, EQ-5D-3L and EQ VAS in stroke patients. *Quality of Life Research*, *24*(6), 1555-1563.

Goldstein, G., Incagnoli, T. M., & Incagnoli, T. (Eds.). (1997). *Contemporary approaches to neuropsychological assessment*. Springer Science & Business Media.

Gorelick, P. B., Counts, S. E., & Nyenhuis, D. (2016). Vascular cognitive impairment and dementia. *Biochimica et Biophysica Acta (BBA)-Molecular Basis of Disease*, *1862*(5), 860-868.

Gorelick, P. B., Scuteri, A., Black, S. E., DeCarli, C., Greenberg, S. M., Iadecola, C., ... & Petersen, R. C. (2011). Vascular contributions to cognitive impairment and dementia: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*, *42*(9), 2672-2713.

Grantham-McGregor, S., & Smith, J. A. (2016). Extending the Jamaican early childhood development intervention. *Journal of Applied Research on Children: Informing Policy for Children at Risk*, *7*(2), 4.

Greif, A. (1994). Cultural beliefs and the organization of society: A historical and theoretical reflection on collectivist and individualist societies. *Journal of political economy*, *102*(5), 912-950.

Grieve, K. W., & Van Eeden, R. (2010). A preliminary investigation of the suitability of the WAIS-III for Afrikaans-speaking South Africans. South African Journal of Psychology, 40(3), 262-271.

Grieve, K. W., & Viljoen, S. (2000). An exploratory study of the use of the Austin Maze in South Africa. *South African Journal of Psychology*, *30*(3), 14-18.

Grimaldi, M., & Jeanmonod, R. (2018). Acute stroke presenting with isolated acalculia. *The American journal of emergency medicine*, *36*(10), 1923-e1.

Guàrdia-Olmos, J., Peró-Cebollero, M., Rivera, D., & Arango-Lasprilla, J. C. (2015). Methodology for the development of normative data for ten Spanish-language neuropsychological tests in eleven Latin American countries. *NeuroRehabilitation*, *37*(4), 493-499.

Hachinski, V., Iadecola, C., Petersen, R. C., Breteler, M. M., Nyenhuis, D. L., Black, S. E., ... & Vinters, H. V. (2006). National Institute of Neurological Disorders and Stroke–Canadian stroke network vascular cognitive impairment harmonization standards. *Stroke*, *37*(9), 2220-2241.

Hackett, M. L., & Pickles, K. (2014). Part I: frequency of depression after stroke: an updated systematic review and meta-analysis of observational studies. *International Journal of Stroke*, *9*(8), 1017-1025.

Hall KS, Gao S, Emsley CL, Ogunniyi AO, Morgan O, Hendrie HC. Community screening interview for dementia (CSI 'D'); performance in five disparate study sites. Int J Geriatr Psychiatry 2000;15:521–31.

Halligan, P., Wilson, B., & Cockburn, J. (1990). A short screening test for visual neglect in stroke patients. *International disability studies*, *12*(3), 95-99.

Hambleton, R. K., & Patsula, L. (1999). Increasing the validity of adapted tests: Myths to be avoided and guidelines for improving test adaptation practices. *Journal of Applied Testing Technology*, *1*(1), 1-13

Hambleton, R. K., Merenda, P. F., & Spielberger, C. D. (Eds.). (2004). *Adapting educational and psychological tests for cross-cultural assessment*. Psychology Press.

Hanke, S. H., & Kwok, A. K. (2009). On the measurement of Zimbabwe's hyperinflation. *Cato J.*, *29*, 353.

Hannula, D. E., Ryan, J. D., & Warren, D. E. (2017). Beyond long-term declarative memory: evaluating hippocampal contributions to unconscious memory expression, perception, and short-term retention. In *The hippocampus from cells to systems* (pp. 281-336). Springer, Cham.

Harwood, D. M., Hope, T., & Jacoby, R. (1997). Cognitive impairment in medical inpatients. II: Do physicians miss cognitive impairment?. *Age and ageing*, *26*(1), 37-39.

He, J., & van de Vijver, F. (2012). Bias and equivalence in cross-cultural research. *Online readings in psychology and culture*, *2*(2), 8.

Heaton, R. K., Ryan, L., & Grant, I. (2009). Demographic influences and use of demographically corrected norms in neuropsychological assessment. *Neuropsychological assessment of neuropsychiatric and neuromedical disorders*, *3*, 127-155.

Heaton, R. K., Ryan, L., Grant, I., & Matthews, C. G. (1996). Demographic influences on neuropsychological test performance. *Neuropsychological assessment of neuropsychiatric disorders*, *2*, 141-163.

Hestad, K. A., Menon, J. A., Serpell, R., Kalungwana, L., Mwaba, S. O., Kabuba, N., ... & Heaton, R. K. (2016). Do neuropsychological test norms from African Americans in the United States generalize to a Zambian population?. *Psychological assessment*, *28*(1), 18.

Hestad, K. A., Menon, J. A., Silalukey-Ngoma, M., Franklin Jr, D. R., Imasiku, M. L., Kalima, K., & Heaton, R. K. (2012). Sex differences in neuropsychological performance as an effect of human immunodeficiency virus infection: a pilot study in Zambia, Africa. *The Journal of nervous and mental disease*, *200*(4).

Higgins, J. P., & Green, S. (Eds.). (2011). *Cochrane handbook for systematic reviews of interventions* (Vol. 4). John Wiley & Sons.

Hingorjo, M. R., & Jaleel, F. (2012). Analysis of one-best MCQs: the difficulty index, discrimination index and distractor efficiency. *JPMA-Journal of the Pakistan Medical Association*, *62*(2), 142.

Høegh, M. C., & Høegh, S. M. (2009). Trans-adapting outcome measures in rehabilitation: Cross-cultural issues. *Neuropsychological rehabilitation*, *19*(6), 955-970.

Hollander, D. (1986). Zimbabwe: mental health. *The Lancet*, *328*(8500), 212-213.

Holsinger, T., Plassman, B. L., Stechuchak, K. M., Burke, J. R., Coffman, C. J., & Williams, J. W. (2012). Screening for Cognitive Impairment : Comparing the Performance of Four Instruments in Primary Care. Journal of the American Geriatrics Society, 60, 1027–1036. doi:10.1111/j.1532-5415.2012.03967.x

Holzer, C. E., Tischler, G. L., Leaf, P. J., & Myers, J. K. (1984). An epidemiologic assessment of cognitive impairment in a community population. *Research in Community & Mental Health*.

Hoogendam, Y. Y., Hofman, A., van der Geest, J. N., van der Lugt, A., & Ikram, M. A. (2014). Patterns of cognitive function in aging: the Rotterdam Study. *European journal of epidemiology*, *29*(2), 133-140.

Howitt, S. C., Jones, M. P., Jusabani, A., Gray, W. K., Aris, E., Mugusi, F., ... & Walker, R. W. (2011). A cross-sectional study of quality of life in incident stroke survivors in rural northern Tanzania. *Journal of neurology*, *258*(8), 1422-1430.

Howitt, S. C., Jones, M. P., Jusabani, A., Gray, W. K., Aris, E., Mugusi, F., ... & Walker, R. W. (2011). A cross-sectional study of quality of life in incident stroke survivors in rural northern Tanzania. *Journal of neurology*, *258*(8), 1422-1430.

Hsu C, Sandford B. The Delphi technique: making sense of consensus.

https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

Hua, P., Pan, X. P., Hu, R., Mo, X. E., Shang, X. Y., & Yang, S. R. (2014). Factors related to executive dysfunction after acute infarct. *PloS one*, *9*(9).

Humphreys, G. W., Bickerton, W. L., Samson, D., &Riddoch, M. J. (2012). The Birmingham Cognitive Screen (BCoS). Psychology Press, London.

Humphreys, Glyn W., Wai-Ling Bickerton, Dana Samson, and M. Jane Riddoch. *BCoS cognitive screen*. 2012.

Hüseyinsinoğlu, B. E., Aslan, G. K., Tarakci, D., ÖZDİNÇLER, A. R., KÜÇÜKOĞLU, H., & BAYBAŞ, S. (2017). Physical Activity Level of Ambulatory Stroke Patients: Is it Related to Neuropsychological Factors?. *Archives of Neuropsychiatry*, *54*(2), 155.

International Test Commission. International Test Commission guidelines for translating and adapting tests. 2010.

International Test Commission. International Test Commission guidelines for translating and adapting tests. 2010.

Iracleous, P., Nie, J. X., Tracy, C. S., Moineddin, R., Ismail, Z., Shulman, K. I., &Upshur, R. E. G. (2010). Primary care physicians' attitudes towards cognitive screening: findings from a national postal survey. International Journal of Geriatric Psychiatry, 25, 23–29.

Ismail, Z., Rajji, T. K., & Shulman, K. I. (2010). Brief cognitive screening instruments: an update. *International Journal of Geriatric Psychiatry: A journal of the psychiatry of late life and allied sciences*, *25*(2), 111-120.

Itabashi, R., Nishio, Y., Kataoka, Y., Yazawa, Y., Furui, E., Matsuda, M., & Mori, E. (2016). Damage to the left precentral gyrus is associated with apraxia of speech in acute stroke. *Stroke*, *47*(1), 31-36.

Jankowski, K. R., Flannelly, K. J., & Flannelly, L. T. (2018). The t-test: An influential inferential tool in chaplaincy and other healthcare research. *Journal of health care chaplaincy*, *24*(1), 30-39.

Jansen, P., & Greenop, K. (2008). Factor analyses of the Kaufman Assessment Battery for Children assessed longitudinally at 5 and 10 years. *South African Journal of Psychology*, *38*(2), 355-365.

Jiang, X. G., Lin, Y., & Li, Y. S. (2014). Correlative study on risk factors of depression among acute stroke patients. *Eur Rev Med Pharmacol Sci*, *18*(9), 1315-23.

Jiang, X. G., Lin, Y., & Li, Y. S. (2014). Correlative study on risk factors of depression among acute stroke patients. *Eur Rev Med Pharmacol Sci*, *18*(9), 1315-23.

Jokinen, H., Gonçalves, N., Vigário, R., Lipsanen, J., Fazekas, F., Schmidt, R., ... & Pantoni, L. (2015). Early-stage white matter lesions detected by multispectral MRI segmentation predict progressive cognitive decline. *Frontiers in neuroscience*, *9*, 455.

Jokinen, H., Melkas, S., Ylikoski, R., Pohjasvaara, T., Kaste, M., Erkinjuntti, T., & Hietanen, M. (2015). Post-stroke cognitive impairment is common even after successful clinical recovery. *European Journal of Neurology*, *22*(9), 1288-1294.

Jongen, P. J., Wesnes, K., van Geel, B., Pop, P., Sanders, E., Schrijver, H., ... & COGNISEC Study Group. (2014). Relationship between working hours and power of attention, memory, fatigue, depression and self-efficacy one year after diagnosis of clinically isolated syndrome and relapsing remitting multiple sclerosis. PloS one, 9(5), e96444.

Kalungwana-Mambwe, L. (2017). Influence of Age and Education on Neuropsychological Tests in Zambia. *Medical Journal of Zambia*, *44*(2), 106-113.

Kaplan, E., Goodglass, H., & Weintraub, S. (1983). Boston Naming Test. Philadelphia, Lee and Febiger.

Kaplan, E., Goodglass, H., & Weintraub, S. (2001). Boston naming test. Pro-ed.

Karunaratne, S., Hanwella, R., & De Silva, V. (2011).Validation of the Sinhala version of the Montreal Cognitive Assessment in screening for dementia.The Ceylon Medical Journal, 56, and 147–53. doi:10.4038/cmj.v56i4.3892

Kaseke, F., Stewart, A., Gwanzura, L., Hakim, J., & Chikwasha, V. (2017). Clinical characteristics and outcomes of patients with stroke admitted to three tertiary hospitals in Zimbabwe: A retrospective one-year study. *Malawi Medical Journal*, *29*(2), 177-182.

Kasner, S. E. (2006). Clinical interpretation and use of stroke scales. *The Lancet Neurology*, *5*(7), 603-612.

Katan, M., & Luft, A. (2018, April). Global burden of stroke. In *Seminars in neurology* (Vol. 38, No. 02, pp. 208-211). Thieme Medical Publishers.

Kevany, S., Murima, O., Singh, B., Hlubinka, D., Kulich, M., Morin, S. F., & Sweat, M. (2012). Socio-economic status and health care utilization in rural Zimbabwe: findings from Project Accept (HPTN 043). *Journal of public health in Africa*, *3*(1).

Khedr, E. M., Hamed, S. A., El-Shereef, H. K., Shawky, O. A., Mohamed, K. A., Awad, E. M., ... & Eltahtawy, M. A. (2009). Cognitive impairment after cerebrovascular stroke: Relationship to vascular risk factors. *Neuropsychiatric Disease and Treatment*, *5*, 103.

Kidia, K., Machando, D., Mangezi, W., Hendler, R., Crooks, M., Abas, M., ... & Jack, H. (2017). Mental health in Zimbabwe: a health systems analysis. *The Lancet Psychiatry*, *4*(11), 876-886.

Kim, H., & Cameron, C. E. (2016). Implications of visuospatial skills and executive functions for learning mathematics: Evidence from children with autism and Williams syndrome. *AERA Open*, *2*(4), 2332858416675124.

Kitsao-Wekulo, P. K., Holding, P. A., Taylor, H. G., Abubakar, A., & Connolly, K. (2013). Neuropsychological testing in a rural African school-age population: evaluating contributions to variability in test performance. *Assessment*, *20*(6), 776-784.

Klerk, G. Cross-cultural testing). In M. Born, C.D. Foxcroft& R. Butter (Eds.), Online

Kline, P. (2013). *Intelligence: The psychometric view*. Routledge.

Kluckhohn, F., & Strodbeck, F. L. (1961). Variations in value organizations. *New York: Row, Peterson*.

Knoetze, J., Bass, N., & Steele, G. (2005). The Raven's Coloured Progressive Matrices: Pilot norms for isiXhosa-speaking primary school learners in peri-urban Eastern Cape. *South African Journal of Psychology*, *35*(2), 175-194.

Kongkasuwan, R., Voraakhom, K., Pisolayabutra, P., Maneechai, P., Boonin, J., & Kuptniratsaikul, V. (2016). Creative art therapy to enhance rehabilitation for stroke patients: a randomized controlled trial. *Clinical rehabilitation*, *30*(10), 1016-1023.

Kosmidis, M. H. (2018). Challenges in the neuropsychological assessment of illiterate older adults. *Language, Cognition and Neuroscience*, *33*(3), 373-386.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of general internal medicine*, *16*(9), 606-613.

Kruithof, W. J., Post, M. W., van Mierlo, M. L., van den Bos, G. A., Janneke, M., & Visser-Meily, J. M. (2016). Caregiver burden and emotional problems in partners of stroke patients at two months and one year post-stroke: Determinants and prediction. *Patient education and counseling*, *99*(10), 1632-1640.

Kumral, E., & Zirek, O. (2017). Major neurocognitive disorder followıng isolated hippocampal ischemıc lesions. *Journal of the neurological sciences*, *372*, 496-500.

Kumral, E., Evyapan, D., & Balkir, K. (1999). Acute caudate vascular lesions. *Stroke*, *30*(1), 100-108.

Kumral, E., Güllüoğlu, H., Alakbarova, N., Deveci, E. E., Çolak, A. Y., Çağında, A. D., ... & Orman, M. (2015). Cognitive decline in patients with leukoaraiosis within 5 years after initial stroke. *Journal of Stroke and Cerebrovascular Diseases*, *24*(10), 2338-2347.

Kuzmina, E., Humphreys, G. W., Riddoch, M. J., Skvortsov, A. A., & Weekes, B. S. (2018). Preliminary validation study of the Russian Birmingham Cognitive Screen. *Journal of clinical and experimental neuropsychology*, *40*(1), 1-16. J INF Technol Educ 2007; 6:1-21.

Langlois, J. A., Rutland-Brown, W., & Wald, M. M. (2006). The epidemiology and impact of traumatic brain injury: a brief overview. The Journal of head trauma rehabilitation, 21(5), 375-378.

Lauren Lent, Elizabeth Hahn, Sonya Eremenco, Kimberly Webster, David Cella, L. (1999). Using cross-cultural input to adapt the Functional Assessment of Chronic Illness Therapy (FACIT) scales. *Acta Oncologica*, *38*(6), 695-702.

Leckman, J., & Taylor, E. (2015). Clinical assessment and diagnostic formulation. *Rutter's Child and Adolescent Psychiatry, ed. Wiley-Beackwell*, 407-418.

Lee, D., LoGalbo, A. P., Baños, J. H., & Novack, T. A. (2004). Prediction of Cognitive Abilities 1 Year Following Traumatic Brain Injury From Inpatient Rehabilitation Cognitive Screening. Rehabilitation Psychology, 49(2), 167.

Leposavić, I., Leposavić, L., & Šaula-Marojević, B. (2010). NEUROPSYCHOLOGICAL ASSESSMENT: COMPUTERIZES BATTERIES OR STANDARD TESTS. *Psychiatria Danubina*, *22*(2), 145-152.

Levenstein, S., Prantera, C., Varvo, V., Scribano, M. L., Berto, E., Luzi, C., & Andreoli, A. (1993). Development of the Perceived Stress Questionnaire: a new tool for psychosomatic research. *Journal of psychosomatic research*, *37*(1), 19-32.

Lezak, M. D., Howieson, D. B., & Bigler, E. D. (2012). Tranel. *Neuropsychological Assessment. 5th Edition ed*.

Lezak, M., Howieson, D., & Loring, D. (2012). Neuropsychological assessment. 5th edn Oxford University Press. *Oxford, New York, ISBN*, *10*, 9780195395525.

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., ... & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med*, *6*(7), e1000100.

Linck, J. A., Osthus, P., Koeth, J. T., & Bunting, M. F. (2014). Working memory and second language comprehension and production: A meta-analysis. *Psychonomic bulletin & review*, *21*(4), 861-883.

Lisa, L. P., Jughters, A., & Kerckhofs, E. (2013). The effectiveness of different treatment modalities for the rehabilitation of unilateral neglect in stroke patients: a systematic review. *NeuroRehabilitation*, *33*(4), 611-620.

Liu, J., Qin, W., Wang, H., Zhang, J., Xue, R., Zhang, X., & Yu, C. (2014). Altered spontaneous activity in the default-mode network and cognitive decline in chronic subcortical stroke. *Journal of the neurological sciences*, *347*(1-2), 193-198.

Mahoney F. Barthel D. Functional evaluation: the Barthel Index. Md Med J. 1965; 14:61–65

Mahoney, F. I., & Barthel, D. W. (1965). Functional evaluation: the Barthel Index: a simple index of independence useful in scoring improvement in the rehabilitation of the chronically ill. *Maryland state medical journal*.

Makin, S. D. J., Turpin, S., Dennis, M. S., & Wardlaw, J. M. (2013). Cognitive impairment after lacunar stroke: systematic review and meta-analysis of incidence, prevalence and comparison with other stroke subtypes. *J Neurol Neurosurg Psychiatry*, *84*(8), 893-900.

Makondo, D. (2012). *The effects of language of instruction on the performance of the Tsonga (Shangani) speaking Grade seven pupils in Zimbabwe* (Doctoral dissertation, University of Limpopo (Turfloop Campus)).

Mandrekar, J. N. (2010). Receiver operating characteristic curve in diagnostic test assessment. *Journal of Thoracic Oncology*, *5*(9), 1315-1316.

Mangezi, W., & Chibanda, D. (2010). Mental health in Zimbabwe. *International Psychiatry*, *7*(4), 93-94.

Manly, J. J. (2008). Critical issues in cultural neuropsychology: profit from diversity. Neuropsychology review, 18(3), 179-183.

Marin, R. S. (1991). Apathy: a neuropsychiatric syndrome. *The Journal of neuropsychiatry and clinical neurosciences*.

Marin, R. S. (1996, October). Apathy: Concept, Syndrome, Neural Mechanisms, and Treatment. In *Seminars in Clinical Neuropsychiatry* (Vol. 1, No. 4, pp. 304-314).

Marin, R. S., Biedrzycki, R. C., & Firinciogullari, S. (1991). Reliability and validity of the Apathy Evaluation Scale. *Psychiatry research*, *38*(2), 143-162.

Martínez, K., Burgaleta, M., Román, F. J., Escorial, S., Shih, P. C., Quiroga, M. Á., & Colom, R. (2011). Can fluid intelligence be reduced to 'simple'short-term storage?. *Intelligence*, *39*(6), 473-480.

Mascolini M. Ischaemic Stroke rate 40% higher in HIV, but not if CD4s top 500. International AIDS Society. 2014; Retrieved from http:// www.iasociety.org/Default.aspx? Page1d=5&elementid=15995.

Mate-Kole, C. C. (2013). Psychology in Ghana revisited. Journal of Black Psychology, 39(3), 316-320.

Matenga, J. (1997). Stroke incidence rates among black residents of Harare-a prospective community-based study. *South African Medical Journal*, *87*(5).

Matenga, J., Kitai, I., & Levy, L. (1986). Strokes among black people in Harare, Zimbabwe: results of computed tomography and associated risk factors. *Br Med J (Clin Res Ed)*, *292*(6536), 1649-1651.

Mathuranath, P. S., Nestor, P. J., Berrios, G. E., Rakowicz, W., & Hodges, J. R. (2000). A brief cognitive test battery to differentiate Alzheimer's disease and frontotemporal dementia. Neurology, 55(11), 1613-1620.

Matsumoto, D., & Hwang, H. C. (2013). Assessing cross-cultural competence: A review of available tests. *Journal of cross-cultural psychology*, *44*(6), 849-873.

McDowell, I., & Newell, C. (1996). A guide to rating scales and questionnaires. *A guide to rating scales and questionnaires*.

Meiring, D., Van de Vijver, A. J. R., Rothmann, S., & Barrick, M. R. (2005). Construct, item and method bias of cognitive and personality tests in South Africa. *SA Journal of Industrial Psychology*, *31*(1), 1-8.

Melby-Lervåg, M., & Lervåg, A. (2014). Reading comprehension and its underlying components in second-language learners: A meta-analysis of studies comparing first- and second-language learners. *Psychological bulletin*, *140*(2), 409.

Miller, J. B., & Barr, W. B. (2017). The technology crisis in neuropsychology. *Archives of Clinical Neuropsychology*, *32*(5), 541-554.

Mioshi, E., Dawson, K., Mitchell, J., Arnold, R., & Hodges, J. R. (2006). The Addenbrooke's Cognitive Examination Revised (ACE-R): a brief cognitive test battery for dementia screening. International journal of geriatric psychiatry, 21(11), 1078-1085.

Mitolo, M., Salmon, D. P., & Gardini, S. (2013). Mini Mental State Examination (MMSE). *hospital*, *7*(3), 484-8.

Mitrushina, M., Boone, K. B., Razani, J., & D'Elia, L. F. (2005). Handbook of Normativ

Mok, V. C., Wong, A., Lam, W. W., Baum, L. W., Ng, H. K., & Wong, L. (2008). A case-controlled study of cognitive progression in Chinese lacunar stroke patients. *Clinical neurology and neurosurgery*, *110*(7), 649-656.

Mokkink, L.B., De Vet, H.C.W., Prinsen, C.A.C, Patrick, D.L., Alonso, J., Bouter, L.M., et al. (2017). COSMIN Risk of Bias checklist, 1–37.

Mokkink, L.B., de Vet, H.C.W., Prinsen, C.A.C., Patrick, D.L., Alonso, J., Bouter, L.M., Moser, R. S., Schatz, P., & Lichtenstein, J. D. (2015). The importance of proper administration and interpretation of neuropsychological baseline and postconcussion computerized testing. *Applied Neuropsychology: Child*, *4*(1), 41-48.

Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., ... & Howard, V. J. (2015). Heart disease and stroke statistics—2016 update: a report from the American Heart Association. *Circulation*, CIR-0000000000000350.

Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., ... & Howard, V. J. (2016). Executive summary: heart disease and stroke statistics-2016 update: a report from the American Heart Association. *Circulation*, *133*(4), 447-454.

Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., ... & Howard, V. J. (2016). Executive summary: heart disease and stroke statistics-2016 update: a report from the American Heart Association. *Circulation*, *133*(4), 447-454.

Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., ... & Howard, V. J. (2015). Heart disease and stroke statistics—2016 update: a report from the American Heart Association. *Circulation*, CIR-0000000000000350.

Muchenje, T. B. (2003). An analysis of the cause and effect of the brain drain in Zimbabwe. Harare: Scientific and Industrial Research and Development Centre.

Mukherjee, D., & Patil, C. G. (2011). Epidemiology and the global burden of stroke. *World neurosurgery*, *76*(6), S85-S90.

Mushquash, C. J., &Bova, D. L. (2007).Cross-cultural assessment and measurement issues. Journal on Developmental Disabilities, 13(1), 53-65.

Myers, N. E., Stokes, M. G., & Nobre, A. C. (2017). Prioritizing information during working memory: beyond sustained internal attention. *Trends in Cognitive Sciences*, *21*(6), 449-461.

Nakling, A. E., Aarsland, D., Næss, H., Wollschlaeger, D., Fladby, T., Hofstad, H., & Wehling, E. (2017). Cognitive deficits in chronic stroke patients: neuropsychological assessment, depression, and self-reports. *Dementia and Geriatric Cognitive Disorders Extra*, *7*(2), 283-296.

Nasreddine, Z. S., Phillips, N. A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., ... & Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society*, *53*(4), 695-699.

Nøkleby, K., Boland, E., Bergersen, H., Schanke, A. K., Farner, L., Wagle, J., & Wyller, T. B. (2008). Screening for cognitive deficits after stroke: a comparison of three screening tools. *Clinical Rehabilitation*, *22*(12), 1095-1104.

Norman, M. A., Moore, D. J., Taylor, M., Franklin Jr, D., Cysique, L., Ake, C., ... & Hnrc Group. (2011). Demographically corrected norms for African Americans and Caucasians on the hopkins verbal learning test–revised, brief visuospatial memory test–revised, stroop color and word test, and wisconsin card sorting test 64-card version. *Journal of clinical and experimental neuropsychology*, *33*(7), 793-804.

Norman, R., Matzopoulos, R., Groenewald, P., & Bradshaw, D. (2007). The high burden of injuries in South Africa. Bulletin of the World Health Organization, 85(9), 695-702.

Nouri, F. M., & Lincoln, N. B. (1987). An extended activities of daily living scale for stroke patients. *Clinical rehabilitation*, *1*(4), 301-305.

Oakland, T., Wechsler, S. M., & Maree, K. (2013). Test use with children across cultures: A view from three countries

Oei, T. P. S., Shaw, S., & Healy, K. L. (2016). Executive function deficits in psychiatric outpatients in Australia. *International Journal of Mental Health and Addiction*, *14*(3), 337-349.

Ojagbemi, A., & Owolabi, M. (2013). Predictors of functional dependency after stroke in Nigeria. *Journal of Stroke and Cerebrovascular Diseases*, *22*(8), e381-e387.

Ojagbemi, A., Owolabi, M., Bello, T., & Baiyewu, O. (2017). Stroke severity predicts poststroke delirium and its association with dementia: longitudinal observation from a low income setting. *Journal of the neurological sciences*, *375*, 376-381.

Oosterhuis, H. (2017). Regression-based norming for psychological tests and questionnaires.

Oosterhuis, H. E., van der Ark, L. A., & Sijtsma, K. (2016). Sample size requirements for traditional and regression-based norms. *Assessment*, *23*(2), 191-202.

Ortiz, G. A., & L. Sacco, R. (2014). National institutes of health stroke scale (nihss). *Wiley StatsRef: Statistics Reference Online*.

Ostrosky-Solís, F., Ardila, A., &Rosselli, M. (1999). NEUROPSI: A brief neuropsychological test battery in Spanish with norms by age and educational level. Journal of the international Neuropsychological Society, 5(05), 413-433.

Ottenbacher KJ, Hsu Y, Granger CV, Fiedler RC. The reliability of the functional independence measure: a quantitative review. Arch Phys Med Rehabil. 1996;77:1226–32.

Owolabi, M. O., Arulogun, O., Melikam, S., Adeoye, A. M., Akarolo-Anthony, S., Akinyemi, R., ... & Lackland, D. (2015). The burden of stroke in Africa: a glance at the present and a glimpse into the future. *Cardiovascular journal of Africa*, *26*(2 H3Africa Suppl), S27.

Paap, K. R., & Sawi, O. (2014). Bilingual advantages in executive functioning: problems in convergent validity, discriminant validity, and the identification of the theoretical constructs. *Frontiers in psychology*, *5*, 962.

Paffenbarger Jr, R. S., & Williams, J. L. (1967). Chronic disease in former college students V. Early precursors of fatal stroke. *American Journal of Public Health and the Nations Health*, *57*(8), 1290-1299. Pract. Assessment, Res. Eval. 2007;12:1-8.

Pagliarin, K. C., Ortiz, K. Z., Parente, M. A. D. M. P., Arteche, A., Joanette, Y., Nespoulous, J. L., & Fonseca, R. P. (2014). Montreal-Toulouse language assessment battery for aphasia: validity and reliability evidence. *NeuroRehabilitation*, *34*(3), 463-471.

Pallavicini, F., Pedroli, E., Serino, S., Dell'Isola, A., Cipresso, P., Cisari, C., & Riva, G. (2015). Assessing Unilateral Spatial Neglect using advanced technologies: The potentiality of mobile virtual reality. *Technology and Health Care*, *23*(6), 795-807.

Pan, X., Bickerton, W., King, J., Lau, L., Pak, A., Kong, H., … Hu, J. (2015). Preliminary findings on the reliability and validity of the Cantonese Birmingham Cognitive Screen in patients with acute ischemic stroke, 2377–2390.

Park, H. L., O'Connell, J. E., & Thomson, R. G. (2003). A systematic review of cognitive decline in the general elderly population. *International journal of geriatric psychiatry*, *18*(12), 1121-1134.

Parmenter, B. A., Testa, S. M., Schretlen, D. J., Weinstock-Guttman, B., & Benedict, R. H. (2010). The utility of regression-based norms in interpreting the minimal assessment of cognitive function in multiple sclerosis (MACFIMS). *Journal of the International Neuropsychological Society*, *16*(1), 6-16.

Party, I. S. W. (2012). National clinical guideline for stroke.

Pendlebury, S. T., Klaus, S. P., Mather, M., De Brito, M., & Wharton, R. M. (2015). Routine cognitive screening in older patients admitted to acute medicine: abbreviated mental test score (AMTS) and subjective memory complaint versus Montreal Cognitive Assessment and IQCODE. *Age and ageing*, *44*(6), 1000-1005.

Piccolo, L. D. R., Arteche, A. X., Fonseca, R. P., Grassi-Oliveira, R., & Salles, J. F. (2016). Influence of family socioeconomic status on IQ, language, memory and executive functions of Brazilian children. *Psicologia: Reflexão e Crítica*, *29*.

Pihlaja, R., Uimonen, J., Mustanoja, S., Tatlisumak, T., & Poutiainen, E. (2014). Post-stroke fatigue is associated with impaired processing speed and memory functions in first-ever stroke patients. *Journal of psychosomatic research*, *77*(5), 380-384.

Prinsen, C. A., Mokkink, L. B., Bouter, L. M., Alonso, J., Patrick, D. L., De Vet, H. C., & Terwee, C. B. (2018). COSMIN guideline for systematic reviews of patient-reported outcome measures. *Quality of Life Research*, *27*(5), 1147-1157.

Qu, Y., Zhuo, L., Li, N., Hu, Y., Chen, W., Zhou, Y., ... & Zhan, S. (2015). Prevalence of post-stroke cognitive impairment in China: a community-based, cross-sectional study. *PLoS One*, *10*(4), e0122864.

RABIN, L. A., BRODALE, D. L., ELBULOK-CHARCAPE, M. M., & BARR, W. B. (2019). Challenges in the neuropsychological assessment of ethnic minorities.

Clinical Cultural Neuroscience: An Integrative Approach to Cross-Cultural Neuropsychology, 55.

Rasquin, S. M., Lodder, J., Ponds, R. W., Winkens, I., Jolles, J., & Verhey, F. R. (2004). Cognitive functioning after stroke: a one-year follow-up study. *Dementia and geriatric cognitive disorders*, *18*(2), 138-144.

Reitan, R. M. (1958). Validity of the Trail Making Test as an indicator of organic brain damage. *Perceptual and motor skills*, *8*(3), 271-276.

Reitan, R. M., & Wolfson, D. The Halstead-Reitan Neuropsychological Test Battery: Therapy and clinical interpretation. 1985. *Tucson AZ: Neuropsychological Press Google Scholar*.

Rey & Osterrieth (1993). Translations of excerpts from Andre Rey" s Psychological examination of traumatic encephalopathy and PA Osterrieth" s The Complex Figure Copy Test.. *Clinical Neuropsychologist*.

Reynolds, C. R. (2002). Comprehensive trail making test (CTMT). *Austin, TX: Pro-Ed*, *408*.

Rivera, D., Olabarrieta-Landa, L., Van der Elst, W., Gonzalez, I., Rodríguez-Agudelo, Y., Aguayo Arelis, A., ... & Arango-Lasprilla, J. C. (2019). Normative data for verbal fluency in healthy Latin American adults: Letter M, and fruits and occupations categories. *Neuropsychology*, *33*(3), 287.

Ritchie, S. J., Bates, T. C., & Deary, I. J. (2015). Is education associated with improvements in general cognitive ability, or in specific skills?. *Developmental Psychology*, *51*(5), 573.

Robbins, R. N., Joska, J. A., Thomas, K. G., Stein, D. J., Linda, T., Mellins, C. A., & Remien, R. H. (2013). Exploring the utility of the Montreal Cognitive Assessment to detect HIV-associated neurocognitive disorder: the challenge and need for culturally valid screening tests in South Africa. *The Clinical Neuropsychologist, 27* (3), 437-454.

Rodrigues, J. D. C., Becker, N., Beckenkamp, C. L., Miná, C. S., Salles, J. F. D., & Bandeira, D. R. (2019). Psychometric properties of cognitive screening for patients with cerebrovascular diseases A systematic review. *Dementia & neuropsychologia*, *13*(1), 31-43.

Rogerson, C. M. (2016, June). Responding to informality in urban Africa: Street trading in Harare, Zimbabwe. In *Urban Forum* (Vol. 27, No. 2, pp. 229-251). Springer Netherlands.

Román, G. C., Tatemichi, T. K., Erkinjuntti, T., Cummings, J. L., Masdeu, J. C., Garcia, J. H., ... & Moody, D. M. (1993). Vascular dementia: diagnostic criteria for research studies: report of the NINDS-AIREN International Workshop. *Neurology*, *43*(2), 250-250.

Roussel, M., Martinaud, O., Hénon, H., Vercelletto, M., Bindschadler, C., Joseph, P. A., ... & GREFEX Study Group. (2016). The behavioural and cognitive executive disorders of stroke: the GREFEX Study. *PloS one*, *11*(1), e0147602.

Roebuck-Spencer, T. M., Glen, T., Puente, A. E., Denney, R. L., Ruff, R. M., Hostetter, G., & Bianchini, K. J. (2017). Cognitive screening tests versus comprehensive neuropsychological test batteries: a national academy of neuropsychology education paper. *Archives of Clinical Neuropsychology*, *32*(4), 491-498.

Sahathevan, R., Siriratnam, P., O'Connor, E., Godfrey, A., Hu, C. C., Low, A., ... & Oqueli, E. (2018). Age as a determinant of risk factors and causes in ischaemic stroke.

Salehinejad, M. A., Wischnewski, M., Nejati, V., Vicario, C. M., & Nitsche, M. A. (2019). Transcranial direct current stimulation in attention-deficit hyperactivity disorder: A meta-analysis of neuropsychological deficits. *PloS one*, *14*(4), e0215095.

Sarfo, F. S., Akassi, J., Adamu, S., Obese, V., & Ovbiagele, B. (2017). Burden and Predictors of Poststroke Cognitive Impairment in a Sample of Ghanaian Stroke Survivors. *Journal of Stroke and Cerebrovascular Diseases*, *26*(11), 2553-2562.

Sauerland, S., & Seiler, C. M. (2005). Role of systematic reviews and meta-analysis in evidence-based medicine. *World journal of surgery*, *29*(5), 582-587.

Saxena, S., Funk, M., & Chisholm, D. (2014). WHO's Mental Health Action Plan 2013-2020: what can psychiatrists do to facilitate its implementation?. *World Psychiatry*, *13*(2), 107-109.

Schlosser, Ralf W. "The role of systematic reviews in evidence-based practice, research, and development." *Focus* 15 (2006): 1-4.

Schneider, A. L., Sharrett, A. R., Gottesman, R. F., Coresh, J., Coker, L., Wruck, L., ... & Mosley, T. H. (2015). Normative data for eight neuropsychological tests in older blacks and whites from the atherosclerosis risk in communities (ARIC) study. *Alzheimer disease and associated disorders*, *29*(1), 32.

Schöttke, H., & Giabbiconi, C. M. (2015). Post-stroke depression and post-stroke anxiety: prevalence and predictors. *International Psychogeriatrics*, *27*(11), 1805-1812.

Semrau, M., Alem, A., Ayuso-Mateos, J. L., Chisholm, D., Gureje, O., Hanlon, C., ... & Shidhaye, R. (2019). Strengthening mental health systems in low-and middle-income countries: recommendations from the Emerald programme. *BJPsych open*, *5*(5).

Serrano, S., Domingo, J., Rodríguez-Garcia, E., Castro, M. D., & del Ser, T. (2007). Frequency of cognitive impairment without dementia in patients with stroke: a two-year follow-up study. *Stroke*, *38*(1), 105-110.

Serpell, Robert. "How specific are perceptual skills? A cross-cultural study of pattern reproduction." *British Journal of Psychology* 70, no. 3 (1979): 365-380.

Shallice, T. (1982). Specific impairments of planning. Philosophical Transactions of the Royal Society of London. B, Biological Sciences, 298(1089), 199-209.

Shen, Y. J., Wang, W. A., Huang, F. D., Chen, J., Liu, H. Y., Xia, Y. L., ... & Zhang, L. (2016). The use of MMSE and MoCA in patients with acute ischemic stroke in clinical. *International Journal of Neuroscience*, *126*(5), 442-447.

Shi, Y., Xiang, Y., Yang, Y., Zhang, N., Wang, S., Ungvari, G. S., ... & Wang, Y. (2015). Depression after minor stroke: prevalence and predictors. *Journal of psychosomatic research*, *79*(2), 143-147.

Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: uses in assessing rater reliability. *Psychological bulletin*, *86*(2), 420.

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

Shuttleworth-Jordan, A. B. (1996). On not reinventing the wheel: A clinical perspective on culturally relevant test usage in South Africa. *South African Journal of Psychology*, *26*(2), 96-102.

Skerrett, T. N., & Moss-Morris, R. (2006). Fatigue and social impairment in multiple sclerosis: the role of patients' cognitive and behavioral responses to their symptoms. Journal of psychosomatic research, 61(5), 587-593.

Skulmoski, G. J. & Hartman, F. T. The Delphi Method for Graduate Research.

Skuy, M., Schutte, E., Fridjhon, P., & O'Carroll, S. (2001). Suitability of published neuropsychological test norms for urban African secondary school students in South Africa. *Personality and Individual Differences*, *30*(8), 1413-1425.

Smit, M., Olney, J., Ford, N. P., Vitoria, M., Gregson, S., Vassall, A., & Hallett, T. B. (2018). The growing burden of noncommunicable disease among persons living with HIV in Zimbabwe. *AIDS (London, England)*, *32*(6), 773.

Smit, M., Olney, J., Ford, N. P., Vitoria, M., Gregson, S., Vassall, A., & Hallett, T. B. (2018). The growing burden of noncommunicable disease among persons living with HIV in Zimbabwe. *AIDS (London, England)*, *32*(6), 773.

Sobreiro, M. F., Miotto, E. C., Terroni, L., Tinone, G., Iosifescu, D. V., de Lucia, M. C., ... & Fraguas, R. (2014). Executive function and depressive symptoms of retardation in nonelderly stroke patients. *Journal of clinical and experimental neuropsychology*, *36*(6), 636-647.

Sommer, M., & Arendasy, M. E. (2014). Comparing different explanations of the effect of test anxiety on respondents' test scores. *Intelligence*, *42*, 115-127.

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of internal medicine*, *166*(10), 1092-1097.

Stiles, J., Reilly, J., Paul, B., & Moses, P. (2005). Cognitive development following early brain injury: evidence for neural adaptation. Trends in cognitive sciences, 9(3), 136-143.

Strauss, E., Sherman, E. M., & Spreen, O. (2006). A compendium of neuropsychological tests.

Stringer, A. Y. (2011). Zangwill, Oliver (1913--1987). In J. S. Kreutzer, J. DeLuca, & B. Caplan (Eds.), *Encyclopedia of Clinical Neuropsychology* (pp. 2741–2743). https://doi.org/10.1007/978-0-387-79948-3_659

Sun, J. H., Tan, L., & Yu, J. T. (2014). Post-stroke cognitive impairment: epidemiology, mechanisms

Sun, J. H., Tan, L., & Yu, J. T. (2014). Post-stroke cognitive impairment: epidemiology, mechanisms and management. *Annals of translational medicine*, *2*(8).

Surawan, J., Areemit, S., Tiamkao, S., Sirithanawuthichai, T., & Saensak, S. (2017). Risk factors associated with post-stroke dementia: a systematic review and meta-analysis. *Neurology international*, *9*(3).

Swain, S., Turner, C., Tyrrell, P., & Rudd, A. (2008). Guidelines: Diagnosis and initial management of acute stroke and transient ischaemic attack: Summary of NICE guidance. *BMJ: British Medical Journal*, *337*(7664), 291-293.

Tatemichi, T. K., Desmond, D. W., Stern, Y., Paik, M., Sano, M., & Bagiella, E. (1994). Cognitive impairment after stroke: frequency, patterns, and relationship to functional abilities. *Journal of Neurology, Neurosurgery & Psychiatry*, *57*(2), 202-207.

Tatemichi, T. K., Desmond, D. W., Stern, Y., Paik, M., Sano, M., & Bagiella, E. (1994). Cognitive impairment after stroke: frequency, patterns, and relationship to functional abilities. *Journal of Neurology, Neurosurgery & Psychiatry*, *57*(2), 202-207.

Tatemichi, T. K., Paik, M., Bagiella, E., Desmond, D. W., Pirro, M., & Hanzawa, L. K. (1994). Dementia after stroke is a predictor of long-term survival. *Stroke*, *25*(10), 1915-1919.

Tax, C., Steenbergen, M. E., Zusterzeel, P. L., Bekkers, R. L., & Rovers, M. M. (2017). Measuring health-related quality of life in cervical cancer patients: a systematic review of the most used questionnaires and their validity. *BMC medical research methodology*, *17*(1), 15.

Teasdale, G., & Jennett, B. (1974). Assessment of coma and impaired consciousness: a practical scale. The Lancet, 304(7872), 81-84.

Teng, E. L., & Manly, J. J. (2005). Neuropsychological testing: helpful or harmful?. *Alzheimer Disease & Associated Disorders*, *19*(4), 267-271.

Teng, E. L., & Manly, J. J. (2005). Neuropsychological testing: helpful or harmful?. *Alzheimer Disease & Associated Disorders*, *19*(4), 267-271.

The World Bank: Education Statistics: UNESCO Institute for Statistics (World Bank Edstats, 2014).

Timmerman, M., Voncken, L., & Albers, C. (2019). A tutorial on regression-based norming of psychological tests with GAMLSS.

Tombaugh, T. N. (2004). Trail Making Test A and B: normative data stratified by age and education. *Archives of clinical neuropsychology*, *19*(2), 203-214.

Tombaugh, T. N., & McIntyre, N. J. (1992). The mini-mental state examination: a comprehensive review. *Journal of the American Geriatrics Society*, *40*(9), 922-935.

Tongco, M. D. C. (2007). Purposive sampling as a tool for informant selection. *Ethnobotany Research and applications*, *5*, 147-158.

Tu, Q., Ding, B., Yang, X., Bai, S., Tu, J., Liu, X., ... & Tang, X. (2014). The current situation on vascular cognitive impairment after ischemic stroke in Changsha. *Archives of gerontology and geriatrics*, *58*(2), 236-247.

UNESCO, Education for All Global Monitoring Report 2013/14: Teaching and Learning – Achieving Quality for All*,* UNESCO, Paris, 2014.

Uyttenboogaart, M., Stewart, R. E., Vroomen, P. C., De Keyser, J., & Luijckx, G. J. (2005). Optimizing cutoff scores for the Barthel index and the modified Rankin scale for defining outcome in acute stroke trials. *Stroke*, *36*(9), 1984-1987.

U.S. Army: Army Individual Test Battery, 1944: Manual of Directions and Scoring. Washington, DC, War Department, Adjutant General’s Office, 1944

Van den Broeck, J., Cunningham, S. A., Eeckels, R., & Herbst, K. (2005). Data cleaning: detecting, diagnosing, and editing data abnormalities. *PLoS medicine*, *2*(10).

Van de Vijver, F. J., & Tanzer, N. K. (1997). Bias and equivalence in cross-cultural assessment: An overview. *European review of applied psychology*, *47*, 263-279.

Van Den Berg, E., Nys, G., Brands, A., Ruis, C., Van Zandvoort, M. J., &Kessels, R. P. (2009). The Brixton Spatial Anticipation Test as a test for executive function: validity in patient groups and norms for older adults. Journal of the International Neuropsychological Society, 15(05), 695-703.

Van Der Elst, W. I. M., Van Boxtel, M. P., Van Breukelen, G. J., &Jolles, J. (2005). Rey's verbal learning test: normative data for 1855 healthy participants aged 24–81 years and the influence of age, sex, education, and mode of presentation. Journal of the International Neuropsychological Society, 11(03), 290-302.

Van Kampen, D. A., Lovell, M. R., Pardini, J. E., Collins, M. W., & Fu, F. H. (2006). The “value added” of neurocognitive testing after sports-related concussion. *The American journal of sports medicine*, *34*(10), 1630-1635.

Van Kampen, D. A., Lovell, M. R., Pardini, J. E., Collins, M. W., & Fu, F. H. (2006). The “value added” of neurocognitive testing after sports-related concussion. *The American journal of sports medicine*, *34*(10), 1630-1635.

van Rooij, F. G., Schaapsmeerders, P., Maaijwee, N. A., van Duijnhoven, D. A., de Leeuw, F. E., Kessels, R. P., & van Dijk, E. J. (2014). Persistent cognitive impairment after transient ischemic attack. *Stroke*, *45*(8), 2270-2274.

Van Widenfelt, B. M., Treffers, P. D., De Beurs, E., Siebelink, B. M., & Koudijs, E. (2005). Translation and cross-cultural adaptation of assessment instruments used in psychological research with children and families. *Clinical child and family psychology review*, *8*(2), 135-147.

van der Velde, J. L., Blanker, M. H., Stegmann, M. E., de Bock, G. H., Berger, M. Y., & Berendsen, A. J. (2017). A systematic review of the psychological impact of false-positive colorectal cancer screening: What is the role of the general practitioner?. *European journal of cancer care*, *26*(3), e12709.

Veerbeek, J. M., Kwakkel, G., van Wegen, E. E., Ket, J. C., & Heymans, M. W. (2011). Early Prediction of Outcome of Activities of Daily Living After Stroke A Systematic Review. *Stroke*, *42*(5), 1482-1488.

Verhaeghen, P., & Cerella, J. (2002). Aging, executive control, and attention: a review of meta-analyses. *Neuroscience & Biobehavioral Reviews*, *26*(7), 849-857.

Verhey, R., Chibanda, D., Gibson, L., Brakarsh, J., & Seedat, S. (2018). Validation of the posttraumatic stress disorder checklist–5 (PCL-5) in a primary care population with high HIV prevalence in Zimbabwe. *BMC psychiatry*, *18*(1), 109.

Vet HCW, Mokkink LBB. COSMIN methodology for evaluating the content validity

Vijayaraghavan, L., Krishnamoorthy, E. S., Brown, R. G., & Trimble, M. R. (2002). Abulia: a delphi survey of British neurologists and psychiatrists. *Movement Disorders*, *17*(5), 1052- 1057. doi. 10.1002/mds.10194.

Viscogliosi, C., Desrosiers, J., Belleville, S., Caron, C. D., Ska, B., & BRAD Group. (2011). Differences in participation according to specific cognitive deficits following a stroke. *Applied Neuropsychology*, *18*(2), 117-126.

Vordenberg, J. A., Barrett, J. J., Doninger, N. A., Contardo, C. P., & Ozoude, K. A. (2014). Application of the Brixton spatial anticipation test in stroke: ecological validity and performance characteristics. *The Clinical Neuropsychologist*, *28*(2), 300-316.

Washida, K., Kowa, H., Hamaguchi, H., Kanda, F., & Toda, T. (2017). Validation of the R2CHADS2 and CHADS2 scores for predicting post-stroke cognitive impairment. *Internal Medicine*, *56*(20), 2719-2725.

Wechsler, D. (2008). Wechsler adult intelligence scale–Fourth Edition (WAIS–IV). *San Antonio, TX: NCS Pearson*, *22*, 498.

Weinstein, G., Preis, S. R., Beiser, A. S., Au, R., Kelly-Hayes, M., Kase, C. S., ... & Seshadri, S. (2014). Cognitive performance after stroke–The F ramingham H eart S tudy. *International Journal of Stroke*, *9*, 48-54.

Weir, J. P. (2005). Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. *The Journal of Strength & Conditioning Research*, *19*(1), 231-240.

Weschler, D. (1997). Wechsler adult intelligent scale III. *San Antonio: The Psychological Corporation*.

Wijedasa, D. (2012). Developmental screening in context: adaptation and standardization of the Denver Developmental Screening Test-II (DDST-II) for Sri Lankan children. *Child: care, health and development*, *38*(6), 889-899.

Wijedasa, D. (2012). Developmental screening in context: adaptation and standardization of the Denver Developmental Screening Test-II (DDST-II) for Sri Lankan children. Child Care Health and Development, 38, 889–99. doi:10.1111/j.1365-2214.2011.01332.x

Willis, G. B. (2004). *Cognitive interviewing: A tool for improving questionnaire design*. Sage Publications.

Wilson, B., Cockburn, J., & Halligan, P. (1987). Development of a behavioural test of visuospatial neglect. *Archives of physical medicine and rehabilitation*, *68*(2), 98-102.

Witter, S., Chirwa, Y., Chandiwana, P., Munyati, S., Pepukai, M., & Bertone, M. P. (2019). The political economy of results-based financing: the experience of the health system in Zimbabwe. *Global health research and policy*, *4*(1), 20.

Wong, A., Xiong, Y. Y., Wang, D., Lin, S., Chu, W. W., Kwan, P. W., ... & Mok, V. (2012). The NINDS-Canadian stroke network vascular cognitive impairment neuropsychology protocols in Chinese. *J Neurol Neurosurg Psychiatry*, jnnp-2012.

Wong, G. K. C., Lam, S. W., Wong, A., Mok, V., Siu, D., Ngai, K., & Poon, W. S. (2014). Early MoCA-assessed cognitive impairment after aneurysmal subarachnoid hemorrhage and relationship to 1-year functional outcome. *Translational stroke research*, *5*(2), 286-291.

Wood, J. J., Piacentini, J. C., Bergman, R. L., McCracken, J., & Barrios, V. (2002). Convergence validity of the anxiety disorders section of the Anxiety Disorders Interview Schedule for DSM-IV: Child and Parent Versions. *Journal of Clinical Child and Adolescent Psychology*, *31*(3), 335-342.

Woodford, H. J., & George, J. (2007). Cognitive assessment in the elderly: a review of clinical methods. *QJM: An International Journal of Medicine*, *100*(8), 469-484.

World Bank Country and Lending Groups. 2017; https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups. Accessed 23 April, 2017.

World Health Organization, & World Health Organization. Management of Substance Abuse Unit. (2014). *Global status report on alcohol and health, 2014*. World Health Organization.

heatWu, A. J., Burgard, E., & Radel, J. (2014). Inpatient rehabilitation outcomes of patients with apraxia after stroke. *Topics in stroke rehabilitation*, *21*(3), 211-219.

Wyrwich, K. W., Bullinger, M., Aaronson, N., Hays, R. D., Patrick, D. L., & Symonds, T. (2005). Estimating clinically significant differences in quality of life outcomes. *Quality of Life Research*, *14*(2), 285-295.

Yang, L., Unverzagt, F. W., Jin, Y., Hendrie, H. C., Liang, C., Hall, K. S., & Gao, S. (2012). Normative data for neuropsychological tests in a rural elderly Chinese cohort. The Clinical Neuropsychologist, 26(4), 641-653.

Zalonis, I., Christidi, F., Bonakis, A., Kararizou, E., Triantafyllou, N. I., Paraskevas, G., & Vasilopoulos, D. (2009). The Stroop effect in Greek healthy population: Normative data for the Stroop neuropsychological screening test. Archives of clinical neuropsychology.

Zhang, H., Zhang, X. N., Zhang, H. L., Huang, L., Chi, Q. Q., Zhang, X., & Yun, X. P. (2016). Differences in cognitive profiles between traumatic brain injury and stroke: a comparison of the Montreal Cognitive Assessment and Mini-Mental State Examination. *Chinese journal of traumatology*, *19*(5), 271-274.

Zhou, A., & Jia, J. (2009). A screen for cognitive assessments for patients with vascular cognitive impairment no dementia. International Journal of Geriatric Psychiatry, 24, 1352–1357.

Zimstat. (2015). Compendium of Statistics 2014.

Zivin, K., Paczkowski, M., & Galea, S. (2011). Economic downturns and population mental health: research findings, gaps, challenges and priorities. *Psychological medicine*, *41*(7), 1343-1348.

Zuo, L., Dong, Y., Zhu, R., Jin, Z., Li, Z., Wang, Y., ... & Wang, Y. (2016). Screening for cognitive impairment with the Montreal Cognitive Assessment in Chinese patients with acute mild stroke and transient ischaemic attack: a validation study. *BMJ open*, *6*(7), e011310.

Appendices

Appendix A

Data Extraction Codebook

Author, year & country	**Summary of objectives**	**Type of study**	**Ages Education No.of participants Controls**	**Sample characteristics**	**Translation/adaptation/norming**	**Instruments used and domains assessed**	**Psychometric properties of cognitive tool**	**Summary of findings**
1. Aharon-Peretz et al. (2002) Israel	To evaluate the rate of cognitive and behavioral changes in patients with probable VaD-L.	Cohort study	N=77 Ages: 65.9 SD 8.1 Edn: not stated	Pts. with vascular dementia following lacunar infarcts. Not clear when baseline test was done.	Not mentioned	**MMSE**: memory, orientation in place and time, naming, reading, visuospatial, writing and the ability to follow a 3-stage command, Wechsler Memory Test—Revised (Digit Span and Logical Memory subscales): Controlled Oral Word Association Test, Category Fluency of the sCERAD battery	None mentioned	The rate of cognitive and behavioral deterioration was determined by the severity of cognitive behavioral impairment

Appendix B

Authors List

Number	**Author**	**Country**	**Age**	**Sample Size**	**Stroke Patient**	**Post Stroke Period**	**Location**	**Study design**	**ETHICS**
1	Abou El-Ella et al., (2013)	Egypt	50.5	150	150		Outpatients	Cross sectional	No
2	Akbari et al., (2013)	Iran	50	27	27	1-6 Months	Rehabilitation centre	Cross sectional	Yes
3	Akinyemi et al., (2014)	Nigeria	60.4	217	143	3 Months	Hospital, Community	Case control	Yes
4	Akinyemi et al., (2015)	Nigeria	60.1	217	143	3 Months	Community	Cross-Sectional	Yes
5	Azad et al., (2017)	Iran	61	87	87	1-30 days	Community	Methodological Study	Yes
6	Bindawas et al., (2018)	Saudi Arabia	18	409	409	31-90 days	Rehabilitation Service	Cohort	Yes
7	Bonini and Radanovic (2015)	Brazil	›18	466	47	2 months +	Outpatient Service	Case control	Yes
8	Campanholo et al., (2015)	Brazil	66.5	55	28	6 months	Community	Case control	Yes
9	Cardoso et al. (2015)	Brazil	58.5	99	99	19-23 months		Cross sectional	Yes
10	Carod et al. (2009a)	Brazil	56.3	300	300		Clinic	Cross-Sectional	Yes
11	Carod et al. (2009b)	Brazil	55.9	260	260	Mean time 20.7 month	Outpatient Clinic	Cross Sectional	Yes
12	Chaiyawat and Kulkantrakorn (2012)	Thailand	67	60	30	6 month	Home Rehabillitation Program / Standard Care (Controls)	Randomised Control Trail	Yes

13	Chen et al. (2015a)	China	62.9	89	89	3 months	Community & Telephone Based Cognitive Test	Cross-sectional	Yes
14	Chen et al., (2015b)	China	62.9	100	50	3 Months	Out Patient Clinic & Community	Case control	Yes
15	Custudio et al., (2017)	Peru	69.12	152	152	30 days	Clinic. Out-patient Setting	Cohort	Yes
16	Das et al., (2013)	India	62.1	281	281	1-5 years	Community	Cohort	Yes
17	de Oliveira et al., (2015)	Brazil	56.48	100	100		Community	Cross-sectional	Yes
18	El-Han et al., (2005)	Turkey	57.9	207	105	152 days	Medical School of Ankara University	Cross sectional	No
19	Ersoz et al., (2017)	Turkey	64.7	143 (16)	85	3+ month	Outpatient Clinic of training hospital	Cross-Sectional	Yes
20	Farhana et al., (2015)	Indonesia	60.27	48	48		Hospital, Out-patient clinic	Quasi-Experimental	Yes
21	Fatoye et al., (2009)	Nigeria	59.6	236	118	1 month-2 years	Hospital-Out- patient	Case control	Yes
22	Ferreira et al., (2015)	Brazil	59.96	45	45	6-10 months	Out-patient Clinic	Cross-Sectional	Yes
23	Gao et al., (2013)	China	33.39	529	26		Hospital	Case control	Yes
24	Gao et al., (2017)	China	67.2	274 (90)	274	After stroke 3-6 months 6-9 months	Outpatient Clinic	Randomised Control Trial	Yes
25	Ghousal et al., (2014)	India	64.27	283	283	6 months plus	Community	Cohort	Yes

26	Heikinheimo et al., (2015)	Malawi	54	81	81	6-8 weeks/ 6 Months / 12 months	Hospital	Cohort	Yes
27	Holderbaum et al., (2016)	Brazil	57.9	17	17	6/ 12 Month	Hospital	Case Series	Yes
28	Howitt et al., (2011)	Tanzania		58	58	1-5 years	Community	Cohort	Yes
29	Hua et al., (2014)	China	67.4	177	177	7 days	Laboratory, community	Cross Sectional	Yes
30	Jiang et al., (2013)	China	63	152	48	≤ 3 months	Hospital	Case-Control	Yes
31	Jiang B et al., (2014)	China	50	231	80	6 months	Out-patient and Hospital	Case-control	Yes
32	Jiang X et al., (2014)	China	67.2	329	329	2-6 weeks	Hospital	Case-control	Yes
33	Kongkasuwan et al., (2015)	Thailand	56.5	118	118		In-patient setting	Randomised Controlled Trial	Yes
34	Kumral & Zirek, (2016)	Turkey	73	7200	7200			Cross-sectional	Yes
35	Kumral et al., (1999)	Turkey	62	3050	3050	3050	Hospital	Cross-sectional	No
36	Kumral et al., (2015)	Turkey	63					Cross sectional	Yes
36	Kumral et al., (2015)	Turkey	63	6800	6800	Hospital		Cross sectional	Yes
38	Liu et al., (2014)	China	55	38	18	≥6 months	University	Experimental	Yes
39	Mehrabi et al., (2015)	Bulgaria	65	110	85		University Hospital	Cohort	Yes

40	Ojagbemi & Owolabi, (2013)	Nigeria	59.77	128	128	3 months to 2 years	Hospital	Cross sectional	Yes
41	Ojagbemi et al., (2017)	Nigeria	60.9	101	101		Hospital	Cohort	Yes
42	Pagiarian et al., (2014)	Brazil		104	104		Hospitals, Clinics, Community	Case control	Yes
43	Pan et al., (2015)	China	≥50	231	98	≤ 2 weeks	Hospital	Cross-sectional	Yes
44	Qu et al., 2014	China	67.91	599	599		Community	Cross-Sectional	Yes
45	Sahathevan et al., 2014	Malaysia	57.2	40	40		Medical Centre	Cross-sectional	Yes
46	Sarfo et al., (2017)	Ghana	59.9	196	147	≥ 3 months	Clinic	Cross-Sectional	Yes
47	Shen et al., (2016)	China	53-89	105	105	≤ 2weeks	Hospital, Laboratory	Cross-Sectional	No
48	Shi et al., (2015)	China	61.14	757 1095 (PRIOD Study)	757		Hospital, Community	Cross-Sectional	Yes
49	Sobreiri et al, 2014	Brazil	50.7	343	87	≤ 2 weeks	Hospital	Cross-Sectional	Yes
50	Song et al., (2014)	China	73.1	105	95	3-5 hours		Cross-Sectional	Yes
51	Tu et al., 2013	China	68.6	689	689	≥ 3 months	Community	Cross-Sectional	No

52	Vincentini et al., (2016)	Brazil	63.8 (45-80)	68	34	24 days, 26 days (mean PSDA group PScon)		Cross-Sectional	Yes
53	Yang et al., (2017)	China	61.9	1418	1418	≤ 14 days. Follow up 1 year		Cohort	Yes
54	Zhou & Jia, (2009)	China	65.85	160	160	3 months		Cohort	Yes

Appendix C1

Screening Questionnaire

Neurocognitive Screening Following Acquired Brain Injury: Norming and validating the Birmingham Cognitive Screen in Zimbabwe (BCoS-Zim)

You are invited to take part in a neurological study. Kindly provide the information asked below as accurately as possible. Feel free to ask the researcher for any additional information.

Use of substances (recreational drugs)

Do you use recreational drugs (e.g. alcohol, cannabis?......If yes: Substance type.................Quantity per week….

Medical History

Are you on medical treatment? If yes: Type of medication..

If you have or have suffered from any of the following illnesses, please tick where applicable:

History of Condition/illness	**YES**	**NO**	**Date when it occurred**
Head injury			
Stroke			
Dependence on ADLs			
Memory/thinking problems			
Colour blindness			
Language, speech or behaviour disorders			
Hearing impairment			
Visual impairment			
Alzheimer’s			
Dementia			
Schizophrenia			
Epilepsy			
Encephalitis			
Parkinson’s Disease			

Huntington’s Disease			
Motor Neuron Disease			
Asperger Syndrome			
Meningitis			
Tumours (If yes, where? ____________________)			
Unconsciousness for more than 10 minutes			

If meeting criteria, proceed to fill in locator form.

Appendix C2

Socio-demographic Questionnaire

Participant ID #: ZW________ Date of application of the protocol: ___/___/___

Date of Birth: ___/___/___ Age: ____ Sex: Male___ Female___

Highest level of education: __________ Number of years of education: _____

Laterality: Right handed___ Left handed___ Ambidextrous___

Residence Area: Rural ___ Urban___

Race: Black___ Coloured___ Indian___ White___ Other (List) ________________

Knows how to read: Yes___ No___ Knows how to write: Yes___ No__

Bilingual (do you speak more than 1 language?): Yes___ No___

Occupation: ____

What is your current work situation? *(Multiple choices)*

Full-time permanent employment ___ Fixed part-time employment _________%

Student___ Unemployed ___

Retired___ Illness or disability pension ____

Housewife ___ Other: ___________________________

What is your current marital status?

Single ___ Married ___ Separated___ Divorced ____ Widower ___ Other (List):____

Do you consume (drink) alcohol?

If yes**, what is your CURRENT alcohol consumption?** *(Multiple choices)*

Almost never or never ___ Once or twice a week ___

3-5 times during the week ___ Every day___

The house in which you live is:

Own _____ Rent _____ Family housing _____

Your monthly income is: USD$ ________

Are you taking medication?

If yes, **are they prescribed by the doctor?** Please indicate the name of the medication or medications and their current frequency:

a) Name of the medication:____________________________________
(Frequency: [ ] Weekly; [ ] Monthly; [ ] Annually)

b) Name of the medication:____________________________________
(Frequency: [ ] Weekly; [ ] Monthly; [ ] Annually)

In general, would you say that your health is: *(Multiple choices)*

Excellent_ Very good__ Good__ Regular__ Bad__

Thank you very much for your cooperation!

Appendix D

Consent Form English

Neuro Psychiatry of Apathy, Norming the Birmingham Cognitive Screen (BCoS) In Zimbabwe (BCoS-Zim)

Phase One- Formative Research- Adaptation Interviews

Version 1.0, Dated 04 December 2015

English

PRINCIPAL INVESTIGATOR:	Phone and Address:
Debra Machando	+263712780355, 157 Borrowdale Road, Gunhill, Harare Email: ddmachando@gmail.com

INTRODUCTION:

You are being asked to take part in the research study named above. The Principal Investigator in charge of the study at this site is Debra Machando.

You should only participate if you want to; choosing not to take part will not disadvantage you in any way. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please feel free to ask us if there is anything that is not clear or if you would like more information. Once you understand the study, and if you agree to take part, you will be asked to sign this consent form or make your mark in front of someone. You will be offered a copy to keep.

Please note that:

- Your participation in this research is entirely voluntary;
- You may decide not to participate or to withdraw from the study at any time.
- If you decide not to participate in this study, you can still join another research study later, if one is available and you qualify.

PURPOSE OF THE STUDY:

The purpose of the BCoS is to detect whether there are any problems in language, memory, action planning and handling numbers in psychiatric patients and in those with acquired brain injury. The detection of any problem is the first step towards trying to do something about it. You were selected as a possible participant in this study because you can provide useful information towards this whether you have brain injury or not.

STUDY PROCEDURES:

If you decide to participate, you will go through a short series of paper-and-pencil assessment tests that will measure your language, memory, sight, planning of action and your ability to handle numbers. The tests last about two hours.

A follow up assessment, using similar paper-and-pencil tasks as before, may be performed after six weeks from the first interview.

POTENTIAL RISKS /BENEFITS:

There may be no other direct benefits to you by participating in this study though we believe this study will benefit the medical community as a whole by increasing knowledge about recovery after stroke.

You will not be subjected to any risk in this study. If you find any question posed by the interviewer is sensitive you can decline responding to that question. You will not be compelled to answer all the questions.

REIMBURSEMENT:

To thank you for taking part you will be given refreshments during the interview and your transport costs using public transport will be reimbursed at the rate of $3.

CONFIDENTIALITY:

Your identity will be secured by assigning you a number before the test and only using that number through the record keeping.

ALTERNATIVES TO PARTICIPATION:

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this form to keep and be asked to sign a consent form. If you decide to take part you are still free to not answer any question that you are not comfortable with at any point in the interview and you can withdraw at any time without giving a reason. Please note that you will not be compensated for your time in participation of this study when you withdraw

PERSONS TO CONTACT FOR PROBLEMS OR QUESTIONS:

If this study has harmed you in any way or if you have any problem or doubt about this study you may clarify from the interviewer or directly contact Debra Machando, Telephone +263712780355 or If you ever have questions about your rights as a research participant you may call the Medical Research Council of Zimbabwe, at 04 791792 or 0712 433 164-7 (offices located corner Tongogara/Mazoe Street in Harare).

NOTE: You are not giving up any of your legal rights by signing this informed consent document.

SIGNATURE PAGE

Neuro Psychiatry of Apathy, Norming the Birmingham Cognitive Screen (BCoS) In Zimbabwe (BCoS-Zim)

Phase One- Formative Research- Adaptation Interviews

Version 1.0, Dated 04 December 2015

English

STATEMENT OF CONSENT

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

- **I understand that if I decide at any time during the research that I no longer wish to participate in this project, I can notify the researchers involved and withdraw from it immediately without giving any reason. Furthermore, I understand that I will be able to withdraw my data up within two weeks of the interview date.**
- **I have read the informed consent or had it read and explained to me. I understand the information and I voluntarily agree to join this study.**
- **This page of the Informed Consent Form is stamped by the Medical Research Council of Zimbabwe to indicate it has been approved by the MRCZ**

- **Participant's Statement:**

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research

Name Signature Date & Time

If illiterate [1]

Witness Statement:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

________________________ __________________________________ __________________

Witness Name Signature Date & Time

Statement of study staff obtaining consent:

I ____

---

[1] **A literate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team).**

Confirm that I have carefully explained the nature, demands and any foreseeable risks (where applicable) of the proposed research to the participant. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

Signed: ________________________________ **Date & Time** __________________________

Consent Form Shona

INFORMED CONSENT FOR HEALTH PARTICIPANTS

Neuro Psychiatry of Apathy, Norming the Birmingham Cognitive Screen (BCoS) In Zimbabwe (BCoS-Zim)

Phase One- Formative Research- Adaptation Interviews

Version 1.0, Dated 04 December 2015

Shona

PRINCIPAL INVESTIGATOR:	Phone and Address:
Debra Machando	+263712780355, 157 Borrowdale Road, Gunhill, Harare Email: ddmachando@gmail.com

NHANGANYAYA

Muri kukumbirwa kuti mupinde muongororo yataurwa pamusoro apa. Muongorori mukuru ari kuona nezveongororo iyi muno ndi Debra Machando.

Munongopinda mutsvakurudzo kana muchida. Kusarudza kusapinda hakukukanganisiyi chero mune ipi nzira. Musati masarudza kuti munoda kupinda, zvakakosha kuti munzwisise kuti sei tsvakurudzo iri kuitwa uye kuti kuve kwenyumo zvinorevei. Ndapota inzwai makasununguka kubvunza kana paine pamusina kunzwisisa uye kana muchida imwe tsanangudzo. Kana manzwisisa tsvakurudzo, uye muchibvuma kupinda, muchakumbirwa kuti musaine gwaro retenderano iri kana kuisa mufananidzo pamberi peumwe munhu. Muchapihwa gwaro rakafanana neiri rekuchengeta.

Ndapota zivai kuti:

- Kuve kwenyu mutsvakurudzo ino kuzvipira kwenyu kuzere;

- Munogona kusarudza kusapinda kana kubuda mutsvakurudzo chero nguva.
- Kana masarudza kusapinda mutsvakurudzo ino, munogona kupinda muneimwe tsvakurudzo inotevera kana iripo uye muchikodzera.

CHINANGWA CHTSVAKURUDZO:

Chinangwa chetsvakiridzo iyi ndechekuongorora kuti pane dambudziko here pamutauro, ndangaririo, kuronga uye kushanda nenhamba pane vanorwara nezvirwere zvepfungwa uye vakakuwara musoro. Kugona kuona kana pane chisiri kuita zvakanaka ndiro gwara rekutanga pakugadzirisa kana munhu achinge akuvara musoro. Masarudzwa kuti muve mutsvakurudzo semuongororwi nekuti munotipa zivo inobatsira nyangwe musina kana kuti makakuvara musoro.

ZVICHAITWA:

Makabvuma kupinda mutsakurudzo, muchaita bvunzo muchishandisa mapepa nepenzura, bvunzo inoongorora mutauro, ndangaririo, kuronga uye kushanda nenhamba. Bvunzo iyi inotora nguva inosvika maawa maviri. Mungangokumbirwa kudzoka mushure memavhiki matanhatu kuzotora bvunzo zvakare muchishandisa mapepa nepunzura.

NJODZI DZINOGONA KUVAPO / PUNDUTSO:

Panogona kunge pasina pundutso yakanangana nemi pakuva kwenyu mutsvakurudzo iyi kunyange tichitenda kuti tsvakurudzo iyi ichabatsira vemunharaunda nanachiremba mukuwedzera ruzivo maererano nekurapwa mushure me stroke. Hamusopindi mune chero ipi njodzi mutsvakurudzo iyi. Kana maona kuti chero mubvunzo wabvunzwa nemubvunzi wakavanzika munogona kuramba kupindura mubvunzo iwoyo. Hamuzomanikidzwi kupindura mibvunzo yese.

MARI YAMUNODZORERWA:

Kukutendai nekuve kwenyu mutsvagurudzo, muchapiwa zvinwiwa pamunenge muchiita hurukuro nemari yenyu yamashandisa pakufamba inoita madhora matatu ($3).

ZVAKAVANZIKA:

Zita renyu richachengetedzwa nekupiwa nhamba musati masangana uye kushandisa nhamba iyoyo chete pazvinyorwa zvese.

SARUDZO YEKUPINDA:

Zviri kwamuri kupinda kana kusapinda. Kana masarudza kupinda muchapiwa gwaro iri kuti murichengete mokumbirwa kusaina gwaro retenderano. Kana masarudza kupinda makasununguka kusapindura mimwe mibvunzo yamunenge musina kusununguka kupindura pane ipi nguva zvayo muhurukuro uyezve munogona kubuda chero pane ipi nguva musingapi tsananguro. Cherechedzayi kuti hamuzo pihwi muripo panguva yenyu kana muchinge mabuda muchirongwa..

VANHU VEKUBATA KANA MUNE MATAMBUDZIKO KANA MIBVUNZO:

Kana tsvakurudzo ino yakukanganisai nenzira ipi zvayo kana kuti kana muine dambudziko kana kukahadzika netsvakurudzo ino munogona kuwana mhinduro kubva kumubvunzi kana munogona kubata Debra Machando, nhamba dzerunhare +263712780355 kana mukazova nemibvunzo maererano nekodzero dzenyu semuongororwi munokwanisa kufonera veKanzuru yeongororo yeutano mu Zimbabwe (MRCZ) parunhare, 04 791792 kana +263 712 433164 -7 (mahofisi anowanikwa panosangana nzira Tongogara/Mazoe Street muHarare).

NDAPOTA:

Hamusi kurasikirwa nekodzero yenyu yemitemo nekusaina gwaro retendereno iri

PEJI YESAINECHA

Neuro Psychiatry of Apathy, Norming the Birmingham Cognitive Screen (BCoS) In Zimbabwe (BCoS-Zim)

Phase One- Formative Research- Adaptation Interviews

Version 1.0, Dated 02 December 2015

Shona

MASHOKO ECHIBVUMIRANO

Tinokutendai nechido chenyu chekuva mutsvagiridzo ino. Mutsvagiridzi arikutungamirira hurukuro dzemuchirongwa ichochi anofanira kunyatsokutsanangurirai nezvetsvagiridzo iyoyi musati mapinda mairi. Kana muine mibvunzo kubva pagwaro rino kana pane zvatsanangurwa, ndapota bvunzai mutsvakurudzi musati masarudza kupinda. Muchapiwa gwaro rakafanana neiri rekuchengeta

nekuzorishandisa pamungadira.

- **Ndinonzwisisa kuti kana ndikasarudza chero nguva kuti handichadi kuve mutsvakurudzo, ndinogona kuudza vaongorori ndobuda chiriporipocho ndisina tsanangudzo yandinopa.**

- **Ndaverenga gwaro retenderano kana ndaverengerwa zvikatsanangurwa kwandiri. Ndazwisisa zvinyorwa uye ndinobvuma ndega kupinda mutsvakurudzo iyi.**

- **Peji ino yegwaro ine chitambi che Medical Research Council of Zimbabwe kutaridza kuti zvkakatenderwa neve MRCZ**

Participant's Statement:

Ndaverenga gwaro retenderano kana ndaverengerwa zvikatsanangurwa kwandiri zvizere. Ndinobvuma ndega kupinda mutsvakiridzo iyi.

_________________________ ___________________________________ ___________________

Zita **Sainecha** **Zuva nenguva**

***If illiterate* [2]**

Witness Statement:

---

[2] A literate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team).

Ndaita chapupu pakuverengwa kwegwaro retenderano, mutsvakirudzwi awana mukana wekubvunza mubvunzo. Mutsvakurudzwi abvuma ega kupinda mutsvakiridzo.

__________________________ ____________________________________ ___________________

Zita **Sainecha** **Zuva nenguva**

Statement of study staff obtaining consent:

I ____

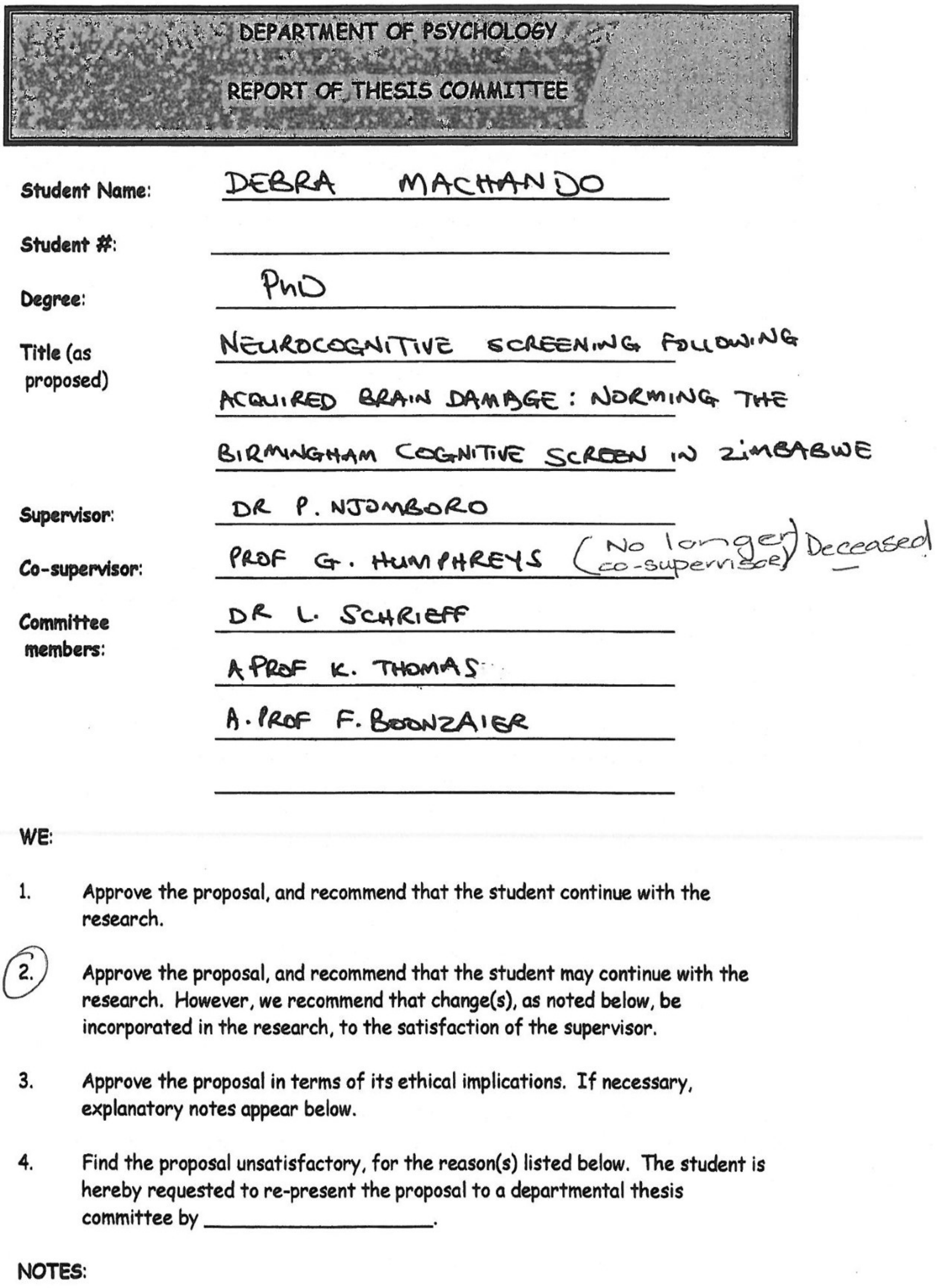
Confirm that I have carefully explained the nature, demands and any foreseeable risks (where applicable) of the proposed research to the participant. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

Signed: ______________________________________ Date & Time ______________________________

Appendix E

Ethics Clearance



DEPARTMENT OF PSYCHOLOGY

REPORT OF THESIS COMMITTEE

Student Name: DEBRA MACHANDO

Student #: ____________

Degree: PhD

Title (as proposed) NEUROCOGNITIVE SCREENING FOLLOWING ACQUIRED BRAIN DAMAGE: NORMING THE BIRMINGHAM COGNITIVE SCREEN IN ZIMBABWE

Supervisor: DR P. NJOMBORO

Co-supervisor: PROF G. HUMPHREYS (No longer co-supervisor) Deceased

Committee members:
DR L. SCHRIEFF
A PROF K. THOMAS
A. PROF F. BOONZAIER

WE:

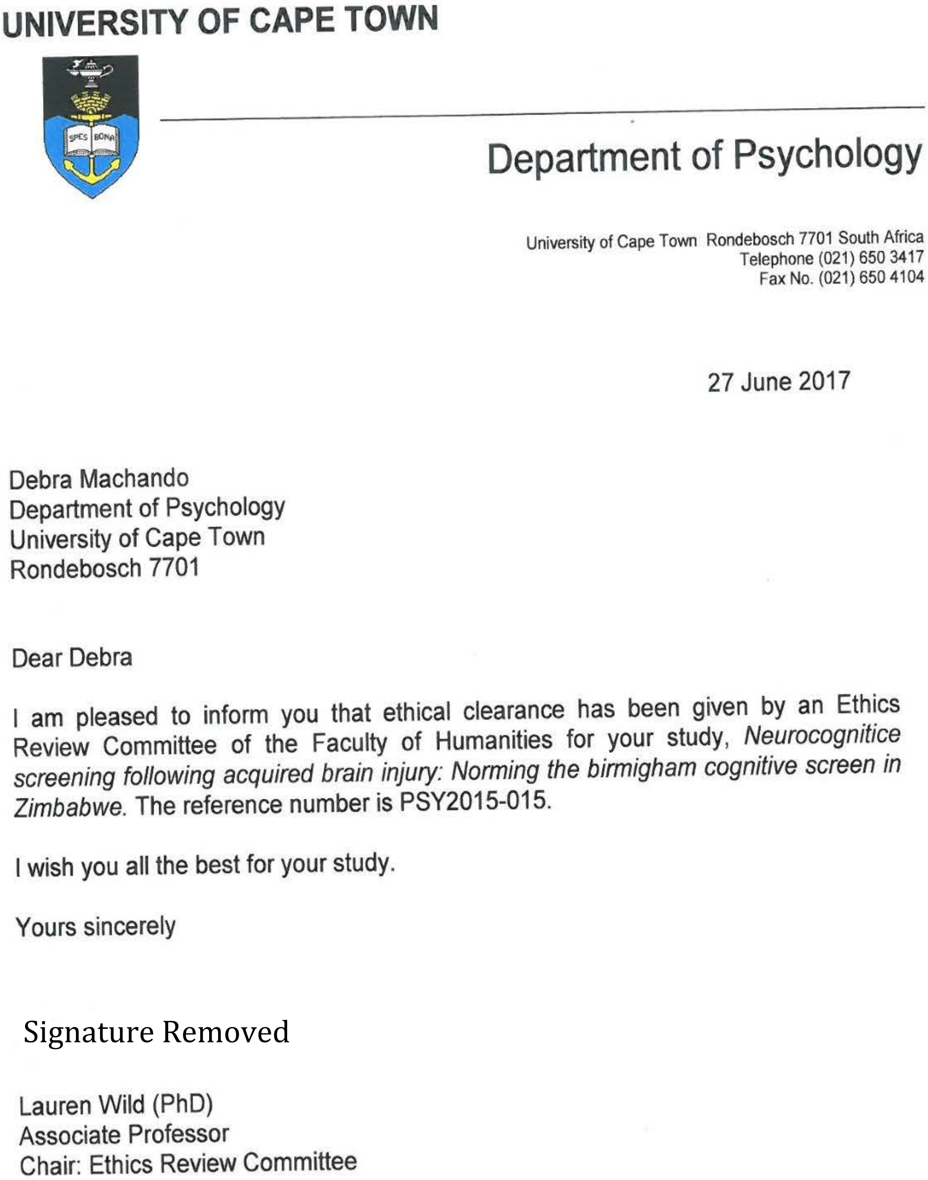
1. Approve the proposal, and recommend that the student continue with the research.

[✓ 2.] Approve the proposal, and recommend that the student may continue with the research. However, we recommend that change(s), as noted below, be incorporated in the research, to the satisfaction of the supervisor.

3. Approve the proposal in terms of its ethical implications. If necessary, explanatory notes appear below.

4. Find the proposal unsatisfactory, for the reason(s) listed below. The student is hereby requested to re-present the proposal to a departmental thesis committee by ____________.

NOTES:



UNIVERSITY OF CAPE TOWN

Department of Psychology

University of Cape Town Rondebosch 7701 South Africa
Telephone (021) 650 3417
Fax No. (021) 650 4104

27 June 2017

Debra Machando
Department of Psychology
University of Cape Town
Rondebosch 7701

Dear Debra

I am pleased to inform you that ethical clearance has been given by an Ethics Review Committee of the Faculty of Humanities for your study, *Neurocognitice screening following acquired brain injury: Norming the birmigham cognitive screen in Zimbabwe.* The reference number is PSY2015-015.

I wish you all the best for your study.

Yours sincerely

Signature Removed

Lauren Wild (PhD)
Associate Professor
Chair: Ethics Review Committee

UNIVERSITY OF CAPE TOWN

DC: HUM /

FACULTY OF HUMANITIES

PROPOSAL APPROVAL FORM

DOCTORATE (A research proposal must accompany this form)	**RESEARCH MASTERS** (A research proposal must accompany this form)	**C/W MASTERS**

SECTION A: (To be completed by candidate)

Please complete this form and return it to the Faculty Office once you have obtained the signatures of the supervisor(s), departmental ethics representative (if relevant) and Head of Department.

Surname	MACHANDO	**First Name(s)**	DEBRA
Title	**Mrs.**	**Student No**	MCHDEB 001
Address	157 BORROWDALE ROAD, GUNHILL, HARARE , ZIMBABWE		
Telephone(Home	+263712780355	**Work/Cell**	+263733825054

Note: Your UCT Email address is the default email address for all official communication – make sure that you access it regularly.

Department	Psychology

Title of Dissertation:

brain

Neurocognitice screening following acquired barin injury: Norming the Birmigham cognitive Screen in Zimbabwe.

Qualifications held

Degree/Diploma	Major(s) &) Subjects	Month/Year awarded	University
MSc Clinical Psychology	Clinical Psychology	2012	University Of Zimbabwe
BSc Special Honors	Psychology	2005	University Of Zimbabwe
BSc Psychology	psychology	2004	Zimbabwe Open University

Signature Removed

Signature of candidate: **Date: 26 FEBRUARY 2015**______________________

SECTION B:

	Name	Signature	Date
Supervisor	Progress Njomboro	Signature Removed	27/02/2015
Co-supervisor (if applicable)			
HOD	KEVIN THOMAS (For C.Ward)	Signature Removed	27/02/2015
Deputy-Dean: Research			
Complies with relevant ethical policy	Confirmed on behalf of Departmental Ethics Committee:	Signature Removed	27/2/2015

St Giles MEDICAL REHABILITATION CENTRE
ST GILES
COURAGE ENDEAVOUR ACHIEVEMENT
Clayton Road, Milton Park, Harare P.O. Box A224, Avondale, Harare, Zimbabwe
Tel/Fax: +263 4 740955, 741998, 741856, 778454. 741856.

Ref: BM/sm

19 September 2017

Mrs Debra Machando
No. 6 Sunriver Manors
Borrowdale Brooke
HARARE

Dear Madam

Re: PERMISSION TO RESUME RESEARCH WITH PATIENTS WITH BRAIN INJURY

Your letter dated 13th September 2017 refers.

We have no objection to you resuming your research at St Giles Medical Rehabilitation Centre subject to you abiding by the ethical considerations as per your research proposal and also getting consent from primary care givers.

I trust you will be guided accordingly. For other logistical requirements you may contact our Psychology Department.

Yours faithfully

Signature Removed

B Mswaka
CHIEF EXECUTIVE OFFICER

c.c. Medical Director
Head – Physio
Head – OT
Matron

Telephone: 621100-19
Fax: 621157

ZIMBABWE

Reference: HCHEC 250216/14

HARARE CENTRAL HOSPITAL
P. O. Box ST 14

SOUTHERTON

Harare

04 March 2016

Mrs. D. Machando
157 Borrowdale Road
Gunhill
HARARE

P.O. BOX CY 573 CAUSEWAY HARARE
RECEIVED
2016 -03- 07
MEDICAL RESEARCH COUNCIL OF ZIMBABWE

Dear Mrs. Machando,

REF: NUEROPSYCHIATRY OF APATHY: NORMING THE BIRMINGHAM COGNITIVE SCREEN IN ZIMBABWE (BCoS-Zim)

I am glad to advice you that your application to conduct a study entitled: **Nueropsychiatry of Apathy: Norming the Birmingham Cognitive Screen in Zimbabwe (BCoS-Zim)_ (Ref: HCHEC250216/14)**, has been approved by the Harare Hospital Ethics Committee.

This approval is premised on the submitted protocol. Should you decide to vary your protocol in any material way please submit these for further approval.

You are advised to avail the results of your study whether positive or negative to the hospital through the committee for our information.

Yours sincerely,

[illegible]
04 MAR 2016
[illegible]
HARARE

DR. C. Pasi
Chairman Harare Central Hospital Ethics Committee

Telephone: (070) 31850
31038
30878
31138
31489
31861
FAX: (070) 22668

HOSPITAL MANAGEMENT BOARD
CHITUNGWIZA CENTRAL HOSPITAL
P.O. BOX CZA 245
ZENGEZA
CHITUNGWIZA ZIMBABWE

All correspondences to be addressed to the Chief Executive Officer

12 September 2014

Debra Machando
157 Borrowdale Rd
Gunhill
Harare

RE: PERMISSION TO CONDUCT RESEARCH ON PATIENTS WITH HEAD INJURIES

This letter serves to confirm that your application to conduct a research at Chitungwiza Central Hospital was approved by the Chief Executive Officer and the Hospital Management has no objection.

We hope and trust you will be guided by your ethical consideration and that your research will benefit the health delivery system of Zimbabwe.

For any further information feel free to contact our Public Relations Department

Yours faithfully

Signature Removed

Mrs A. Tasaranarwo
Public Relations Officer

For:- **Chief Executive Officer**

NGWIZA CENTRAL HOSPI
UBLIC RELATIONS OFFICER
12 09 14
P.O. BOX CZA 245, CHITU
ZIMBABWE

WOMEN`S UNIVERSITY IN AFRICA

Addressing Gender Disparity and Fostering Equity in University Education

Education Services Center
Upper East/Brighton Rd
P.O Box MP 1222
Mount Pleasant
Harare

Tel: 307930/333139
Tel/Fax: 333154

FROM THE OFFICE OF THE REGISTRAR

8 December 2015

Mrs Debra Machando
157 Borrowdale Road
Gunhill
Harare

Dear Mrs Machando

Re: **REQUEST FOR PERMISSION TO CARRY OUT RESEARCH AT WUA**

Reference is made to your request for permission to carry out research on the following topic: "Neuro Psychiatry of Apathy, Norming the Birmingham Cognitive Screen in Zimbabwe," in fulfillment of a Doctoral Studies in Psychology which you are undertaking with the University of Cape Town.

After due diligence of your research proposal, you are hereby granted permission to carry out your research. However, the findings of your study should be confined to your original intentions only i.e research. Any breaching of this understanding can constitute an act of misconduct.

Thank you for your cooperation.

Yours sincerely

Signature Removed

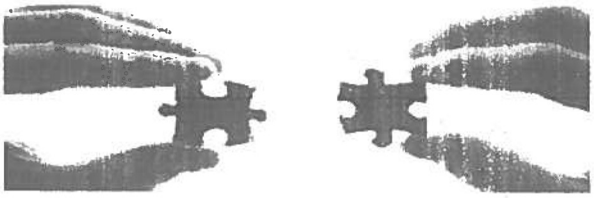
B. Mugwise (Mrs)
REGISTRAR

CC: Pro-Vice Chancellor
Research Board Chairperson

SIVERSPRING CLINIC

4th Floor Medical Chambers, 60 Baines Ave, Harare, +263772807029

miranda.january@gmail.com jamesj@medsc.uz.ac.zw



0 November, 2015

Debra Machando

157 Borrowdale Road, Gunhill

Harare

RE: PERMISSION TO CONDUCT RESEARCH AT SILVERSPRING CLINIC

This letter serves to inform you that you have been granted permission to conduct research entitled **'Neuro Psychiatry of Apathy, Norming the Birmingham Cognitive Screen In Zimbabwe, (BCoS-Zim)'** at Silverspring Clinic, provided you get clearance from Medical Research Council of Zimbabwe.

Yours faithfully,

SILVER I G PS HOL Y,
COU SELLI G & ELLNESS
CE. RF
60 I ES AVENUE
Th FLOOR DICAL CHAMBERS
CELL. 0776 268 830/0718 049 781

Signature Removed

James January,

Practitioner in charge (Registered Clinical Psychologist)

Appendix F

Delphi Panel Template

Good day to you.

You are invited to take part in the Cultural adaptation of the Birmingham Cognitive Screen (BCoS-Zim) because of your experience and wealth of knowledge.

The Birmingham Cognitive Screen was developed and normed in the UK to screen for cognitive impairment on patients with acquired brain injury (ages 16-70). We are working to adapt it and make it appropriate to be used in Zimbabwe.

Please identify possible problem items, instructions or words that may not be culturally appropriate to the Zimbabwean setting. Looking foward to your input. The process is as follows:

1. Please find attached test booklet. Comment on how the item is a problem and suggest alternatives.
2. Please follow the example on attached document and submit your comments by 29 May 2017.
3. Attend the expert panel discussion on Wednesday, 31 May

Expert panel meeting detail:

Date: 31 May 2017

Venue: Therapy Room (UZ Psychiatry Department)

Time: 4.30-6.30pm

An example has been given below:

Page & item	Inappropriate item/word/phrase	Comments- what is the problem?	Alternative How can it be improved?
Example:			
2	Current year missing	No correct response	Add current year

BCoS Expert Panel Delphi Questionnaire/Template

Add local cities: please rate cities in order of preferences

Kadoma

Mutare

Gweru

Harare

Masvingo

Bulawayo

Kwekwe

Other suggestions________________________

Replace Colander with:

plate

teapot

dish

other suggestions ___________________

Replace Chisel with:

Hammer

Shovel

Spade

Other______________________

Suggestions:

Watch

Scale

O'clock

Other suggestions__________________

Replace ‘Leek’ with:

Onion

Potato

Cabbage

Other__________________

Viscount pronunciation (ideal pronunciation is ‘vycount’

Accept viscount with

Replace word with (4 options) ______________________

The passive sentence is not accepted in response to the prompt. The examinee has not been told instructed not to use passive sentences. An instruction may be inserted stating that the examinee should only use active sentences. Yes/No

Mrs. Davis from Manchester met her neighbor in the supermarket. She told her that she had been robbed the day before while coming out of the post office, just after having drawn her pension. The two thieves, who were teenage boys, managed to get twenty-five pounds from her handbag. A passer-by, who was a trainee police officer, caught the thieves just round the corner.

Replace Davis with local names:

Dube

Ngwenya

Bere

Moyo

Other suggestions_____________________________________

Replace ‘Post Office’ with ‘Bank’ (any other 4 suggestions)

Replace pension with the following:

Pay

Salary

Wages

Allowances

Alternative

Replace ‘salt cellar’ with ‘salt shaker’

Replace the word ‘gesture’ with the word ‘action’

Replace the word ‘pantomime’ with the word ‘pretend’

Replace the pound symbol with the dollar symbol Yes/No

BCoS Ammendments

Item	Sex___ ___ Age _____ Edn___ ___	Sex___ ___ Age _____ Edn___ ___	Sex___ ___ Age _____ Edn___ ___	Sex___ ___ Age _____ Edn___ ___	Sex___ ___ Age _____ Edn___ ___	Sex___ ___ Age _____ Edn___ ___	Sex___ ___ Age _____ Edn___ ___	Sex___ ___ Age _____ Edn___ ___	Sex___ ___ Age _____ Edn___ ___	Sex___ ___ Age _____ Edn___ ___
Chisel modify										
Sieves										
Scale										
Mulberry										
Shovel										
Lion										
Onion										
Gesture for money										
Sandwich										
Lieutenant										
Colonel										

Appendix G1

BCos Original Examiner's Booklet

Examinee's ID:

Date of Examination:

Examiner:

bcos
brain behaviour analysis

EXAMINER'S BOOKLET

(Version 4.3)

Materials required ✐ *General instructions*

Time limitation

Adaptation in case of aphasia

Contents

Examinee's ID: .... Date: ....

1A. ORIENTATION – PERSONAL INFORMATION

"I will ask you some questions."

- Allow a MAXIMUM of 15 sec. per question.

- STOP if an ERROR or NO-RESPONSE is made on all the first 3 questions.

- In case of an unreliable verbal production, ask the examinee to write down their answers.

1. What is your first name?

2. What is your surname?

3. How old are you?

4. When were you born (day, month, year)?

5. What is the number and name of your street?

6. Are you left or right handed? ☐ Left ☐ Right ☐ Ambidextrous

7. What is/was your occupation?

8. What is your highest qualification? ☐ Primary school ☐ Non-university diploma ☐ Secondary school ☐ University diploma ☐ College ☐ University Degree

Determine how many years the examinee has spent in education/training: years

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Number of correct/plausible responses NOTE: If stopped because of errors on first 3 questions, score=0/8.	_______/8
Modality of response	☐ oral ☐ written
Ask the examinee to write his/her first name with the left and the right hand and record what you judge to be the best hand here for further testing:	☐ Left ☐ Right
How well did the examinee understand the questions? (1=poor understanding even after the questions were repeated, 2=relatively good understanding but often the questions had to be repeated, 3=good understanding, almost no need to repeat the questions) NOTE: This assessment should be based on the examinee's verbal or nonverbal request(s) for repetition.	

1B. ORIENTATION – TIME AND SPACE

Test Book pp. 1–6. See www.cognitionmatters.org.uk for alternative locations options.

✎ ***"I will ask you some more questions."***

- *In the case of an ERROR or NO-RESPONSE, allow the examinee to select from the multiple choices.*

- *Allow a MAXIMUM of 15 sec. per question.*

- *STOP if an ERROR or NO-RESPONSE is given on all of the first 3 MULTIPLE CHOICE questions.*

- *In case of an unreliable verbal production, give the multiple-choice questions immediately.*

	Free response	**Multiple choice response**			
1. Where are you right now?		☐ Church	☐ Hospital	☐ School	☐ Supermarket
2. In which city?		☐ Bulawayo	☐ Gweru	☐ Harare	☐ Mutare
3. What time of the day is it now?		☐ Morning	☐ Afternoon	☐ Evening	☐ Night
4. What month is it?		☐ January	☐ April	☐ July	☐ October
		☐ February	☐ May	☐ August	☐ November
		☐ March	☐ June	☐ September	☐ December
5. What day of the week is it?		☐ Monday	☐ Wednesday	☐ Friday	☐ Sunday
		☐ Tuesday	☐ Thursday	☐ Saturday	
6. What year is it?		☐ 1986	☐ 2016	☐ 2012	☐ 2013

FREE responses ONLY (condition of testing) ________

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

FREE responses ONLY (number of correct responses) _______/6

NOTE: If stopped because of errors and/or no-responses on the first 3 questions, score=0/6.
NOTE: If skipped because of aphasia, score=NA.

MULTIPLE CHOICE ONLY (condition of testing) _______

(1=normal; NT/stopped due to 2=aphasia; 3=visuospatial; 4=confusion; 5=fatigue; 6=motor; 7=other: ......)
NOTE: If the examinee made no errors in the free response condition, write "1".

FREE responses + MULTIPLE CHOICE responses (number of correct responses) _______/6

(number correct free responses + number correct multiple choice responses)
NOTE: If stopped because errors and/or no-responses on first 3 questions, score=0/6.

How well did the examinee understand the questions?

(1=poor understanding even after the questions were repeated, 2=relatively good understanding but often the questions had to be repeated, 3=good understanding, almost no need to repeat the questions)

NOTE: This assessment should be based on the examinee's verbal or nonverbal request(s) for repetition.

Examinee's ID: .... Date: ....

1C. ORIENTATION – NOSOGNOSIA

✎ ***"I have still a few questions."***

- Allow a MAXIMUM of 15 sec. per question.

1. Why are/were you in hospital?	
2a. Can you show me your right hand? 2b. Can you show me your left hand?	
3. Do you have any problems moving your arms or legs?	

Condition of testing ________

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Number of correct responses ________/3

How well did the examinee understand the questions?

(1=poor understanding even after the questions were repeated, 2=relatively good understanding but often the questions had to be repeated, 3=good understanding, almost no need to repeat the questions)

NOTE: This assessment should be based on the examinee's verbal or nonverbal request(s) for repetition.

---

2. PICTURE NAMING

🗎 *Test Book pp. 7–20.*

✎ ***"I will show you some pictures and ask you for the name of each object."***

- Allow a MAXIMUM of 15 sec. per picture.

- STOP if there are ERRORS or NO-RESPONSE for any of the first 4 pictures.

	Response
1. Bell	
2. Peas	
3. Grapes	

4. Umbrella

5. Raspberry

6. Colander

7. Leek

8. Stopwatch

9. Bat

10. Pineapple

11. Chisel

12. Tiger

13. Hook

14. Spanner

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Number of correct responses **_______/14**

NOTE: If stopped because of errors and/or no-responses to the first 4 pictures, score=0/14.

NOTES:

1) Plural and singular forms are equally acceptable.

2) Synonyms such as “strainer” and “colander” are equally acceptable.

3) “Blackberry” is an acceptable response for the picture of a raspberry.

4) Visually similar items such as “clock” or “pocket clock” for “stopwatch” or “spring onions” for “leek” CANNOT be accepted as correct responses.

5) Phonological/phonemic distortions should be considered as errors

Examinee's ID: .... Date:
....

3. SENTENCE CONSTRUCTION

Test Book pp. 21–25. See Appendix 3 of the Manual for scoring examples.

✐ ***"I will show you a photograph and give you two words. Can you please tell me what the person is doing? Use only one sentence and include the two words. The sentence should fit with what you see in the photograph. For example, if I show you this picture*** *(show the first picture)* ***and these two words 'sugar' and 'tea', you could make a sentence such as: The man is putting some sugar in his tea."***

- For each picture, GIVE the prompt as indicated below AND read aloud the written pair of words.

- If the examinee describes the photograph in more than one sentence, instruct the examinee to rephrase using one sentence. Rephrasing is only allowed once per trial.

- Allow a MAXIMUM of 30 sec. per picture.

- STOP if NO-RESPONSE is given to the first picture.

Prompt **Response**

1. Describe what the person is doing in one sentence and use the words "Book – bag".

If the examinee uses an active sentence:

(e.g., the woman is putting the book in her bag)

☐ *Correct use of subject ("she" or "the woman" or "a woman")*

☐ *Correct use of verb ("puts" or "is putting" or "takes" or "is taking")*

☐ *Correct use of direct object ("the book" or "her book" or "a book")*

☐ *Correct use of adverb phrase (is putting…"in the bag" or is putting… "in her bag" or is taking "from the bag" or is taking "from the bag")*

NOTE1: synonyms can be accepted

NOTE2: the passive sentence is not accepted in response to the prompt

2. Describe what the person is doing in one sentence and use the words "Coat – man".

If the examinee uses an <u>active</u> sentence <u>with</u> the verb "help":
(e.g., the man is helping the woman (to) put her coat on)

☐ *Correct use of subject ("the man" or "a man")*

☐ *Correct use of verb ("helps…(to) put(…)on" or "is helping…(to) put(…)on" or "helps with" or "is helping with")*

☐ *Correct use of direct object 1 ("the woman" or "her")*

☐ *Correct use of direct object 2 ("her coat" or "the woman's coat")*

If the examinee uses an <u>active</u> sentence <u>without</u> the verb "help":
(e.g., the man is putting the coat on the woman)

☐ *Correct use of subject ("the man" or "a man")*

☐ *Correct use of verb ("is putting(…)on" or "puts(…)on")* ☐ *Correct use of direct object ("coat")*

☐ *Correct use of adverb phrase (“on the woman”)*

If the examinee uses a passive sentence with the verb “help”:
(e.g., the woman is being helped by the man to put her coat on)

☐ *Correct use of subject (“she” or “the woman” or “ a woman”)*

☐ *Correct use of verb (“is being helped (to) put(…)on” or “is helped (to) put(…)on”)* ☐ *Correct use of agent (“by the man” or “by a man”)*

☐ *Correct use of direct object with possessive (“her coat”)*

If the examinee uses a passive sentence without the verb “help”: (e.g., the woman is having her coat put on by the man)

☐ *Correct use of subject (“she” or “the woman” or “a man”)* ☐ *Correct use of verb (“is having… put(…)on”)*

☐ *Correct use of agent (“by the man” or “by a man”)*

☐ *Correct use of direct object with possessive (“her coat”) NOTE: synonyms can be accepted*

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	______
Total number of correct responses NOTE: If stopped because no-response has been made for the first picture, score=0/8.	**______/8**
How well did the examinee understand the instructions? (1=poor understanding even after the instructions were repeated, 2=relatively good understanding but the instructions had to be repeated, 3=good understanding, no need to repeat the instructions) NOTE: This assessment should be based on the examinee’s verbal or nonverbal request(s) for repetition.	

4. SENTENCE READING

🗎 *Test Book pp. 26–27, stopwatch.*

✎ *- Hide the sentences while giving the instructions.*

“Now, I will show you a page with a sentence. Please read the sentence aloud as quickly and as accurately as possible. You can start when I say GO.”

- Once the page is placed in front of the examinee, say “go” and record the time taken to read the sentence.

- Stop timing when the examinee finishes the pronunciation of the last item on the page.

- STOP if NO-RESPONSE is made to the first sentence.

Response

The swords and treasures,

which belong to The viscount,

are kept in his castle.

Time: sec.

After we listened to the award-

winning concert at Our daughter' s
house, we took a leisurely walk
home while debating whether the
jury members had been impartial.

Time: sec.

Condition of testing ________

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Total time ________sec.

(summing the time for both the sentences)

NOTE: If stopped because no-response to the first sentence, score=NA.

Total number of words correctly read ________/42

(subtract 1 point for each word addition)

NOTE: If stopped because no-response has been made for the first sentence, score=0/42.

NOTES:

1) Exception words are underlined.

2) Auto-corrections are accepted.

3) Phonological/phonemic distortions should be considered as errors.

---

5. NONWORD READING

Test Book pp. 28–29, stopwatch.

✎ ***"Now I will show you a page with 3 written nonwords, that is, words that do not exist. Please read them aloud as quickly and as accurately as possible. You can start when I say GO."***

- *Once the nonwords are visible to the examinee, say "go" and record the time taken to read the words.*
- *Stop timing when the examinee finishes the pronunciation of the last item on the page.*
- *Repeat the instructions for each test page.*

- STOP if NO-RESPONSE is made to the first 3 nonwords.

	Response
1. dwend (with **en** like in *end*)	
2. brilt (with **i** like in *bill*)	
3. flosp (with **o** like in pot)	
4. glurms (with **ur** like in *urn*)	
5. shreel (with **ee** like in *wheel*)	
6. vench (with **en** like in *bench*)	

Number correct responses: /3

Total time: sec.

Number correct responses: /3

Total time: sec.

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Total time _______**sec.**

(summing the time for the 2 sets of nonwords)

NOTE: If stopped because no-response has been made for the first 3 words, score=NA.

Number of correct responses _______**/6**

NOTE: If stopped because no-response was made to the first 3 words, score=0/6.

Examinee’s ID: .... Date: ....

---

6. STORY RECALL AND RECOGNITION – IMMEDIATE RECALL

🗎 *Test Book pp. 30–44, stopwatch.*

✐ ***“I will read you a story. Listen carefully because I will ask you to recall as many details of the story as possible afterwards.”*** *Make sure the examinee is listening to you before starting to read the story.*

- *Read the story only ONCE. Then ask for free recall of the story.*

- *At the END of the free recall, present the corresponding multiple choice trials for any items that were either not reported, reported incompletely or reported incorrectly.*
- *Give FEEDBACK on the multiple choice questions.*

- *Allow a MAXIMUM of 2 min. for the FREE recall.*

- *If no response after 30 sec., give non-specific prompts (e.g., “how did the story start?”) every 30 sec.*

- *Allow a MAXIMUM of 15 sec. for each set of MULTIPLE choices.*

- *If ERRORS and/or NO-RESPONSES occur on ALL 5 first questions, GIVE the responses for questions 6 to 12 IMMEDIATELY, and ask again for a response to question 13.*

- *If no reliable verbal response can be produced, give the multiple choice possibilities.*

Mrs Davis / from Manchester / met her neighbour / in the supermarket /. She told her that she had been robbed / the day before / while coming out of the post office /, just after having drawn her pension /. The two thieves /, who were teenage boys /, managed to get twenty-five pounds / from her handbag /. A passer-by who was a trainee police officer /, caught the thieves / just round the corner /.

Segments	**Free recall 1**		**Recognition 1** (for error or omissions only)	
1) Mrs Davis	*(1) ☐ Mrs Davis*	*(0.5) ☐ Lady or Mr Davis*	1) What is the name of the person in the story? 1 **2** 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
2) Manchester	*(1) ☐ Mutare*		2) Where is she from? 1 2 **3** 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
3) Neighbour	*(1) ☐ Neighbour*		3) Who did she meet? 1 **2** 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
4) Supermarket	*(1) ☐ Supermarket*	*(0.5) ☐ Shop*	4) Where did she meet her? 1 2 3 **4**	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
5) Had been robbed	*(1) ☐ Robbed*	*(0.5) ☐ Attacked*	5) What did she tell her? 1 **2** 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
6) The day before	*(1) ☐ Day before*		6) When was she robbed? **1** 2 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*

7) Post office	*(1) ☐ Coming out of post office*	*(0.5) ☐ (in) Post office*	7) Where was she robbed? 1 2 3 **4**	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
8) Pension	*(1) ☐ Drew her pension*	*(0.5) ☐ (was going to draw) Pension*	8) What was she doing at the post office? 1 2 **3** 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
9) Two	*(1) ☐ Two*		9) How many thieves were there? 1 2 3 **4**	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
10) Teenage boys	*(1) ☐ Teenage boys*	*(0.5) ☐ Boys*	10) Who were the thieves? 1 2 3 **4**	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
11) 25 pounds	*(1) ☐ 25 pounds*		11) How much did they steal? 1 2 **3** 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
12) Handbag	*(1) ☐ Handbag*	*(0.5) ☐ Bag*	12) Where did they steal the money from? 1 2 **3** 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
13) Caught	*(1) ☐ Were caught*		13) What happened to the thieves at the end? **1** 2 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
14) Trainee police officer	*(1) ☐ Trainee police officer*	*(0.5) ☐ Police*	14) Who caught the thieves? 1 **2** 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
15) Round the corner	*(1) ☐ Round the corner*		15) Where were the thieves caught? **1** 2 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*

FREE recall ONLY – condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
FREE recall ONLY – total score (summing the "1" and "0.5" points columns)	_______**/15**
RECOGNITION ONLY – condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
FREE recall + RECOGNITION total score (summing the "1" points column BUT NOT the "0.5" points column) NOTE: If you skipped trials 6 to 12 in the multiple choice, give 0 points for trials 6 to 12. NOTE: Synonyms can be scored as "1"; information that is partially complete should be scored as "0.5".	_______**/15**

Comments (confabulations, perseverations etc.):

Examinee’s ID: .... Date: ....

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7. APPLE CANCELLATION

🗎 *Examinee’s Booklet and stopwatch.*

✐ ***“I will show you a page with apples. Sometimes, the apple is complete, sometimes incomplete. Please cross out the complete apples only. Try this example first.”*** *Give the example and correct if necessary. Two practice trials can be presented (but not more).*

“I give you a few minutes to do the same on this page. Please don’t move the page.” *Place the test sheet in a landscape position with the black triangle nearest to the examinee’s midline and start recording the time.*

- Do NOT give any cues for the test sheet.

- STOP if NO-RESPONSE is made on the practice sheet. -
Allow a MAXIMUM of 5 min. for the task.

Scoring transparancy can be found in the Test Book.

Boxes as indicated on the template below:

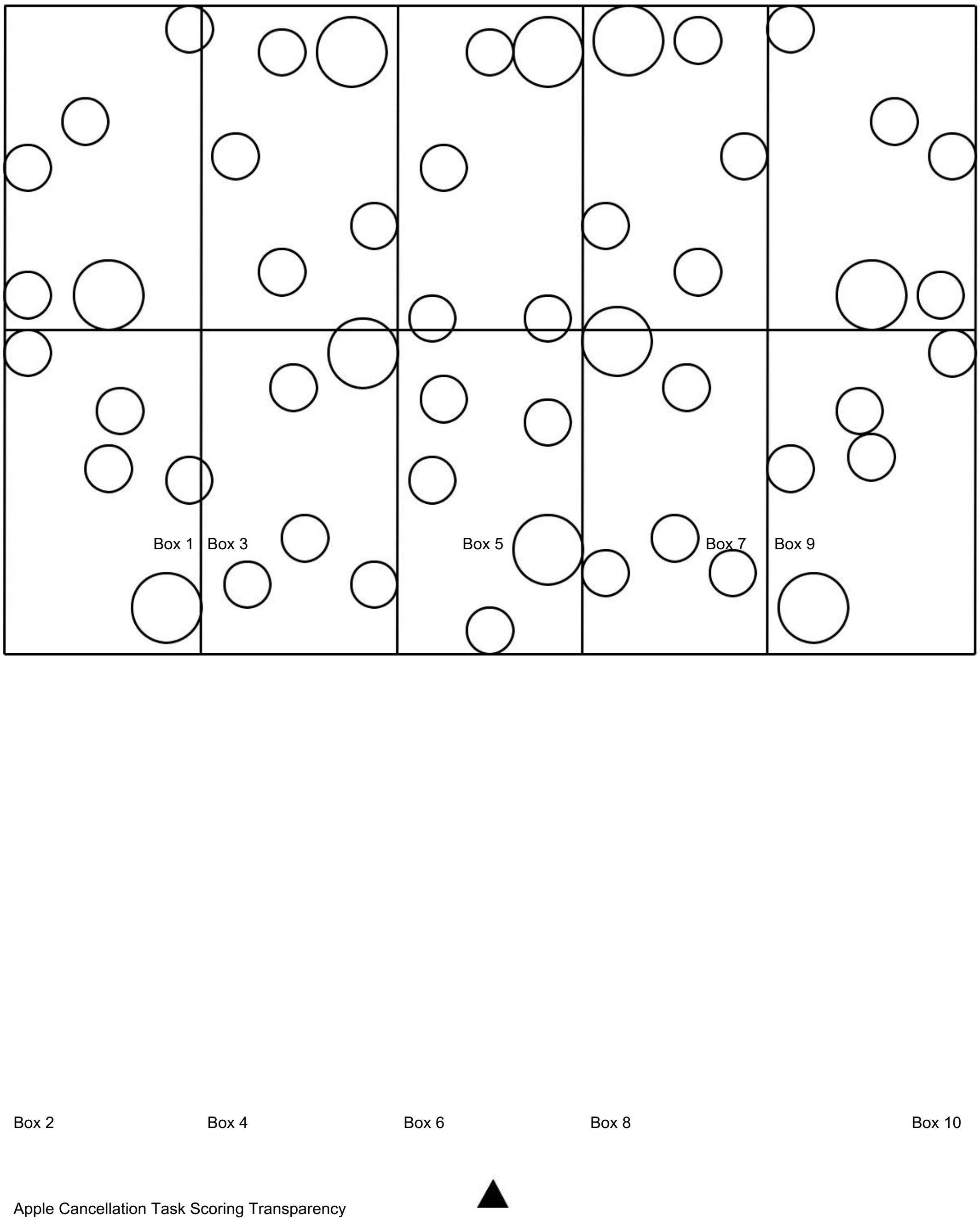
Box1 No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box3** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box5** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box7** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box9** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5
Box2 No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box4** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box6** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box8** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box10** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Total number of complete apples selected	_______**/50**
Total number of false positives with RIGHT opening	_______**/50**
Total number of false positives with LEFT opening	_______**/50**
Asymmetry score for the complete apple (no. correct in boxes 7 + 8 + 9 + 10) *minus* (no. correct in boxes 1 + 2 + 3 + 4)	_______

Asymmetry score for the incomplete apple ______

(no. false positives with LEFT opening) minus (no. false positives with RIGHT opening)

Template for scoring the Apple cancellation test (re-scaled):



Examinee’s ID: .... Date: ....

8. VISUAL EXTINCTION

✎ *- Place yourself approximately 1 metre opposite the examinee and at their midline.*

- Hold up the index finger of your left and right hand on either side of your head (approximately 20 cm from your nose). Say:

> ***“Look at my nose. Don’t move your eyes. I will move my finger either on your left, on your right or on both sides simultaneously. Please tell me or show me by pointing which side moved. Always keep looking at my nose.”***
>
> *- For each trial, bend your finger(s) twice.*
>
> *- Allow a MAXIMUM of 15 sec. per trial.*

- STOP if NO-RESPONSE is made on the first 3 trials.

(R=right; L=left; B=bilateral):

Hands to use from your perspective	**Examinee’s response**	**Examinee’s perspective (expected responses)**
R B L		L B R
B B R		B B L
B L L		B R R
B B L		B B R
R B		L B
R B		L B

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

LEFT UNILATERAL – number of correct detections _______**/4**

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

RIGHT UNILATERAL – number of correct detections _______**/4**

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

~~**LEFT BILATERAL – number of correct detections**~~ _______**/8**

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

~~**RIGHT BILATERAL – number of correct detections**~~ _______**/8**

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

NOTE: If the examinee perceives unilateral stimuli to be bilateral, mark as an error.

9. TACTILE EXTINCTION

- *Place yourself opposite the examinee and at their midline. Say:*

"Put your hands on your knees (or on the bed cover). Now, close your eyes. I will touch your hand, either your left hand, your right hand or both your hands simultaneously. Please tell me or show me by lifting your hand briefly which hand I touched. Always keep your eyes closed."

- *Make sure the examinee is sitting or lying straight and symmetrically (no crossed arms or legs).*
- *For each trial, touch by gently tapping twice with your hand the dorsal part of the examinee's hand.*
- *Allow a MAXIMUM of 15 sec. per trial.*
- *STOP if NO-RESPONSE is made for the first 3 trials.*

(R=right; L=left; B=bilateral):

Hands to use from your perspective	**Examinee's response**	**Examinee's perspective (expected responses)**
B B L		B B R
B L B		B R B
B R R		B L L
B B R		B B L
B L		B R
R L		L R

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

LEFT UNILATERAL – number of correct detections **_______/4**

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

RIGHT UNILATERAL – number of correct detections **_______/4**

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

LEFT BILATERAL – number of correct detections **_______/8**

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

RIGHT BILATERAL – number of correct detections **_______/8**

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

NOTE: If the examinee perceives unilateral stimuli to be bilateral, mark as an error.

10. RULE FINDING AND CONCEPT SWITCHING TEST

🗎 *Test Book pp. 45–68.*

✎ ***"You will see a grid with a black dot. Can you please point to the black dot?"*** *Show where the black dot is if the examinee cannot point to it. Then ask the examinee again to point to the black dot (this is just to ensure that they can give a reliable pointing response). Stop the task if the examinee cannot point reliably on the second attempt.*

"Ok. This dot will now move from page to page to a specific location. It can move to any of the grey or the coloured squares. The dot does not move randomly but follows a pattern. However, the rule governing the pattern can change. Look carefully at how the dot moves on each trial. You have to anticipate and show me where the dot will move next. Please remain attentive so that you can keep track of the changes."

- Present the practice trials saying:

"So for instance, if the dot is first here, then moves here *(show the second practice trial),* ***where is the dot most likely to move next?*** *(show the third practice trial)****"***

- Correct the examinee's response on the third practice item if necessary.

- When showing the trials, ALWAYS keep the previous trial directly above for the examinee to see.

- When showing the trials, point to the black dot.

- If the examinee does not know the location of the dot, ask him/her to guess.

- Allow a MAXIMUM of 15 sec. per trial.

- STOP if FEWER THAN 2 CORRECT responses are given up to TRIAL 11.

	Rule	**Stimulus**	**Expected response**	**Actual response**	**Accuracy 0/1**	
1	To the right	B3	any		■	
2	To the right	C3	D3			
3	To the right	D3	E3			
4	To the right	E3	F3			Cross dimension switch
5	To red	B5	E3			
6	To red	E3	B5			
7	To red	B5	E3			
8	To red	E3	B5			
9	To red	B5	E3			
10	To red	E3	B5			
11	To red	B5	E3			Within dimension switch
12	To red	E6	B5			
13	To green	B5	E6			
14	To red	E6	B5			
15	To green	B5	E6			
16	To red	E6	B5			
17	To green	B5	E6			
18	To red	E6				
19	To green	B5				

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Pointing PRETEST score

(2=points correctly on the first attempt; 1=points correctly on the second attempt; 0=cannot point reliably)

Number of correct responses

NOTE: If stopped because no-response has been made up to trial 11, score=number correct until trial 11 /18.

Number of correct rules detected

(number of rules that are applied correctly on at least 2 consecutive trials) NOTE: If stopped because no-response has been made up to trial 11, score=number correct rules until trial 11 /3.

How well did the examinee understand the instructions?

(1=poor understanding even after the instructions were repeated, 2=relatively good understanding but the instructions had to be repeated, 3=good understanding, no need to repeat the instructions)

NOTE: This assessment should be based on the performance on the practice trials and the examinee's verbal or nonverbal request(s) for repetition.

____

____

_______/18

_______/3

Examinee's ID: .... Date: ....

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11. AUDITORY ATTENTION

CD, Test Book pp. 69–72 for aphasic examinees. (Audio stimuli also available from www.cognitionmatters.org.uk)

✎ ***"You will hear a recording with a man saying different words. When the man says 'hello', 'please' or 'no' you have to tap on the table. When the man says something else, just ignore him. So the three words you have to respond to are: hello, please and no. Can you repeat these words?"*** *(if the examinee does not recall the three words, repeat the words).* ***"We will start with an example."***

- *Where indicated on the protocol below, ask the examinee to recall the three target words.*
- *Practice should be repeated until the examinee makes no errors in a practice block OR can correctly recall the three target words after the practice block. If after the third practice block these conditions are not met, continue the test ONLY if the examinee tapped (correctly or incorrectly) to at least one of the spoken items.*

- *STOP if MORE THAN 8 ERRORS have occurred at the end of ANY BLOCK (block 1 OR block 2) but DO NOT FORGET to ASK for the three correct words at the end.*

When asking for the target words, present a multiple choice.

PRACTICE 1

"Can you tell me the three words you have to respond to?"____

1. Please	☐ **Taps**	☐ Does not tap
2. Thanks	☐ Taps	☐ **Does not tap**
3. Goodbye	☐ Taps	☐ **Does not tap**
4. Hello	☐ **Taps**	☐ Does not tap
5. Yes	☐ Taps	☐ **Does not tap**
6. No	☐ **Taps**	☐ Does not tap

"Can you tell me the three words you have to respond to?"____

PRACTICE 2 (if necessary)

"Can you tell me the three words you have to respond to?"____

1. Please	☐ **Taps**	☐ Does not tap
2. Thanks	☐ Taps	☐ **Does not tap**
3. Goodbye	☐ Taps	☐ **Does not tap**
4. Hello	☐ **Taps**	☐ Does not tap
5. Yes	☐ Taps	☐ **Does not tap**
6. No	☐ **Taps**	☐ Does not tap

"Can you tell me the three words you have to respond to?"____

PRACTICE 3 (if necessary)

“Can you tell me the three words you have to respond to?”____

1. Please	☐ **Taps**	☐ Does not tap
2. Thanks	☐ Taps	☐ **Does not tap**
3. Goodbye	☐ Taps	☐ **Does not tap**
4. Hello	☐ **Taps**	☐ Does not tap
5. Yes	☐ Taps	☐ **Does not tap**
6. No	☐ **Taps**	☐ Does not tap

“Can you tell me the three words you have to respond to?”____

TEST

Block 1

Hello	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
Goodbye	☐ Taps	☐ **Does not tap**
Yes	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap
No	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
Thanks	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Hello	☐ **Taps**	☐ Does not tap
Goodbye	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
Goodbye	☐ Taps	☐ **Does not tap**
Hello	☐ **Taps**	☐ Does not tap
No	☐ **Taps**	☐ Does not tap

Date: ....

Examinee’s ID: ....

Block 2

Hello	☐ **Taps**	☐ Does not tap
No	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap
Goodbye	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Goodbye	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
Hello	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
Goodbye	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Hello	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
Yes	☐ Taps	☐ **Does not tap**
Thanks	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap

Block 3

Yes	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Please	☐ **Taps**	☐ Does not tap
Goodbye	☐ Taps	☐ **Does not tap**
Thanks	☐ Taps	☐ **Does not tap**
Goodbye	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
Hello	☐ **Taps**	☐ Does not tap
Please	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Hello	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
Goodbye	☐ Taps	☐ **Does not tap**
Hello	☐ **Taps**	☐ Does not tap

Can you tell me the three words you had to respond to? ____________________

	Block 1	Block 2	Block 3
Number of correct responses:	**/18**	**/18**	**/18**
Number of false positives:	**/9**	**/9**	**/9**
Number of omissions:	**/9**	**/9**	**/9**

Condition of testing

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

____

Total number of correct responses

NOTE: If you stopped after block 1 or 2, score=total number of correct responses until you stopped /54

________**/54**

Total number of false positives

NOTE: If you stopped after block 1 or 2, score= total number of false positives until you stopped.

________**/27**

Total number of omissions

NOTE: If you stopped after block 1 or 2, score= total number of omissions until you stopped.

________**/27**

Sustained attention index

(number of correct responses in block 1 minus number of correct responses in block 3)
NOTE: If you stopped after block 1 or 2, score=NA.

____

Response mode for recalling the target words

☐ free response

☐ multiple choice

Number of practices required

Number of words recalled at the end of the test

________**/3**

How well did the examinee understand the instructions?

(1=poor understanding even after the instructions were repeated, 2=relatively good understanding but the instructions had to be repeated, 3=good understanding, no need to repeat the instructions)

NOTE: This assessment should be based on the performance on the practice trials and the examinee's verbal or nonverbal request(s) for repetition.

________**/3**

Examinee's ID: .... Date:
....

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12. STORY RECALL AND RECOGNITION – DELAYED RECALL

Test Book pp. 73–87, stopwatch.

✐ ***"I read a story to you earlier on. Can you now tell me all the details of the story you remember?"***

- *Do NOT read the story.*
- *At the END of the free recall, present the corresponding multiple choice trials for any items that were either not reported, reported incompletely or reported incorrectly.*
- *FEEDBACK is NOT necessary.*
- *Allow a MAXIMUM of 2 min. for the FREE recall.*
- *If no response after 30 sec., give non-specific prompts (e.g., "how did the story start?") every 30 sec.*
- *Allow a MAXIMUM of 15 sec. For each MULTIPLE choice recognition test.*
- *If ERRORS and/or NO-RESPONSES on ALL the first 5 questions, give the responses for questions 6 to 12 IMMEDIATELY, and ask for a response for question 13 again.*

If no reliable verbal response can be produced, give the multiple choice possibilities.

Segments	**Free recall 1**	**Recognition 1** (for error or omissions only)	
1) Mrs Davis	*(1) ☐ Mrs Davis* *(0.5) ☐ Lady or Mr Davis*	1) What is the name of the person in the story? 1 2 3 **4**	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
2) Manchester	*(1) ☐ Mutare*	2) Where is she from? **1** 2 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
3) Neighbour	*(1) ☐ Neighbour*	3) Who did she meet? 1 2 **3** 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
4) Supermarket	*(1) ☐ Supermarket* *(0.5) ☐ Shop*	4) Where did she meet her? **1** 2 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
5) Had been robbed	*(1) ☐ Robbed* *(0.5) ☐ Attacked*	5) What did she tell? 1 2 **3** 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
6) The day before	*(1) ☐ Day before*	6) When was she robbed? 1 **2** 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
7) Post office	*(1) ☐ Coming out of post office* *(0.5) ☐ (in) Post office*	7) Where was she robbed? 1 **2** 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*

8) Pension	*(1) ☐ Drew her pension*	*(0.5) ☐ (was going to draw) Pension*	8) What was she doing at the post office? **1** 2 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
9) Two	*(1) ☐ Two*		9) How many thieves were there? 1 **2** 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
10) Teenage boys	*(1) ☐ Teenage boys*	*(0.5) ☐ Boys or Teenage Thieves*	10) Who were the thieves? 1 2 **3** 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
11) 25 pounds	*(1) ☐ 25 pounds*		11) How much did they steal? **1** 2 3 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
12) Handbag	*(1) ☐ Handbag*	*(0.5) ☐ Bag*	12) Where did they steal the money from? 1 2 3 **4**	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
13) Caught	*(1) ☐ Were caught*		13) What happened to the thieves at the end? 1 2 3 **4**	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
14) Trainee police officer	*(1) ☐ Trainee police officer*	*(0.5) ☐ Police*	14) Who caught the thieves? 1 2 3 **4**	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*
15) Round the corner	*(1) ☐ Round the corner*		15) Where were the thieves caught? 1 2 **3** 4	*(1) ☐ correct in free recall* *(1) ☐ correct in MC*

FREE recall ONLY – condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
FREE recall ONLY – total score (summing the “1” and “0.5” points columns)	_______**/15**
RECOGNITION ONLY – condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
FREE recall + RECOGNITION total score (summing the “1” points BUT NOT the “0.5” points columns) NOTE: if you skipped trials 6 to 12 in the multiple choice, give 0 points for trials 6 to 12. NOTE: Synonyms can be scored as “1”; information that is partially complete should be scored as “0.5”.	_______**/15**

Comments (confabulations, perseverations etc.):

Examinee's ID: .... Date: ....

13. MULTI-STEP OBJECT USE

🗎 *Test Book p. 88 and objects from the zipped bag.*

✏ *- Arrange the objects in midline, in the order of: (nearest to the examinee) matches, batteries, glue stick, screwdriver, torch (furthest from the examinee).*

- Show the picture of the lighted torch.

"Please can you make the torch work, everything you need is here for you. Do the best you can."

- For examinees with unilateral weakness, the examiner can help e.g., stabilising the torch barrel on the examinee's request or when examinees show signs of initiating the appropriate action.

- As much as possible, make sure every action step of the examinee is observed and recorded for reliable scoring.

- If after 30 sec. the examinee fails to initiate any given step, then repeat the instruction and show the picture.

- STOP if the examinee still FAILS TO INITIATE any given step.

SEQUENCE	**Order**	**Description**
Open barrel		
Put batteries in		
Close barrel		
Switch torch on		
Other:		

For each criterion take into account only the examinee's FIRST attempt to complete the step. Give 1 point for each criterion achieved on first attempt.

Start by unscrewing the barrel (after checking if torch works) WITHOUT any cue from the examiner	☐ 0 point ☐ 1 point
Fill barrel after opening	☐ 0 point ☐ 1 point

Insert batteries from the cylindrical opening	☐ 0 point ☐ 1 point
2 batteries inserted	☐ 0 point ☐ 1 point
Close barrel after inserting the batteries	☐ 0 point ☐ 1 point
Top replaced the right way and screwed in	☐ 0 point ☐ 1 point
Switch torch on after closing barrel	☐ 0 point ☐ 1 point
Maximum 2 attempts to insert the batteries the right way	☐ 0 point ☐ 1 point
Torch lit up eventually	☐ 0 point ☐ 1 point
No use of irrelevant objects	☐ 0 point ☐ 1 point
No irrelevant actions with the target objects	☐ 0 point ☐ 1 point
No perseveration	☐ 0 point ☐ 1 point
Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Hand used	☐ left only ☐ right only ☐ both hands
Total score (summing points)	_______**/12**

Examinee's ID: .... Date: ....

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14. GESTURE PRODUCTION

Test Book pp. 89–100.

✐ ***"This is the gesture for 'be quiet'."*** *Show the word and demonstrate the gesture.*

"Now, I will ask you to carry out some gestures for me. Can you please be as precise as possible. Could you show me the gesture for…with your right (or left) hand?" *Choose the examinee's best hand (refer to your record of the examinee's best hand in task 1A).*

- Show and read aloud the written name of each gesture, one at a time.

- Please follow the detailed scoring instructions below and describe the examinee's errors in the "comments" section whenever possible.

- Allow a MAXIMUM of 15 sec. per item.

INTRANSITIVE	**Scoring****	**Comments**
1. Hitch-hiking	☐ 2 points ☐ 1 point ☐ 0 point	
2. Military salute	☐ 2 points ☐ 1 point ☐ 0 point	
3. Stop	☐ 2 points ☐ 1 point ☐ 0 point	

Total score: /6

** Give 0 points for (1) no response after 15 sec. or (2) an unrecognisable gesture (e.g., for *hitch-hiking*, shaking open palm forwards) or (3) a perseveration from the previous gesture.

Give 1 point for a recognisable but inaccurate gesture: errors can include spatial errors (e.g., for the *salute*, the hand touches the cheek instead of the forehead), or movement errors (e.g., for *hitch-hiking*, the hand gesture is correct but with wrist rotation instead of forearm oscillation).

Give 2 points for a correct and accurate gesture.

✐ *Use the same procedure as before but say:*

"I will give you the name of an object and ask you to pretend that you have the object in your hand. I will then ask you to show me how to use it. For example, if you have to show how you would use a toothbrush, you could make a gesture like this *(show gesture)**.***

Now, how would you use …?"

- Show and read aloud the name of each item, one at a time.

- Allow a MAXIMUM of 15 sec. per item.

TRANSITIVE	**Scoring****	**Comments**
1. A glass, pretending it is	☐ 2 points ☐ 1 point ☐ 0 point	

in your hand		
2. A salt cellar, pretending it is in your hand*	☐ 2 points ☐ 1 point ☐ 0 point	
3. A hammer, pretending it is in your hand	☐ 2 points ☐ 1 point ☐ 0 point	

Total score: **/6**

* For the salt cellar, if the examinee pantomimes the use of a salt spoon rather than a pot, ask him/her to show the alternative gesture for a pot.

** Give 0 points for (1) no response after 15 sec. or (2) an unrecognisable gesture (e.g., for hammer, waving hand) or (3) a perseveration from the previous gesture.

Give 1 point for a recognisable but inaccurate gesture, with errors including spatial errors (e.g., for the *glass*, a pouring gesture is made towards the chest instead of the mouth; or in the case of the *glass* and the *salt cellar*, no space is allowed for the object in the hand – note that if no space is allowed for the *hammer*, this should not be considered as error), or incorrect grip errors (e.g., for the *hammer*, the grip indicates that the hammer is being held perpendicular to forearm), or movement errors (e.g., for the *hammer*, the oscillation is too small to be effective for a hammer or for the *salt cellar*, a big throwing movement rather than a shaking movement is made), or an incomplete sequence of action (e.g., for the *salt cellar*, the grip is correct but there is no shaking of the pot), or concretisation, i.e., the use of an irrelevant object or body part (e.g., holding the other hand, or a pen for the *hammer*/*glass* or the *salt cellar*).

Give 2 points for each correct and accurate gesture.

Condition of testing ________

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Hand used ☐ left ☐ right

Total score ________**/12**

(summing scores for transitive and intransitive gestures)

Examinee’s ID: .... Date: ....

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15. GESTURE RECOGNITION

🗎 *Test Book pp. 101–112.*

✎ ***“I am going to produce a gesture, I would like you to choose a meaning that matches my gesture. For example, if I show you this gesture”*** *(show the gesture for ‘be quiet’ and repeat the gesture while showing and reading the multiple choice possibilities)*, ***“and give you these meanings: counting, be quiet, hello, it’s crazy; ‘be quiet’ is the meaning that best matches the gesture. Now if I show you this gesture, what does it mean?”***

- Always repeat the gesture while showing and reading aloud the multiple choice possibilities.

- MAXIMUM 15 sec. per item.

INTRANSITIVE

Show gesture of	**Response**			
1. (Come over) ✋ moving the hand towards you	☐ **Come over**	☐ Salute	☐ Go away	☐ No
2. (Good) 👍	☐ Hitch-hiking	☐ Applause	☐ I swear	☐ **Good**
3. (Goodbye) ✋ moving the hand from the left to the right	☐ Stop	☐ **Goodbye**	☐ OK	☐ Thank you

Total score: /3

✎ *Use the same procedure but say:*

“I am going to pantomime the use of an object; I would like you to choose the object that I am pretending to use. For example, if I show you this gesture” *(show the gesture for toothbrush and repeat the gesture while showing and reading the multiple choice)* ***“and give you these objects: dental floss, shaver, toothbrush, cheese grater; toothbrush is the correct answer. Now if I show you this gesture, which object do I pretend to use?”***

- Always repeat the gesture while showing and reading aloud the multiple choice possibilities.

- Allow a MAXIMUM of 15 sec. per item.

TRANSITIVE

Show gesture of	**Response**			
1. cup	☐ teapot	☐ glass	☐ **cup**	☐ perfume
2. key	☐ **key**	☐ tap	☐ doorbell	☐ door handle

3. lighter	☐ gun	☐ match	☐ torch	☐ **lighter**

Total score: /3

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	________
Total score (summing scores for transitive and intransitive gestures)	________/6

16A. MEANINGLESS GESTURE IMITATION: FOR EXAMINEES USING THEIR RIGHT HAND

✎ *- Place yourself in front of the examinee.*

"I am going to carry out some actions, they do not mean anything, but try your best to copy me. I will use this hand" *(use your left hand)* ***"and you should mirror what I do with this hand"*** *(touch the examinee's right hand).* ***"For example, if I lift this hand"*** *(lift your hand),*

"you should lift this hand" *(touch the examinee's hand).* ***"Watch carefully how I position my hand, then copy what I do. Wait until I have finished before you start. This is the sequence."*** *Hold each gesture in the sequence for 2 sec., then say "now it's your turn."*

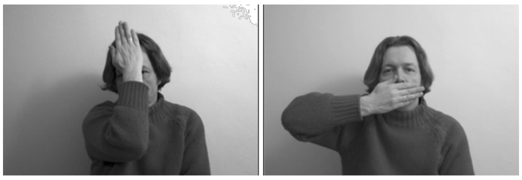
- Make sure the examinee starts the gesture only when you have finished demonstrating (and not before).

- If the examinee's gesture is incorrect or imprecise, repeat the demonstration (but repeat only ONCE).

- Allow a MAXIMUM of 15 sec. per item.

Important! Use your LEFT hand to demonstrate the gesture. The examinee should use his/her RIGHT hand.

HAND	**Scoring**	**Comments**
1.	☐ 3 points (correct and precise after one presentation) ☐ 2 points (correct and precise after 2nd presentation) ☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*) ☐ 0 point (more than one error, no response or perseveration from a previous item after the 2nd presentation)	
2.	☐ 3 points (correct and precise after 1 presentation)	



☐ 2 points (correct and precise after 2nd presentation)

☐ 1 point (only ONE error after 2nd presentation

– see below for list of errors*)

☐ 0 point (more than one error, no response or perseveration from a previous item after the 2nd presentation)

Total score: /6

* Give 1 point if ONLY ONE of the following errors is committed (during the second attempt):

- incorrect finger/hand position
- incorrect spatial relationship between hand and head
- incomplete movement sequence

✐ ***"Now watch carefully how I position my fingers, then copy what I do. Wait until I have finished before you copy. This is the gesture…"*** *Show each gesture for 2 sec., then say* ***"now it's your turn."***

- Make sure the examinee starts the gesture only when you have finished demonstrating (and not before).

- If the examinee's gesture is incorrect or imprecise, repeat the demonstration (but repeat only ONCE).

- Allow a MAXIMUM of 15 sec. per item.

Important! Use your LEFT hand to demonstrate the gesture. The examinee should use his/her RIGHT hand.

FINGER	**Scoring***	**Comments**
1. 	☐ 3 points (correct and precise after one presentation) ☐ 2 points (correct and precise after 2nd presentation) ☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*) ☐ 0 point (more than one error, no response or perseveration from a previous item after 2nd presentation)	
2.	☐ 3 points (correct and precise after one presentation) ☐ 2 points (correct and precise after 2nd presentation)	

☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*)

☐ 0 point (more than one error, no response

or perseveration from a previous item after 2nd presentation)

Total score: /6

* Give 1 point if the following error ONLY is committed (during the second attempt):

- finger posture is correct but hand orientation is incorrect

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Hand used ☐ ~~left~~

☐ right

Total score _______/12

(summing scores for hand and finger posture imitation)

16B. MEANINGLESS GESTURE IMITATION: FOR EXAMINEES USING THEIR LEFT HAND

- Place yourself in front of the examinee.

"I am going to carry out some actions, they do not mean anything, but try your best to copy me. I will use this hand" *(use your right hand)* ***"and you should mirror what I do with this hand*** *(touch the examinee's left hand)****. "For example, if I lift this hand"*** *(lift your hand)****, "you should lift this hand"*** *(touch the examinee's hand).* ***"Watch carefully how I position my hand, then copy what I do. Wait until I have finished before you start. This is the sequence…"*** *Hold each gesture in the sequence for 2 sec., then say* ***"now it's your turn."***

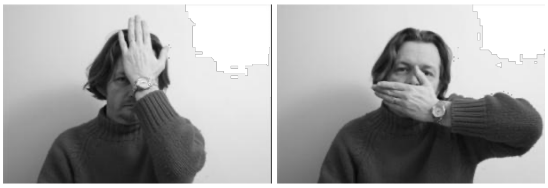
- Make sure the examinee starts the gesture only when you have finished demonstrating (and not before).

- If the examinee's gesture is incorrect or imprecise, repeat the demonstration (but repeat only ONCE).

- Allow a MAXIMUM of 15 sec. per item.

Important! Use your RIGHT hand to demonstrate the gesture. The examinee should use his/her LEFT hand.

HAND	**Scoring**	**Comments**
1.	☐ 3 points (correct and precise after one	

	presentation) ☐ 2 points (correct and precise after 2nd presentation) ☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*) ☐ 0 point (more than one error, no response or perseveration from a previous item after 2nd presentation)
2. 	☐ 3 points (correct and precise after one presentation) ☐ 2 points (correct and precise after 2nd presentation) ☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*) ☐ 0 point (more than one error, no response or perseveration from a previous item after 2nd presentation)
Total score:	**/6**

* Give 1 point if ONLY ONE of the following errors is committed (during the second attempt):

- incorrect finger/hand position
- incorrect spatial relationship between hand and head
- incomplete movement sequence

✏ ***“Now watch carefully how I position my fingers, then copy what I do. Wait until I have finished before you copy. This is the gesture…”*** *Show the gesture for 2 sec., then say* ***“now it’s your turn”****.*

- Make sure the examinee starts the gesture only when you have finished demonstrating (and not before).

- If the examinee’s gesture is incorrect or imprecise, repeat the demonstration (but repeat only ONCE).

- Allow a MAXIMUM of 15 sec. per item.

Important! Use your RIGHT hand to demonstrate the gesture. The examinee should use his/her LEFT hand.

FINGER	**Scoring***	**Comments**
1.	☐ 3 points (correct and precise after one	

presentation)

☐ 2 points (correct and precise after 2nd presentation)

☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*)

☐ 0 point (more than one error, no response or perseveration from a previous item after 2nd presentation)

2.

☐ 3 points (correct and precise after one presentation)

☐ 2 points (correct and precise after 2nd presentation)

☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*)

☐ 0 point (more than one error, no response or perseveration from a previous item after 2nd presentation)

Total score:	**/6**

* Give 1 point if the following error ONLY is committed (during the second attempt):

- finger posture is correct but hand orientation is incorrect

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Hand used	☐ left ☐ right
Total score (summing scores for hand and finger posture imitation)	_______**/12**

17. TASK RECALL – DELAYED RECOGNITION

Test Book pp. 113–122.

“Here are some questions about the tasks we have done today.”

- Show AND read aloud each question and the accompanying multiple choice possibilities.

- Allow a MAXIMUM of 15 sec. per item.

Recognition	**Multiple choice**	**Comments**
1. “Which item did I present to you?”	☐ **1** ☐ 2 ☐ 3 ☐ 4	
2. “What did you have to read?”	☐ 1 ☐ 2 ☐ **3** ☐ 4	
3. “What did you have to remember?”	☐ 1 ☐ **2** ☐ 3 ☐ 4	
4. “Which item did you have to name?”	☐ 1 ☐ **2** ☐ 3 ☐ 4	

5. What did I ask you to do?
MIME THE ACTIONS while reading the multiple choice possibilities:
For (1) move 1 hand with 1 finger raised horizontally (✉ →)
For (2) raise 2 fingers on a hand (✌)
For (3) snap your fingers with one hand
For (4) put your hands in the same position as in the visual extinction task
	☐ 1 ☐ 2 ☐ 3 ☐ **4**	

6. “What did I play to you from a recording?”	☐ **1** ☐ 2 ☐ 3 ☐ 4	
7. “Which item did you have to cross out?”	☐ 1 ☐ 2 ☐ 3 ☐ **4**	
8. “Which object did I ask you to use?”	☐ 1 ☐ 2 ☐ **3** ☐ 4	
9. “For which picture did you have to make a sentence?”	☐ 1 ☐ **2** ☐ 3 ☐ 4	
10. “Which gesture did I ask you to do?”	☐ 1 ☐ 2 ☐ 3 ☐ **4**	

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Total score (if all tests were presented to the examinee) NOTE: If not all 10 tasks were presented, write NA in the box here.	_______/10
Modified total score (if some tests were NOT presented to the examinee) NOTE: If all 10 tasks were presented, write NA in the box here.	_______/_____

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18. WORD/NONWORD WRITING

Examinee’s booklet.

✎ ***“I will read you some words. Please try to write each word down.”***

- STOP if NO-RESPONSE is made to the first 3 words and skip the nonword writing.

WORDS	**Response**
1. mustard	
2. scissors	
3. thinking	

4. although

✎ ***"I will now give you a nonword, that is, a word that does not exist, and again please write it down."***

NONWORD

5. troom (with **oom** like in *room*)

NOTE: Only the following spellings for the nonword are acceptable: troom, trume, treum.

Condition of testing ________

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Number of correct responses ________**/5**

NOTE: If stopped because of no-response to the first 3 words, score=0/5.

Examinee's ID: .... Date: ....

19. NUMBER/PRICE/TIME READING

Test Book pp. 123–125.

✐ ***"I will show you some written numbers, prices and clock times. Please can you read them."***

- If the examinee read 539 as "5-3-9" instead of the correct response "five hundred and thirty nine", say

"Can you read it like a whole number, as if you are describing the number of people in a room?"

- Allow a MAXIMUM of 15 sec. per number.

- STOP if NO-RESPONSE is made to the first 3 numbers.

NUMBERS	**Response**
1. 539	
2. 2,304	
3. 17,290	

Score (correct responses): /3

✐ ***"Now I will show you prices. Please can you read them."***

- *If the examinee does not say "pounds" on the first item say* ***"Can you please read this price again and make clear that it is a price?"***

PRICE	**Response**
1. £3.99	
2. £109.50	
3. £724.89	

Score (correct responses): /3

✐ ***"Now I will show you some clock times. Please can you read them."***

TIME*	**Response**
1. 9:30	
2. 2:45	

3. 6:10	

Score (correct responses): /3

* Absolute and relative clock reading is accepted (e.g., *nine thirty* and *half past nine*)

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Total number of correct responses NOTE: If stopped because of no-response to the first 3 numbers, score=0/9.	_______/9

20. NUMBER WRITING

Examinee's Booklet.

✎ ***"I will read some numbers. Please write down the numbers as indicated."*** *Numbers should be systematically repeated once while the examinee is writing.*

- MAXIMUM 15 sec. per number.

- STOP if NO-RESPONSE on both of the first 2 numbers.

NUMBER	**Response**
1. 807	
2. 12,500	

✎ ***"Now I will read some prices; please write down the prices as indicated."***

- *If the examinee does not write "£" on the first item say* ***"Can you please write this price again and make clear that it is a price?"***

PRICE	
3. £5.99	
4. £25.50	
5. £329.89	

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Total number of correct responses NOTE: If stopped because of no-response on first 2 numbers, score=0/5.	_______/5

Examinee’s ID: .... Date: ....

21. CALCULATION

Test Book pp. 126–129 and Examinee’s Booklet.

✐ ***“I will ask you to do some calculations. You can use this page if you want to write the calculation or write the response”*** *(give the relevant page from the Examinee’s Booklet).* ***“How much is…”***

- Show and read each calculation aloud.

- Allow a MAXIMUM of 30 sec. per item.

- In the case of an unreliable verbal production, ask the examinee to write down their answers.

	Response
1. 15 + 38 = (53)	
2. 45 – 7 = (38)	
3. 8 × 6 = (48)	
4. 63 ÷ 7 = (9)	

Total score (correct responses): **/4**

Specify if the response is written rather than given orally: ____

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Modality of response	☐ oral ☐ written
Number of correct responses	_______/4

22. COMPLEX FIGURE COPY

Examinee’s Booklet, stopwatch. See Appendices 4 and 5 of the Manual for details on scoring.

- Hide the figure while giving the instructions.

“I will show you a figure. Please copy it as best you can.”

- Show the figure to the examinee and record the time.

- Allow a MAXIMUM of 5 min.

		Scoring
1. Middle square	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
2. Middle arrow	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect
3. Middle right curve	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect
4. Middle left curve	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect
5. Middle cross	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect
6. Middle main diagonal	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect
7. Left diagonal end (3 bars)	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect
8. Left rectangle	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect
9. Left horizontal bar	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect
10. Left double oblique bars (parallel)	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect
11. Left circle	presence	☐ yes ☐ no
	shape/proportion	☐ correct ☐ incorrect
	placement	☐ correct ☐ incorrect

Examinee’s ID: .... Date: ....

12. Right diagonal end (1 curved line)	presence	☐ yes	☐ no
	shape/proportion	☐ correct	☐ incorrect
	placement	☐ correct	☐ incorrect
13. Right rectangle	presence	☐ yes	☐ no
	shape/proportion	☐ correct	☐ incorrect
	placement	☐ correct	☐ incorrect
14. Right horizontal bar	presence	☐ yes	☐ no
	shape/proportion	☐ correct	☐ incorrect
	placement	☐ correct	☐ incorrect
15. Right double oblique (triangle shape)	presence	☐ yes	☐ no
	shape/proportion	☐ correct	☐ incorrect
	placement	☐ correct	☐ incorrect
16. Right double dot	presence	☐ yes	☐ no
	shape/proportion	☐ correct	☐ incorrect
	placement	☐ correct	☐ incorrect

Note: When scoring an erroneous production, try not to penalise the same error twice.

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	________
Total score (1 point for each “yes” or “correct” box)	________**/47**
Total MIDDLE score ONLY	________**/17**
Total LEFT score ONLY	________**/15**
Total RIGHT score ONLY	________**/15**

Please tick any of the following if they are evident in the examinee’s figure copy:

☐ Closing-in Behaviour (the copy is made very close to or on top of the original figure)

☐ Micrographia (the copy is less than half the size of the original figure, both in height and width)

☐ Macrographia (the copy is more than one and a half times the size of the original figure, both in height and width)

☐ Neglect (the performance is substantially worse on the left <u>or</u> right parts relative to the other parts of the figure)

☐ Additions/Perseverations (the drawing contains elements not present in the original figure)

---

23. INSTRUCTION COMPREHENSION

✎ *Evaluate the examinee's overall understanding of the instructions*

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Total score

(1=poor understanding even after repetition, 2=relatively good understanding but instructions need often to be repeated, 3=good understanding, almost no need to repeat the instructions)

NOTE: This assessment should be *primarily* based on the scoring for instruction/question comprehension in the following tasks: orientation (1a–1b–1c), sentence construction (3), rule finding and concept switching (10) and auditory attention (11).

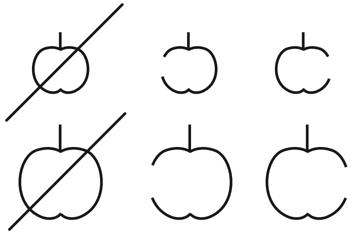
Appendix G2

BCoS Examinee Booklet

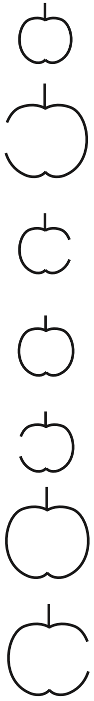
bcos
brain behaviour analysis

EXAMINEE'S BOOKLET

Cross out the full apples

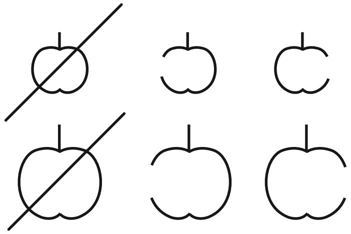


Try this example

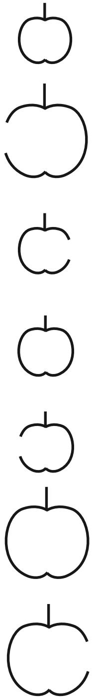


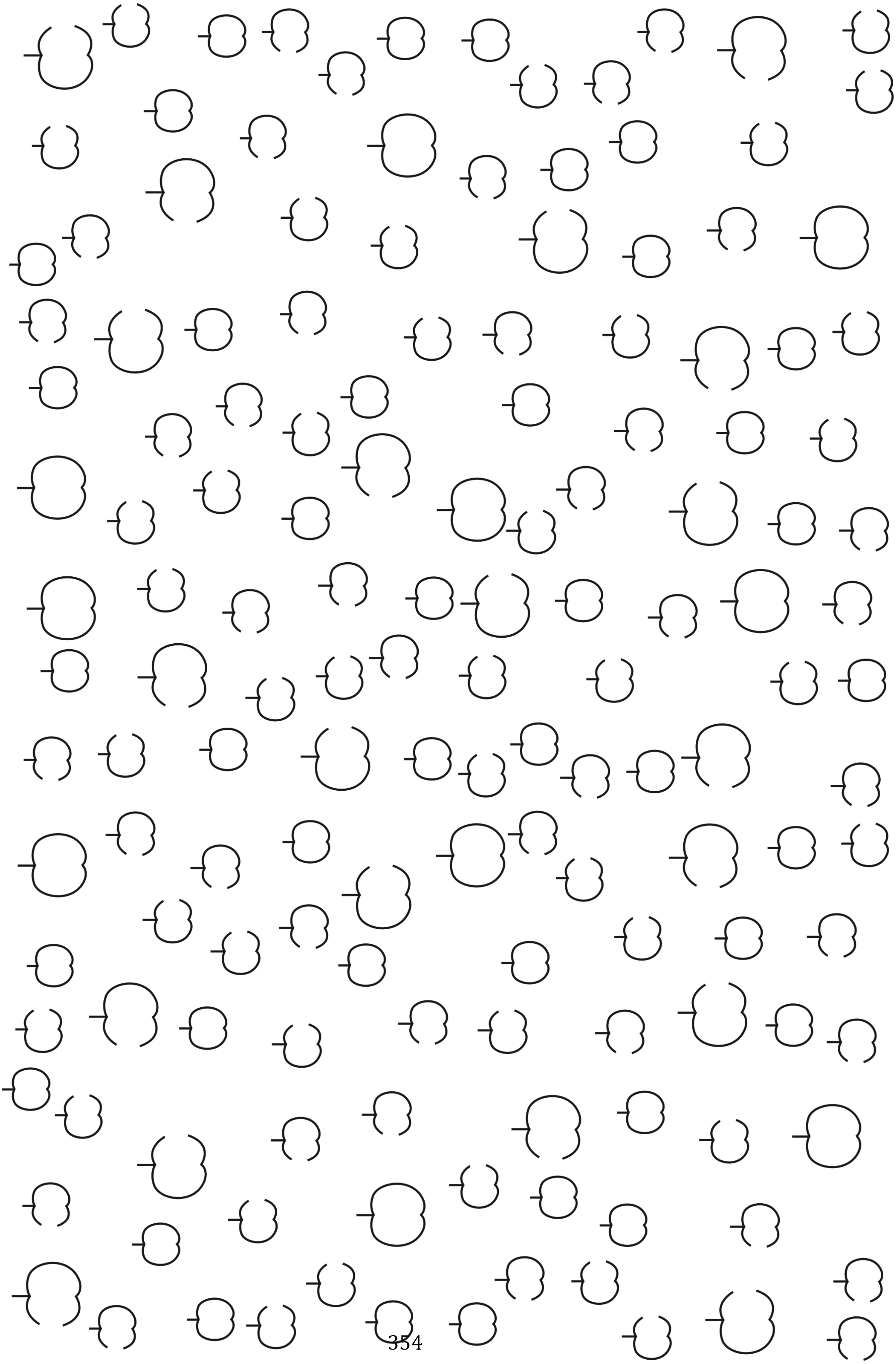
AppleCancellation
Examinee'sID:
Date:

Cross out the full apples



Try this example

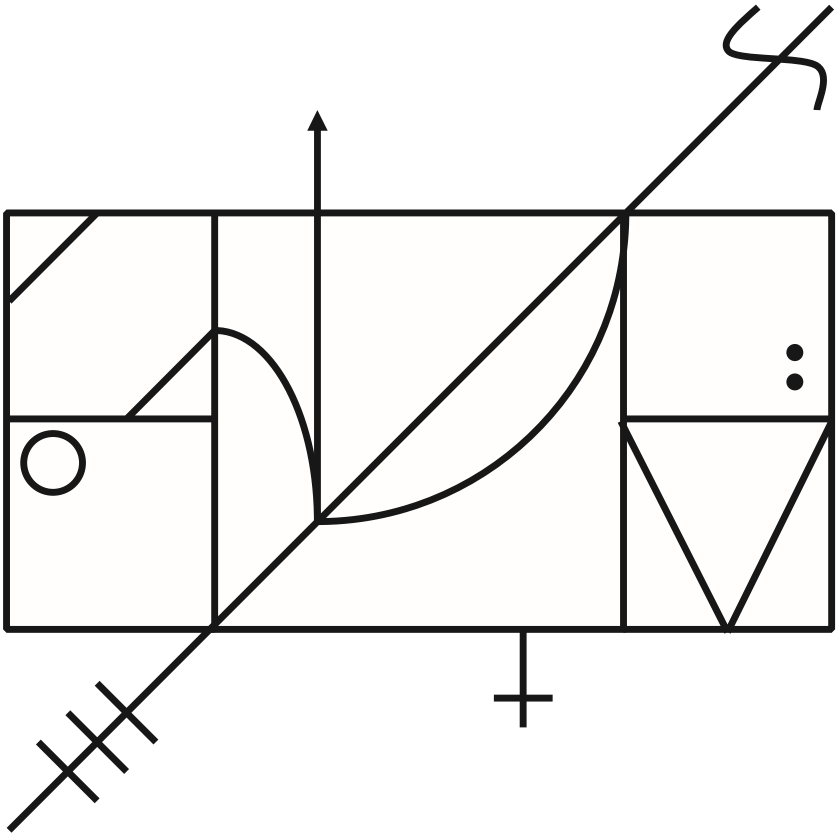




Word/Nonword Writing

Number Writing

Examinee’s ID:
Date:



Complex Figure Copy

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Appendix G3

Zim-BCos Examiner's Booklet

BcoS Test

Examiner:__________

Participant ID_________

START:___________

FINISH:___________

Contents

1A. ORIENTATION – PERSONAL INFORMATION

"I will ask you some questions. Some of them are easy, some of them may be difficult. Don't worry, just do the best you can. We just want to see how you are functioning. Ndichakubvunzai mibvunzo, imwe yacho yakaoma, imwe yakapfava. Musanyanyonetsekane, ingoedzai nepamunogona.

- *Allow a MAXIMUM of 15 sec. per question.*
- *STOP if an ERROR or NO-RESPONSE is made on all the first 3 questions.*

In case of an unreliable verbal production, ask the examinee to write down their answers.

1. What is your first name? Zita renyu rekutanga ndiani?	
2. What is your surname? Surname yenyu ndiyani	
3. How old are you? Mune makore mangani	
4. When were you born (day, month, year)? Makazvarwa gore ripi (zuva mwedzi gore)?	
5. What is your address? Munogara kupi- kero	

6.Are you left or right handed?

Munoshandisa ruoko rwupi ☐ Left/ ☐ Right ☐ Ambidextrous

7.What is/was your occupation?

Munoshanda basa rei?

8. What is your highest qualification?

Makadzidza kusvika papi

☐ Primary school Gr__	☐ Non-university diploma
☐ Secondary Form__	☐ University diploma
☐ College	☐ Degree

Determine how many years the examinee has spent in education/training: years

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Number of correct/plausible responses NOTE: If stopped because of errors on first 3 questions, score=0/8.	_______**/8**
Modality of response	☐ oral

	☐ written
Ask the examinee to write his/her first name with the left and the right hand and record what you judge to be the best hand here for further testing:	☐ Left ☐ Right
How well did the examinee understand the questions? (1=poor understanding even after the questions were repeated, 2=relatively good understanding but often the questions had to be repeated, 3=good understanding, almost no need to repeat the questions) NOTE: This assessment should be based on the examinee's verbal or nonverbal request(s) for repetition.	

1B. ORIENTATION – TIME AND SPACE

Test Book pp. 1–6. See www.cognitionmatters.org.uk for alternative locations options.

✎✎ ***"I will ask you some more questions."***

- *In the case of an ERROR or NO-RESPONSE, allow the examinee to select from the multiple choices.*
- *Allow a MAXIMUM of 15 sec. per question.*
- *STOP if an ERROR or NO-RESPONSE is given on all of the first 3 MULTIPLE CHOICE questions.*

- *In case of an unreliable verbal production, give the multiple-choice questions immediately.*

1	**Free response**	**Multiple choice response**
1Where are you right now? . Tiri panzvimbo ipi?		☐☐ Church ☐☐ Hospital ☐☐ School ☐☐ Supermarket
In which city? 2. Muguta ripi		☐☐ Bulawayo ☐☐ Gweru ☐☐ Harare ☐☐ Gweru
What time of the day is it now? 3. Inguvai parizvino		☐☐ Morning mangwanani ☐☐Afternoon masikati ☐☐ Evening Manheru ☐☐ Night usiku
What month is it? 4. Tirimumwedzi upi		☐☐ January ☐☐ April ☐☐ July ☐☐ October ☐☐ February ☐☐ May ☐☐ August ☐☐ November ☐☐ March ☐☐ June ☐☐ September ☐☐ December
What day of the week is it? 5. Nhasi chingani		☐☐ Monday ☐☐ Wednesday ☐☐ Friday ☐☐ Sunday ☐☐ Tuesday ☐☐ Thursday ☐☐ Saturday
What year is it?		☐☐ 1986 ☐☐ 20162017 ☐☐ 2015 ☐☐ 2016

6. Igore ripi?		

FREE responses ONLY (condition of testing)

(1= normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

FREE responses ONLY (number of correct responses) ______/6

1C. ORIENTATION – NOSOGNOSIA

✏ ***"I have still a few questions."***

☐ *- Allow a MAXIMUM of 15 sec. per question.*

1. Why are/were you in hospital/here? 2. Sei muripano kana muchipatara chino	
2a. Can you show me your right hand? Ndiratidzei ruokorwenyu rwerudyi 2b. Can you show me your left hand? Ndiratidzei ruoko rwenyu rweruboshwe	
3. Do you have any problems moving your arms or legs? 4. Mune dambudziko here pakushandisa maoko kana makumb enyu?	

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Number of correct responses _______/3

How well did the examinee understand the questions?

(1=poor understanding even after the questions were repeated, 2=relatively good understanding but often the questions had to be repeated, 3=good understanding, almost no need to repeat the questions)

NOTE: This assessment should be based on the examinee's verbal or nonverbal request(s) for repetition.

2. PICTURE NAMING

🗎🗎 *Test Book pp. 7–20.*

✏✏ ***"I will show you some pictures and ask you for the name of each object."*** ✏✏ ***Ndichakutaridzi mifananidzo, ndiudzei zita rechinhu chiri pamufananidzo***

- *Allow a MAXIMUM of 15 sec. per picture.*
- *STOP if there are ERRORS or NO-RESPONSE for any of the first 4 pictures.*

PICTURE	**RESPONSES GIVEN**
Bell/ bhera	
Peas/ bhinzi	
Grapes/ mazambiringa	
Umbrella	
Mulberry/ mahabhurosi	
Strainer/ sefa	
Onion/ hanyanisi	
Scale/chikero	
Bat muremwaremwa	
Pineapple chinananazi	
Sieve/sefa	
Lion/shumba	
Hook/ hook	
Spanner/ chipanera	

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Number of correct responses **_______/14**

NOTE: If stopped because of errors and/or no-responses to the first 4 pictures, score=0/14.

NOTES: Plural and singular forms are equally acceptable.

1) Synonyms such as "strainer" and "sieve" are equally acceptable.
2) Phonological/phonemic distortions should be considered as errors.

3. SENTENCE CONSTRUCTION

Test Book pp. 21–25.

✏✏ ***"I will show you a photograph and give you two words. Can you please tell me what the person is doing? Use only one sentence and include the two words. The sentence should fit with what you see in the photograph. For***

example, if I show you this picture** (show the first picture) **and these two words 'sugar' and 'tea', you could make a sentence such as: The man is putting some sugar in his tea."

✏✏

! ***"Ndinoda kukuratidzai mufananidzo ndokupai mavara maviri. Ndinoda kuti mundiudze zvirikuitika pamufananidzo muchishandisa mavara maviri andichakupai kugadzira mutsara umwe chete. Mutsara wenyu unofanira kuenderana nezvamuri kuona pamufananidzo. Semuenzaniso, ndikakuratidza mufananidzo uyu ndokupai mavara maviri ekuti sugar, tea', munogona kugadzira mutsara wekuti: murume ari kuisa shuga mutea yake."***

- *For each picture, GIVE the prompt as indicated below AND read aloud the written pair of words.*
- *If the examinee describes the photograph in more than one sentence, instruct the examinee to rephrase using one sentence. Rephrasing is only allowed once per trial.*
- *Allow a MAXIMUM of 30 sec. per picture.*
- *STOP if NO-RESPONSE is given to the first picture.*

Prompt	**Response**
1. Describe what the person is doing in one sentence and use the words "Book – bag". Tsanangura zviri kuitwa nemunhu ari pamufananidzo uchishandisa mutsara mumwechete nemazwi anoti "bhuku- bhegi" 2.	

If the examinee uses an active sentence: (e.g., the woman is putting the book in her bag) ☐☐ *Correct use of subject ("she" or "the woman" or "a woman")* ☐☐ *Correct use of verb ("puts" or "is putting" or "takes" or "is taking")* ☐☐ *Correct use of direct object ("the book" or "her book" or "a book")*

☐☐ *Correct use of adverb phrase (is putting…"in the bag" or is putting… "in her bag" or is taking "from the bag" or is taking "from the bag")*

NOTE1: synonyms can be accepted

2. Describe what the person is doing in one sentence and use the words "Coat – man". Tsanangura zviri kuitwa nemunhu ari pamufananidzo muchishandisa mutsara mumwechete nemazwi anoti "coat, man"	

NOTE2: the passive sentence is not accepted in response to the prompt

If the examinee uses an <u>active</u> sentence <u>with</u> the verb "help":

(e.g., the man is helping the woman (to) put her coat on) ☐☐ *Correct use of subject ("the man" or "a man")* ☐☐ *Correct use of verb ("helps…(to) put(…)on" or "is helping…(to) put(…)on" or "helps with" or "is helping with")* ☐☐ *Correct use of direct object 1 ("the woman" or "her")*
☐☐ *Correct use of direct object 2 ("her coat" or "the woman's coat")*

If the examinee uses an <u>active</u> sentence <u>without</u> the verb "help":
(e.g., the man is putting the coat on the woman)
☐☐ *Correct use of subject ("the man" or "a man")*
☐☐ *Correct use of verb ("is putting(…)on" or "puts(…)on")* ☐☐ *Correct use of direct object ("coat")* ☐☐ *Correct use of adverb phrase ("on the woman")*

If the examinee uses a <u>passive</u> sentence <u>with</u> the verb "help":
(e.g., the woman is being helped by the man to put her coat on)
☐☐ *Correct use of subject ("she" or "the woman" or " a woman")*
☐☐ *Correct use of verb ("is being helped (to) put(…)on" or "is helped (to) put(…)on")* ☐☐ *Correct use of agent ("by the man" or "by a man")* ☐☐ *Correct use of direct object with possessive ("her coat")*

If the examinee uses a <u>passive</u> sentence <u>without</u> the verb "help": (e.g., the woman is having her coat put on by the man)
☐☐ *Correct use of subject ("she" or "the woman" or "a*

man”) ☐☐ *Correct use of verb (“is having… put(…)on”)*
☐☐ *Correct use of agent (“by the man” or “by a man”)*
☐☐ *Correct use of direct object with possessive (“her coat”) NOTE: synonyms can be accepted*

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	______
Total number of correct responses NOTE: If stopped because no-response has been made for the first picture, score=0/8.	______/8

4. SENTENCE READING

🗎🗎 *Test Book pp. 26–27, stopwatch.*

✐✐ *- Hide the sentences while giving the instructions.*

“Now, I will show you a page with a sentence. Please read the sentence aloud as quickly and as accurately as possible. You can start when I say GO.”
“Ikozvino ndichakuratidza peji ine mutsara. Verengai mutsara uyu nekukasika uye nemagonero enyu muchitaura zvinonyatsonzwika. Munotanga kana ndati tangai.”

- *Once the page is placed in front of the examinee, say “go” and record the time taken to read the sentence.*
- *Stop timing when the examinee finishes the pronunciation of the last item.*

- *STOP if NO-RESPONSE is made to the first sentence.*

Response

The swords and treasures,
which belong to the viscount,
are kept in his castle.

Time: **sec.**

After we listened to the award-
winning concert at our daughter’ s house,
we took a leisurely walk home while
debating whether the jury members
had been impartial.

Time: **sec.**

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Total time (summing the time for both the sentences) NOTE: If stopped because no-response to the first sentence, score=NA.	_______**sec.**
Total number of words correctly read (subtract 1 point for each word addition) NOTE: If stopped because no-response has been made for the first sentence, score=0/42.	_______**/42**

NOTES:

1) Exception words are underlined.
2) Auto-corrections are accepted.

3) Phonological/phonemic distortions should be considered as errors.

---

5. NONWORD READING

Test Book pp. 28–29, stopwatch.

✐✐ ***"Now I will show you a page with 3 written nonwords, that is, words that I have made up. Please read them aloud as quickly and as accurately as possible. You can start when I say GO."***

"Iye zvino ndichakuratidza peji ine mavara matatu emashoko andagadzira ndega, haana zvaanoreva aso ndinoda kuti muaverenge sezvaari muchikasika uye muchitaura zvinonzwika. Munotanga pandinoti GO!"
✐✐

- *Once the nonwords are visible to the examinee, say "go" and record the time taken to read the words.* - *Stop timing when the examinee finishes the pronunciation of the last item on the page.* - *Repeat the instructions for each test page.*
- STOP if NO-RESPONSE is made to the first 3 nonwords.

	Response		
1. dwend (with **en** like in *end*)		**Number correct responses:**	**/3**
2. brilt (with **i** like in *bill*)		**Total time:**	**sec.**
3. flosp (with **o** like in pot)			
4. glurms (with **ur** like in *urn*)		**Number correct responses:** **Total time:**	**/3**
5. shreel (with **ee** like in *wheel*)			**sec.**
6. vench (with **en** like in *bench*)			

Condition of testing ________

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Total time ________**sec.**

(summing the time for the 2 sets of nonwords)

NOTE: If stopped because no-response has been made for the first 3 words, score=NA.

6. STORY RECALL AND RECOGNITION – IMMEDIATE RECALL

🗎🗎 *Test Book pp. 30–44, stopwatch.*

✐✐ ***"I will read you a story once. Listen carefully because I will ask you to recall as many details of the story as possible afterwards."*** *Make sure the examinee is listening to you before starting to read the story.*

"Ndichakuverengera nyaya kamwechete. Tereresai nokuti ndichakukumbirai kuti mundirondedzere nyaya iyi kana ndichinge ndapedza. Moedza nepamunogona kurangarira mashoko enyaya yacho." (Iva nechokwadi chokuti munhu ari kuteerera iwe usati watanga kuverenga nyaya yacho)

- *Read the story only ONCE. Then ask for free recall of the story.*
- *At*Mrs Moyo / from Gweru / met her neighbour / in the supermarket /. She told her that her money was stollen / the day before / while coming out of the bank /, just after having drawn her pension/. The two thieves /, who were teenage boys /, managed to get twenty-five dollars / from her handbag /. A passer-by who was a trainee police officer /, caught the thieves / just round the corner /. ***Please tell me all the detail of the story you can remember.***

Mai Moyo / vanobva kuGweru / vakasangana nemuvakidzani wavo / muchitoro. Vakamuudza kuti vakanga vabirwa / zuva radarika apo vaibuda kubva mubhanga/ apo vainge vatora mari yavo yepay./ Mbavha mbiri/, vaive vekomana vadiki,/ vakakwanisa kutora mari inoita makumi maviri neshanu emadhora/ mubhagi ravo/. Pane aipfuura hake akanga ari mupurisa arikudzidzira basa/ ndiye akazobata mbavha idzi/ dzisina kure kwadzainge dzaenda.

Segments	**Free recall 1**		**Recognition 1** (for error or omissions only)	
1) Mrs Moyo	*(1) ☐☐ Mrs Moyo*	*(0.5) ☐☐ Lady or Mr Moyo*	1) What is the name of the person in the story? Zita rake ndiyani? 1 **2** 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
2) Gweru	*(1) ☐☐ Gweru*		2) Where is she from? Vaigara kupi? 1 2 **3** 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
3) Neighbour	*(1) ☐☐ Neighbour*		Who did she meet? Vakasangana nani? 1 **2** 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
4) Supermarket	*(1) ☐☐ Supermarket*	*(0.5) ☐☐ Shop*	4) Where did she meet her? Vakasangana kupi 1 2 3 **4**	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
5) Her money was stolen	*(1) ☐☐ stolen*	*(0.5) ☐☐ Attacked*	5) What did she tell her? Vakamuudza kuti chii? 1 **2** 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
6) The day before	*(1) ☐☐ Day before*		6) When was her money? Vakabirwa rini? **1** 2 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
7) Bank	*(1) ☐☐ Coming out of the bank*	*(0.5) ☐☐ (in) Post office*	7) Where was her money stolen? Vakabirwa kupi? 1 2 3 **4**	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
8) Pension	*(1) ☐☐ Drew her*	*(0.5) ☐☐ (was going*	8) What was she doing at the bank Vaitei pabhanga?	*(1) ☐☐ correct in free recall*

	pension *to draw)* *her pension*	*(1) ☐☐ correct in MC* 1 2 **3** 4
9) Two	*(1) ☐☐ Two*	9) How many thieves were there? Mbavha idzi dzaive ngani? *(1) ☐☐ correct in free recall* 1 2 3 **4** *(1) ☐☐ correct in MC*
10) Teenage boys	*(1) ☐☐ Teenage boys* *(0.5) ☐☐ Boys*	10) Who were the thieves? Mbvha idzi dzvaive vanani? *(1) ☐☐ correct in free recall* 1 2 3 **4** *(1) ☐☐ correct in MC*
11) 25 dollars	*(1) ☐☐ 25 dollars*	11) How much did they steal? Vakaba marii? *(1) ☐☐ correct in free recall* 1 2 **3** 4 *(1) ☐☐ correct in MC*
12) Handbag	*(1) ☐☐ Handbag* *(0.5) ☐☐ Bag*	12) Where did they steal the money from? Mari iyi vakaiba pai? *(1) ☐☐ correct in free recall*

1) ☐☐ correct in MC

13) Caught	*(1) ☐☐ Were caught*	13) What happened to the thieves at the end Chii chakazoitika kumbvha idzi pakuguma? **1** 2 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
14) Trainee police officer	*(1) ☐☐ Trainee police (0.5) ☐☐ Police officer*	14) Who caught the thieves? Mbavha dzakabatwa nani? 1 **2** 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
15) Round the corner	*(1) ☐☐ Round the corner*	15) Where were the thieves caught? Mbavha dzakabatirwa kupi? **1** 2 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*

FREE recall ONLY – condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
FREE recall ONLY – total score (summing the “1” and “0.5” points columns)	_______**/15**
RECOGNITION ONLY – condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
FREE recall + RECOGNITION total score (summing the “1” points column BUT NOT the “0.5” points column) NOTE: If you skipped trials 6 to 12 in the multiple choice, give 0 points for trials 6 to 12. NOTE: Synonyms can be scored as “1”; information that is partially complete should be scored as “0.5”.	_______**/15**

Comments (confabulations, perseverations etc.):

7. APPLE CANCELLATION

🗎🗎 *Examinee’s Booklet and stopwatch.*

✎✎ ***“I will show you a page with apples. Sometimes, the apple is complete, sometimes incomplete. Please cross out the complete apples only. Try this example first.”*** *Give the example and correct if necessary. Two practice trials can be presented (but not more).*
“I give you a few minutes to do the same on this page. Please don’t move the page.” *Place the test sheet in a landscape position with the black triangle nearest to the examinee’s midline and start recording the time.*

"Ndichakuratidza peji rine maapuro. Dzimwe nguva, apuro rinenge rakazara, dzimwe nguva risina kuzara.
Ndokumbira kuti mucheke pamaapuro akazara chete.
"Ndinokupai maminetsi mashomanana kuita zvakafanana peji ino. Ndinokumbira usafambisa peji.”

- *Do NOT give any cues for the test sheet.*
- *STOP if NO-RESPONSE is made on the practice sheet. - Allow a MAXIMUM of 5 min. for the task.*

Scoring transparancy can be found in the Test Book.

Boxes as indicated on the template below:

Box1 No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box3** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box5** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box7** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box9** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5
Box2 No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box4** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box6** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box8** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box10** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Total number of complete apples selected **_______/50**

Total number of false positives with RIGHT opening **_______/50**

Total number of false positives with LEFT opening **_______/50**

Asymmetry score for the complete apple _______

(no. correct in boxes 7 + 8 + 9 + 10) *minus* (no. correct in boxes 1 + 2 + 3 + 4)

Asymmetry score for the incomplete apple _______

(no. false positives with LEFT opening) minus (no. false positives with RIGHT opening)

____

✐✐ **VISUAL EXTINCTION**- *nose). Say:Hold up the index finger of your left and right h - Place yourself approximately 1 metre opposite the examinee and at their midline.and on either side of your head (approximately 20 cm from your*

"Look at my nose. Don't move your eyes. I will move my finger either on your left, on your right or on both sides simultaneously. Please tell me or show me by pointing which side moved. Always keep looking at my nose."

"Tarisai pamhino yangu. Musafambisa maziso enyu. Ini ndichafambisa munwe wangu kuruboshwe, kurudyi kana kumativi ose maviri pamwe chete. Ndinoda kuti mundiudze kana kuti mundiratidze nokunongedza nechigunwe kana nokutaura kuti rutivi rwupi rwandafambisa. Nguva dzose rambai makatarisa mhino dzangu. "

- *For each trial, bend your finger(s) twice.*
- *Allow a MAXIMUM of 15 sec. per trial.*
- *STOP if NO-RESPONSE is made on the first 3 trials.*

(R=right; L=left; B=bilateral):

Hands to use from your perspective	**Examinee's response**	**Examinee's perspective (expected responses)**
R B L		L B R
B B R		B B L
B L L		B R R
B B L		B B R
R B		L B
R B		L B

Condition of testing ______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

LEFT UNILATERAL – number of correct detections ______/4

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

RIGHT UNILATERAL – number of correct detections ______/4

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

LEFT BILATERAL – number of correct detections ______/8

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

RIGHT BILATERAL – number of correct detections _______/8

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

NOTE: If the examinee perceives unilateral stimuli to be bilateral, mark as an error.

9. TACTILE EXTINCTION

✎✎ - *Place yourself opposite the examinee and at their midline. Say:*

"Put your hands on your knees (table or on the bed cover). I will touch your hand, either your left hand, your right hand or both your hands simultaneously. Please tell me or show me by lifting your hand briefly which hand I touched.

Now, close your eyes. Always keep your eyes closed."

"Isai maoko enyu pamabvi kana patafura (kana pamubhedha wemuchipatara). Ndichabata ruoko rwenyu rworuboshwe, kana rworudyi kana maoko enyu ese maviri panguva imwe chete. Ndinoda kuti mundiudze kana kuti mundiratidze nokusimudza ruoko rwenyu muchidimbu paruoko rwandinenge ndabata. Ndichada kuti muvhare maziso enyu." *Make sure the examinee is sitting or lying straight and symmetrically (no crossed arms or legs).*

- *For each trial, touch by gently tapping twice with your hand the dorsal part of the examinee's hand.*

- *Allow a MAXIMUM of 15 sec. per trial.*
- *STOP if NO-RESPONSE is made for the first 3 trials.*

(R=right; L=left; B=bilateral):

Hands to use from your Perspective	**Examinee's response**	**Examinee's perspective (expected responses)**
B B L		B B R
B L B		B R B
B R R		B L L
B B R		B B L
B L		B R
R L		L R

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

LEFT UNILATERAL – number of correct detections _______/4

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

RIGHT UNILATERAL – number of correct detections _______/4

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

LEFT BILATERAL – number of correct detections _______/8

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

RIGHT BILATERAL – number of correct detections _______/8

NOTE: If stopped because no-response has been made for the first 3 items, score=0.

NOTE: If the examinee perceives unilateral stimuli to be bilateral, mark as an error.

10. RULE FINDING AND CONCEPT SWITCHING TEST

Test Book pp. 45–68.

“You will see a grid with a black dot. Can you please point to the black dot?” *Show where the black dot is if the examinee cannot point to it. Then ask the examinee again to point to the black dot (this is just to ensure that they can give a reliable pointing response). Stop the task if the examinee cannot point reliably on the second attempt.*

“Ok. This dot will now move from page to page to a specific location. It can move to any of the grey or the coloured squares. The dot does not move randomly but follows a pattern. However, the rule governing the pattern can change. Look carefully at how the dot moves on each trial. You have to anticipate and show me where the dot will move next. Please remain attentive so that you can keep track of the changes.” *- Present the practice trials saying:*
“So for instance, if the dot is first here, then moves here *(show the second practice trial),* ***where is the dot most likely to move next?*** *(show the third practice trial)****”***

"Muchaona peji rine mabhokisi nedodzi dema. Nongedzerai pane dodzi

Ok. Dodzi iri rinenge richifamba richichinja nzvimbo kuenda pane imwe nzvimbo papeji yega yega. Dodzi iri rinokwanisa kuenda kune chero ipi zvayo nzvimbo ye grey kana kuti rumwe ruvara, haringofambi zvisina kurongeka asi kuti rinotevedza patani, asi patani iyi inokwanisa kushanduka. Tarisisai mafambiro anoita dodzi iri. Ndinoda kuti mundiudze kuti dodzi richaenda panzvimbo ipi. Ndinokumbira munyatsocherechedza kuti mukwanise kuona mashandukiro achaita patani. "Saka somuenzaniso, kana dodzi riri apa iye zvino, roenda apa, ringangoenda papi papeji rinotevera?

- *Correct the examinee’s response on the third practice item if necessary.*
- *When showing the trials, ALWAYS keep the previous trial directly above for the examinee to see. - When showing the trials, point to the black dot.*

	Rule	Stimulus	Expected response	Actual response	Accuracy 0/1	
1	To the right	B3	Any		■	
2	To the right	C3	D3			
3	To the right	D3	E3			
4	To the right	E3	F3			Cross dimension switch
5	To red	B5	E3			
6	To red	E3	B5			
7	To red	B5	E3			
8	To red	E3	B5			
9	To red	B5	E3			
10	To red	E3	B5			
11	To red	B5	E3			Within dimension switch
12	To red	E6	B5			
13	To green	B5	E6			
14	To red	E6	B5			
15	To green	B5	E6			
16	To red	E6	B5			
17	To green	B5	E6			
18	To red	E6	B5			
19	To green	B5	E6			

Condition of testing
(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Pointing PRETEST score
(2=points correctly on the first attempt; 1=points correctly on the second attempt; 0=cannot point reliably)

Number of correct responses
NOTE: If stopped because no-response has been made up to trial 11, score=number correct until trial 11 /18.

Number of correct rules detected
(number of rules that are applied correctly on at least 2 consecutive trials) NOTE: If stopped because no-response has been made up to trial 11, score=number correct rules until trial 11 /3.

How well did the examinee understand the instructions?
(1=poor understanding even after the instructions were repeated, 2=relatively good understanding but the instructions had to be repeated, 3=good understanding, no need to repeat the instructions)
NOTE: This assessment should be based on the performance on the practice trials and the examinee’s verbal or nonverbal request(s) for repetition.

11. AUDITORY ATTENTION

CD, Test Book pp. 69–72 for aphasic examinees. (Audio stimuli also available from www.cognitionmatters.org.uk)

✎✎ ***“You will hear a recording with a man saying different words. When the man says ‘hello’, ‘please’ or ‘no’ you have to tap on the table. When the man says something else, just ignore him. So the three words you have to respond to are: hello, please and no. Can you repeat these words?”*** *(if the examinee does not recall the three words, repeat the words).* ***“We will start with an example.”***

“ Iyezvino muchanzwa karekodha kemurume achitaura mazwi akasiyana. Kana murume wacho ati 'hello', 'please' kana kuti 'no' munofanira kurova patafura. Asi kana akataura chimwe chinhu, hamurove tafura. Saka mazwi matatu aunofanira kupindura ndeawo: hello, please, no. Dzokororai mazwi aya ". "Tichatanga nemuenzaniso."

- *Where indicated on the protocol below, ask the examinee to recall the three target words.*
- *Practice should be repeated until the examinee makes no errors in a practice block OR can correctly recall the three target words after the practice block. If after the third practice block these conditions are not met, continue the test ONLY if the examinee tapped (correctly or incorrectly) to at least one of the spoken items.*

- *STOP if MORE THAN 8 ERRORS have occurred at the end of ANY BLOCK (block 1 OR block 2) but DO NOT FORGET to ASK for the three correct words at the end.*

When asking for the target words, present a multiple choice.

PRACTICE 1

"Can you tell me the three words you have to respond to?"

"Ndiudza mazwi matatu aunofanira kupindura?"______________________________

1.Please	☐☐ **Taps**	☐☐ Does not tap
2.Thanks	☐☐ Taps	☐☐ **Does not tap**
3.Goodbye	☐☐ Taps	☐☐ **Does not tap**
4.Hello	☐☐ **Taps**	☐☐ Does not tap
5.Yes	☐☐ Taps	☐☐ **Does not tap**
6.No	☐☐ **Taps**	☐☐ Does not tap

"Can you tell me the three words you have to respond to?"______________________________

"Iwe unogona kundiudzei mazwi matatu aunofanira kupindura here?"

PRACTICE 2 (if necessary)

"Can you tell me the three words you have to respond to?"______________________________

1.Please	☐☐ **Taps**	☐☐ Does not tap
2.Thanks	☐☐ Taps	☐☐ **Does not tap**
3.Goodbye	☐☐ Taps	☐☐ **Does not tap**
4.Hello	☐☐ **Taps**	☐☐ Does not tap
5.Yes	☐☐ Taps	☐☐ **Does not tap**
6.No	☐☐ **Taps**	☐☐ Does not tap

"Can you tell me the three words you have to respond to?"______________________________

PRACTICE 3 (if necessary)

“Can you tell me the three words you have to respond to?”
"Ndiudza mazwi matatu aunofanira kupindura?"____

1.Please	☐☐ **Taps**	☐☐ Does not tap
2.Thanks	☐☐ Taps	☐☐ **Does not tap**
3.Goodbye	☐☐ Taps	☐☐ **Does not tap**
4.Hello	☐☐ **Taps**	☐☐ Does not tap
5.Yes	☐☐ Taps	☐☐ **Does not tap**
6.No	☐☐ **Taps**	☐☐ Does not tap

“Can you tell me the three words you have to respond to?”____

"Ndiudza mazwi matatu aunofanira kupindura?"____

TEST

Block 1

Hello	☐☐ **Taps**	☐☐ Does not tap
Thanks	☐☐ Taps	☐☐ **Does not tap**
Goodbye	☐☐ Taps	☐☐ **Does not tap**
Yes	☐☐ Taps	☐☐ **Does not tap**
Please	☐☐ **Taps**	☐☐ Does not tap
No	☐☐ **Taps**	☐☐ Does not tap
Yes	☐☐ Taps	☐☐ **Does not tap**
Thanks	☐☐ Taps	☐☐ **Does not tap**
No	☐☐ **Taps**	☐☐ Does not tap
Hello	☐☐ **Taps**	☐☐ Does not tap
Goodbye	☐☐ Taps	☐☐ **Does not tap**
Please	☐☐ **Taps**	☐☐ Does not tap

Yes	☐☐ Taps	☐☐ **Does not tap**
Please	☐☐ **Taps**	☐☐ Does not tap
Thanks	☐☐ Taps	☐☐ **Does not tap**
Goodbye	☐☐ Taps	☐☐ **Does not tap**
Hello	☐☐ **Taps**	☐☐ Does not tap
No	☐☐ **Taps**	☐☐ Does not tap

Block 2

Hello	☐ **Taps**	☐ Does not tap
No	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap
Goodbye	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Goodbye	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
Hello	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
Goodbye	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Hello	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
Yes	☐ Taps	☐ **Does not tap**
Thanks	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap

Yes	☐ Taps	☐ **Does not tap**
Please	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Please	☐ **Taps**	☐ Does not tap
Goodbye	☐ Taps	☐ **Does not tap**
Thanks	☐ Taps	☐ **Does not tap**
Goodbye	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
Hello	☐ **Taps**	☐ Does not tap
Please	☐ **Taps**	☐ Does not tap
Thanks	☐ Taps	☐ **Does not tap**
No	☐ **Taps**	☐ Does not tap
Hello	☐ **Taps**	☐ Does not tap
Yes	☐ Taps	☐ **Does not tap**
Goodbye	☐ Taps	☐ **Does not tap**
Hello	☐ **Taps**	☐ Does not tap

Can you tell me the three words you had to respond to? ______________________

Block 1 Block 2 Block 3

Block 3

Number of correct responses: /18 /18 /18 Number of false positives: /9 /9 /9 Number of omissions: /9 /9 /9

Condition of testing (1= normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	________
Total number of correct responses NOTE: If you stopped after block 1 or 2, score=total number of correct responses until you stopped /54	________/54
Total number of false positives NOTE: If you stopped after block 1 or 2, score= total number of false positives until you stopped.	________/27
Total number of omissions NOTE: If you stopped after block 1 or 2, score= total number of omissions until you stopped.	________/27
Sustained attention index (number of correct responses in block 1 minus number of correct responses in block 3) NOTE: If you stopped after block 1 or 2, score=NA.	________
Response mode for recalling the target words	☐☐ free response ☐☐ multiple choice
Number of practices required	________/3
Number of words recalled at the end of the test	________/3
How well did the examinee understand the instructions? (1=poor understanding even after the instructions were repeated, 2=relatively good understanding but the instructions had to be repeated, 3=good understanding, no need to repeat the instructions) NOTE: This assessment should be based on the performance on the practice trials and the examinee's verbal or nonverbal request(s) for repetition.	

⑫

12. STORY RECALL AND RECOGNITION – DELAYED RECALL

"I read a story to you earlier on. Can you now tell me all the details of the story you remember?"

"Ndambokuverengerai nyaya panguva yapfuura. Ndinoda kuti mundirondedzere zvose zvamuchiri kurangagrira panyaya iya."

- *At the END of the free recall, present the corresponding multiple choice trials for any items that were either not reported, reported incompletely or reported incorrectly.FEEDBACK is NOT necessary.*
- *Allow a MAXIMUM of 2 min. for the FREE recall.*
- *If no response after 30 sec., give non-specific prompts (e.g., "how did the story start?") every 30 sec.*

- *Allow a MAXIMUM of 15 sec. For each MULTIPLE choice recognition test.*
- *If ERRORS and/or NO-RESPONSES on ALL the first 5 questions, give the responses for questions 6 to 12 IMMEDIATELY, and ask for a response for question 13 again.*

If no reliable verbal response can be produced, give the multiple choice possibilities.

Segments	**Free recall 1**	**Recognition 1** (for error or omissions only)	
1) Mrs Moyo	*(1) ☐☐ Mrs Moyo* *(0.5) ☐☐ Lady or Mr Moyo*	1) What is the name of the person in the story? Zita remunhu ari munyaya ndiyani? 1 2 3 **4**	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
2) Gweru	*(1) ☐☐ Gweru*	2) Where is she from? Anobvepi? **1** 2 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
3) Neighbour	*(1) ☐☐ Neighbour*	3 Who did she meet Akasangana nani? 1 2 **3** 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
4) Supermarket	*(1) ☐☐ Supermarket* *(0.5) ☐☐ Shop*	4) Where did she meet her? Vakasangana pai? **1** 2 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
5) Her money had been stolen	*(1) ☐☐ stolen* *(0.5) ☐☐ Attacked*	5) What did she tell her? Vakamuudza kuti kudini? 1 2 **3** 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
6) The day before	*(1) ☐☐ Day before*	6 When was her money stolen? Vakabirwa rinhi? 4) 1 **2** 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
7) The bank	*(1) ☐☐ Coming out of the bank* *(0.5) ☐☐ (in) the bank*	7) Where was her money stolen? Vakabirwa kupi? 1 **2** 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
8) Pension	*(1) ☐☐ Drew her Pension* *(0.5) ☐☐ (was going to draw) Pension*	8) What was she doing at the post office? Vaiitei kubhanga? **1** 2 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*

9) Two	*(1) ☐☐ Two*		9 How many thieves were there? Mbavha idzi dzaive ngani? 1 **2** 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
10) Teenage boys	*(1) ☐☐ Teenage boys (0.5) ☐☐ Boys or teenage thieves*		10) Who were the thieves? Mbavha dzaive anani? 1 2 **3** 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
11) 25 dollars	*(1) ☐☐ 25 dollars*		11) How much did they steal? Vakabirwa marii? **1** 2 3 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
12) Handbag	*(1) ☐☐ Handbag (0.5) ☐☐ Bag*		12) Where did they steal the money from? Mari yakabiwa pai? 1 2 3 **4**	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
13) Caught	*(1) ☐☐ Were caught*		13) What happened to the thieves at the end? Chii chakazoitika kumbavha pakuguma? 1 2 3 **4**	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
14) Trainee police officer	*(1) ☐☐ Trainee police officer*	*(0.5) ☐☐ Police*	14) Who caught the thieves? Mbavha dzakabatwa nani 1 2 3 **4**	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*
15) Round the corner	*(1) ☐☐ Round the corner*		15) Where were the thieves caught Mbavha dzakabatirwa kupi 1 2 **3** 4	*(1) ☐☐ correct in free recall* *(1) ☐☐ correct in MC*

(summing the “1” and “0.5” points c

olumns)

RECOGNITION ONLY – condition of testing

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

____

FREE recall + RECOGNITION total score

(summing the "1" points BUT NOT the "0.5" points columns)

NOTE: if you skipped trials 6 to 12 in the multiple choice, give 0 points for trial 6 to 12.

NOTE: Synonyms can be scored as "1"; information that is partially complete should be scored as "0.5".

________/15

Comments (confabulations, perseverations etc.):

13. MULTI-STEP OBJECT USE

🗎 *Test Book p. 88 and objects from the zipped bag.*

✎ - *Arrange the objects in midline, in the order of: (nearest to the examinee) matches, batteries, glue stick, screwdriver, torch (furthest from the examinee).*
- *Show the picture of the lighted torch.*

"Please can you make the torch work, everything you need is here for you. Do the best you can."

"Ndinokumbira kuti muite kuti tochi ishande, zvose zvaunoda zviri pano. Itai zvamunogona."

For examinees with unilateral weakness, the examiner can help e.g., stabilising the torch barrel on the examinee's request or when examinees show signs of initiating the appropriate action.

- *As much as possible, make sure every action step of the examinee is observed and recorded for reliable scoring.*

□ - *If after 30 sec. the examinee fails to initiate any given step, then repeat the instruction and show the picture.*
- *STOP if the examinee still FAILS TO INITIATE any given step.*

SEQUENCE	Order	Description
Open barrel		
Put batteries in		
Close barrel		
Switch torch on		
Other:		

For each criterion take into account only the examinee's FIRST attempt to complete the step. Give 1 point for each criterion achieved on first attempt.

Start by unscrewing the barrel (after checking if torch works) WITHOUT any cue from the examiner	❑❑ 0 point	❑❑ 1 point
Fill barrel after opening	❑❑ 0 point	❑❑ 1 point
Insert batteries from the cylindrical opening	❑❑ 0 point	❑❑ 1 point

2 batteries inserted	☐☐ 0 point ☐☐ 1 point
Close barrel after inserting the batteries	☐☐ 0 point ☐☐ 1 point
Top replaced the right way and screwed in	☐☐ 0 point ☐☐ 1 point
Switch torch on after closing barrel	☐☐ 0 point ☐☐ 1 point
Maximum 2 attempts to insert the batteries the right way	☐☐ 0 point ☐☐ 1 point
Torch lit up eventually	☐☐ 0 point ☐☐ 1 point
No use of irrelevant objects	☐☐ 0 point ☐☐ 1 point
No irrelevant actions with the target objects	☐☐ 0 point ☐☐ 1 point
No perseveration	☐☐ 0 point ☐☐ 1 point
Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	________
Hand used	☐☐ left only ☐☐ right only

	☐☐ both hands
Total score (summing points)	**_______/12**

14. GESTURE PRODUCTION

Test Book pp. 89–100.

✐✐ ***"This is the sign for 'be quiet'."*** *Show the word and demonstrate the gesture.*

"Now, I will ask you to carry out some signs for me. Can you please be as precise as possible. Could you show me the sign for…with your right (or left) hand?" *Choose the examinee's best hand (refer to your record of the examinee's best hand in task 1A).*

- *Show and read aloud the written name of each gesture, one at a time.*
- *Please follow the detailed scoring instructions below and describe the examinee's errors in the "comments" section whenever possible.*
- ***"Ichi chiratidzo (sign) inoreva kuti 'nyarara'." .***
- ***"Iye zvino ndichakukumbirai kuti munditire zviratidzo, (masaini) emazwi andichakupai.***

- *Allow a MAXIMUM of 15 sec. per item.*

INTRANSITIVE	**Scoring****	**Comments**
1. Money	☐☐ 2 points ☐☐ 1 point ☐☐ 0 point	
2. Military salute	☐☐ 2 points ☐☐ 1 point ☐☐ 0 point	
3. Stop	☐☐ 2 points ☐☐ 1 point ☐☐ 0 point	

Total score: /6

** Give 0 points for (1) no response after 15 sec. or (2) an unrecognisable gesture (e.g., for (2) a perseveration from the previous gesture.

Give 1 point for a recognisable but inaccurate gesture: errors can include spatial errors (e.g., for the *salute*, the hand touches the cheek instead of the forehead), or movement errors Give 2 points for a correct and accurate gesture.

✐✐ *Use the same procedure as before but say:*

"I will give you the name of an object and ask you to <u>pretend that you have the object</u> <u>in your hand</u>. I will then ask you to show me how to use it. For example, if you have to show how you would use a toothbrush, you could make a gesture like this** (show gesture)**.

Now, how would you use …?"

"Ndichakupa zita rechinhu uye ndikukumbira kuti muite sokuti mune chinhu chacho muruoko rwenyu, mondiratidza kuti munochishandisa sei.

- Show and read aloud the name of each item, one at a time.

- Allow a MAXIMUM of 15 sec. per item.

TRANSITIVE	**Scoring****	**Comments**
1. A water glass, pretending it is in your hand Water glass, tomboti ririmuruoko	☐☐ 2 points ☐☐ 1 point ☐☐ 0 point	
2. A salt shaker, pretending it is in your hand*	☐☐ 2 points ☐☐ 1 point ☐☐ 0 point	
3. A hammer, pretending it is in your hand tomboti sando irimuruoko rwenyu.	☐☐ 2 points ☐☐ 1 point ☐☐ 0 point	

Total score: /6

** Give 0 points for (1) no response after 15 sec. or (2) an unrecognisable gesture (e.g., for hammer, waving hand) or (3) a perseveration from the previous gesture.

Give 1 point for a recognisable but inaccurate gesture, with errors including <u>spatial errors</u> (e.g., for the *glass*, a pouring gesture is made towards the chest instead of the mouth; or in the case of the *glass* and the *salt shaker*, no space is allowed for the object in the hand – note that if no space is allowed for the *hammer*, this should not be considered as error), or <u>incorrect grip</u> errors (e.g., for the *hammer*, the grip indicates that the hammer is being held perpendicular to forearm), or <u>movement errors</u> (e.g., for the *hammer*, the oscillation is too small to be effective for a hammer or for the *salt shaker*, a big throwing movement rather than a shaking movement is made), or an <u>incomplete sequence of action</u> (e.g., for the *salt shaker*, the grip is correct but there is no shaking of the pot), or <u>concretisation</u>, i.e., the use of an irrelevant object or body part (e.g., holding the other hand, or a pen for the *hammer*/*glass* or the *salt shaker*).

Give 2 points for each correct and accurate gesture.

Condition of testing

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Hand used

____

Total score ________/12

☐☐ left
☐☐ right

🕮🕮 *Test Book pp. 101–112.*

✎✎ ***"I am going to produce a sign, I would like you to choose a meaning that matches my sign. For example, if I show you this sign"*** *(show the gesture for 'be quiet' and repeat the gesture while showing and reading the multiple choice possibilities)****, "and give you these meanings: counting, be quiet, hello, it's crazy; 'be quiet' is the meaning that best matches the sign. Now if I show you this sign, what does it mean?"***

- Always repeat the gesture while showing and reading aloud the multiple choice possibilities.

- MAXIMUM 15 sec. per item.

"Ndiri kuzoita chiratidzo, ndinoda musarudze zvinoreva chiratidzo changu. Somuenzaniso, kana ndikakuratidza ichi ",

✎✎ ***"uye ndokupa sarudzo pamhinduro idzi?" counting, be quiet, hello, it's crazy; 'be quiet' zvinorevei?"***

INTRANSITIVE

Show sign of	**Response**			
1. (Come over) ✋✋ moving the hand towards you/ Huya	☐☐ **Come over**	☐☐ Salute	☐☐ Go away	☐☐ No
2. (Good)	☐☐ Hitch-hiking	☐☐ Applause	☐☐ I swear	☐☐ **Good**
3. (Goodbye) ✋✋ moving the hand from the left to the right	☐☐ Stop	☐☐ **Goodbye**	☐☐ OK	☐☐ Thank you

Total score: /3

✎✎ *Use the same procedure but say:*

"I am going to demonstrate the use of an object; I would like you to choose the object that I am pretending to use. For example, if I show you this action" *(show the gesture for toothbrush and repeat the gesture while showing and reading the multiple choice)* ***"and give you these objects: dental floss, shaver, toothbrush, cheese grater; toothbrush is the correct answer. Now if I carry out this action, which object do I pretend to use?"***

- Always repeat the gesture while showing and reading aloud the multiple choice possibilities.

 - Allow a MAXIMUM of 15 sec. per item.

 "Ndiri kuzonyepedzera kushandiswa kwechinhu; Ndinoda kuti musarudze chinhu chamunofungidzira kuti ndicho chandiri kushandisa.

 Somuenzaniso,: dental floss, shaver, toothbrush, cheese grater; toothbrush

TRANSITIVE

Show gesture of	**Response**			
1. cup	☐☐ teapot	☐☐ glass	☐☐ **cup**	☐☐ perfume
2. key svumbunuro	☐☐ **key**	☐☐ tap	☐☐ doorbell	☐☐ door handle
3. lighter gwenya	☐☐ gun	☐☐ match	☐☐ torch	☐☐ **lighter**

Total score: /3

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....) ________

Total score ________**/6**
(summing scores for transitive and intransitive gestures)

✐✐ *- Place yourself in front of the examinee.*

"I am going to carry out some actions, they do not mean anything, but try your best to copy me. I will use this hand" *(use your left hand)* ***"and you should mirror what I do with this hand"*** *(touch the examinee's right hand).* ***"For example, if I lift this hand"*** *(lift your hand),*

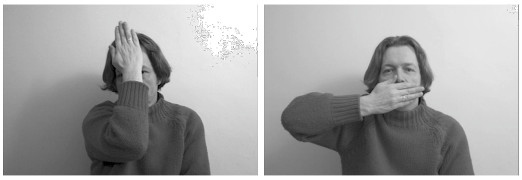
"you should lift this hand" *(touch the examinee's hand).* ***"Watch carefully how I position my hand, then copy what I do. Wait until I have finished before you start. This is the sequence."*** *Hold each gesture in the sequence for 2 sec., then say "now it's your turn."*

- *Make sure the examinee starts the gesture only when you have finished demonstrating (and not before).*
- *If the examinee's gesture is incorrect or imprecise, repeat the demonstration (but repeat only ONCE).*

- *Allow a MAXIMUM of 15 sec. per item.*

"Ndiri kuzoita zviito (maction), asi hazvirevi chinhu, ndinoda kuti muedze nepaunokwanisa kutevedzera zvandinenge ndaita. Ini ndichashandisa ruoko urwu "(shandisa ruoko rwako rworuboshwe)" uye imi munofanira kutevedzera zvandinoita neruoko urwu "(shandisa ruoko rworudyi rwekuongorora).
"Somuenzaniso, kana ndikasimudza ruoko" (simudza ruoko rwako), "Imi unofanira kusimudza ruoko urwu" (bata ruoko rwekuongorora). "Cherechedza zvakanyatsonaka kuti ndinogadza sei ruoko rwangu. Mirai kusvikira ndapedza musati matanga.

Important! Use your LEFT hand to demonstrate the gesture. The examinee should use his/her RIGHT hand.

HAND	**Scoring**	**Comments**
1. 	☐☐ 3 points (correct and precise after one presentation) ☐☐ 2 points (correct and precise after 2nd presentation) ☐☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*) ☐☐ 0 point (more than one error, no response or perseveration from a previous item after the 2nd presentation)	
2. 	☐☐ 3 points (correct and precise after 1 presentation) ☐☐ 2 points (correct and precise after 2nd presentation) ☐☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*) ☐☐ 0 point (more than one error, no response or perseveration from a previous item after the 2nd presentation)	

Total score: /6

* Give 1 point if ONLY ONE of the following errors is committed (during the second attempt):

- incorrect finger/hand position
- incorrect spatial relationship between hand and head

--- incomplete movement sequence

Zvino cherechedzai zvakanaka kuti ndinoita sei minwe yangu, motedzerai zvandiri kuita. Mirai kusvikira ndapedza musati watanga. " ikozvino ndiyo nguva yenyu. " ✎✎

- *Make sure the examinee starts the gesture only when you have finished demonstrating (and not before).*
- *If the examinee's gesture is incorrect or imprecise, repeat the demonstration (but repeat only ONCE).*
- *Allow a MAXIMUM of 15 sec. per item.*

Important! Use your LEFT hand to demonstrate the gesture. The examinee should use his/her RIGHT hand.

FINGER	**Scoring***	**Comments**
 1.	☐☐ 3 points (correct and precise after one presentation) ☐☐ 2 points (correct and precise after 2nd presentation) ☐☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*) ☐☐ 0 point (more than one error, no response or perseveration from a previous item after 2nd presentation)	

2.	☐ 3 points (correct and precise after one presentation) ☐ 2 points (correct and precise after 2nd presentation) ☐ 1 point (only ONE error after 2nd presentation – see below for list of errors*) ☐ 0 point (more than one error, no response or perseveration from a previous item after 2nd presentation)	

Total score: /6

* Give 1 point if the following error ONLY is committed (during the second attempt): - finger posture is correct but hand orientation is incorrect

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	______
Hand used	☐ left ☐ right
Total score (summing scores for hand and finger posture imitation)	_______**/12**

Test Book pp. 113–122.

“Here are some questions about the tasks we have done today.”
“ Heino mimwe mibvunzo pamusoro pemabasa ataita nhasi.”

- *Show AND read aloud each question and the accompanying multiple choice possibilities.*
- *Allow a MAXIMUM of 15 sec. per item.*

Recognition	**Multiple choice**	**Comments**
“Which item did I present to you?” 1. Chii chandakuratidzai nhasi?	☐☐ **1** ☐☐ 2 ☐☐ 3 ☐☐ 4	
“What did you have to read?” 2. Chii chandati muverenge nhasi?	☐☐ 1☐☐ 2 ☐☐ **3** ☐☐ 4	
“What did you have to remember?” 3. Chii chandati mugorangarira?	☐☐ 1☐☐ **2** ☐☐ 3 ☐☐ 4	
“Which item did you have to name?” 4. Chii chandati mundiudze zita racho	☐☐ 1☐☐ **2** ☐☐ 3 ☐☐ 4	

What did I ask you to do?
5. Ndakukumbirai kuti muitesei
MIME THE ACTIONS while reading the multiple choice possibilities:
For (1) move 1 hand with 1 finger raised horizontally (✉✉ →)
For (2) raise 2 fingers on a hand (✌✌)
For (3) snap your fingers with one hand
For (4) put your hands in the same position as in the visual extinction task
	☐☐ 1
	☐☐ 2 ☐☐ 3 ☐☐ **4**	

“What did I play to you from a recording?” 6. Chii chandakuridzirai?	☐☐ **1**☐☐ 2 ☐☐ 3 ☐☐ 4	
“Which item did you have to cross out?” 7. Chii chandakupai kuti mucheke	☐☐ 1☐☐ 2 ☐☐ 3 ☐☐ **4**	
“Which object did I ask you to use?” 8. Ndakukumbirai kut mushandise chiro chipi?	☐☐ 1☐☐ 2 ☐☐ **3** ☐☐ 4	
“For which picture did you have to make a sentence Mufananidzo upi wandati muumbe mutsara nawo? 9.	☐☐ 1☐☐ **2** ☐☐ 3 ☐☐ 4	

10. “Which sign did I ask you to do?” Ndakukumbirai kuti muite chiratidzo chipi?	☐☐ 1 ☐☐ 2 ☐☐ 3 ☐☐ <u>4</u>	

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Total score (if all tests were presented to the examinee) NOTE: If not all 10 tasks were presented, write NA in the box here. _______**/10**

Modified total score (if some tests were NOT presented to the examinee) NOTE: If all 10 tasks were presented, write NA in the box here. _______/_____

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18. WORD/NONWORD WRITING

✎✎ ***“I will read you some words. Please try to write each word down.”***

✎

☐ - *STOP if NO-RESPONSE is made to the first 3 words and skip the nonword writing.*

WORDS	**Response**
1. mustard/mastered	
2. scissors	
3. thinking	
4. although	

✎ ***“I will now give you a nonword, that is, a word that I have made up, and again please write it down.”***

✎ ***Ndichakupai izwi randaumba ndoga isiri shoko, Ndinokumbira nyora pasi***

NONWORD 5. troom (with **oom**	

Ndichakuverengerai mamwe mazwi. Edzai kunyora shoko rimwe nerimwe pasi: like in *room*) *NOTE: Only the following spellings for the nonword are acceptable: troom, trume, treum.*

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Number of correct responses NOTE: If stopped because of no-response to the first 3 words, score=0/5. _______**/5**

19. NUMBER/PRICE/TIME READING

Test Book pp. 123–125.

✎✎ ***“I will show you some written numbers, prices and clock times. Please can you read them.”***

“Ndichakuratidza dzimwe nhamba dzakanyorwa, nguva nemitengo. Ndinokumbira mundiverengere.

“Ndinoda kuti muverengae sekunge muri kurondedzera nhamba yevanhu vari mumba?”

✎✎

- If the examinee read 539 as "5-3-9" instead of the correct response "five hundred and thirty nine", say ***"Can you read it like a whole number, as if you are describing the number of people in a room?"***

"Ndinoda kuti muverenge sekunge uri kurondedzera nhamba yevanhu muimba?"

- Allow a MAXIMUM of 15 sec. per number.

- STOP if NO-RESPONSE is made to the first 3 numbers.

NUMBERS	**Response**
1. 539	
2. 2,304	
3. 17,290	

Score (correct responses): /3

✐ ***"Now I will show you prices. Please can you read them."***

- If the examinee does not say "dollars" on the first item say ***"Can you please read this price again and make clear that it is a price?" Ndichakuratidzai mitengo, ndichakumbira muiverenge. Ndokumbirisawo kut muverenge mitengo iyi zvekare muchiburita kuti mutengo.***

PRICE	**Response**
1. $3.99	
2. $109.50	
3. $724.89	

Score (correct responses): /3

✐✐ ***"Now I will show you some clock times. Please can you read them." Ndichakuratidzai nguva ndokumbirawo mundiverengere.***

TIME*	**Response**
1. 9:30	
2. 2:45	
3. 6:10	

Score (correct responses): /3

* Absolute and relative clock reading is accepted (e.g., *nine thirty* and *half past nine*)

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Total number of correct responses NOTE: If stopped because of no-response to the first 3 numbers, score=0/9.	_______/9

20. NUMBER WRITING

Examinee's Booklet.

✐ ***"I will read some numbers. Please write down the numbers as indicated."*** *Numbers should be systematically repeated once while the examinee is writing.*

- MAXIMUM 15 sec. per number.
- STOP if NO-RESPONSE on both of the first 2 numbers.
Ndichakuverengerai manumber ndokumbirawo kuti mumanyore pasi sezvazviri.

NUMBER	**Response**
1. 807	
2. 12,500	

- If the examinee does not write "$" on the first item say ***"Can you please write this price again and make clear that it is a price?"***
Ikozvino ndichakuverengerai mitengo ndichakumbira kuti mumanyore pasi sezvazviri. Ndokumbirawo kuti munyore pasi mitengo iyi muchiratidza kuti mitengo.

PRICE	
3. $5.99	
4. $25.50	
5. $329.89	

Condition of testing _______

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Total number of correct responses NOTE: If stopped because of no-response on first 2 numbers, score=0/5. _______**/5**

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21. CALCULATION

Test Book pp. 126–129 and Examinee's Booklet.

✐✐ ***"I will ask you to do some calculations. You can use this page if you want to write the calculation or write the response"*** *(give the relevant page from the Examinee's Booklet).* ***"How much is…"***

- *Show and read each calculation aloud.*
- *Allow a MAXIMUM of 30 sec. per item.*
- *In the case of an unreliable verbal production, ask the examinee to write down their answers.*

Ini ndichakukumbirai kuti mundiitiro svomhu. Munokwanisa kushandisa peji iyi kana muchida kunyora asi mondipa mhinduro yakanyorwa pasi. Zvakawanda sei ...

	Response

1.15 + 38 = (53)	
2.45 – 7 = (38)	
3.8 × 6 = (48)	
4.63 ÷ 7 = (9)	

Total score (correct responses): **/4**

Specify if the response is written rather than given orally: ____

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Modality of response	☐☐ oral ☐☐ written
Number of correct responses	_______**/4**

Examinee's Booklet, stopwatch. See Appendices 4 and 5 of the Manual for details on scoring.

- *Hide the figure while giving the instructions.*

"I will show you a figure. Please copy it as best you can."

Ndichakuratidzai mufananidzo. Ndinokumbira yedzai kuiburitsa sezvairi.

- *Show the figure to the examinee and record the time.*
- *Allow a MAXIMUM of 5 min.*

		Scoring
1. Middle square	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct☐☐ incorrect
2. Middle arrow	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct☐☐ incorrect
	placement	☐☐ correct☐☐ incorrect
3. Middle right curve	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct☐☐ incorrect
	placement	☐☐ correct☐☐ incorrect
4. Middle left curve	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct☐☐ incorrect
	placement	☐☐ correct☐☐ incorrect
5. Middle cross	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct☐☐ incorrect
	placement	☐☐ correct☐☐ incorrect
6. Middle main diagonal	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct☐☐ incorrect
	placement	☐☐ correct☐☐ incorrect
7. Left diagonal end (3 bars)	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct☐☐ incorrect
	placement	☐☐ correct☐☐ incorrect
8. Left rectangle	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct☐☐ incorrect
	placement	☐☐ correct☐☐ incorrect

9. Left horizontal bar	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct ☐☐ incorrect
	placement	☐☐ correct ☐☐ incorrect
10. Left double oblique bars (parallel)	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct ☐☐ incorrect
	placement	☐☐ correct ☐☐ incorrect
11. Left circle	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct ☐☐ incorrect
	placement	☐☐ correct ☐☐ incorrect
12. Right diagonal end (1 curved line)	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct ☐☐ incorrect
	placement	☐☐ correct ☐☐ incorrect
13. Right rectangle	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct ☐☐ incorrect
	placement	☐☐ correct ☐☐ incorrect
14. Right horizontal bar	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct ☐☐ incorrect
	placement	☐☐ correct ☐☐ incorrect
15. Right double oblique (triangle shape)	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct ☐☐ incorrect
	placement	☐☐ correct ☐☐ incorrect
16. Right double dot	presence	☐☐ yes ☐☐ no
	shape/proportion	☐☐ correct ☐☐ incorrect
	placement	☐☐ correct ☐☐ incorrect

Note: When scoring an erroneous production, try not to penalise the same error twice.

Condition of testing ________

(1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)

Total score (1 point for each “yes” or “correct” box)	_______**/47**
Total MIDDLE score ONLY	_______**/17**
Total LEFT score ONLY	_______**/15**
Total RIGHT score ONLY	_______**/15**

☐☐ Micrographia (the copy is less than half the size of the original figure, both in height and width) ☐☐ Macrographia (the copy is more than one and a half times the size of the original figure, both in height and width) ☐☐ Neglect (the performance is substantially worse on the left or right parts relative to the other parts of the figure) ☐☐ Additions/Perseverations (the drawing contains elements not present in the original figure)

23. INSTRUCTION COMPREHENSION

✎✎ *Evaluate the examinee’s overall understanding of the instructions*

Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_______
Total score (1=poor understanding even after repetition, 2=relatively good understanding but instructions need often to be repeated, 3=good understanding, almost no need to repeat the instructions) NOTE: This assessment should be *primarily* based on the scoring for instruction/question comprehension in the following tasks: orientation (1a–1b–1c), sentence construction (3), rule finding and concept switching (10) and auditory attention (11).	

Appendix H

BCoS Difficult Index Word Images

BCoS Items	Difficulty Index	
1. Umbrella	0.98	Easy
2. Bell	0.95	Easy
3. Grapes	0.92	Easy
4. Pineapple	0.90	Easy
5. Hook	0.88	Easy
6. Bat	0.85	Easy
7. Spanner	0.79	Substantial
8. Peas	0.52	Moderate
9. Colander	0.35	Fair
10. Tiger	0.34	Fair
11. Chisel	0.32	Fair
12. Stop watch	0.13	Difficulty
13. Leek	0.03	Difficulty
14. Raspberry	0.02	Difficulty

All difficulty indexes that are less than or equal to 0.3 are considered difficult and all those above 0.8 are considered easy. From the table above, we note that there are three BCoS items with indexes less than 0.3 and these are Stop watch, leek and raspberry. These items are considered difficult. Raspberry and Leek were almost wrongly identified by all participants with difficult indexes of 0.02 and 0.03 respectively. Colander, tiger and chisel have also very small difficult indexes. As a result they can also be considered difficult items. Peas have a moderate difficult index meaning that at least half of the participants could correctly identify them. The rest of the BCoS items scored high indexes meaning they were easy for most of the participants.

BCosS Items	Difficulty Index	
1. The	1.00	Easy
2. Belong	1.00	Easy
3. To0	1.00	Easy
4. The1	1.00	Easy
5. Are	1.00	Easy
6. In0	1.00	Easy
7. After	1.00	Easy
8. We	1.00	Easy
9. The2	1.00	Easy
10. At	1.00	Easy
11. Daughter’s	1.00	Easy
12. House	1.00	Easy
13. ,	1.00	Easy
14. A	1.00	Easy
15. Home	1.00	Easy

16. Whether	1.00	Easy
17. The3	1.00	Easy
18. Had	1.00	Easy
19. Been	1.00	Easy
20. Which	0.98	Easy
21. Kept	0.98	Easy
22. Castle	0.98	Easy
23. To1	0.98	Easy
24. Concert	0.98	Easy
25. Our	0.98	Easy
26. Walk	0.98	Easy
27. Members	0.98	Easy
28. While	0.97	Easy
29. Debating	0.97	Easy
30. And0	0.97	Easy
31. Treasures	0.97	Easy
32. His	0.97	Easy
33. Award winning	0.97	Easy
34. Listen	0.95	Easy
35. Took	0.95	Easy

36. Impartial	0.90	Easy
37. Leisurely	0.90	Easy
38. Jury	0.81	Easy
39. Swords	0.80	Easy
40. Viscount	0.22	Difficult

Most of the participants managed to read the sentences very well. There was only one BCoS item that proved to be difficult for the majority of the participants. The item is “Viscount” and this was correctly read by only 22% of the participants meaning a difficult index of 0.22. All other items had difficult indexes of 0.8 and higher.

BCoS items	Difficulty Index	
1. Vench	0.91	Easy
2. Flosp	0.88	Easy
3. Dwend	0.86	Easy
4. Shreel	0.84	Easy
5. Glurms	0.82	Easy
6. Brilt	0.75	Easy

Non words reading, that is reading of words that do not mean anything was easy for all the participants recording difficult indexes of at least 0.75. The only non word that was not easily read was Brilt and that has the lowest difficult index of 0.75. Not all words were easily read with the one that was easily read by the majority having a 0.91 difficult index.

BCoS Items	Difficulty indexes

	Free recall1	Multiple choice	Recognition1
1. Mrs. Davis	0.51	0.27	0.22
2. Manchester	0.39	-	0.61
3. Neighbor	0.54	-	0.46
4. Super	0.42	0.07	0.51
5. Robbed	0.85	-	0.15
6. Day	0.16	-	0.84
7. Office	0.16	0.07	0.76
8. Pension	0.28	0.02	0.71
9. Two	0.71	-	0.29
10. Teenage	0.41	0.10	0.48
11. Pounds	0.41	-	0.59
12. Handbag	0.05	0.07	0.88
13. Caught	0.46	0.02	0.53
14. Trainee			
15. Corner	0.14	-	0.86

On free recall, the only item that was easy for most of the participants p=0.85 was “robbed”. All other BCoS items that were being tested have difficult indexes ranging between 0.05 and 071. Considering that if the difficulty index of less than or equal to 0.3 is considered difficult, there are quite a number of items that were difficult for the participants. These are Handbag (p=0.05), Corner (p=0.14), day (p=016), Office (p=0.16) and Pension (p=0.28). After some probing, most of the items remained difficult for the participants. The highest difficult index was p=0.27 for the item “Mrs. Davis”. All other items had very low difficulty indexes meaning that participants could not recall them. The items “Caught” and “Pension” had difficulty indexes of p=0.02 meaning that almost all participants found recalling difficult. There were only three BCoS items that were easily recognized by participants. These are Handbag (p=0.88), Day (p=0.84) and Corner (p=0.86). The item with the smallest recognition was “Robbed” with difficulty index, p=0.15.

BCoS Items	Difficulty indexes		
	Free recall1	Multiple choice	Recognition1
1. Mrs. Davis2	0.56	0.19	0.25
2. Manchester2	0.39	-	0.61
3. Neighbor2	0.76	-	0.24
4. Super 2	0.66	0.03	0.31
5. Robbed2	0.75	0.02	0.24
6. Day 2	0.38	-	0.63
7. Office2	0.45	0.15	0.40
8. Pension2	0.47	0.05	0.48
9. Two 2	0.69	0.02	0.29
10. Teenage2	0.61	0.19	0.20
11. Pounds2	0.63	-	0.37
12. Handbag2	0.17	0.16	0.67
13. Caught 2	0.86	-	0.14
14. Trainee 2	0.69	0.17	0.14
15. Corner 2	0.68	0.02	0.30

The second free recall had only one BCoS item that was easy for the participants. This item was "Robbed", p=0.86. There were some other items that were freely recalled with substantial difficulty. Items like Neighbor and Robbed had difficulty indexes of 0.76 and 0.75 respectively. The item "Handbag" was freely recalled by about 17% of the participants meaning a difficulty index of p=0.17. This means it was difficult. After some probing, the items still remained difficult. No item was easy with all items having a difficulty index of less than p=0.3. There was no BCoS item that was easily recognized since all difficulty indexes are less than p=0.3. This means on recognizing items, all the items were difficult for the participants. The most difficult ones were Caught (p=0.14) and Trainee (p=0.14).

AASOCIATIONS BETWEEN BCOS ITEMS AND GENDER

BCoS Items	**Male** N (%)	**Female** N (%)	**Total**	**Association P-value**
Bell				
Incorrect	1(3%)	2(6%)	3	P=1.000
Correct	28(97%)	30(94%)	58	
Total	29	32	61	
Peas				
Incorrect	14(48%)	15(47%)	29	P=1.000
Correct	15(52%)	17(53%)	32	
Total	29	32	61	
Grapes				
Incorrect	4(14%)	1(3%)	5	P=0.182
Correct	25(86%)	31(97%)	56	
Total	29	32	61	
Umbrella				
Incorrect	1(3%)	0	1	P=0.475
Correct	28(97%)	32(100%)	60	
Total	29	32	61	
Raspberry				
Incorrect	28(97%)	32(100%)	60	P=0.475
Correct	1(3%)	0	1	
Total	29	32	61	
Colander				
Incorrect	24(83%)	15(48%)	39	P=0.007
Correct	5(17%)	16(52%)	21	
Total	29	31	60	
Leek				
Incorrect	29(100%)	30(94%)	59	P=0.493
Correct	0	2(6%)	2	
Total	29	32	61	
Stopwatch				
Incorrect	23(79%)	30(94%)	53	P=0.135
Correct	6(21%)	2(6%)	8	
Total	29	32	61	

Bat				
Incorrect	5(17%)	4(13%)	9	P=0.602
Correct	24(83%)	28(88%)	52	
Total	29	32	61	
Pineapple				
Incorrect	4(14%)	2(6%)	6	P=0.411
Correct	25(86%)	30(94%)	55	
Total	29	32	61	
Chisel				
Incorrect	11(38%)	30(97%)	41	P<0.001
Correct	18(62%)	1(3%)	19	
Total	29	31	60	
Tiger				
Incorrect	19(66%)	21(66%)	40	P=1.000
Correct	10(34%)	11(34%)	21	
Total	29	32	61	
Hook				
Incorrect	3(10%)	11(34%)	14	P=0.034
Correct	26(90%)	21(66%)	47	
Total	29	32	61	
Spanner				
Incorrect	0	13(41%)	13	P<0.001
Correct	29(100%)	19(59%)	48	
Total	29	32	61	

The null hypothesis H_0 assumes that there is no association between the variables (in other words, one variable does not vary according to the other variable), while the alternative hypothesis H_a claims that some association does exist.

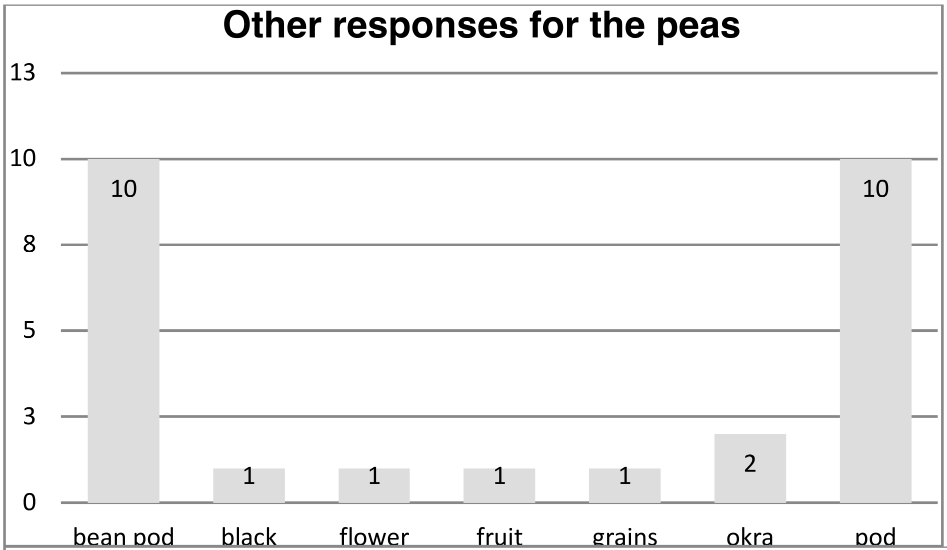
Of interest here is to test whether gender is associated with participants correctly or incorrectly naming the pictures shown. Chi-square tests were performed to test the null hypothesis of no association between correctly and incorrectly naming pictures and gender. For statistical significance, a p-value of 0.05 or less was considered to be statistically significant. There was a significant statistical association between gender and items colander, p=0.007, chisel, p<0.001, hook, p=0.034 and spanner, p<0.001. All other items were not statistically associated with gender.

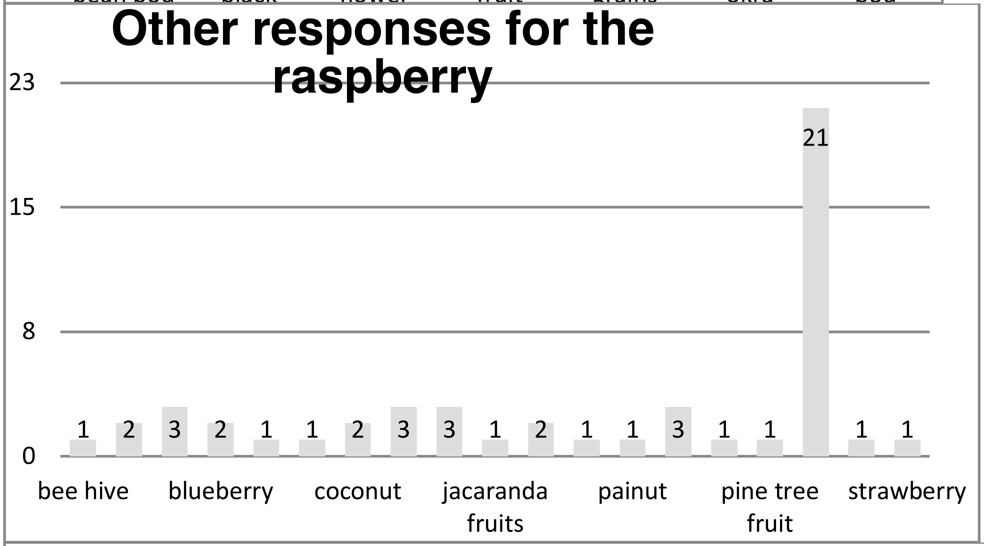
LOGISTIC REGRESSION TO TEST THE ODDS OF CORRECTLY INDENTIFYING AN OBJECT ACCORDING TO GENDER

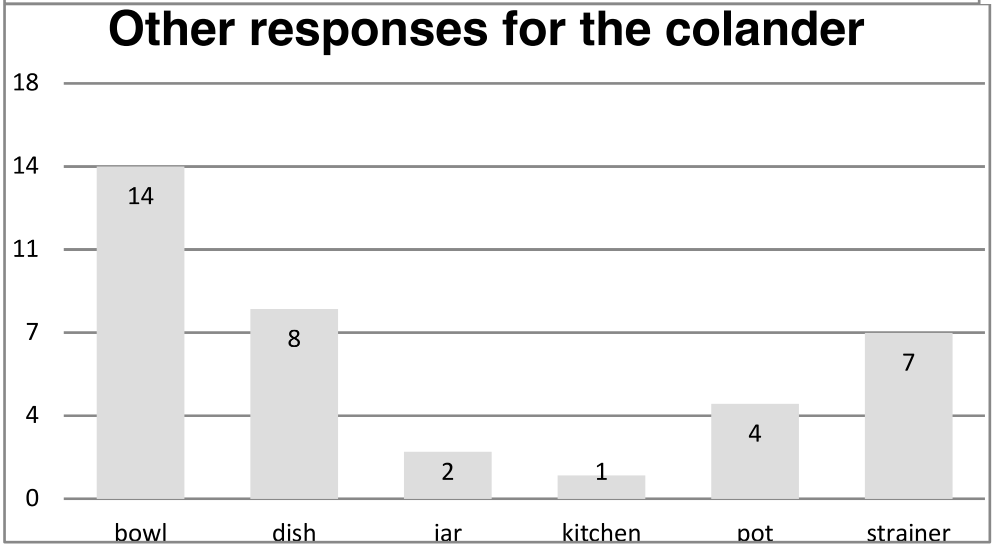
Dependent variable	**Independent variable**	Odds ratio	95% CI		P-value
Bell	Gender				
	Male	1 (Base)			P=0.618
	Female	0.536	0.046	6.240	
Peas	Gender				
	Male	1 (Base)			P=0.913
	Female	1.058	0.387	2.893	
Grapes	Gender				
	Male	1(Base)			P=0.164
	Female	4.960	0.521	47.236	
Umbrella	Gender				
	Male	1 (Base)			
	Female	1			
Raspberry	Gender				
	Male	1 (Base)			
	Female	1			
Colander	Gender				
	Male	1 (Base)			P=0.007
	Female	5.120	1.552	16.890	
Leek	Gender				
	Male	1 (Base)			
	Female	1			
Stopwatch	Gender				
	Male	1 (Base)			P=0.114
	Female	0.256	0.047	1.385	
Bat	Gender				
	Male	1 (Base)			P=0.603
	Female	1.458	0.351	6.054	
Pineapple	Gender				
	Male	1 (Base)			P=0.335
	Female	2.400	0.405	14.209	
Chisel	Gender				
	Male	1 (Base)			P<0.001
	Female	0.020	0.002	0.171	
Tiger	Gender				
	Male	1 (Base)			P=0.993
	Female	0.995	0.346	2.866	

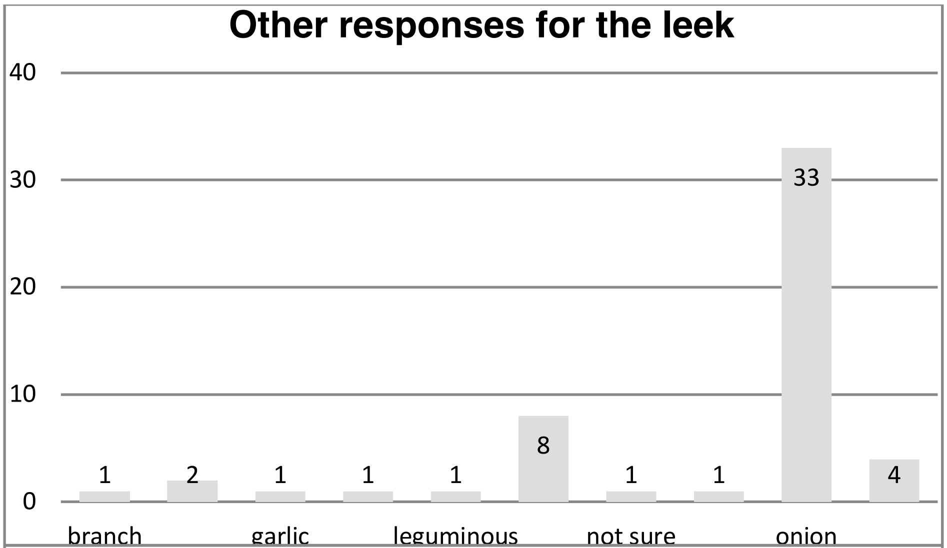
Hook	Gender				
	Male	1 (Base)			P=0.034
	Female	0.220	0.054	0.893	
Spanner	Gender				
	Male	1 (Base)			
	Female	1			

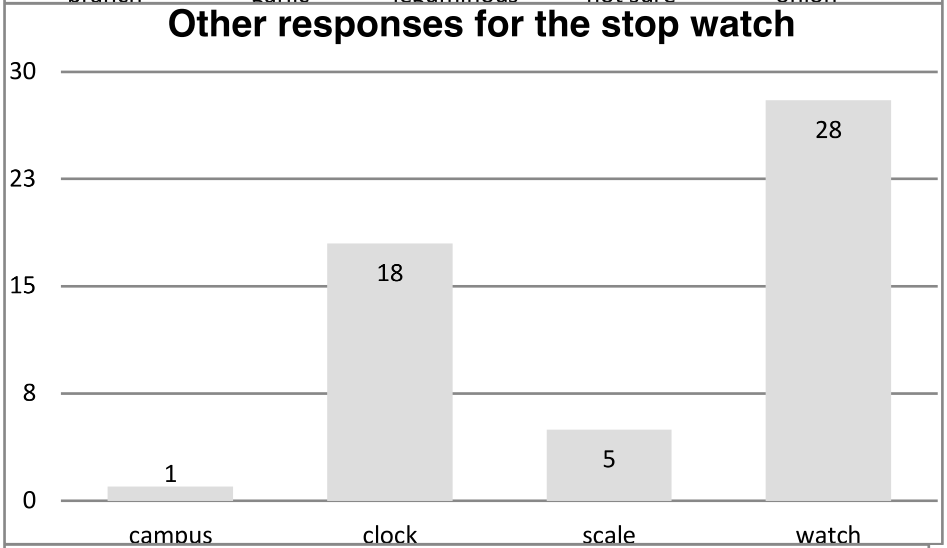
Logistic regression was used to predict membership of one or other of the two dependent variable categories and this will be reported in odds ratios as they are useful because they provide estimates with confidence intervals of the relationships between response and explanatory variables. Logistic regression models the relationship between a binary or ordinal response variable and one or more explanatory variables. Females were less likely to be able to name a bell compared to their male counterparts but they were approximately 5 times more likely to be able to name grapes compared to males though this was not statistically significant, p=0.164. For the item colander, there was statistical significance, p=0.007 where females were 5.12 times more likely to be able to name colander compared to males. Other statistical significant results were observed on items chisel and hook, p<0.001 and p=0.034 respectively. On naming chisel, females were 0.98 times less likely to be able to name chisel compared to males and 0.78 times less likely to be able to name hook compared to their male counterparts. There were no other significant results for other BCoS items that were under investigation.

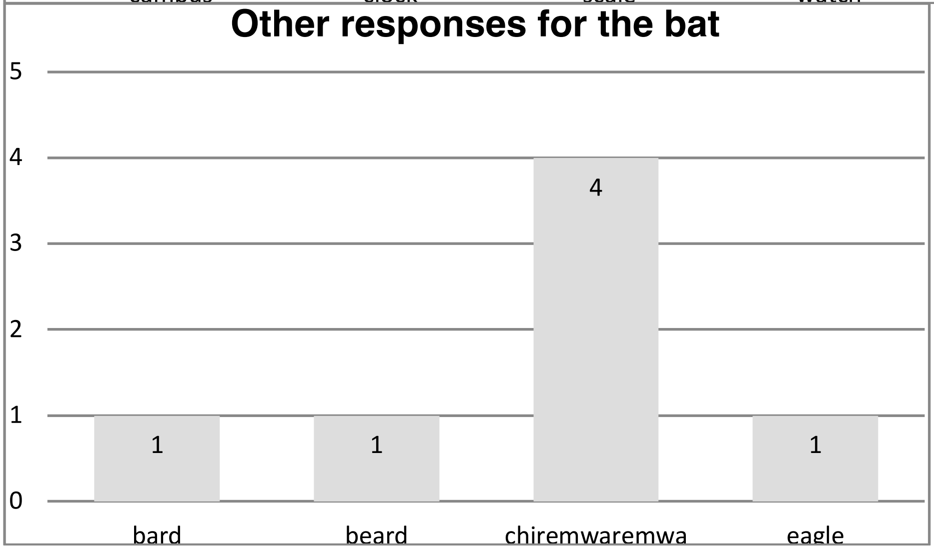

Other responses for the peas
13
10
8
5
3
0
10
1
1
1
1
2
10
bean pod
black
flower
fruit
grains
okra
pod

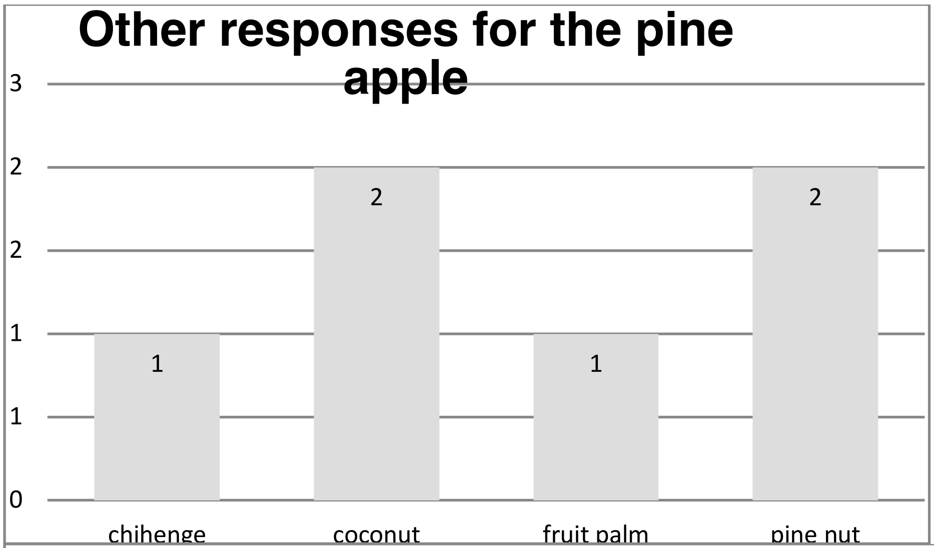

Other responses for the raspberry
23
15
8
0
1
2
3
2
1
1
2
3
3
1
2
1
1
3
1
1
21
1
1
bee hive
blueberry
coconut
jacaranda fruits
painut
pine tree fruit
strawberry

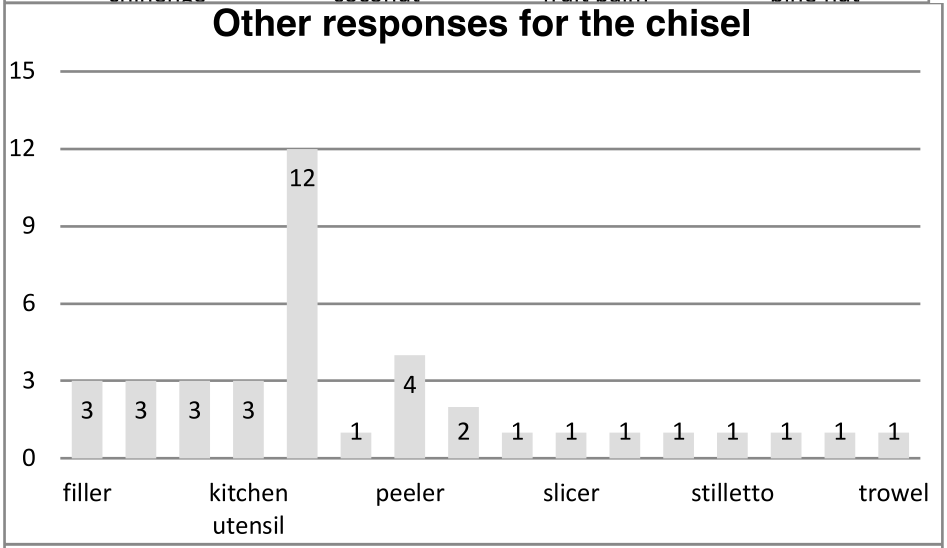

Other responses for the colander
18
14
11
7
4
0
14
8
2
1
4
7
bowl
dish
jar
kitchen
pot
strainer

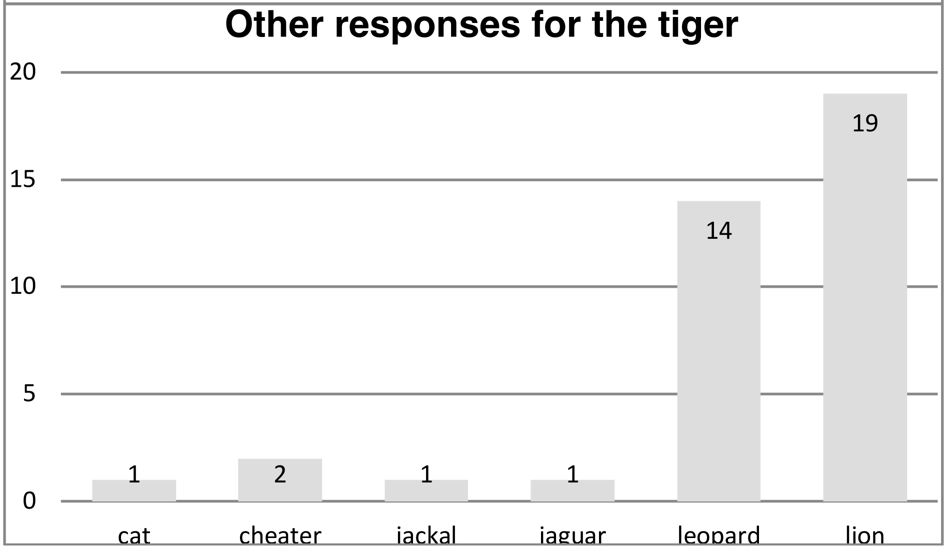

Other responses for the leek
40
30
20
10
0
1
2
1
1
1
8
1
1
33
4
branch
garlic
leguminous
not sure
onion

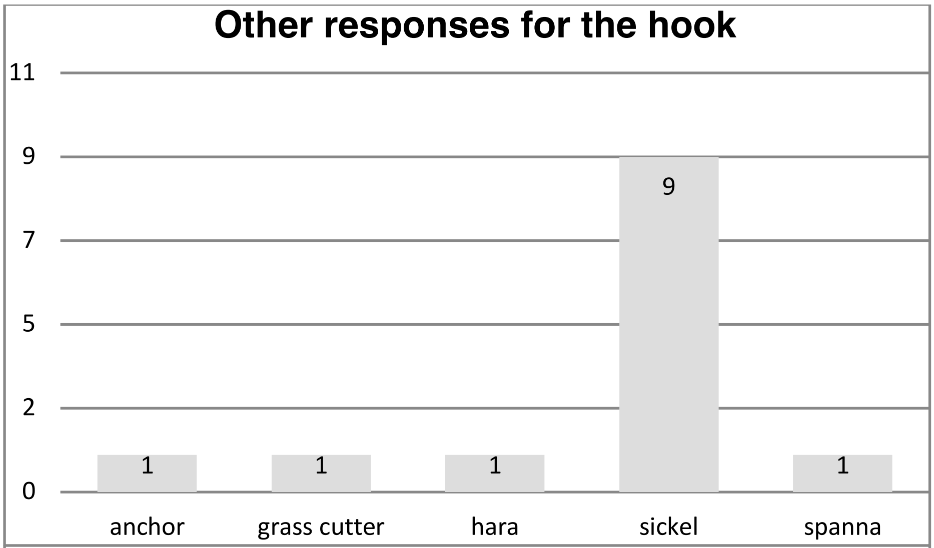

Other responses for the stop watch
30
23
15
8
0
1
18
5
28
campus
clock
scale
watch


Other responses for the bat
5
4
3
2
1
0
1
1
4
1
bard
beard
chiremwaremwa
eagle

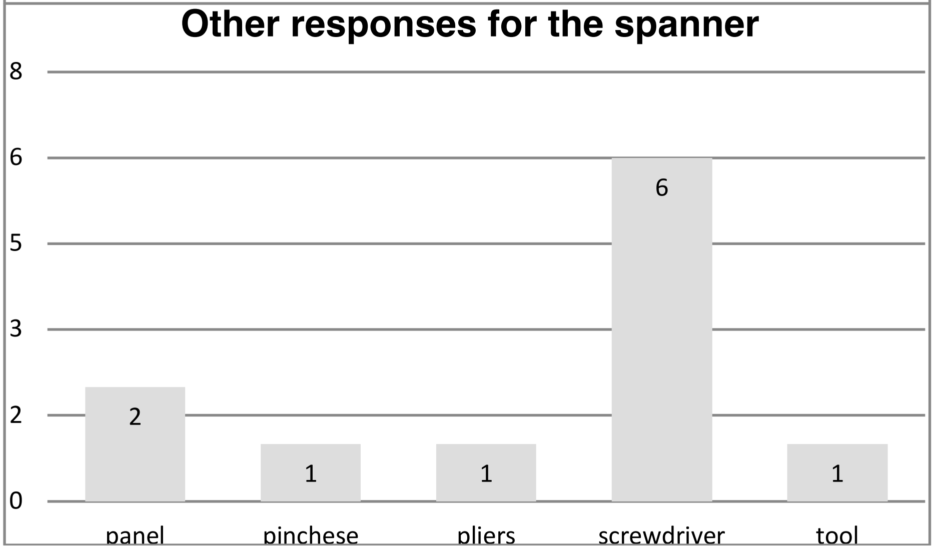

Other responses for the pine apple


Other responses for the chisel


Other responses for the tiger

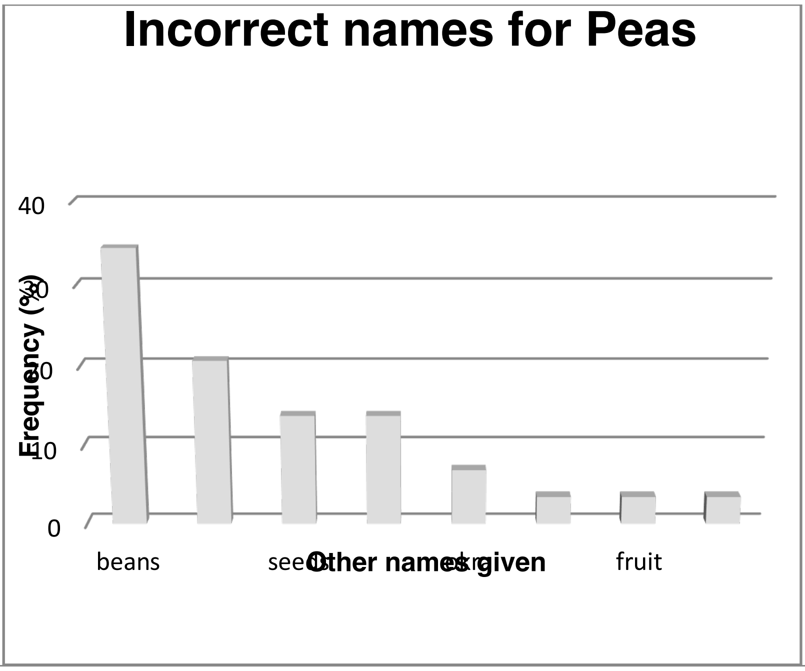


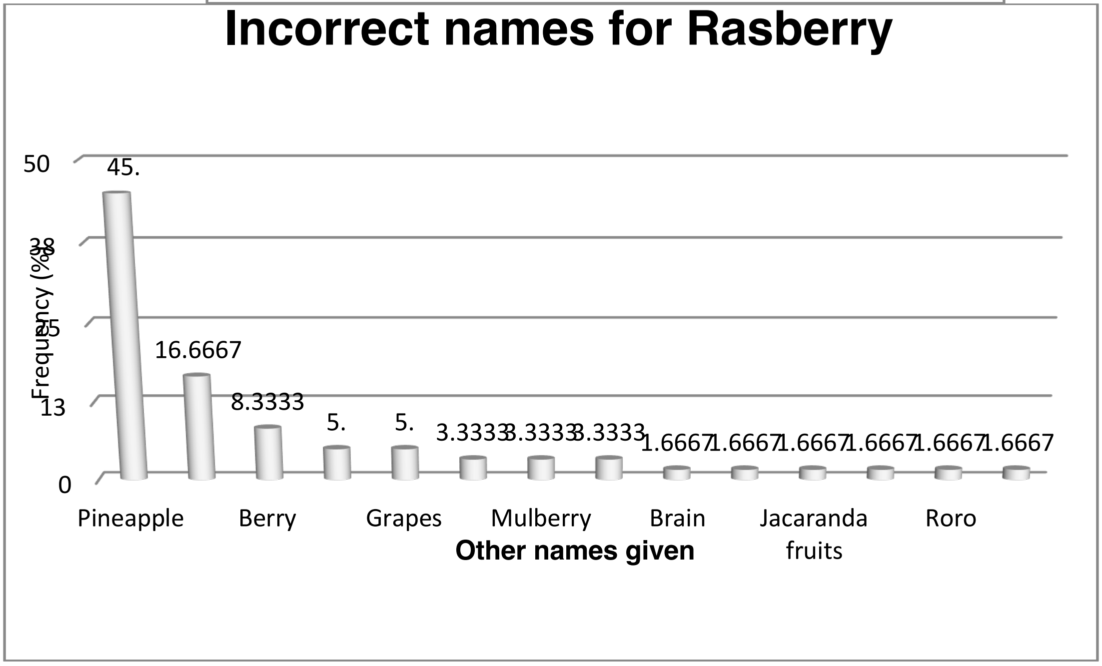
Other responses for the hook



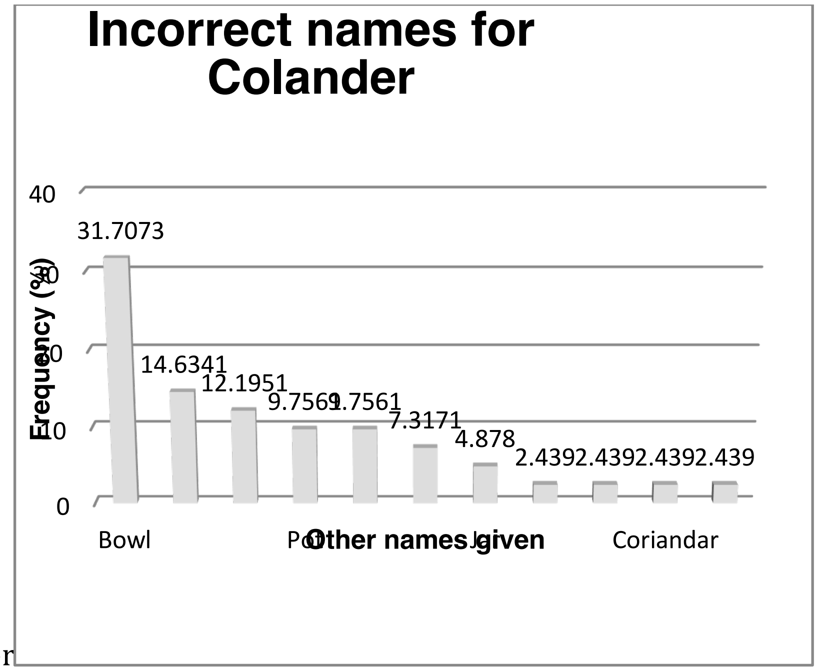
Other responses for the spanner

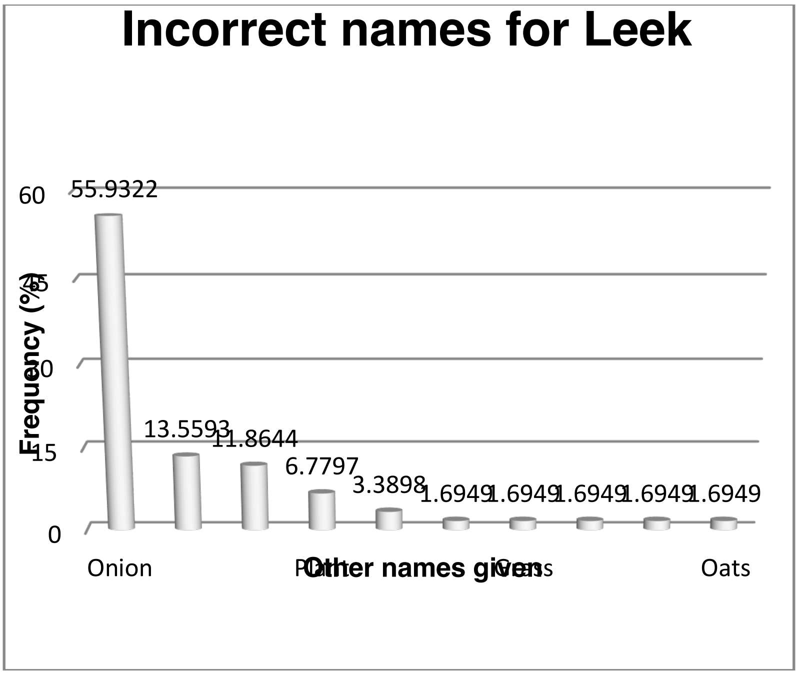
Images of Incorrect Responses


Incorrect names for Peas
Frequency (%)
40
30
20
10
0
beans
seeds
Other names given
okra
fruit


Incorrect names for Rasberry
Frequency (%)
50
38
25
13
0
45.
16.6667
8.3333
5.
5.
3.3333
3.3333
3.3333
1.6667
1.6667
1.6667
1.6667
1.6667
1.6667
Pineapple
Berry
Grapes
Mulberry
Brain
Jacaranda fruits
Roro
Other names given

Colander


Incorrect names for Colander
40
30
20
10
0
Frequency (%)
31.7073
14.6341
12.1951
9.7561
9.7561
7.3171
4.878
2.439
2.439
2.439
2.439
Bowl
Pot
Other names given
Jug
Coriandar


Incorrect names for Leek
60
45
30
15
0
Frequency (%)
55.9322
13.5593
11.8644
6.7797
3.3898
1.6949
1.6949
1.6949
1.6949
1.6949
Onion
Plant
Other names given
Greens
Oats

Appendix I

Cognitive Debriefing Interview Guide

Examinee experience:

How was the test?

What is easy/difficulty?

Anything else?

What can be improved/changed?

Is it culturally relevant?

Anything unfamiliar?

Which task was difficulty, how, why

Which task was easy, how, why

Examiner experiences:

Check where they scored badly and ask how that task was

Report any refusals and give reasons

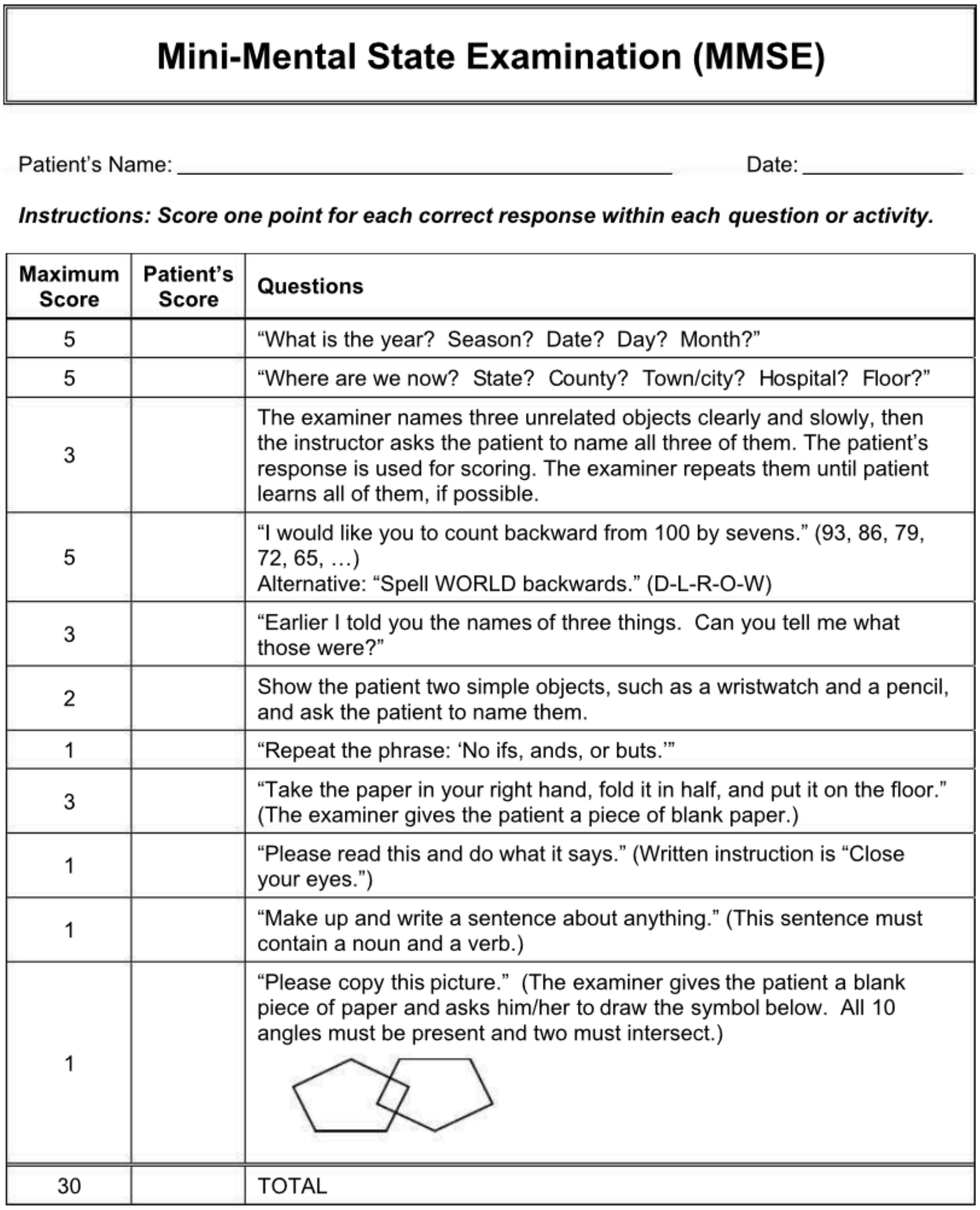
Any incomplete and why, Interruptions?

Any people not meeting criteria? Why?

How are you experiencing administering the test?

Appendix J1

Mini-mental State Examinamtion (MMSE)



Mini-Mental State Examination (MMSE)

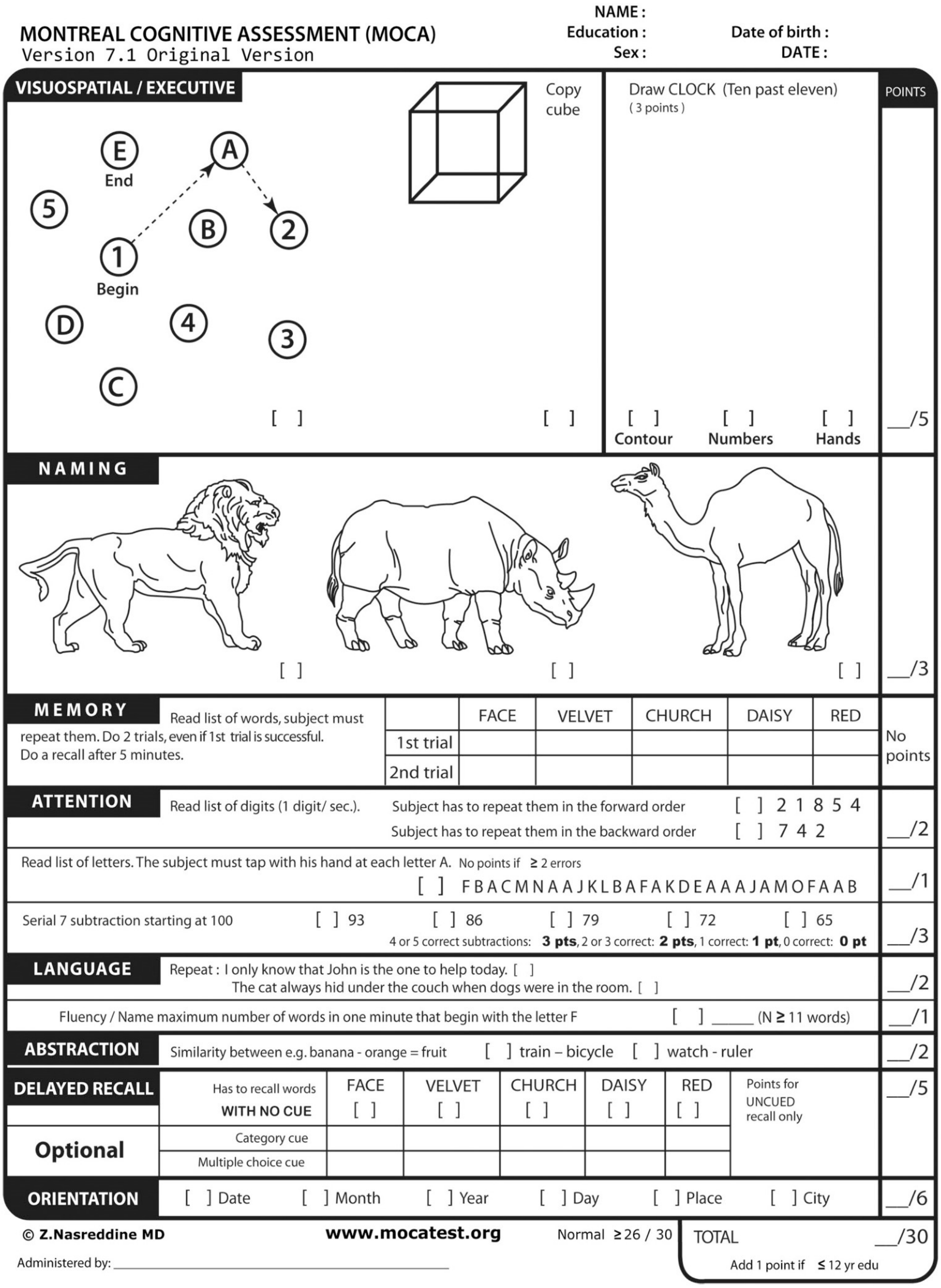
Patient's Name: ____ Date: ______________

Instructions: Score one point for each correct response within each question or activity.

Maximum Score	Patient's Score	Questions
5		"What is the year? Season? Date? Day? Month?"
5		"Where are we now? State? County? Town/city? Hospital? Floor?"
3		The examiner names three unrelated objects clearly and slowly, then the instructor asks the patient to name all three of them. The patient's response is used for scoring. The examiner repeats them until patient learns all of them, if possible.
5		"I would like you to count backward from 100 by sevens." (93, 86, 79, 72, 65, …) Alternative: "Spell WORLD backwards." (D-L-R-O-W)
3		"Earlier I told you the names of three things. Can you tell me what those were?"
2		Show the patient two simple objects, such as a wristwatch and a pencil, and ask the patient to name them.
1		"Repeat the phrase: 'No ifs, ands, or buts.'"
3		"Take the paper in your right hand, fold it in half, and put it on the floor." (The examiner gives the patient a piece of blank paper.)
1		"Please read this and do what it says." (Written instruction is "Close your eyes.")
1		"Make up and write a sentence about anything." (This sentence must contain a noun and a verb.)
1		"Please copy this picture." (The examiner gives the patient a blank piece of paper and asks him/her to draw the symbol below. All 10 angles must be present and two must intersect.)
30		TOTAL

Appendix J2

MoCA Test English



MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Original Version

NAME :
Education : **Date of birth :**
Sex : **DATE :**

VISUOSPATIAL / EXECUTIVE

[ ]

Copy cube

[ ]

Draw CLOCK (Ten past eleven)
(3 points)

[ ] Contour [ ] Numbers [ ] Hands

POINTS

___/5

NAMING

[ ] [ ] [ ]

___/3

MEMORY Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful.
Do a recall after 5 minutes.

	FACE	VELVET	CHURCH	DAISY	RED
1st trial					
2nd trial					

No points

ATTENTION Read list of digits (1 digit/ sec.).
Subject has to repeat them in the forward order [ ] 2 1 8 5 4
Subject has to repeat them in the backward order [ ] 7 4 2
___/2

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors
[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B
___/1

Serial 7 subtraction starting at 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65
4 or 5 correct subtractions: **3 pts**, 2 or 3 correct: **2 pts**, 1 correct: **1 pt**, 0 correct: **0 pt**
___/3

LANGUAGE Repeat : I only know that John is the one to help today. [ ]
The cat always hid under the couch when dogs were in the room. [ ]
___/2

Fluency / Name maximum number of words in one minute that begin with the letter F [ ] _____ (N ≥ 11 words)
___/1

ABSTRACTION Similarity between e.g. banana - orange = fruit [ ] train – bicycle [ ] watch - ruler
___/2

DELAYED RECALL

Has to recall words **WITH NO CUE**	FACE [ ]	VELVET [ ]	CHURCH [ ]	DAISY [ ]	RED [ ]	Points for UNCUED recall only
Optional Category cue						
Multiple choice cue						

___/5

ORIENTATION [ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City
___/6

© Z.Nasreddine MD **www.mocatest.org** Normal ≥26 / 30

TOTAL ___/30
Add 1 point if ≤ 12 yr edu

Administered by: ______________________________

Appendix J3

Brixton Spatial Anticipation Test

Instructions and Scoring sheet

Each page in this book has a blue circle. Can you point to the blue circle. The position of this blue circle changes from one page to the next, and the changes are governed by a series of simple rules that vary without warning. I am going to open each page one at a time. Please to point to where you think the blue circle will be on the next page based on the pattern or rule that you observe from the previous pages.

PAGE NO.	POSITION	
0-point to circle	EXAMPLE	EXAMPLE
1	Any	Any
2	2	
3	3	
4	4	
5	5	
6	6	
7	5 or 8	
8	4	
9	3	
10	2	
11	1	
12	10	
13	5	
14	10	
15	5	
16	10	
17	5	
18	10	
19	5	
20	6	
21	7	
22	8	
23	9	
24	10	
25	1	
26	2	
27	1	
28	10	
29	9	
30	10	
31	1	
32	2	
33	3	

34	4 or 5	
35	10	
36	4	
37	4	
38	10	
39	4	
40	9 or 10	
41	9	
42	9	
43	9	
44	9	
45	9	

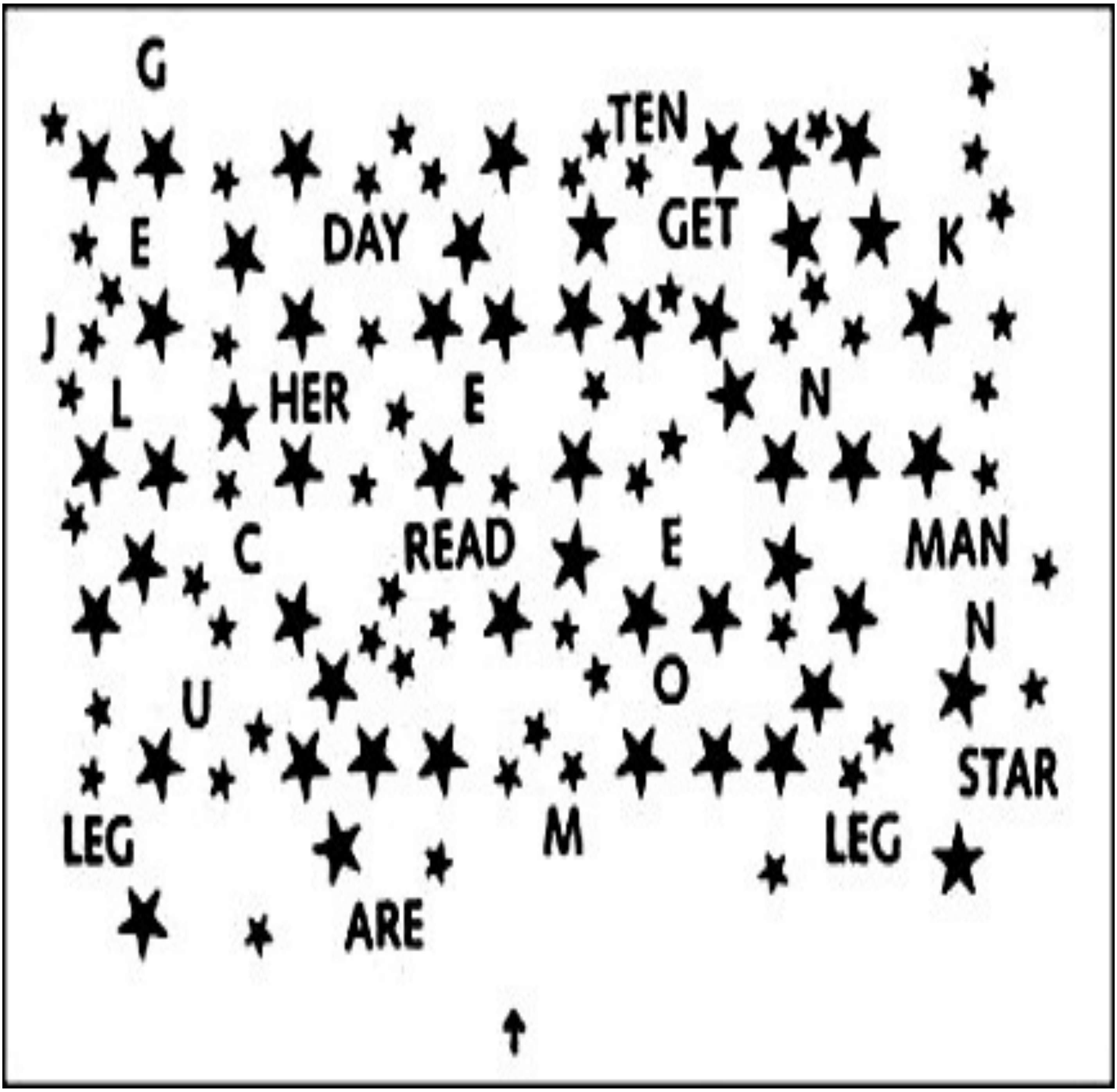
46	9	
47	9	
48	9	
49	8 or 9	
50	9	
51	8	
52	9	
53	8	
54	9	
55	8	
56	9	

Total correct ________

Number of rules detected /

Appendix J4

Star Cancellation



Appendix J5

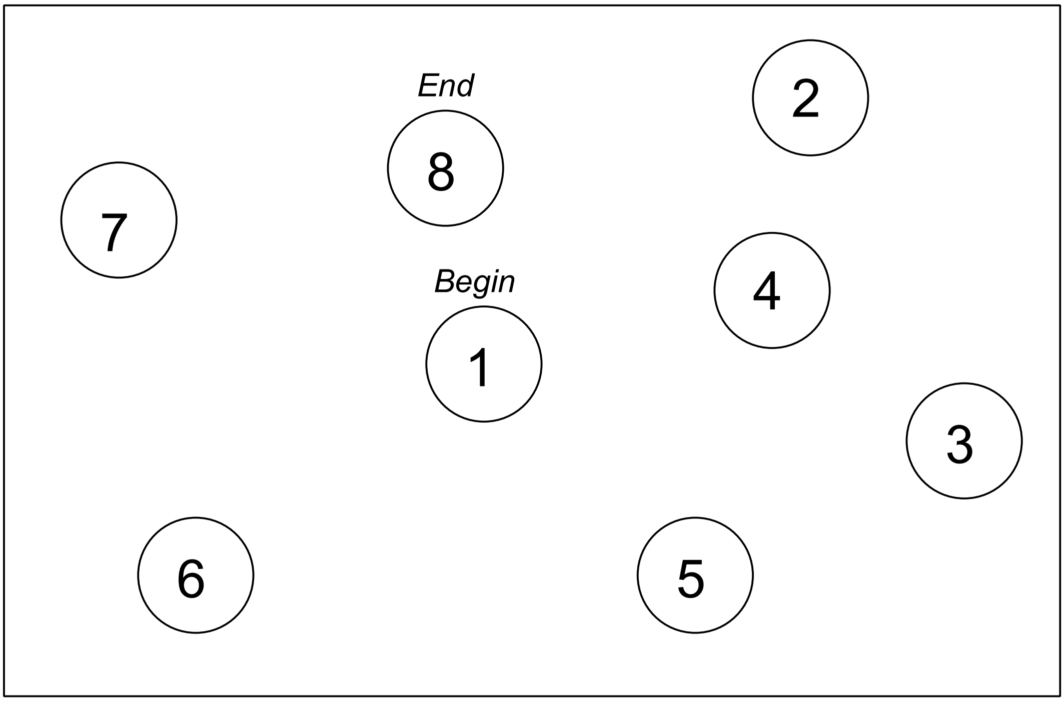
Trail Making Test

Instruction: Say to the patient: *I want you to connect these numbers in order, starting with*

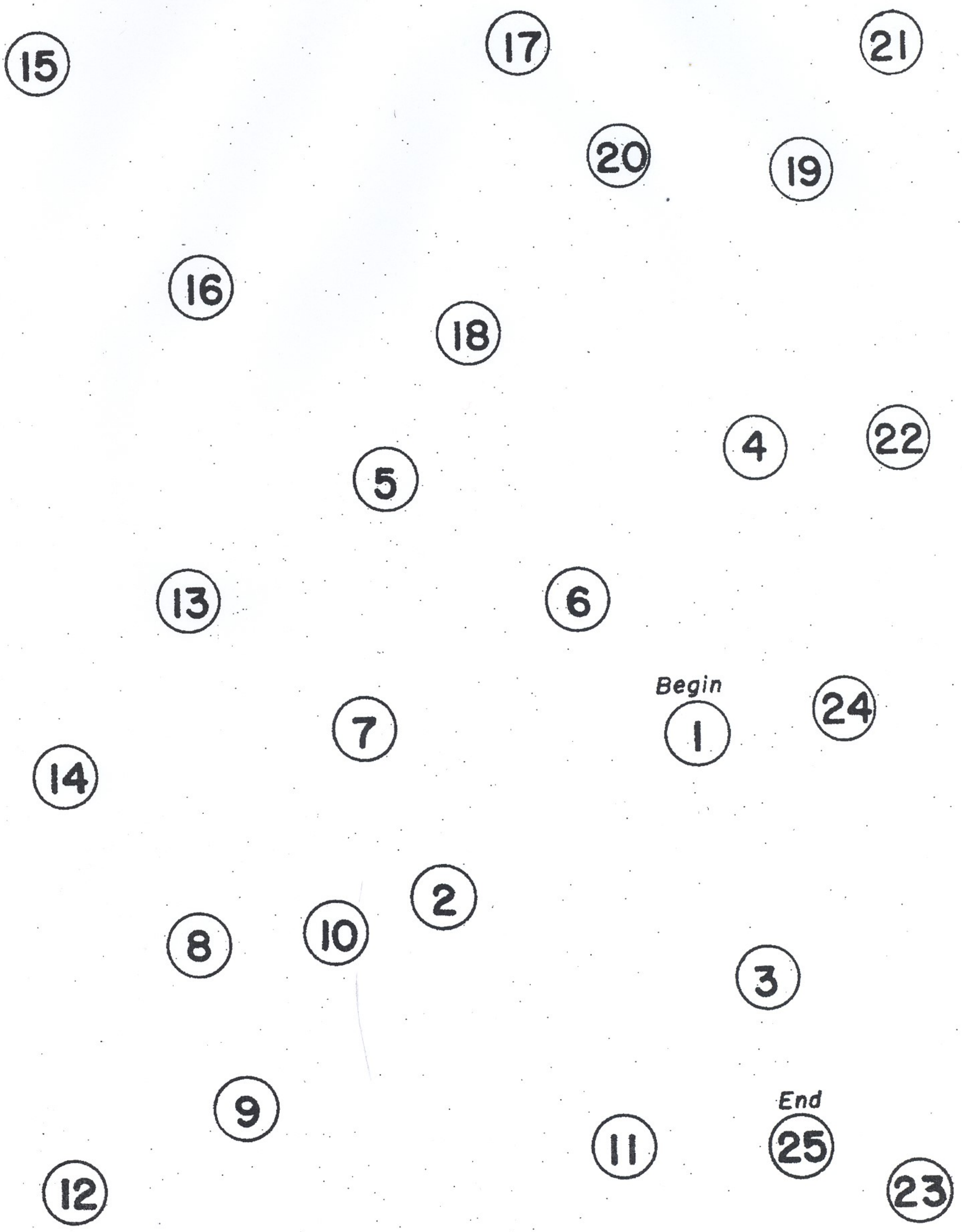
number one and ending with number eight. Do it as quickly as you can without making any errors, and try not to lift your pen from the page. Correct performance as necessary.

When they have completed the practice item, turn over the page and ask them to complete the test item in the same manner.
(Time for 4 minutes)

Practice:



Completed Test Item: **Number of Errors:**



Time

Time **Discontinued**

Secs Secs

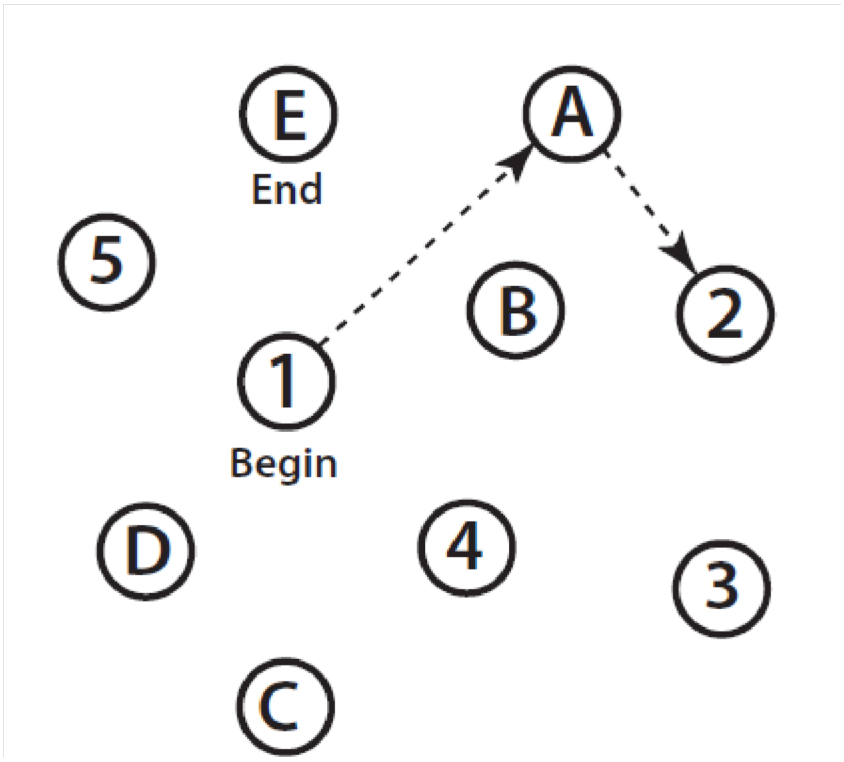
Not done Please ☐ specify …………………………………………………………………………

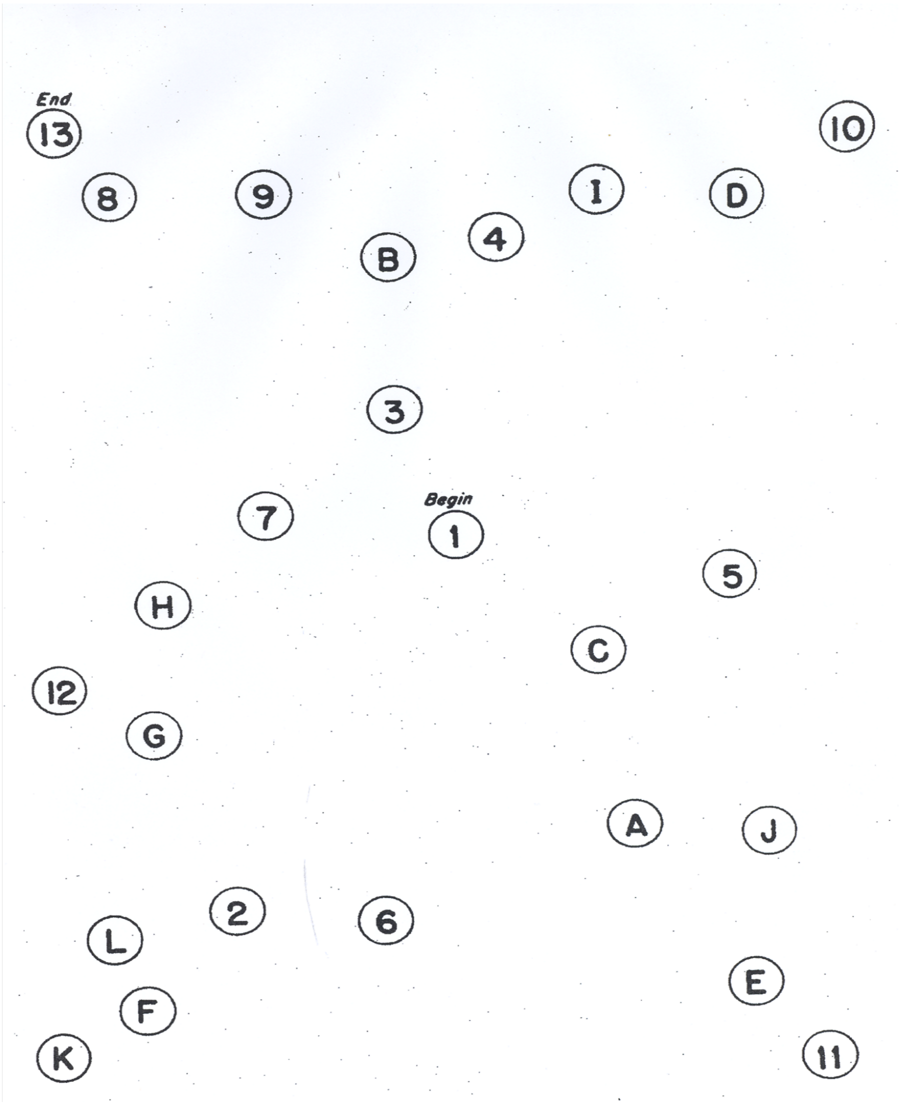
L5.2 Assess the patient's **cognitive switching**

Instruction: Say to the patient: *Now I want you to connect these numbers and letters in order, starting with a number, and then a letter, and then a number and so on. So you would start with 1, then draw a line to A, and then draw a line to 2., alt the way to the letter E. Do it as quickly as you can without making any errors, and try not to lift your pen from the page.*

(Time for 4 minutes)

Test Item:





Time **Completed?** ☐ Secs

Time: **Discontinued** ☐ Secs

Number of Errors: ☐

Not done ☐ Please specify …………………………………………

Appendix K1

Patient Health Questionnaire-9

PHQ-9

	Over the LAST 2 WEEKS, how often have you been <u>bothered</u> by any of the following problems? *Mumasvondo maviri apfuura makashungurudzwa kangani nematambudziko anotevera?*	Not at all *Kwete*	Several days *Mamwe mazuva* *Apo neapo*	More than half the days *Zviri pakati nepakati*	Nearly every day *Zuva rega rega*
1	Little interest or pleasure in doing things. *Kusanyatsova nechido chekuita zvinhu.*	0	1	2	3
2	Feeling down, depressed, or hopeless. Kusanyatsonzwa chido nezvehupenyu, *kufunganya zvakapfuurikidza kana kushaya tariro muhupenyu*	0	1	2	3
3	Trouble falling or staying asleep, or sleeping too much. *Kutadza kuwana hope kana kurara zvakapfuurikidza.*	0 1	2	3	
4	Feeling tired or having little energy. *Kunzwa kuneta uye kuve nesimba shoma rekuita zvinhu.*	0 1	2	3	
5	Poor appetite or overeating. Kusanyatsodya zvakakwana kana kudyisa.	0 1	2	3	
6	Feeling bad about yourself — or that you are a failure or have let yourself or your family down. *Kuzvizvidza pachezvako kana kuti knzwa sekuti uri mukundikani muhupenyu kana kutadza kuzadzikisa zvaitarisirwa nemhuri yekwako.*	0	1	2	3
7	Trouble concentrating on things, such as reading the newspaper or watching television. *Kutadza kuita zvinhu zvakaita sekuverenga pepanhau nekuona chivhitivhiti pfungwa dziri pamwechete*	0 1	2	3	
8	Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual.	*Kufamba kana kutaura zvine kunonokera mukati zvekuti zvinogona* 0 1 2 3 *zvakaonekwa nevamwe vakakutenderedza? Kana kuti kutadza kugarisika zvekuti wange urikufamba-famba zvakapfuurikidza zvaunofanirwa kunge uchiita*			

9	Thoughts that you would be better off dead or of hurting yourself in some way. *Kuve nendangariro dzekuti zvirinani kuti dai wafa zvakodu kana kuda kuzvikuvadza neimwe nzira*	0	1	2	3

A11 – PHQ9 total score ☐

Appendix K2
Generalized Anxiety Disorder-7

GAD-7

	Over the LAST 2 WEEKS, how often have you been <u>bothered</u> by any of the following problems?	Not at all *Kana*	Several days *Mamwe mazuva* *Apo neapo*	More than half the days *Zviri pakati nepakati*	Nearly every day *Zuva rega rega*
1	Feeling nervous, anxious or on edge. *Ndainzwa kugarotya, kutambudzika nekushushikana*	0	1	2	3
2	Not being able to stop or control worrying. *Kutadza kuregedza kushushikana mupfungwa*	0	1	2	3
3	Worrying too much about different things. *Kushushikana zvakanyanya nekuda kwezvinhu zvakasiyana- siyana*	0	1	2	3
4	Trouble relaxing. *Kutadza kuzorora/kugadzikana zvakanaka*	0	1	2	3
5	Being so restless that it is hard to sit still. *Kushushikana zvekuti kugarisika kwainetsa*	0	1	2	3
6	Becoming easily annoyed or irritable. *Kukurumidza kusvotwa nezvinhu*	0	1	2	3
7	Feeling afraid as if something awful might happen. *Kunzwa kutya kuti kungangoitike chinhu chakaipa*	0	1	2	3

A12 – GAD7 total score ☐

Appendix K3

Perceived Stress Scale

The questions in this scale ask about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, don't try to count up the number of times you felt a particular way; rather indicate the alternative that seems like a reasonable estimate. *Mibvunzo iyi yakanangana nemanzwiro uye mafungiro amanga muchiita mumwedzi wapfuura. Muchikamu chega chega muchakumbirwa kuti mutaure kuti zvinhu izvi zvaiitika kakawanda zvakadii. Mimwe mibvunzo ichaita seyakafanana, asi pane kamusiyano karipo. Imi munongopindura mubvunzo umwe neumwe wakazvimiririra. Zvinokurudzirwa kuti mungopindura nekukurumidza, kureva kuti, musanyanyonetseka nekunyatsoverenga kuti zvakaitika kangani, ingosarudzai zviripadyo.* **For each of the following, choose from the following:**

0-Never 1-Almost Never 2-Sometimes 3- Fairly Often 4-Very Often 0-Hazvina kumboitika 1-Zvakaitika zviri kure kure 2-Dzimwe nguva 3-Apo neapo 4-Nguva zhinji

______l. In the last month, how often have you been upset because of something that happened unexpectedly? *Mumwedzi wadarika kangani kamakatsamwiswa nechinhu chakangoitika zvamanga musingatarisire?*

______2. In the last month, how often have you felt that you were unable to control the important things in your life? *Mumwedzi wadarika kangani kamainzwa muchikundikana kukurira zvinhu zvakakosha zvine chekuita nehupenyu hwenyu?*

______3. In the last month, how often have you felt nervous and stressed? *Mumwedzi wadarika kangani kamainzwa kusagadzikana nekushushikana?*

_____4. In the last month, how often have you felt confident about your ability to handle your personal problems? *Mumwedzi wadarika kangani kamainzwa muchigona kukurira zvinhu zvinokunetsai?*

_____5. In the last month, how often have you felt that things were going your way? *Mumwedzi wadarika kangani kamainzwa zvinhu zvichikufambirai nenzira yamunoda?*

6. In the last month, how often have you found that you could not cope with all the things that you had to do? *Mumwedzi wadarika kangani kamainzwa* kuti murikukundikana kuita zvinhu zvose zvamaitarisira kuita?

_____7. In the last month, how often have you been able to control irritations in your life? *Mumwedzi wadarika kangani kamaigona kuzvidzora pakukurumidza kusvotwa?*

____8. In the last month, how often have you felt that you were on top of things? *Mumwedzi wadarika kangani kamainzwa muchikunda zvinhu zvose?*

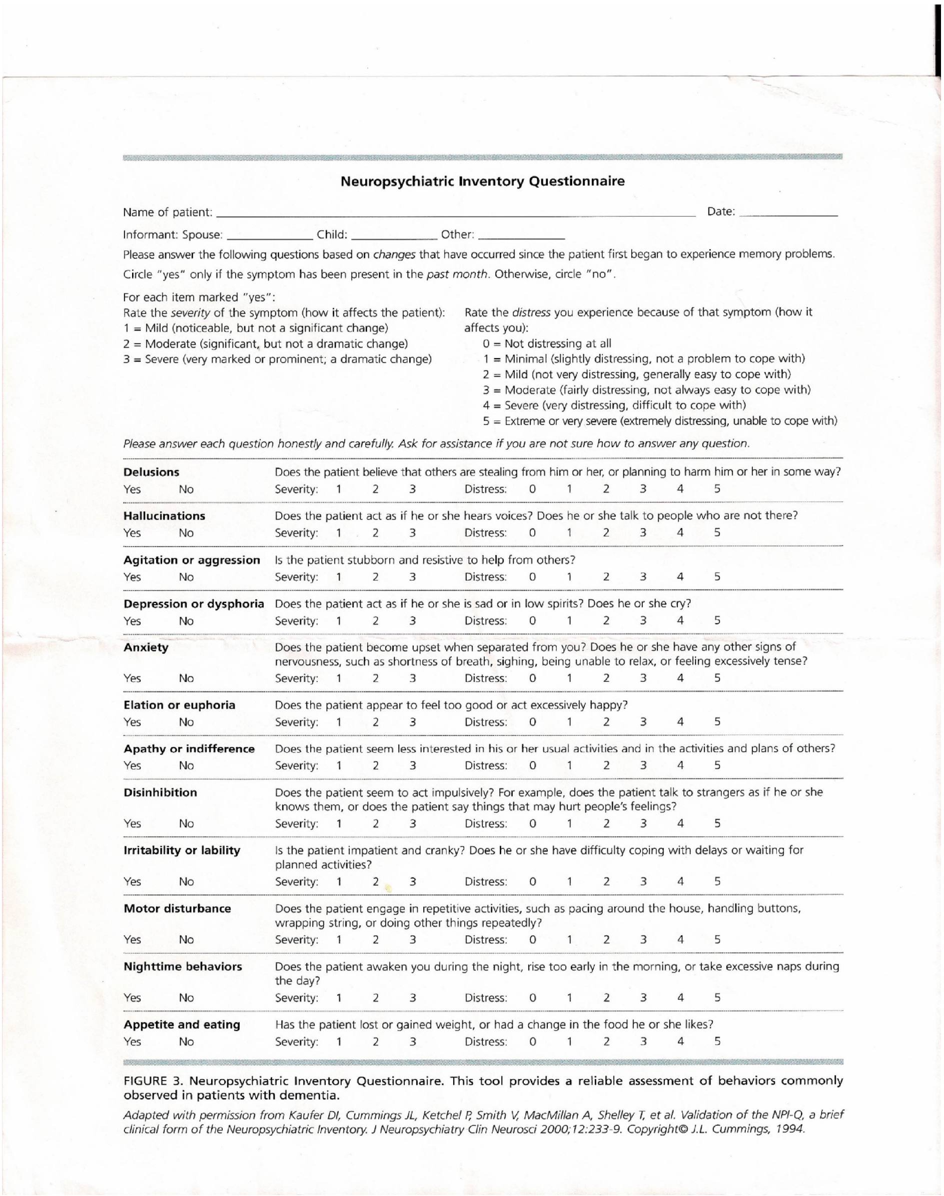
_____9. In the last month, how often have you been angered because of things that happened that were outside of your control? *Mumwedzi wadarika kangani kamaitsamwiswa nezvinhu zvamusina masimba pamusoro pazvo?*

___10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? *Mumwedzi wadarika kangani kamainzwa zvinhu zvichikuomerai zvekuti mainzwa muchikundikana pamusoro pazvo?*

- First, reverse scores for questions 4, 5, 7, and 8. On these 4 questions, change the scores like this: 0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0.

Appendix K4

Neuropsychioatric Inventory



Neuropsychiatric Inventory Questionnaire

Name of patient: ______________________________ Date: ______________

Informant: Spouse: ______________ Child: ______________ Other: ______________

Please answer the following questions based on *changes* that have occurred since the patient first began to experience memory problems.

Circle "yes" only if the symptom has been present in the *past month*. Otherwise, circle "no".

For each item marked "yes":

Rate the *severity* of the symptom (how it affects the patient):
1 = Mild (noticeable, but not a significant change)
2 = Moderate (significant, but not a dramatic change)
3 = Severe (very marked or prominent; a dramatic change)

Rate the *distress* you experience because of that symptom (how it affects you):
0 = Not distressing at all
1 = Minimal (slightly distressing, not a problem to cope with)
2 = Mild (not very distressing, generally easy to cope with)
3 = Moderate (fairly distressing, not always easy to cope with)
4 = Severe (very distressing, difficult to cope with)
5 = Extreme or very severe (extremely distressing, unable to cope with)

Please answer each question honestly and carefully. Ask for assistance if you are not sure how to answer any question.

Delusions	Does the patient believe that others are stealing from him or her, or planning to harm him or her in some way?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Hallucinations	Does the patient act as if he or she hears voices? Does he or she talk to people who are not there?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Agitation or aggression	Is the patient stubborn and resistive to help from others?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Depression or dysphoria	Does the patient act as if he or she is sad or in low spirits? Does he or she cry?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Anxiety	Does the patient become upset when separated from you? Does he or she have any other signs of nervousness, such as shortness of breath, sighing, being unable to relax, or feeling excessively tense?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Elation or euphoria	Does the patient appear to feel too good or act excessively happy?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Apathy or indifference	Does the patient seem less interested in his or her usual activities and in the activities and plans of others?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Disinhibition	Does the patient seem to act impulsively? For example, does the patient talk to strangers as if he or she knows them, or does the patient say things that may hurt people's feelings?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Irritability or lability	Is the patient impatient and cranky? Does he or she have difficulty coping with delays or waiting for planned activities?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Motor disturbance	Does the patient engage in repetitive activities, such as pacing around the house, handling buttons, wrapping string, or doing other things repeatedly?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Nighttime behaviors	Does the patient awaken you during the night, rise too early in the morning, or take excessive naps during the day?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5
Appetite and eating	Has the patient lost or gained weight, or had a change in the food he or she likes?
Yes No	Severity: 1 2 3 Distress: 0 1 2 3 4 5

FIGURE 3. **Neuropsychiatric Inventory Questionnaire. This tool provides a reliable assessment of behaviors commonly observed in patients with dementia.**

Adapted with permission from Kaufer DI, Cummings JL, Ketchel P, Smith V, MacMillan A, Shelley T, et al. Validation of the NPI-Q, a brief clinical form of the Neuropsychiatric Inventory. J Neuropsychiatry Clin Neurosci 2000;12:233-9. Copyright© J.L. Cummings, 1994.

Appendix K5

Marin Apathy Evaluation Scale

(Informant-female) Name: ____ Date: ___/___/___
Informant's Name: _______________________________ Relationship:__________

For each statement, circle the answer that best describes the subject's thoughts, feelings, and activity in the past 4 weeks.

1. She is interested in things.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

2. She gets things done during the day.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

3. Getting things started on her own is important to her.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

4. She is interested in having new experiences.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

5. She is interested in learning new things .

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

6. S/he puts little effort into anything.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

7. S/he approach life with intensity

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

8. Seeing a job through to the end is important to him/her.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

9. S/he spent time doing things that that interest him /her

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

.

10. Someone has to tell him or her what to do each day.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

.

11. S/he is less concerned about her/ his problems than s/he should be.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

12. S/he has friends.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

13. Getting together with friends is important to him/her.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

14. When something good happens, s/he gets excited.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

15. S/he has an accurate understanding of her /his problems.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

16. Getting things done during the day is important to her / him.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

17. S/he has initiative.

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

18. S/he has motivation

NOT AT ALL	SLIGHTLY	SOMEWHAT	A LOT
(4)	(3)	(2)	(1)

The Apathy Evaluation Scale was developed by Robert S. Marine ,M.D. Development and validation studies are descried in RS Marine , RC Biedrzycki S Firinciogullari: "Reliabilityand validity of the Apathy Evaluation Scale," Psychiatriy Research,38:143-162,1991.

Total scores

Appendix L1

The Short-Form Health Questionnaire (SF-36)

Medical Outcomes Study Questionnaire Short Form 36 Health Survey (SF-36)

About: The SF-36 is an indicator of overall health status.

Items: 10

Reliability: Most of these studies that examined the reliability of the SF_36 have exceeded 0.80 (McHorney et al., 1994; Ware et al., 1993). Estimates of reliability in the physical and mental sections are typically above 0.90.

Validity: The SF-36 is also well validated.

Scoring:
The SF-36 has eight scaled scores; the scores are weighted sums of the questions in each section. Scores range from 0 - 100 Lower scores = more disability, higher scores = less disability Sections:

- Vitality
- Physical functioning
- Bodily pain
- General health perceptions
- Physical role functioning
- Emotional role functioning
- Social role functioning
- Mental health

References:

McHorney CA, Ware JE, Lu JFR, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36®): III. tests of data quality, scaling assumptions and reliability across diverse patient groups. *Med Care*1994; 32(4):40-66.

Ware JE, Snow KK, Kosinski M, Gandek B. *SF-36® Health Survey Manual and Interpretation Guide*. Boston, MA: New England Medical Center, The Health Institute, 1993.

Ware JE, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36®): I. conceptual framework and item selection. Med Care 1992; 30(6):473-83.

Medical Outcomes Study Questionnaire Short Form 36 Health Survey

This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. Thank you for completing this survey! For each of the following questions, please circle the number that best describes your answer.

1. In general, would you say your health is:	
Excellent	1
Very good	2
Good	3
Fair	4
Poor	5
2. Compared to one year ago,	
Much better now than one year ago	1
Somewhat better now than one year ago	2
About the same	3
Somewhat worse now than one year ago	4
Much worse now than one year ago	5

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?
(Circle One Number on Each Line)

	Yes, Limited a Lot (1)	**Yes, Limited a Little (2)**	**No, Not limited at All (3)**
a. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	1	2	3

c. Lifting or carrying groceries	1	2	3
d. Climbing **several** flights of stairs	1	2	3
e. Climbing **one** flight of stairs	1	2	3
f. Bending, kneeling, or stooping	1	2	3
g. Walking **more than a mile**	1	2	3
h. Walking **several blocks**	1	2	3
i. Walking **one block**	1	2	3
j. Bathing or dressing yourself	1	2	3

4. During the **past 4 weeks,** have you had any of the following problems with your work or other regular daily activities **as a result of your physical health**?
(Circle One Number on Each Line)

	Yes (1)	**No (2)**
a. Cut down the amount of time you spent on work or other activities	1	2
b. **Accomplished less** than you would like	1	2
c. Were limited in the **kind** of work or other activities	1	2
d. Had **difficulty** performing the work or other activities (for example, it took extra effort)	1	2

5. During the **past 4 weeks,** have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)?
(Circle One Number on Each Line)

	Yes	**No**
a. Cut down the amount of time you spent on work or other activities	1	2
b. **Accomplished less** than you would like	1	2

c. Didn't do work or other activities as **carefully** as usual	1	2

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?	
Not at all	1
Slightly	2
Moderately	3
Quite a bit	4
Extremely	5

7. How much bodily pain have you had during the past 4 weeks?	
None	1
Very mild	2
Mild	3
Moderate	4
Severe	5
Very severe	6
8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	
Not at all	1
A little bit	2
Moderately	3
Quite a bit	4
Extremely	5

These questions are about how you feel and how things have been with you **during the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling. **(Circle One Number on Each Line)**

9. How much of the time during the **past 4 weeks** . . .

	All of the Time	**Most of the Time**	**A Good Bit of the Time**	**Some of the Time**	**A Little of the Time**	**None of the Time**
a. Did you feel full of pep?	1	2	3	4	5	6
b. Have you been a very nervous person?	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d. Have you felt calm and peaceful?	1	2	3	4	5	6
e. Did you have a lot of energy?	1	2	3	4	5	6

	All of the Time	**Most of the Time**	**A Good Bit of the Time**	**Some of the Time**	**A Little of the Time**	**None of the Time**
f. Have you felt downhearted and blue?	1	2	3	4	5	6
g. Did you feel worn out?	1	2	3	4	5	6

h. Have you been a happy person?	1	2	3	4	5	6
i. Did you feel tired?	1	2	3	4	5	6

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)? **(Circle One Number)**	
All of the time	1
Most of the time	2
Some of the time	3
A little of the time	4
None of the time	5

11. How TRUE or FALSE is each of the following statements for you.
(Circle One Number on Each Line)

	Definitely True	**Mostly True**	**Don't Know**	**Mostly False**	**Definitely False**
a. I seem to get sick a little easier than other people	1	2	3	4	5
b. I am as healthy as anybody I know	1	2	3	4	5
c. I expect my health to get worse	1	2	3	4	5
d. My health is excellent	1	2	3	4	5

Appendix L2

Stroke Impact Scale

These questions are about the physical problems which may have occurred as a result of your stroke.

1. In the past week, how would you rate the strength of your....	A lot of strength	Quite a bit of strength	Some strength	A little strength	No strength at all
a. Arm that was most affected by your stroke?	5	4	3	2	1
b. Grip of your hand that was most affected by your stroke?	5	4	3	2	1
c. Leg that was most affected by your stroke?	5	4	3	2	1
d. Foot/ankle that was most affected by your stroke?	5	4	3	2	1

These questions are about your memory and thinking.

2. In the past week, how difficult was it for you to...	Not difficult at all	A little difficult	Somewhat difficult	Very difficult	Extremely difficult
a. Remember things that people just told you?	5	4	3	2	1
b. Remember things that happened the day before?	5	4	3	2	1
c. Remember to do things (e.g. keep scheduled appointments or take medication)?	5	4	3	2	1
d. Remember the day of the week?	5	4	3	2	1
e. Concentrate?	5	4	3	2	1
f. Think quickly?	5	4	3	2	1
g. Solve everyday problems?	5	4	3	2	1

These questions are about how you feel, about changes in your mood and about your ability to control your emotions since your stroke.

3. In the past week, how often did you...	None of the time	A little of the time	Some of the time	Most of the time	All of the time
a. Feel sad?	5	4	3	2	1
b. Feel that there is nobody you are close to?	5	4	3	2	1
c. Feel that you are a burden to others?	5	4	3	2	1
d. Feel that you have nothing to look forward to?	5	4	3	2	1
e. Blame yourself for mistakes that you made?	5	4	3	2	1
f. Enjoy things as much as ever?	5	4	3	2	1
g. Feel quite nervous?	5	4	3	2	1
h. Feel that life is worth living?	5	4	3	2	1
i. Smile and laugh at least once a day?	5	4	3	2	1

The following questions are about your ability to communicate with other people, as well as your ability to understand what you read and what you hear in a conversation.

4. In the past week, how difficult was it to...	Not difficult at all	A little difficult	Somewhat difficult	Very difficult	Extremely difficult
a. Say the name of someone who was in front of you?	5	4	3	2	1
b. Understand what was being said to you in a conversation?	5	4	3	2	1

c. Reply to questions?	5	4	3	2	1
d. Correctly name objects?	5	4	3	2	1
e. Participate in a conversation with a group of people?	5	4	3	2	1
f. Have a conversation on the telephone?	5	4	3	2	1
g. Call another person on the telephone, including selecting the correct phone number and dialing?	5	4	3	2	1

The following questions ask about activities you might do during a typical day.

5. In the past 2 weeks, how difficult was it to...	Not difficult at all	A little difficult	Somewhat difficult	Very difficult	Could not do at all
a. Cut your food with a knife and fork?	5	4	3	2	1
b. Dress the top part of your body?	5	4	3	2	1
c. Bathe yourself?	5	4	3	2	1
d. Clip your toenails?	5	4	3	2	1
e. Get to the toilet on time?	5	4	3	2	1
f. Control your bladder (not have an accident)?	5	4	3	2	1
g. Control your bowels (not have an accident)?	5	4	3	2	1
h. Do light household tasks/chores (e.g. dust, make a bed, take out garbage, do the dishes)?	5	4	3	2	1
i. Go shopping?	5	4	3	2	1
j. Do heavy household chores (e.g. vacuum, laundry or yard work)?	5	4	3	2	1

The following questions are about your ability to be mobile, at home and in the community.

6. In the past 2 weeks, how difficult was it to...	Not difficult at all	A little difficult	Somewhat difficult	Very difficult	Could not do at all

a. Stay sitting without losing your balance?	5	4	3	2	1
b. Stay standing without losing your balance?	5	4	3	2	1
c. Walk without losing your balance?	5	4	3	2	1
d. Move from a bed to a chair?	5	4	3	2	1
e. Walk one block?	5	4	3	2	1
f. Walk fast?	5	4	3	2	1
g. Climb one flight of stairs?	5	4	3	2	1
h. Climb several flights of stairs?	5	4	3	2	1
i. Get in and out of a car?	5	4	3	2	1

The following questions are about your ability to use your hand that was MOST AFFECTED by your stroke.

7. In the past 2 weeks, how difficult was it to use your hand that was most affected by your stroke to...	Not difficult at all	A little difficult	Somewhat difficult	Very difficult	Could not do at all
a. Carry heavy objects (e.g. bag of groceries)?	5	4	3	2	1
b. Turn a doorknob?	5	4	3	2	1
c. Open a can or jar?	5	4	3	2	1
d. Tie a shoe lace?	5	4	3	2	1
e. Pick up a dime?	5	4	3	2	1

The following questions are about how stroke has affected your ability to participate in the activities that you usually do, things that are meaningful to you and help you to find purpose in life.

8. During the past 4 weeks, how much of the time have you been limited in...	None of the time	A little of the time	Some of the time	Most of the time	All of the time
a. Your work (paid, voluntary or other)	5	4	3	2	1
b. Your social activities?	5	4	3	2	1
c. Quiet recreation (crafts, reading)?	5	4	3	2	1
d. Active recreation (sports, outings, travel)?	5	4	3	2	1

e. Your role as a family member and/or friend?	5	4	3	2	1
f. Your participation in spiritual or religious activities?	5	4	3	2	1
g. Your ability to control your life as you wish?	5	4	3	2	1
h. Your ability to help others?	5	4	3	2	1

9. Stroke Recovery

On a scale of 0 to 100, with 100 representing full recovery and 0 representing no recovery, how much have you

recovered from your stroke?

_________ 100 Full Recovery

__

_______ 90

__

_______ 80

__

_______ 70

__

_______ 60

__

_______ 50

__

_______ 40

__

_______ 30

__

_______ 20

__

_______ 10

_________ 0 No Recovery

Appendix M

Barthel Index

THE BARTHEL INDEX

Patient Name: ____________________________

Rater Name: ____________________________

Date: ____________________________

Activity	**Score**
FEEDING 0 = unable 5 = needs help cutting, spreading butter, etc., or requires modified diet 10 = independent	______
BATHING 0 = dependent 5 = independent (or in shower)	______
GROOMING 0 = needs to help with personal care 5 = independent face/hair/teeth/shaving (implements provided)	______
DRESSING 0 = dependent 5 = needs help but can do about half unaided 10 = independent (including buttons, zips, laces, etc.)	______
BOWELS 0 = incontinent (or needs to be given enemas) 5 = occasional accident 10 = continent	______
BLADDER 0 = incontinent, or catheterized and unable to manage alone 5 = occasional accident 10 = continent	______
TOILET USE 0 = dependent 5 = needs some help, but can do something alone	

10 = independent (on and off, dressing, wiping) ______

TRANSFERS (BED TO CHAIR AND BACK)

0 = unable, no sitting balance

5 = major help (one or two people, physical), can sit

10 = minor help (verbal or physical)

15 = independent ______

MOBILITY (ON LEVEL SURFACES)

0 = immobile or < 50 yards

5 = wheelchair independent, including corners, > 50 yards

10 = walks with help of one person (verbal or physical) > 50 yards

15 = independent (but may use any aid; for example, stick) > 50 yards ______

STAIRS

0 = unable

5 = needs help (verbal, physical, carrying aid)

10 = independent ______

TOTAL (0–100): ______

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The Barthel ADL Index: Guidelines

1. The index should be used as a record of what a patient does, not as a record of what a patient could do.
2. The main aim is to establish degree of independence from any help, physical or verbal, however minor and for whatever reason.
3. The need for supervision renders the patient not independent.
4. A patient's performance should be established using the best available evidence. Asking the patient, friends/relatives and nurses are the usual sources, but direct observation and common sense are also important. However direct testing is not needed.
5. Usually the patient's performance over the preceding 24-48 hours is important, but occasionally longer periods will be relevant.
6. Middle categories imply that the patient supplies over 50 per cent of the effort.
7. Use of aids to be independent is allowed.