The relationship between acculturation and neuropsychological test performances.

Thesis submitted for the degree of
Doctor of Philosophy
At the University of Leicester

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University of Leicester
2020

Abstract

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Many neuropsychological tests are described as biased toward Western cultural orientations, thus may not be accurately measuring cognitive abilities of ethnic minorities. Such tests are theorised to also measure the construct of acculturation. However, the operationalisation of acculturation, and neuropsychological tests are inconsistent across the literature. Therefore, the relationship between acculturation and test performances, and the practical value of acculturation during clinical examination is unclear. Four major investigations were conducted in this thesis to assess the relationship between acculturation and test performance. A systematic literature review revealed heterogeneity over different studies, but higher levels of adoption in acculturation broadly influenced better performance. The effects of acculturation could be unique to sample characteristics within each study, and the clinical use of acculturation was inconclusive. Limitations identified among these studies informed subsequent investigations in this thesis. An empirical study found that the language component of adoption predicted tests of language, and cultural knowledge predicted tests of orientation. However, a different measure of historical experiences with language predicted rates of false positives for a group of healthy ethnic minorities, better than ratings of acculturation. The introduction of ethnicity could have altered findings for rates of false positives on test performances. However, ethnicity and ratings of acculturation did not interact when predicting test performances, each predicted different types of tests independently. A further investigation revealed that dimensions of cultural intelligence could be underlying mechanisms involved in domains of acculturation. In conclusion, the domain of language and culturally specific knowledge were most likely influential toward test performance, but it was uncertain what type of neuropsychological tests would be more sensitive to these domains. The practical use of ratings of acculturative scales, when assessing for the probability of scoring a true negative, was reduced to language proficiency. Other factors (motivation, test length, fatigue) should not be overlooked when testing ethnic minorities. Limitations of the study, original contributions, and future directions were discussed.

Acknowledgements

I would like thank Dr Gerald H Burgess for being an exemplary supervisor and advisor, allowing me to partake in this journey of the PhD. I also would like to thank Dr Robin J Green for his excellent role as supervisor, guiding me in the final course of my PhD. I also would like to extend my appreciation to Prof. Mike Wang who have helped me more holistically at the initial course of my PhD.

I would like to thank my parents, friends, and family for their support throughout this ardours journey. I would like to thank the KYDD group, Shu Wen Tay, Ivan Kan, Jacquelyn, Chika, Joanne, and Edward Kang for their emotional and moral support. Dr Brandon Keung, Dr Shaun Goh, and Dr Thomas Lee, for their immensely helpful professional guidance over my career in my PhD. I would like to thank those from Leicester Chinese Christian Church for providing moral and spiritual support in my time in Leicester. In particular, the Tang, Chim, and Ma family have been most encouraging during my course here. Honourable mentions include Shirley Chu, Kevin Li, Ian Chu, Wai Tong, Lai Wah, Quy Te, Dr Yang, Micheal Chiu, Ankh Lau, Nicholas Saw, Ps Esther, the Chua, Lee (William and Crystal), and Ng family. I also would like to thank friends and colleagues, Dr Amornchat Sermcheep, Dr Edith Lee, Dr Chatwiboon Peijsel, Dr Hacer Belen, Dr Seydar Euryar, Dr Beatriz Alvarez, Dr Izzadin, and Jochebed Lui for all their support and encouragement. Also not forgetting auntie Kwai Moi, may she rest in peace with the Lord.

Finally, I would like to thank God for all that He has done for me in my life.

Table of contents

List of Tables

List of Figures

List of Abbreviations

A

AAAS= African American Acculturation Scale

ACE= Addenbrookes Cognitive Examination

ACI= Attention Concentration index

ACT= Auditory Consonant Trigrams

AMAS= Abbreviated Multidimensional Acculturation Scale

AAMAS/M= Asian American Multidimensional Acculturation Scale / Modified

ARSMA= Acculturation Rating Scale for Mexican Americans

APA= American Psychological Association.

B

BAS= Bidimensional Acculturation Scale

BA= Black African

BCoS= Birmingham Cognitive Screener

BNT= Boston Naming Test

BPS= British Psychological Society

BVMT= Benton Visual Memory Test

BVDT= Benton Visual Discrimination Test

BME= Black Minority Ethnicity

BF-10= Big Five Inventory Brief

C

CASP = Critical appraisal skills programme

CD= Culturally Diverse

CFI= Cognitive Fluency index

CFA= Confirmatory Factor Analyses

C-LIM= Culture-Language Interpretative Matrix

CLOX= Clock Drawing Test

COWAT= Controlled Word Order Association Test

CVLT= California Verbal Learning Test

CVS= Cultural Values Scale

CQ= Cultural Intelligence

CQT=Cultural Quotient

D

DRS= Dementia Rating Scale

E

EA= East Asian

EBMT= East Boston Memory Test

ECI= Efficiency index

EFA= Exploratory Factor Analyses

ESL= English as a second language

F

FAS= Family Attitude Scale

FSIQ = Full scale intelligence quotient

G

G*c* = Crystallised intelligence

GEQ= General Ethnicity Questionnaire

G*f* = Fluid intelligence

GOAT= Galveston Orientation and Amnesia Test

GSES= Generalised Self-efficacy Scale

H

HAS= Hazuda Acculturation Scale

HVLT = Hopkins Verbal Learning Test

I

IQ = Intelligence Quotient

K

KBNA= Kaplan Baycrest Neurocognitive Assessment

L

LAI= Langauge index

M

MAS= Marin Acculturation Scale

MEA= Multilingual Aphasia Examination

MMSE= Mini-Mental Status Exam

MOCA= Montreal Cognitive Assessment

MLI= Memory and learning index

N

NAB= Neuropsychological Assessment Battery

NS= Normative sample.

O

OCS = Oxford Cognitive Screen

P

PASAT = Pace Auditory Serial Addition Test

PIQ = Performance IQ

PINE = Population study of Chinese Elderly.

PRI = Processing information

R

RASI/M = Riverside Acculturative Stress Inventory/ Modified

RAVLT= Rey Auditory Verbal Learning Test

RFCT= Rey Complex Figure Test

RFFT= Ruff Figural Fluency Test

RBANS= Repeatable Battery of Assessment of Neuropsychological Status

RUDAS =Rowland Universal Dementia Assessment Scale

RPM=Ravens Progressive Matrices

S

SASH = Short Acculturation Scale for Hispanics

SAME= South Asian and Middle Eastern

SDMT= Symbol Digits Modalities Test

SEA= South East Asian

SES = Socio-economic Status

SPANS= Short Parallel Assessment of Neuropsychological Status

SL-ASIA = Suinn-Lew Asian Self-Identification Acculturation

SRT= Serial Reminding Test

T

TMT = Trail Making Test

TBI= Traumatic Brain Injury

V

VIQ = Verbal IQ

VPI= Visuo-spatial index

W

WASI= Wechsler Abbreviated Scale of Intelligence.

WAIS= Wechsler Adult Intelligence Scale

WRAT= Wechsler Reading Ability Test

WMS-R = Wechsler Memory Scale Revised

Chapter 1: General introduction

1.1 Neuropsychological testing in the UK

In the UK, ethnic diversity proliferated from nine percent to 13% over a ten-year period (Rees, Wohland, Norman, & Boden, 2012) and this is projected to grow to about 30% in the next 50 years (Rees et al., 2012). This is largely attributed to immigration from various countries, but local ethnic groups within the UK also proliferate (Rees et al., 2012). In the neuropsychological literature, healthy ethnic minorities usually tend to perform below clinical thresholds across many tests, resulting in misclassification of neurological deficits (Gasquoine, 2009; Puente et al., 2013; Melikyan, Agranovich, & Puente, 2019). In Britain, ethnic groups (such as Black Minority Ethnicity [BME]) are known to score significantly lower than White British Caucasians on brief screening measures of impairment like the Mini-Mental Status Examination (MMSE) (Richard et al., 2000; Tuerk & Sauer, 2015), and the Addenbrookes Cognitive Examination (ACE) (Tuerk & Sauer, 2015). Epidemiological studies in the UK demonstrate that rates of neurological conditions such dementia are higher for BME populations compared to the majority White British population (Truswell, 2013). Within these minority groups, these rates are even higher for non-English speaking Asian (South Asian, East Asian, etc.) populations (Mcracken et al., 1997). This potentially leads to negative consequences that affect clinical pathways such as specialist referrals or access to early intervention (Tuerk & Sauer, 2015). Substantial globalisation, and mass migration between countries indicate a need for culturally appropriate instruments and practices here in the UK (British Psychological Society, 2017).

1.2 Clinical neuropsychological tests

Traditionally intelligence tests and neuropsychological assessments were developed for different purposes. Tests of intelligence typically assess for a range of intellectual ability (e.g., low, average, high functioning) based on a population distribution of scores. Theoretical conceptualisations of intelligence vary. Early conceptualisation by Spearman (1904; 1927) proposed a single factor of intelligence ‘g’. Advancements in research however suggests that intelligence has a hierarchical structure, consisting of several distinct abilities (Horn & Cattell, 1966; 1967; Carroll, 1993). Such hierarchical structures are reflected on several intelligence tests such as the Wechsler Adult Intelligence Scale IV (WAIS-IV). The WAIS-IV assembles numerous

subtests, such as Digit Span, Block Design, Information, etc., to form indices (i.e., Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed), and these indices are combined to form a general intelligence quotient (Full Scale IQ).

Neuropsychological assessments primarily diagnose or assess how neurological impairments correspond to a change in cognitive function (Benton, 1994; Puente & Puente, 2013). Such tests are developed to discriminate between healthy and clinical populations, thus typically producing a ceiling effect for healthy populations (Ardila, 1999). In practice, the singular construct of intelligence is rarely considered as neurological damage can impair certain functions while leaving others intact (Ardila, 1999). Consequently, clinicians typically measure distinct cognitive domains such as orientation, attention, memory, language, executive functioning, and visuo-motor functioning (Puente & Puente, 2013). This provide comparative 'strengths' and 'weaknesses' between different abilities to assist diagnoses and rehabilitative efforts (Benton, 1994; Goldstein et al., 2004; Puente & Puente, 2013).

Although tests of intelligence and neuropsychological assessments were developed through different theoretical perspectives, both types of tests are used for similar purposes in clinical settings (Ardila, 1999). For instance, brief neuropsychological assessments like the Mini-Mental State Examination may be initially used to identify the presence of a neurological disorder. The WAIS-IV may then follow for a more detailed identification of specific areas of cognitive impairment (Strauss, Sherman & Spreen, 2006). The performances of these tests are compared against a known distribution of scores (norms), informing the clinician the presence and extent of cognitive impairment. Therefore, it is important for tests and norms to discriminate between healthy and clinical populations within a clinical approach.

Clinical testing may take a 'flexible' approach (i.e., person centred approach), to 'mix and match' different tests designed for specific neurological conditions through hypothesis testing (Goldstein, Hersen, & Beers, 2004; Puente & Puente, 2013). This is opposed to fixed or standardised batteries, where a series of tests are administered according to a specified order for all neurological conditions (Puente & Puente, 2013). Table 1.1 describes common neuropsychological tests and approaches found in the literature. Therefore, a clinical perspective makes use of a wide variety of intelligence and neuropsychological assessments depending on the needs of the patient.

Table 1.1 Different test approaches and examples of neuropsychological tests.

Test Approach	Examples of Tests
Fixed batteries: Comprehensive set of tests administered in a fixed order, typically combines individual subtests to form several indices (or cognitive domains).	WAIS, Halsted Reitan Neuropsychological Battery, Luria Nebraska Neuropsychological Test Battery.
Flexible approach: The practitioner decides which tests to administer, each measures a specific cognitive construct.	(Executive functioning) Trail Making Test, Controlled Word Order Association Test, Wisconsin Card Sorting Test.
Cognitive screeners: These are short tests specifically designed to be sensitive to cognitive dysfunction with a specified cut-off criterion.	Mini-Mental Status Examination, Montreal Cognitive Assessment, The Addenbrookes Cognitive Examination.

1.3 Clinical neuropsychological testing in a cultural context

A desired aim of cross-cultural neuropsychology is to determine the universality of cognitive processes across different populations. This ensures accuracy in the representation of human cognitive functions over different cultural groups (Puente, Perez-Garcia, Lopez, Hidalgo-Ruzzante & Fasfous, 2013). Several challenges have emerged where authors question the validity of tests when applied to culturally dissimilar populations (Gasquoine, 2009; Puente et al., 2013; Melikyan et al., 2019). Problems arise with interpreting test scores from different cultural perspectives. Individuals who are linguistically, racially, and/or culturally different from the majority group within a country (an ethnic minority) usually perform poorly relative to the majority (typically Western Caucasians) (Gasquoine, 2009; Puente et al., 2013; Melikyan et al., 2019). Integrating a clinical perspective, normative references used to determine the relative performance of specific ethnic group are non-existent for some populations (Brickman, Cabo & Manly, 2006; Gasquoine, 2009).

A lack of appropriate norm data, heterogeneity in test scores between cultural groups, and inappropriate interpretations of test performance potentially lead to

incorrect identification of neurological deficits. This negatively affects clinical decisions, diagnoses, and access to appropriate care for culturally diverse populations (Romero et al., 2009; Rivera-Mindt, Byrd, Seaz & Manly, 2010). Neuropsychological tests are thus known to be sensitive to cultural factors, undermining psychometric properties of tests, and hinder objective representations of cognitive ability for culturally diverse populations (Fletcher-Janzen, Strickland & Reynolds, 2000; Strauss, et al., 2006; Melikyan et al., 2019). However, there is a lack of consensus as to how culture is operationalised in the neuropsychological literature (Fletcher-Janzen et al., 2000; Betancourt & Lopez, 1993). This may be due to its broad and fluid nature (American Psychological Association, 2000; Betancourt & Lopez, 1993).

1.3.1 Defining culture in neuropsychological testing

Culture has been described as an 'integrated sum of total learned behavioural traits manifested and shared by members of a society' (Terpstra, 1987, pg 168), or ways of 'living' that are transmitted between generations (Rohner, 1984). In any case, culture includes of a variety of sub-constructs within its framework, and thus requires deconstruction to provide more precision in its position on test performance (Betancourt & Lopez, 1993; Fletcher-Janzen et al., 2000). Some authors separate the cultural environment from a subjective form of culture (Triandis et al., 1980; Ardila, 2007). The former usually indicate external sources of culture (religion, art, poetry, etc.), while subjective experiences of culture usually include social norms, values, and beliefs. In relation to neuropsychological testing, however, the cultural constructs of race, ethnicity, and language are commonly found in the literature.

1.3.2 Language and neuropsychological testing

The relationship between spoken language ability on test performance is also relatively well documented (see Strauss, et al., 2006). A systematic review by Walker, Batchelor, and Shores (2009) revealed that native English speakers outperformed English as a second language (ESL) speakers on the WAIS-III performance IQ (PIQ) and processing speed index (PRI). Other studies also noted similar discrepancies in performance over verbal fluency (Boone, Victor, Wen & Ponton, 2007; Kisser, Wendell, Spencer & Waldstein, 2012), WAIS-III digit span (Boone, et al., 2007), Boston naming test (Boone et al., 2007), and the Trail making test (Kisser et al., 2012).

Subjective assessments of language, such as English usage and preference, also associated with performance on tests such as WAIS-III VCI, POI (Harris, Tulsky, & Schultheis, 2013), and a naming test (Sheng, Lu, & Gollan, 2014).

Intriguingly, differences in test scores persist between language groups, even when the same ethnic group is tested in their preferred language. For example, English-dominant Hispanics and Arabs outperform non-English-dominant speakers on tests of visual memory, tests of inhibition, and language (Jacobs et al., 1997; Taussig, Henderson, Mack, 1992; Rosseli et al., 2016; Erdodi, Nussbaum, Sagar, Abreare & Schwartz, 2017). French-speaking participants also performed lower than English-speaking participants on the MMSE (Bravo & Hebet, 1997).

Direct translations of tests may not necessarily eliminate group differences and reduce cultural biases that exist in test performances (Melikyan et al., 2019; Ortiz et al., 2012). Words in one language may not have equivalent meaning when these are translated, or that items themselves used in language tests may be unfamiliar toward other cultures (Toomey, 2017). For example, words like 'lime tree' was replaced by 'pine tree', as the former was unfamiliar and not indigenous to the Lebanese population (Abou-Mrad, et al., 2015). In other tests like the MOCA, the word 'velvet' was either a two or three syllable word depending on different Chinese dialects and was changed to 'teacup' (Zheng et al., 2012). Also, phonetic fluency on the MOCA could not be administered in Chinese as this is a monosyllabic language (Zheng et al., 2012). Therefore, while language has a significant implication on testing, there might be other cultural constructs affecting performance on these tests by ethnic minorities (Helms, 1992; Jacobs et al., 1997; Taussig et al., 1992; Nell, 2000).

1.3.3 Race and Ethnicity

Race is defined as a group of individuals who share distinguishable phenotypic and genotypic traits; thus, people are segregated by biological demarcation (skin colour, genetic commonalities, etc.) (Betancourt & Lopez, 1993; Lynn, 2006; Sankar, 2002). Empirical studies have supported population clusters according to genetic similarity (Rosenberg et al., 2002; Tishkoff et al., 2009). Rosenberg et al. (2002) formed five groups based on genetic cluster analyses: Eurasia, Africa, East Asia, Americas, and Oceania. However, some authors even denying the validity of the concept of race itself (Betancourt & Lopez, 1993; The British Psychological Society, 2017). These arguments

range from socio-political criticisms of racism (Helms, 1992; Betancourt & Lopez, 1993) to empirical work demonstrating that genetic variation occurs as a gradient, as opposed to discrete categories (Serre & Pääbo, 2004).

The concepts of race and ethnicity have been used interchangeably in the psychological literature (Phinney, 1996; Fletcher- Janzen et al., 2000). The American Psychological Association (APA, 2002) defines ethnicity as the 'acceptance of the group mores and practices of one's culture of origin and the concomitant sense of belonging' (pg, 9), suggesting it comprises a wide range of cultural constructs, like language and specific traditions (Fletcher-Janzen et al., 2000; Reyes, 2010). As such, the constructs of race and ethnicity are not necessarily interchangeable (Helms & Talleyrand, 1997). However, genetic clustering analyses has revealed a rough correspondence with self-identification of ethnicity in at least two studies (Rosenberg et al., 2002; Tang et al., 2005). Therefore, while there are conceptual differences between race and ethnicity, there may be some shared elements between these two constructs.

1.3.4 Race and neuropsychological performance

Several researchers have purported that that genetic compositions exclusively underlie IQ differences between racial groups independent of any environmental factor (Jensen, 1970; Rushton & Jensen, 2005; Lynn, 2006; Herrnstein & Murray, 2010). For instance, Lynn (2006) compiled more than 200 studies over three decades worldwide, where IQ scores significantly differ between racial groups (e.g., East Asian average IQ = 105, Europeans = 99, Pacific Islander IQ= 85, etc.). However, evidence in the literature has dismantled claims of the exclusivity of genetic effects on cognitive ability. Genetic variation within a purported racial group is approximately 10 times larger than between racial groups (Nei & Roychoudhury, 1982; 1993). Limited genetic variance between racial is not likely to account for IQ differences (Colman, 2015), and IQ scores are known to vary within racial groups (Kura, 2013; Daniele, 2015). Some brain imaging studies also found no relationship between IQ scores, genes, brain functions, and race (Balaresque, Ballereau, & Jobling, 2007; Richardson, 2011).

Research into the relationship between race and intelligence highlights two schools of thought underlying intelligence. The hereditarian (nature) view assuages that IQ is exclusively influenced by genetics, which is heritable and immutable (Rushton & Jensen, 2005; Lynn, 2006; Herrnstein & Murray, 2010). On the contrary, a nurture

position posits that environmental factors (i.e., nutrition, socio-economic [SES], familial factors) are more important to cognitive ability. Traditionally, the literature conceptualised the influence of nature and nurture on intelligence by means of assigning a percentage to each of these approaches i.e., 60% nature, 40% nurture, etc. However, this view falsely assumes that components of nature and nurture are negatively linear (Maccoby, 2000), i.e., as one component increases, the other decreases. Instead, it is the interaction between genes and the environment (i.e., genes multiplied by environment) that is most likely associated with cognitive ability (Maccoby, 2000). Elements in nature (i.e., nutrition, education, SES) are constantly interacting with an individual's genetic predispositions, thus having a simultaneous impact on intelligence (Maltby, Day & Macaskill, 2017). Therefore, attributing cognitive ability solely to either position (nature vs. nurture) is reductionistic.

A further response to the nature and nurture issue was raised by culturalists perspectives on cognitive ability. Neuropsychological tests and tests of intelligence have been described as a measure of familiarity with the 'White/Western' cultures (Helms, 1992; Nell, 2000). Helms (1992) is adamant that a range of cultural factors (values, beliefs, etc.) better explain test performance differences between African Americans and White Caucasians. Helms (1992) argues that the nature and nurture approach cannot adequately measure cultural differences that exist between racial or ethnic groups. Both approaches are inherently biased, imposing their Westernised presumptions of what constitutes environmental factors, race, and intelligence, neglecting that these may differ between cultures. For example, socio-economic differences between Black and White populations merely reflect these individuals' level of orientation toward Western standards of SES (Helms, 1992). At the same time, the concept of race or ethnicity cannot directly measure cultural nuances unique to a group of people (Helms, 1992; Brickman et al., 2009; Arends-Toth & Van de Vivjer, 2006a). These proposals signify that there may be other subjective forms of culture (values, beliefs, familiarity, orientation, etc.), perhaps conceptually distinct from traditional notions of nature and nurture, that are somehow important to test performance (Helms, 1992; Nell, 2000; Ardila, 2005).

1.4 Cultural perspectives on test performance

Aside from the implication of race, ethnicity, and language on test performance, another view that begun to attract attention stems from the idea that test instruments and procedures themselves are sensitive to subjective cultural elements (Helms, 1992; Nell, 2000; Ardila, 2007; Puente, 2013; Melikyan et al., 2019). Typically, neuropsychological tests are Western oriented, often developed in North America (Perez-Arce, 1999; Pedreaz & Mungas, 2008; Harris et al., 2013), and thus cannot account for the wider implications of cultural diversity (Melikyan, et al., 2019). For instance, Westernised tests adopt epistemological positions of formal logic, or syllogism, which may not be equally held in other cultures (Helms, 1992; Perez-Arce, 1999; Ardila, 2007; Melikyan et al., 2019). Tests of processing speeds, for example, assume that speed and efficiency (finishing a task quickly) are equally valued in all cultures (Nell, 2000; Ardilla, 2005); that abstract reasoning would be a standard strategy adopted by all cultures when responding to the Ravens progressive matrices (RPM) (Helms, 1992; Nell, 2000; Ardilla, 2005).

Studies that inspected the construct validity of IQ tests demonstrated that these are not always measuring the same underlying construct for different ethnic groups (Wicherts, 2016; Cockroft, Alloway, Copello & Milligan, 2015). Cockroft et al. (2015) found four factors on the WAIS-III for Native Black South Africans, but just three for White British populations. Evidently, what constitutes intelligent behaviour varies between cultures (Cocodia, 2014). For instance, Helms (1992) presented evidence that the dimension of spirituality is not represented in many neuropsychological tests but is an important construct in defining intelligence in some African American groups. Therefore, many 'Western' developed neuropsychological tests cannot capture the full range of intelligent behaviour across different cultures (Helms, 1992). Cultural theorists believe that many neuropsychological tests are biased toward Westernised interpretations of cognitive ability (Helms, 1992; Nell, 2000; Ardila, 2007). Therefore, it is unknown whether cognitive tests measure ability or merely idiosyncratic thinking styles for different cultures (Helms, 1992).

Constructs such as test-wiseness and task familiarity are frequently used to explain why performance differs between ethnic groups (Nell, 2000; Sternberg, 1984; 2004; Ardila, 2007). Test-wiseness can be described as an 'educated guess', where individuals exploit characteristics of a test structure, or use strategies to maximise the

probability of obtaining a correct answer; such as eliminating incorrect answers on multiple choice questions (Nell, 2000). As for familiarity, those who are familiar with test items, or test procedures are likely to perform quicker and efficiently compared to novel tasks (Nell, 2000; Sternberg, 2004).

Task familiarity and Western thinking styles have been explicitly linked with Western systems of education (Nell, 2000; Sternberg, 1984; Ardila, 2007). This exposes the individual to many tests and exams, facilitating test-wiseness and familiarity during neuropsychological assessments (Nell, 2000). Urbanised societies that endorse Western systems of education usually adopt aspects of the Western lifestyle, such as language, norms, and so on (Nell, 2000). Some studies in the US found that ethnic minority adolescents with higher academic achievement tend to have less inclinations toward their cultural heritage, preferring instead modern American lifestyles (Baldauf & Ayabe, 1977; Knight et al., 1978). As a result, cultural theorists suggest that variation in levels of immersion in or adoption of a mainstream culture (usually a Western-oriented culture) might predict test performances (Helms, 1992; Nell, 2000; Ardila, 2007). This alludes to the concept of 'acculturation', where higher acculturation (greater immersion into a foreign culture) ought to lead to better test performance (Helms, 1992; Nell, 2000; Van de Vijver, Helms-Lorenz & Feltzer, 1999).

1.5 Acculturation

Historically, acculturation was described as a process of change, bringing immediate, extended, and continual contact between individuals of different cultures (Redfield, Linton, & Herskovits, 1936). Graves (1967) distinguishes between group-level acculturation (changes in social norms, socio-political structures) and individual acculturation (psychological acculturation, affect, behaviour, cognitive, etc.). Another important aspect is that acculturation is dimensional. Traditionally, unidimensionality assumes that the adoption of or immersion in a new culture is synonymous with shedding of one's heritage culture (Sam, 2006). However, recent advances advocate for multiple dimensions, and a bi-dimensional framework is most common. These independent dimensions are; a) cultural adoption, which deals with how much an individual absorbs attributes of the dominant culture; and b) cultural maintenance, which is the level of retention of a heritage culture (Berry, 1997; Sam, 2006; Arends-Tóth & Van de Vivjer, 2006a). There exist other models of acculturation in the

literature. For instance, authors have proposed a 'third' dimension, or a subculture (Chung et al., 2004; Ferguson, et al., 2012). For example, 'African-American' culture is distinct from native 'African' cultures. However, there are limited scales that validly measure this 'third' dimension (see Celenk & Van de Vivjer, 2012). Such models may not be as well established as bi-dimensional models, the latter having significantly more empirical evidence (Ferguson et al., 2012). Fundamentally, this bi-dimensional framework forms the basic structure for theories of acculturation.

1.5.1 Berry's theory of acculturation

Seminal work by Berry (1997; 2017) explains that the process of acculturation occurs through a series of stages. Figure 1.1 illustrates a simplified model of Berry's acculturative framework, separating acculturation at the group and individual levels (Berry, 2017). First, sociocultural characteristics of the dominant (culture A) and non-dominant group (culture B), determine the process of acculturation. These include characteristics like inter-racial attitudes, reasons for migration, foreign policies, and economic conditions of the host culture. Pre-existing factors at the individual level also govern the process of acculturation. Individual differences in personality traits (i.e., five-factor model; openness, extraversion, etc.), or self-efficacy (confidence to exert control over variety of life demands) could also influence the process of acculturation at an individual level (Berry, 1997).

At the individual or psychological level, shifts in behaviour serve as a function for adaptation into the wider society. In this model, if individuals cannot resolve negative experiences associated with a new culture (discrimination, prejudice, alienation, etc.), acculturative stress is said to occur. This is typically associated with psychological disorders such as anxiety and depression (William & Berry, 1991; Berry et al., 1997). Adaptation is the end product of acculturation, subdivided into 'psychological' and 'socio-cultural' (Berry, 1997; 2017). Psychological adaptation is defined as sense of belonging, personal achievement, and an overall sense of well-being. Socio-cultural adaptation, on the other hand, is the acquired skills and competencies of the dominant culture, such as language proficiency, knowledge of traditions, and degree of contact with host society, primarily related to managing daily functions in the host society.

Berry (1997) is best known for his work on acculturative strategies, contending that there is a relationship between maintenance and inter-cultural contact. The latter is a process similar to adoption, but emphasises overt interaction between cultures, or the extent to which ethnic minorities participate in or become involved with the dominant society. Placing these on two axes forms four quadrants, each representing an acculturative strategy. These are: a) assimilation, where an individual adopts the host culture while shedding their native culture; b) separation, which is the rejection of the host culture to maintain one's own culture; c) integration, where both cultures are equally maintained, leading to biculturalism; and d) marginalisation, where the individual rejects both the host and their heritage cultures.

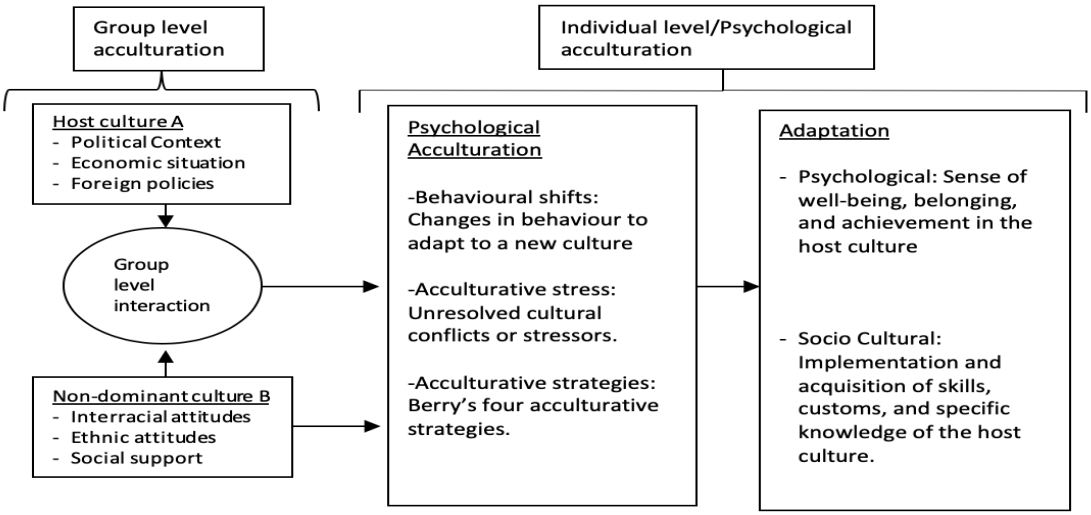

Figure 1.1. Berry's model of acculturation (adapted from Berry, 2017).

1.5.2 Three-stage model of acculturation

Berry (1997; 2017) dominates the literature, with conclusions that have been integrated into other models of acculturation. For instance, Van de Vivjer and colleagues (Arends-Tóth, & Van de Vivjer, 2006a, 2006b; Celenk & Van de Vivjer, 2011) proposed a three-stage model of acculturation that mirrors Berry's work (see Figure 1.2). Firstly, pre-existing cultural conditions (acculturative conditions), such as inter-racial attitudes and individual personality characteristics between the host and heritage culture, determine how the dominant and non-dominant society interact, and subsequent processes of acculturation. Acculturative orientation follows, as the individual manages their attitudes toward the heritage culture (maintenance) and the

host culture (adoption). Berry's acculturative strategies are hypothesised to occur here. Finally, acculturative outcomes broadly concern the degree of successful behavioural and psychological adaptation into the dominant society.

Under acculturative outcomes, Celenk and Van de Vivjer (2011) further divided this into 'internal' (or psychological) and 'external' (or socio-cultural competency) or behavioural adjustments. These definitions are similar to Berry's conceptualisation of psychological and socio-cultural adaptation. Internal adjustment is represented by well-being, satisfaction with the host culture, and so on, while external adjustment is indicated by acquiring culturally specific knowledge, such as language, familiarity with customs, traditions, and so on. In addition, acculturative stress is conceptualised as an acculturative outcome.

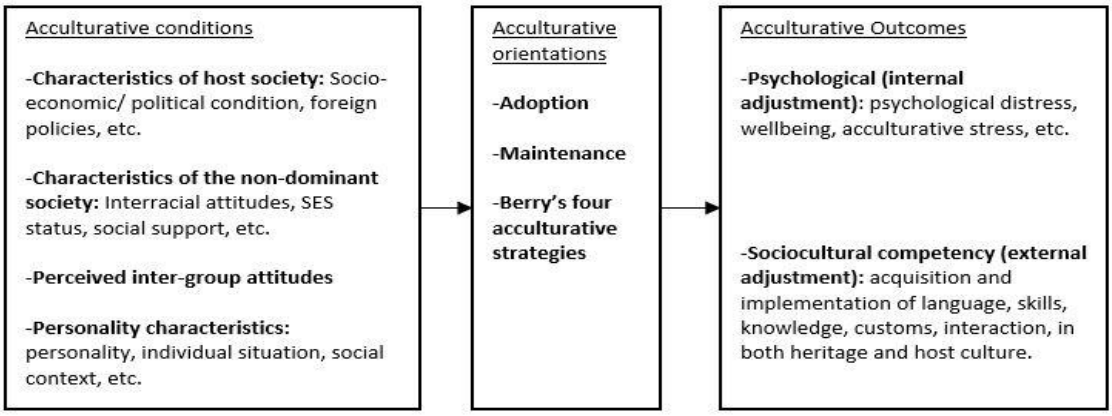

Figure 1.2. The three-stage model of acculturation (adapted from Arends-Tóth & Van de Vivjer 2006a).

1.5.3 Limitations of the theories of acculturation

Concerning statistical limitations, empirical work produced conflicting results over the validity and independence of Berry's four acculturative strategies (Rudmin, 2003; Laroche, Kim, Schwartz & Zamboagna, 2008). In other studies, strong correlations between these strategies have been found (Rudmin, 2003; Matsudaira, 2006). Schwartz and Zamboanga (2008) found six latent factors, concluding that there were more variants for each of these acculturative strategies. For example, a mixture of separation and assimilation formed a single bi-cultural construct (Schwartz & Zamboagna, 2008). There have also been reports of low reliability in the use of Berry's scales to measure these strategies. One study found that internal consistency was

inadequate (< 0.7, Kline, 2015) for integration, assimilation, and marginalisation (Berry et al., 2010).

Conceptually, Berry's four strategies do not specify which specific traditions or cultural activities the individual is rejecting or accepting (Boski, 2008). For instance, ethnic minorities may adhere to heritage practices or speak their native language at home, while behaving more like the host culture in public environments (i.e., domain-specific hypothesis, Arends-Tóth & Van de Vivjer, 2006a). Importantly, the context of acculturative change arises in different domains of a person's life, such as spoken language, ethnic identity, social affiliation, and media preferences. Proficiency in the host culture's language will not automatically produce a strong affiliation to the host culture or society (Matsudaira, 2006; Arends-Tóth & Van de Vivjder, 2006a). Schwartz et al. (2010) demonstrated this with a study of Hispanic and Asian Americans, who felt a strong sense of heritage identity despite having low proficiency in their heritage language. These different domains can be independent and not fully represented by a single index of acculturation – be it a composite score or reliance on a single domain such as language (Matsudaira, 2006; Arends-Tóth & Van de Vivjer, 2006a; Schwartz et al., 2010). In any case, these four strategies do not make distinctions between these different domains of acculturation.

Other conceptual limitations also exist for Berry's framework of acculturation and the three-stage model of acculturation. For example, evidence for the effects of individual differences (personality, self-efficacy, etc.) as determinants of acculturation is equivocal in the literature (Berry, 1997; Kosic, 2006). In the five-factor model, conscientiousness predicted adoption in one study of Japanese Americans (Gungor et al., 2013), but only emotional stability and extraversion predicted adaptation for Hispanic Americans (Ahadi & Puente-Diaz, 2011). Moreover, recent publications have shown that Berry's theory has not been updated (Berry, 2017). The main limitation of the three-stage model is that there is little information about how this was developed, how each stage was assessed, and the empirical work that ties the stages together. In any case, there are subtle differences between these models. Acculturative stress is considered an acculturative outcome in the three-stage model, whereas Berry identifies this as a mediating factor. In addition, the three-stage model evaluates socio-cultural competencies (socio-cultural adaptation in Berry's model) in both dimensions. This may

give it a slight advantage over Berry's model, as this is in line with the bi-dimensional framework, where adoption and maintenance can occur independently.

1.6 Application of acculturation in clinical neuropsychological settings

Berry's theories and work on acculturation remains widely cited and highly recognised in the psychological literature (Rudmin, 2003; Ferguson et al., 2012). Applications of theories of acculturation include a broad range of disciplines like organisational psychology (Peeters & Oerlemans, 2014) and mental and physical health (Yoon et al., 2012; Aqtash & Van Servellen, 2013; Tailakh et al., 2016). Generally, adoption positively correlated with better wellbeing and physical health (Yoon et al., 2012; Aqtash & Van Servellen, 2013; Tailakh et al., 2016). In a systematic review, higher maintenance was associated with lower mental well-being (Yoon et al., 2012).

Some researchers have also pushed for its practical value of acculturative measures in the field of neuropsychology. It is well documented that ethnic minorities underperform compared to majority groups; and, importantly, some of these groups perform below acceptable clinical thresholds (Gasquoine, 2009; Strauss et al., 2009; Puente, 2013). This results in false classification of neurological impairment (also known as a false positive), creating barriers to accessing appropriate healthcare (Romero et al., 2009; Mindt et al., 2014). Consequently, clinical codes of conduct like the British Psychological Society (BPS, 2017) recommend assessing the socio-cultural background of ethnic minorities to reduce cultural biases during clinical examinations. In a similar fashion, authors have recommended using acculturative measures during clinical examinations of ethnic minorities to account for cultural confounds during testing (Fletcher-Janzen et al., 2000; Fujii, 2018). However, these authors do not provide explicit guidelines, or standardised procedures, for how measures of acculturation are to be used.

1.6.1 Acculturation and test norms

A long-standing challenge in neuropsychological assessments is the availability of demographic and ethnically correct test-norms. Ideally, standardised normed references are used to compare the performance of an individual relative to a peer group of a similar sociodemographic background (Flanagan & Harrison, 2012). There are reports that rates of misdiagnosis increase significantly when Caucasian norms are used

for some ethnic minority groups (Adams, Boake & Caine, 1982; Hestad et al., 2016; O'Driscol & Shaikh, 2017). Some norms exist for African- and Hispanic-Americans, but norms for other ethnic groups are sparse (Wong et al., 2000). Efforts to retrieve normative references were criticised as unsystematic or biased toward particular socio-demographic groups (Wong et al., 2000; Ardila, 2007), thus unrepresentative of other demographic characteristics in that population. Generally, test norms derived from English-speaking Western populations of higher SES may not be transferrable to culturally dissimilar populations (Ardila, 2007; Melikyan et al., 2019). Since it is unclear how acculturative measures can be used in clinical practice, it is uncertain whether the construct of acculturation undermines the generalisability of test norms between different cultural groups.

1.7 Acculturation and neuropsychological testing

The integration between the concept of acculturation and neuropsychological assessments is not an entirely new endeavour (Fletcher-Janzen et al., 2000), but the literature on this relationship remains unclear. First, cultural theorists such as Helms (1992), Nell (2000) and Ardila (2007) do not generally present a clear definition of neuropsychological testing. These authors discuss neurocognitive testing as a conglomerate of all standardised test instruments, including scholastic aptitude tests, consequently proposing a generalised effect of culture and acculturation on test performance. In contrast, Horn and Blankson (2005), theorise that only verbal tests on the WAIS-IV, such as tests of vocabulary and general knowledge, ought to be related to concepts in acculturation.

At the same time, there appear to be conflicting definitions of acculturation in the literature. Some researchers in neuropsychology treat only language proficiency (Ardila, 2007; Harris et al., 2013) or proxy measures of acculturation, such as years of residency (Boone et al., 2007), as surrogates of acculturation. This is despite the theoretical literature advocating that a single proxy estimate cannot account for the complexity of acculturation (Arends-Tóth & van de Vijver, 2006a; Lopez-Class, Castro, & Ramirez, 2011). Other neuropsychologists on the other hand has produced more accurate descriptions of acculturation. Fujii (2018), for instance, acknowledges the bi-dimensionality in acculturation and provides appropriate measurements for its assessment. Horn and Blankson (2005) operationalises acculturation as 'acculturative

knowledge', which is the acquisition of a broad range of culturally specific skills and knowledge. Therefore, the concept of acculturation and neuropsychological assessments may not be consistently defined in the literature, making it difficult to integrate these concepts.

1.8 Definitions

In summary, cognitive tests may not fully represent cognitive functions due to confounding influences of culture. Significant variation in test scores both within and between ethnic groups persist even when adjusting for demographic and linguistic variables (Jacobs et al., 1997; Taussig et al., 1992; Boone et al., 2007; Melikyan et al., 2019). Consequently, test instruments were conceptualised to intrinsically measure cultural constructs like acculturation. In line with the current literature, this thesis operationalises acculturation as the following: a) dimensionality (bi-dimensional, unidimensional, etc.); b) occurring independently in multiple domains (e.g., language, ethnic identity); c) is determined by pre-existing factors (e.g., group and individual differences/characteristics); and d) conceptualised as a form of adaptation (socio-cultural competency, stress, well-being, etc.).

Berry's (1997) work on acculturation remains highly influential despite criticisms over the independence of the four acculturative strategies. Berry's framework of acculturation allows a wide conceptualisation concerning neuropsychological testing. Although the three-stage model has not received ample validation, the model is parsimonious compared to Berry's model. The three-stage model also measures domains in both dimensions of acculturation. Nonetheless, both models will be explored upon for this thesis to broaden the theoretical contribution of this thesis. Additional constructs pertinent to theories of acculturation, such as acculturative stress, and individual differences or personality factors were explored in later chapters where appropriate.

As previously discussed, some authors do not present a clear definition of what constitutes cognitive tests with respect to acculturation. To clarify, this thesis adopts a clinical perspective in three ways. First, this thesis considers all forms of tests that has been normed and/or developed for clinical populations. Second, it is clinically important for clinicians to assess distinct cognitive processes is pertinent to clinical practice (Ardila, 1999). Therefore, this thesis considers neuropsychological performance over

different domains of cognitive functioning (i.e., attention, working memory, etc.), along with the hierarchical structure of test instruments (e.g., index vs. subtest, WAIS-IV test structure). Finally, clinicians usually compare individual's test scores with existing norms to inform them of clinically useful information. Therefore, this thesis considers the relationship between acculturation and tests scores and norms, rather than underlying theories of intelligence or neuropsychology.

1.9 Gaps in the literature

While the implication of acculturation has recently attracted interest in the neuropsychological community, gaps remain in the literature. This was illustrated with two themes, showing the fundamental problems in the literature.

1.9.1 Integrating acculturation and neuropsychological testing

Acculturation and neuropsychological tests performances are not consistently defined in the literature. Few authors acknowledge the complex nature of acculturation or make explicit reference to specific models, though some provide definitions of acculturation that are more accurate with theories of acculturation. Also, some authors are less specific about the type of tests that ought to be related with acculturation, while others provide more explicit propositions. Because of these loose definitions, it is less clear which aspects of acculturation (dimensionality, domains, stress, etc.) would be related to which type of neuropsychological tests performance (index, subtest, attention, working memory, etc.). Subsequently, the relative importance of concepts in acculturation for neuropsychological testing is less clear compared to well-established predictors of cognitive ability like age, education, and to a certain extent race and ethnicity.

1.9.2 Practical value of acculturation

While there are recommendations for the practical use of acculturative scales in clinical neuropsychology, these are not without limitations. Despite authors advocating the use of acculturative measures when assessing culturally diverse populations, there are no explicit guidelines or standardised procedures for use. In addition, while reliance on normative data can potentially 'correct' for any cultural confounds, this too has limitations. The use of ethnic or race-based norms is controversial, as these cannot

account for the cultural variability within groups of people. Two individuals of the same race or ethnicity can have different acculturative experiences. For instance, Mexican immigrants in the US are likely to have acculturative experiences different to those of local-born Mexican Americans. Existing norms may not necessarily be equivalent for both groups. Furthermore, whether measurements of acculturation would be adequate to explain why existing norms cannot be applied to culturally diverse populations has not been fully investigated in the literature.

1.10 Proposed thesis

The guiding principle is to integrate two fields of disciplines, specifically the relationship between various concepts of acculturation and neuropsychological test performance. More specifically, this thesis investigates what areas of acculturation would predict which type of neuropsychological tests performance (i.e., tests of attention, language, working memory, etc.). This thesis also investigates how acculturative measures can potentially be used in relation to existing test norms. Finally, this thesis is expanded upon by exploring whether there are pre-existing individual differences that may associate with the process of acculturation, in relation to neuropsychological testing.

Based on the aforementioned gaps in the literature, a proposal of six consecutive investigations forms the basis of the thesis. More specific definitions of various constructs are presented below to provide clarity for this work.

1.10.1 Structure of the thesis

Chapter 2: A systematic review. The review synthesised a series of studies in the wider literature, to explore the relationship the relationship between acculturation and neuropsychological test performance. Findings from the systematic review identified more specific gaps in the literature, informing subsequent studies in this thesis. Synthesising these studies provided a useful comparison of the empirical findings in this study, revealing the degree of consistency of acculturation over test performance.

Chapter 3: Validation study. This chapter primarily outlines a rationale for selecting neuropsychological tests and acculturative scales. The psychometrics of the neuropsychological battery and acculturative scales were reported.

Chapter 4: A quantitative study. An empirical study was conducted to demonstrate the relationship between the multidimensional nature of acculturation and a broad framework of neuropsychological tests. This allows an in-depth exploration of the relationship between different aspects of acculturation and different types of neuropsychological tests performance

Chapter 5: Practical application. As there are no explicit guidelines as to how acculturative scales may be used during routine assessments, an exploration of its practical value should be undertaken. This was achieved by exploring whether acculturative measures invalidated existing norms, and whether ratings on acculturative scales would predict the likelihood of a theoretical false diagnosis based on these norms. The plausibility of using acculturative measures for practical or clinical purposes were discussed.

Chapter 6: Ethnicity and test performance. This chapter investigates the relationship between ethnic group membership, acculturation, and test performances. Claims that acculturation underlies performance differences between ethnic groups was tested in this chapter. Additionally, this chapter explores whether the introduction of ethnicity would change rates of false positives. This chapter therefore assess whether ethnicity confounded results from previous chapters.

Chapter 7: Individual differences in acculturation. This chapter broadens the scope of the thesis by exploring whether there are underlying mechanisms that could predict the process of acculturation. This provides a better understanding about how individual differences and personal characteristics might affect relevant domains of acculturation involved in neuropsychological testing.

Chapter 8: General discussion. This chapter synthesises findings from all chapters and discussed these findings relevant to theories of acculturation. Conclusions

about practical recommendations are also summarised. More general aspects of limitations and recommendations for future research are also discussed.

A systematic literature review is presented in the next chapter. This highlight specific gaps in the literature and provides a synthesis of existing studies and a detailed account of the recommendations pertinent to other investigations in this thesis.

Chapter 2: Acculturation and test performance: A systematic literature review

The following chapter is modified (where appropriate) from a peer-reviewed and published paper (Tan, Burgess, & Green, 2020). This includes the introduction (2.1), methods (2.2), results (2.3, 2.4), and significant portions of the discussion (2.5).

2.1 Introduction

Many neuropsychological tests have been described as 'Western' styled or influence (Helms, 1992; Nell, 2000; Ardila, 2005), and thus inadvertently measure cultural constructs like acculturation (Helms, 1999; Nell, 2000). However, the integration between concepts of acculturation and neuropsychological tests is weak and inconsistent in the literature. Within the literature, few authors elaborate on the complex nature of acculturation (e.g., dimensionality, multi-domains, acculturative strategies, etc.) in relation to neuropsychological testing (e.g., Helms, 1992; Nell, 2000; Ardila, 2007). Therefore, a systematic literature search into the wider literature was conducted to further illuminate this relationship. The overall aim was to explore whether there is specific neuropsychological test performance that would associate with individual components within acculturation.

2.1.2 Acculturation and demographic variables

There are other complications pertinent to the study of acculturation and neuropsychological testing that needs to be addressed prior to the review. Cognitive performance tends to decrease with age; at the same time older adults in some societies tend to maintain their heritage culture with lower cultural adoption (Cheung, Chudek, & Heine, 2011; Khawaja, Yang, & Cockshaw, 2016). Those with higher levels of education usually perform better on neuropsychological tests; likewise, education is known to mediate the process of acculturation (Berry, 1997; Khawaja et al., 2016). This adds complexity to the relationship with neuropsychological performance, as it is difficult to ascertain the exclusive effect of acculturation on testing. Without adjusting or controlling for these demographic variables, spurious conclusions can result about the predictive value of acculturation, marred by demographic factors like age and education. Therefore, it is vital for empirical work to account for these potentially confounding factors, to ascertain the unique and independent effect of acculturation on testing.

It is also important that the construct of acculturation is directly evaluated, rather than relying on proxy estimates of acculturation like years of residency. Proxies of acculturation, such as generational status, and years of foreign residency are frequently used to validate scales of acculturation, but these proxies cannot represent complex nuances associated with the construct of acculturation (Arends-Tóth & Van de Vivjer, 2006a; Matsudaira, 2012). This line of reasoning extends to other sociodemographic constructs, like educational attainment or SES. While these factors do influence neuropsychological testing (Gasquoine, 2009; Melikyan et al., 2019), these cannot capture variation and nuances about the acculturative experience or process within these nominal groups (Arends-Tóth & Van de Vivjer, 2006a). Therefore, the reliance on proxy measures (years of residency, generational status, etc.), sociodemographic variables (SES etc.), or a single index of acculturation (e.g., only accounting for language proficiency), risks misrepresenting the complex nature of acculturation (Arends-Tóth & van de Vijver, 2006a, 2006b; Lopez-Class, et al., 2011; Matsudaira, 2012). As such, it is important to use direct measures to obtain a clearer representation of the multifaceted construct of acculturation.

2.1.3 Aims of the review

To date, only a published abstract of a systematic literature review addressed the relationship between concepts of acculturation and neuropsychological test performances (Goette, Schmitt, & Carballo, 2017). Therefore, it was not possible to comprehensively assess or critique its results and interpretations. O'Bryant, O'Jile, and McCaffrey (2004) found that acculturation was the least publicised factor in the neuropsychological literature, appearing in less than one percent of their total findings. Beyond these papers, no other systematic review appeared on the topic, thus the effects of acculturation on neuropsychological test performance has received little attention and is not well understood. Therefore, the aim of this review is to redress this absence and collate and synthesise available quantitative studies in the literature. Below summarises the aims and hypotheses of the review.

- Authors have proposed that imbuing attributes of the dominant culture (white/Western in this case) is advantageous toward better test performances (Helms, 1992; Nell, 2000). These interpretations suggest that adoption benefits one's performance on neuropsychological testing. It was first hypothesised that

higher levels of adoption, above-and-beyond the effects of age and education, will associate with better performance on neuropsychological test performances.

- The theoretical literature is unclear as to whether linguistic and non-linguistic domains of acculturation would associate with different tests. As such, this was explored in this review.

- Finally, this review attempts to consolidate additional findings pertinent to this thesis. This include clinical implications, methodology, and limitation, all these would be discussed in view of informing further studies in this thesis.

2.2 Methods

A literature search was conducted exploring the available studies between acculturation and neuropsychological tests in October 2019. The search terms were modified from Goette et al.'s, (2017) review, using the following: (neuropsych* OR neurocog* OR cognit*) AND (assessment OR evaluation OR testing OR test OR measure) AND (accult*). This study used four databases: PsycInfo, PubMed, Scopus, and Web of Science. The latter two were added on top of Goette et al.'s (2017) search strategy.

The following inclusion criteria were used: a) derived from peer reviewed journals; b) studies using clinical or non-clinical samples were accepted; and c) papers had to be written in English. To capture a representative concept of acculturation, only studies that used direct measures acculturation were accepted. Different from Goette et al.'s (2017) abstract, acculturation scales used in the selected papers must have been published, validated, and contained items relevant to the faceted theories of acculturation. These scales must assessed at least one of the following: a) multiple-domains of acculturation, such as ethnic identity, food or media preference; b) dimensional (bi-idimensional, unidimensional, etc.); or c) constructs related to adaptation, like acculturative strategies or acculturative stress.

This review only included papers that evidenced methods to isolate the unique effects of acculturation on test performances. Statistical methods must have accounted or controlled for the confounding variables of at least age and/or education simultaneously with acculturation in their analyses. These analyses could include a)

hierarchical regression; b) analyses of covariance; c) partial correlations; or d) multiple regression that analysed acculturation simultaneously with age and/or education. Studies that solely depended on demographically correcting raw scores, such norm referenced metric were also accepted, as these potentially removed the effects of age and education prior to statistical analyses. Norms were assessed for whether age, education, and ethnicity were accounted for as reported in these respective studies. Citations from articles that met the inclusion criteria were also screened against these same inclusion criteria.

The exclusion criteria included: a) non-quantitative or qualitative studies, b) non-clinical measures of neuropsychological assessment, such as scholastic or standardised academic tests, c) studies that did not include a scale of acculturation, d) reviews and e) unpublished work. Studies that were unclear or diluted in their reporting of results regarding the relationship between acculturation and neuropsychological testing were also excluded (e.g., unreported coefficients, acculturation was not the primary analyses, etc.). The included studies were subjected to the Critical Appraisal Skills Programme (CASP) Cohort Study checklists to assess the quality of their findings.

2.3 Results

After removing duplicates from four databases, a total of 520 articles were retrieved. Titles were first viewed for relevance, and where appropriate the abstract was evaluated. Subsequently, the entire article was scrutinised against the inclusion and exclusion criteria where appropriate. Six studies did not meet inclusion criteria, and a total of 20 studies were used. Table 2.1 summarises all included studies (see Appendix A for a flowchart of excluded studies).

Table 2.1 Summaries of studies included in this review.

Study	Aims	N	Scale	Cognitive test	Summary of results
Acevedo et al., 2007	Explore impact of socio-demographic variables on cognitive tests, and present normative data.	89, elderly Spanish speaking Americans	MAS	WMS-III Logical Memory, WMS-R Visual Reproduction, COWAT, BNT, WAIS-III Digit	Acculturation predicted Digit Span.

				Span, Block design, Similarities.	
Arentof et al., 2012	Explore relationship between acculturation and testing in HIV+ Latino adults	85, Hispanic American HIV+	AMAS	COWAT, WCST, TMT, PASAT, HVLT, BVMT, Groove Pegboard, WAIS-III – Digit Symbol, symbol search, and Letter Number Substitution	US and Hispanic acculturation predicted different cognitive domains
Arnold, et al., 1994	The effect of acculturation on HRNB in healthy Hispanics	150, US-Spanish	ARMSA	Halstead-Reitan Neuropsychological Battery	Lower acculturated groups had lower scores for Tactual Performance Test, TMT, and Seashore rhythm test.
Coffery, et al., 2005	Explore levels of acculturation on the WCST and compare norms between two groups of Spanish speakers.	52, Mexican.	ARMSA-II	WCST	Less acculturated Mexicans had lower scores, but differences were attenuated when scores were demographically corrected.
Fariah et al., 2011	Evaluate demographic variables in relation to longitudinal global cognitive decline	639, elderly Mexican.	ARSMA-II	Modified MMSE	No relationship between acculturation and testing.
Hasson et al., 2019	Explore the effects of socio-demographic variables on the WASI-II	80, Arab Americans (12-17 years old).	AMAS	WASI-II	Language acculturation predicted VIQ and vocabulary subtest.

Kemmotsu et al., 2013	Investigate the impact of acculturation and generational status.	65, Japanese Americans	SL-ASIA	BNT, COWAT, CVLT, BVMT, TMT, WRAT-III.	No relationship between acculturation and testing.
Kennephol, et al., 2004	Assess acculturation on cognitive tests in brain-injured sample.	71, Brain inured African Americans	AAAS	GOAT, MAE-Token test, COWAT, BVDT, WAIS-R Block design, RAVLT, Groove Pegboard, SDMT, WCST, WMS-R Digit Span, and Logical Memory,	Acculturation uniquely predicted GOAT, MAE-Token task, WAIS-R Block Design, RAVLT total trials, SDMT
Manly, et al, 2004	Explore demographic variables and acculturation on cognitive tests.	554, Elderly African Americans	AAAS	SRT, MMSE, WAIS-R similarities, DRS, BNT, COWAT, BDEA repetition, and comprehension, Rosen Drawing, BVRT Matching, and recognition memory	Acculturation attenuated when demographic variables were controlled. Only predicted the Rosen drawing test.
Manly et al., 1998	Explore acculturation on cognitive tests on HIV status in African Americans.	210, HIV+ and HIV- African Americans	AAAS	Category test, TMT, BNT, PASAT, Story/Figure learning and memory, sensory tests, groove pegboard, WAIS-R Information, block design, digit symbol, and Digit Span	Acculturation uniquely predicted WAIS-R information and BNT.

Mindt et al., 2014	Compared HIV+ Latinos and Caucasians on cognitive tests.	126, HIV+ US Latino & Non-Hispanic	AMAS	WCST, Iowa gambling test, TMT, PASAT, HVLT, BVMT, groove peg board, COWAT, WAIS-III, Digit symbol, Symbol search, Letter Number Substitution	No relationship between acculturation and testing.
Mungas et al., 2005	The influence of demographic and cultural variables on SENAS.	527, Hispanics and Caucasians (US)	ARMSA-II	Spanish and English Assessment of Scales.	Acculturation was unrelated to test scores, but associated with language and education.
Nielsen et al., 2012a	Compare performance between the MMSE and RUDAS, and the impact of demographic variables.	83, elderly Turkish in Denmark	SASH	MMSE, RUDAS	High and low acculturated groups differed. But acculturation was not a significant predictor for tests performances
Nielsen et al., 2012b	Cross-cultural differences between Turkish immigrants and Danish locals across three cognitive tests.	109 elderly Turkish immigrants, 73 Danish	SASH	Recall of pictures, Clock reading test, Supermarket fluency	Age and acculturation predicted CRT and fluency tests.
Razani et al., 2007a	The effects of acculturation, and language status on tests of attention.	83, ethnically diverse Americans	ARMSA	TMT, Digit Span, Stroop Test, ACT, SDMT.	Acculturation correlated with Digit Span, Digit Symbol, Trails A, and Stroop Test B. But no differences were detected for high and low acculturated groups

Razani et al., 2007b	The effects of language status, and acculturation on the WASI.	86, ethnically diverse Americans	ARSMA	WASI	Acculturation correlated with FSIQ and VIQ. It uniquely predicted WASI-Vocabulary
Royal et el., 2003	Effects of cultural and demographic variables on the CLOX	1309 elderly Mexicans	HAS	CLOX, MMSE	'Failure' rates differ between high and low acculturation. But acculturation did not predict any cognitive tests.
Seaz et al., 2014	The relationship between sociocultural factors and non-verbal tests performance	305 Latinos and non-Latinos	BAS	RFCT, BVMT, groove pegboard, RFFT, WCST	Only epileptic patients' acculturation correlated with WCST, RFFT, and a global composite cognitive score.
Simpao et al., A2005	The effects of acculturation, structural assimilation, on the MMSE	457 elderly Mexican Americans	HAS, FAS, CVS	MMSE	Lower functional integration increased likelihood of cognitive impairment.
Tang et al., 2018	The relationship between social, religious, and acculturative engagements on cognitive functioning.	3159 Chinese elderly adults	PINE Acculturation Scale	MMSE, EBMT, WMS-R, SDMT	No relationship between acculturation and testing

Notes. Neuropsychological measures; ACT = Auditory Consonant Trigrams, BNT=Boston Naming Test, BVMT = Benton Visual Memory Test, BVDT = Benton Visual Discrimination Test, COWAT= Controlled Word Order Association Test, CVLT= California Verbal Learning Test, DRS= Dementia Rating Scale, CLOX= Clock Drawing Test, EBMT= East Boston Memory Test, GOAT= Galveston Orientation and Amnesia Test, HVLT = Hopkins Verbal Learning Test, MMSE= Mini-Mental Status Exam, MEA= Multilingual Aphasia Examination, RAVLT= Rey Auditory Verbal Learning Test, RUDAS =Rowland Universal Dementia Assessment Scale, RFCT= Rey Complex Figure Test, RFFT= Ruff Figural Fluency Test, SDMT= Symbol Digits Modalities Test, SRT= Serial Reminding Test, TMT = Trail Making Test, PASAT = Pace Auditory Serial Addition Test, WAIS= Wechsler Adult Intelligence

Scale, WRAT= Wechsler Reading Ability Test, WMS-R = Wechsler Memory Scale Revised, WASI= Wechsler Abbreviated Scale of Intelligence. Acculturative measures; AAAS = African American Acculturation Scale, AMAS= Abbreviated Multidimensional Acculturation Scale, AAMAS= Asian American Multidimensional Acculturation Scale, ARSMA = Acculturation Rating Scale for Mexican Americans, BAS= Bidimensional Acculturation Scale, CVS= Cultural Values Scale, HAS= Hazuda Acculturation Scale, FAS= Family Attitude Scale, SASH = Short Acculturation Scale for Hispanics, SL-ASIA = Suinn-Lew Asian Self-Identification Acculturation, MAS= Marin Acculturation Scale, PINE = Population study of Chinese Elderly.

2.3.1 Study characteristics

Demographics. One study recruited adolescents aged between 12 and 17 years (Hasson, Wu, & Fine, 2019), while the remaining studies included participants above 18 years old. Education were on average 11 years for all studies, two studies included illiterate and literate Turkish immigrants with less than four years of education. Ethnic groups covered in these studies were labelled as, Latino, Mexican, Hispanic, African, Japanese Americans, Chinese Americans, Arab Americans, and Non-Hispanic White (NHW) Caucasians. Two studies formed a single multi-ethnic group (Razani, Burciaga, Madore & Wong, 2007a; Razani, Murcia, Tabares, & Wong, 2007b). Two studies sampled Turkish immigrants in Denmark (Nielsen, Vogel & Waldemar, 2012a; Nielsen, Vogel, Gade & Waldenmare, 2012b).

Neuropsychological tests. Two studies combined independent tests forming cognitive domains. These included executive functioning, working memory, processing speed, motor function, learning, verbal fluency, and a global composite score combining all tests (Arentoft et al., 2012; Mindt et al., 2014). Fixed neuropsychological batteries were evaluated in three studies, and these were the Halsted-Reitan Neuropsychological Battery (HRNB: Arnold, Montgomery, Castañeda, & Longoria, 1994), Wechsler Abbreviated Scale of Intelligence (WASI: Razani et al., 2007b; Hasson, Wu & Fine, 2019), Spanish and English Neuropsychological Assessment Scales (SENAS: Mungas, Reed, Haan, & González, 2005).

The range of these tests varied considerably over the remaining studies, but there were overlaps in the type of test used between studies. For instance, verbal fluency like the Controlled Word Association Test (COWAT) appeared in six studies. A majority of the studies used a flexible test approach, with various subtests from Wechsler Adult Intelligence Scale (WAIS) and/or Wechsler Memory Scales (WMS). Test translations, including the language of administration, were reported in eight studies.

Norms. Raw score conversions into demographically corrected scores were found in seven studies (Arnold et al., 1994; Manly et al., 1998; Coffey, Marmol & Adams, 2005; Arentof et al. 2012; Kemmotsu, Enobi & Murphy, 2013; Mindt et al., 2014; Hasson et al, 2019). Arentof et al. (2012) and Mindt et al (2014) used age, education, and gender corrected T-scores from several sources for each of their tests. Only Mindt et al. (2014) reported ethnically-corrected Hispanic norms, and these were included in their analyses. Several versions of Heaton et al. (1991; 1992; 2004) norms

were used over three studies (Arnold et al., 1995; Manly et al., 1998; Kemmotsu et al., 2013). Only Kemmotsu et al. (2013) acknowledged that they used all-Caucasian norms. Coffey et al. (2005) used Spanish speaking norms as reported by Artiola i Fortuny et al. (1999).

2.3.2 Acculturation

Dimensions and domains. Table 2.2 summarises all scales used by these studies. For unidimensional scales, higher scores reflect higher adoption of the dominant culture, lower scores reflect higher maintenance of their heritage culture, and these were assessed along the same continuum. Language proficiency or usage was the most common domain of acculturation among these scales. Only three studies used bi-dimensional scales in their analyses (Seaz et al., 2004; Arentoft et al., 2012; Hasson et al., 2019), and three included multiple domains in their study (Kennepohl, Shore, Nabors & Hanks, 2004; Arentoft et al., 2012; Hasson et al., 2019).

Razani et al. (2007a, 2007b) and Arnold et al. (1995) used the old version of the Acculturation Rating Scale for Mexican Americans (ARSMA) (Celluar, Harris & Jasso, 1980). The ARSMA-II (Celluar, Arnold & Maldano, 1995) was used for the remaining studies. Nielsen et al. (2012a, 2012b) and Acevedo et al. (2007) cited the same acculturation scale despite labelling them with a different name.

Table 2.2 Dimensions and domains of all acculturative measures

Study	Dimension	Domains	Scale
Acevedo et al., 2007, Nielsen et al., 2012a	Unidimensional	Language, media, social relations	MAS/SASH
Arentoft et al., 2012; Hasson et al., 2019	Bi-dimensional	Language, knowledge, ethnic identity	AMAS
Arnold et al., 1995; Coffey et al., 2005; Razani et al., 2007a,b;	Unidimensional	Language, ethnicity identity, cultural behaviours, ethnic interaction	ARSMA-I/II
Fariah, et al., 2011	Adoption	Language, ethnicity identity, cultural behaviours, ethnic interaction	ARSMA-II
Kemmotsu et al., 2013	Unidimensional	Language, ethnic interaction, ethnic identity, food preference, generational identity	SL-ASIA
Kennpohl et al., 2004; Manly et al., 1998; 2004	Maintenance	Lifestyle, family practices, health beliefs, socialization, food, religion, interracial attitudes	AAAS
Mindt et al., 2014	Adoption	Language, knowledge, ethnic identity	AMAS
Seaz et al., 2014	Bi-dimensional	Language use, proficiency, media preference	BAS
Simpao et al., 2005	Maintenance	Knowledge of history and customs (CVS). Importance of family values (FVS).	CVS/FVS
Simpao et al., 2005; Royal et al., 2003	Unidimensional	Language proficiency, friendship preference	HAS
Tang et al., 2018	Unidimensional	Language, media preference, friendship preference.	PINE

Notes. AAAS = African American Acculturation Scale, AMAS= Abbreviated Multidimensional Acculturation Scale, ARSMA = Acculturation Rating Scale for Mexican Americans, BAS=Bidimensional Acculturation Scale, CVS= Cultural Values Scale, HAS= Hazuda Acculturation Scale, FAS= Family Attitude Scale, SASH = Short Acculturation Scale for Hispanics, SL-ASIA = Suinn-Lew Asian Self-

Identification Acculturation, MAS= Marin Acculturation Scale, PINE = Population study of Chinese Elderly.

Scale psychometric properties. Two studies used a translated scale (Nielsen et al, 2012a, 2012b), another two modified items on scales to suit their participants (Razani et al., 2007a, 2007b). These studies did not report psychometric properties of their scales for their target sample. Manly et al. (2004) and Hasson et al. (2019) reported acceptable reliabilities specific to their study, defined as > 0.7 (Kline, 2015). Internal consistencies were > 0.7 for all scales from their original validation study. Table 2.3 summarises exploratory factor analyses (EFA), and criterion validation for five scales.

The African American Acculturation Scale (AAAS) was validated by differentiating scores between 'traditional' and 'non-traditional' African Americans according to how long they lived in a 'Black' neighbourhood (Klonoff & Landrine, 1995). The Hazuda Acculturation Scale (HAS), Cultural Values Scale (CVS) and Family Attitudes Scale (FAS) were co-validated in the same study, but the results were unclear (Hazuda, Stern & Heffner, 1988). No psychometric information was reported for the Population of Chinese Elderly (PINE) acculturation scale (Tang, Chi, Zhang & Dong, 2018).

Table 2.3 Criterion and construct validity of included scales of acculturation

Author	Scale	Psychometric properties	Target ethnic group
Marin et al., 1996	BAS	All adoption subscales correlated positively with years of US residency; all maintenance subscales correlated negatively with years of US residency. English language subscale showed the strongest correlations. Each adoption and maintenance scale yielded three factors.	Hispanic
Celluar et al.,1995	ARSMA-II	Scores were significantly different between five generations of Mexicans. Each adoption and maintenance scale yielded three factors.	Mexicans
Zea et al., 2003	AMAS	All adoption subscales correlated positively with years of US residency, all maintenance subscales except for Spanish language use correlated negatively with years of US residency. Each adoption and maintenance scale yielded three factors.	Latinos
Suinn et al., 1992	SL-ASIA	Total score correlated positively with time spent in the US, and time spent in a non-Asian neighbourhood. EFA found five factors.	Asian American
Marin et al., 1987	SASH/MAS	All subscales discriminated between foreign and local born individuals. All adoption subscales correlated positively with years of US residency; English proficiency showed strongest correlations. Each adoption and maintenance scale yielded three factors.	Hispanics

Notes. AMAS= Abbreviated Multidimensional Acculturation Scale, ARSMA = Acculturation Rating Scale for Mexican Americans, AMAS= Asian American Multidimensional Acculturation Scale, BAS=Bidimensional Acculturation Scale, SASH = Short Acculturation Scale for Hispanics, SL-ASIA = Suinn-Lew Asian Self-Identification Acculturation, MAS= Marin Acculturation Scale

2.3.3 Acculturation and demographics

Studies found that more years of education and rates of literacy were associated with higher adoption, or higher scores on acculturative scales (Manly et al., 1998, 2004; Arentoft et al., 2012; Nielsen et al., 2012b). Mindt et al. (2014) reported that Latinos had lower levels of education with high levels of adoption. Two studies demonstrated that older adults, and lower generational statuses, associated with lower adoption (Manly et al., 1998; Kemmotsu et al., 2013). Kennepohl et al (2004) reported no

significant association between the AAAS and age, education, or SES. Correlations for these relations were low to moderate, ranging from 0.2 to 0.3.

2.3.4 Acculturation and test performances

Results in this section were divided into three broad categories: a) statistical comparisons between groups; b) correlations; and c) regression analyses. Some studies used a combination of statistical analyses, but methods that were able to account for demographic variables were reported upon to best represent the unique contribution of acculturation on test performances. One exception was with Arentoft et al. (2012), where a significant portion of their interpretation was based on correlational analyses. The *p* values for significant findings were followed according to the thresholds set by each paper.

Comparisons between groups. These studies divided their data into high and low scores on a unidimensional scale based on a median or mean split of scores. Arnold et al. (1994) found that those with high scores on the ARSMA performed significantly better on the Tactual Performance Test (dominant hand), Seashore Rhythms Test, and Category Test of the HRNB, than those with low scores. Coffey et al. (2005) also found significant differences between these two groups of Hispanics on the Wisconsin Card Sorting Task (WCST), but no significant results were found after demographically correcting raw scores.

Correlations of acculturation and neuropsychological tests. Table 2.4 summarises the results of studies that used correlational analyses. At an index level of testing, Arentoft et al. (2012) found that among a sample of Latinos/as, linguistic and non-linguistic aspects of adoption (US) and maintenance (Latin) correlated with different aspects of neuropsychological indices. However, Mindt et al. (2014) were unable to replicate such findings in their sample of HIV+ Latinos/as. Seaz et al. (2014) used partial correlations, adjusting for age and education, where adoption on the Bidimensional Acculturation Scale (BAS) correlated positively with the Ruff Figural Fluency Test (RFFT) Perseverative Errors, and negatively with the WCST, among epileptic patients.

Table 2.4 Significant correlations between acculturation and neuropsychological tests

Author-labelled domain/test	Correlations (coefficients)
Arentof et al. 2012	AMAS
Verbal fluency	US language (r= .44)
	Total US acculturation (r=.32)
Speed of processing	US language (r= .34)
	US competency (r=.25)
	US identity (r=.29)
	Total US acculturation (r =.33)
Executive function	Total Latin maintenance (r= -.27)
Attention/Working memory	US cultural competency (r=.27)
Learning/Memory	Latin identity (r= -.27)
Global composite	US language (r=.32)
	Total US acculturation (r=.26)
Seaz et al. (2014)*	BAS English domain
RFFT perseverative errors	Adoption (r=.33)
WCST Total Categories	Adoption (r=-.66)
WCST perseverative errors	Adoption (r=-.54)

Notes; AMAS= Abbreviated Multidimensional Acculturation Scale, BAS= Bidimensional Acculturation Scale. *Partial correlations adjusting for age and education.

Acculturation as a predictor variable. Table 2.5 shows the results of regression analyses, and study characteristics for the relationship between composite or subscale scores of acculturative measures and 13 neuropsychological tests. The table shows that two studies used stepwise linear regression analyses and thus only the R^2 was reported (Acevedo et al., 2007; Nielsen et al., 2012a, 2012b). To reduce reporting bias, significant findings for tests were reported together with studies that found non-significant results for the same tests where possible. In addition, Arentof et al. (2012) found that total US adoption predicted an index of processing speeds (R^2 =14%) for HIV+ Latinos. Hasson et al. (2019) found that language competency on the Abbreviated

Multidimensional Scale of Acculturation predicted the WAIS-VIQ after adjusting for demographic variables.

Table. 2.5 Results of regression analyses (ΔR^2 or R^2) for acculturation and 15 tests across all studies.

Test	Study	Covariates	Scale	Ethnicity	R^2 / ΔR^2
Block design	Kennephol, et al., 2004	Age, gender, education, TBI injury	AAAS	African	ΔR^2 4%
Block design	Manly et al., 1998	Age, gender, education	AAAS	African	NS
Block design	Hasson et al., 2019	Age, parental education, SES, language, place of birth	AMAS	Arab	NS
Block design	Razani et al., 2007b	Age, education, WRAT	ARSMA	Multi-ethnic	NS
Block design	Acevedo et al., 2007	Age, gender, education, US residency, Depression score	MAS	Hispanic	NS
BNT	Manly et al., 1998	Age, gender, education	AAAS	African	ΔR^2 6%
BNT	Manly et al., 2004	Age, gender, WRAT	AAAS	African	NS
BNT	Kemmotsu et al., 2013	Age, gender, education	SL-ASIA	Japanese	NS
BNT	Acevedo et al., 2007	Age, gender, education, US residency, Depression	AMAS	Hispanic	NS
COWAT	Kennephol, et al., 2004	Age, gender, education, TBI	AAAS	African	NS
COWAT	Manly et al., 2004	Age, gender, WRAT	AAAS	African	NS
COWAT	Kemmotsu et al., 2013	Age, gender, education	SL-ASIA	Japanese	NS
COWAT	Arentof et al., 2012	NA	AMAS	Latino	R^2 12%
COWAT	Acevedo et al., 2007	Age, gender, education, US residency, Depression	MAS	Hispanic	NS
CRT	Nielsen et al., 2012a	Age, education	SASH	Turkish	R^2 12%
Digit Span	Kennephol, et al., 2004	Age, gender, education, TBI injury	AAAS	African	NS
Digit Span	Manly et al., 1998	Age, gender, education	AAAS	African	NS
Digit Span Forward	Acevedo et al., 2007	Age, gender, education, US residency, Depression score	MAS	Hispanic	R^2 16%
Digit Span	Acevedo et al., 2007	Age, gender, education, US residency, Depression score	MAS	Hispanic	R^2 15%
GOAT	Kennephol, et al., 2004	Age, gender, education, TBI	AAAS	Africa	ΔR^2 7%
MEA-Token Test	Kennephol, et al., 2004	Age, gender, education, TBI	AAAS	African	ΔR^2 8%

RAVLT- Total trial	Kennephol, et al., 2004	Age, gender, education, TBI	AAAS	African	ΔR^2 6%
Rosen Drawing test	Manly et al., 2004	Age, gender, WRAT	AAAS	African	ΔR^2 5%
SDMT	Kennephol, et al., 2004	Age, gender, education, TBI	AAAS	African	ΔR^2 5%
Semantic fluency	Nielsen et al., 2012a	Age, education	SASH	Turkish	R^2 20%
WAIS-Vocabulary	Hasson et al., 2019	Age, parental education, SES, language, place of birth	AMAS (English competency)	Arab	ΔR^2 18%
WAIS-Vocabulary	Razani et al., 2007b	Age, education, WRAT	ARSMA	Multi-ethnic	ΔR^2 8%
	Manly et al., 2004	Age, gender, WRAT	AAAS	African	NS

Notes. AAAS = African American Acculturation Scale, ARSMA = Acculturation Rating Scale for Mexican Americans, AMAS= Abbreviated Multidimensional Acculturation Scale, AAMAS=Asian American Multidimensional Acculturation Scale, BNT=Boston Naming Test, COWAT= Controlled Word Order Association Test, CRT= Clock Reading Test, GOAT= Galveston Orientation and Amnesia Test, LAI= Language index, NS= Non-significant, MAS= Marin Acculturation Scale, MEA= Multilingual Aphasia Examination, ORI= Orientation index, RAVLT= Rey Auditory Verbal Learning Test, SES = Socioeconomic Status, SL-ASIA = Suinn-Lew Asian Self-Identification Acculturation, SDMT= Symbol Digits Modalities Test, SASH = Short Acculturation Scale for Hispanics, SPANS= Short Parallel Assessment of Neuropsychological Status, TBI = Traumatic Brain Injury, WAIS= Wechsler Adult Intelligence Scale, WRAT= Wechsler Reading Ability Test.

2.3.4.1 Clinical Studies

Clinical studies included in the review covered traumatic brain injury (Kennepohl et al., 2004), HIV-related dementia (Manly et al, 1998; Arentoft et al., 2012; Mindt et al., 2014), and epilepsy (Seaz, et al., 2014). The independent effects of acculturative scales on neuropsychological tests were still present in two studies after adjusting for TBI injury variables, epileptic frequency and duration, HIV+ statuses (Kennepohl et al., 2004; Arentoft et al., 2012; Seaz et al., 2014). Two studies found no association between acculturation and substance abuse or TBI injury factors (Kennepohl et al, 2004; Arentoft et al., 2012).

Simpao et al (2005) found that a one-point increase in Hazuda Acculturation Scale (HAS) scores predicted a 65% higher likelihood of obtaining a score greater than a 24-point cut-off on the MMSE, after adjusting for demographic variables and physical illness factors. Royal et al. (2003) found that the proportion of 'failures' (cut-off score less than 10) on the Clock Drawing Task (CLOX) were significantly different between categorical high and low scores on the HAS, but this did not account for confounding effects of age or education. Simpao et al. (2005), Royal et al. (2003) and Tang et al. (2017) did not report pre-screening methods, like reviewing medical history, in their inclusion or exclusion criteria.

Misdiagnosis (false positives). All studies that recruited healthy participants, except for Arnold et al (1994), screened participants for any known history of neurological and/or psychiatric disorders prior to inclusion. Based on norms derived from Heaton et al. (1991; 1992; 2004), three studies adopted a T-score of < 40 as an indication of false identification neurological impairment, a 'false positive' (Arnold et al., 1994; Manly et al., 1998; Kemmotsu et al., 2013). Manly et al. (1998) reported that rates of false positives across tests ranged from 7% to 65% in healthy African Americans. Male Japanese Americans were more likely to score within the impaired range of the CVLT and BNT (Kemmotsu et al., 2013). Arnold et al. (1994) reported that rates of false positives ranged from 8% to 48%, but test scores between categorically high and low scores of acculturation differentiated by less than 1SD.

2.3.4.2 Non-significant findings

Seven studies did not find any significant relationships between scales of acculturation and neuropsychological test scores (Royal et al., 2003; Mungas et al.,

2005; Faria et al., 2011; Nielsen et al., 2012a; Kemmotsu et al., 2013; Mindt et al., 2014; Tang et al., 2018;). Kemmotsu et al. (2013) reported that generational status independently predicted performance on the California Verbal Learning Test (CVLT) and Trail Making Test (TMT) above age and education. Language of administration (English vs. Spanish) predicted performance on the CLOX (Royal et al., 2003), subtests of the SENAS (Mungas et al., 2005) and the Mini-Mental Status Examination (Faria et al., 2011). Tang et al. (2018) found significant two-way interactions between religious or social behaviour with acculturative measures on tests of episodic memory and the Mini-Mental Status Examination (MMSE). Scores on the Short Acculturation Scale for Hispanics did not predict performance on the MMSE and the Rowland Universal Dementia Assessment Scale (RUDAS) on Turkish immigrants (Nielsen et al., 2012a). Razani et al. (2007a) reported significant positive correlations between ARSMA and tests of attention, but when adjusted for age, no differences were reported between categorical high and low scores of the ARSMA.

2.4 Limitations of included studies

The studies were appraised based on the quality and accuracy of their findings. These were based on elements extracted from the Critical Appraisal Skills Program – Cohort study (CASP) Cohort Study Checklists. No study was sufficiently flawed to be excluded from data extraction in this review, but limitations existed in all studies, and thus no study was given exceptional weightage in these conclusions. Papers were scrutinised according to: a) quality, definition (psychometric properties) of acculturative scales and neuropsychological tests; and b) methodological constraints that may have limited the independent effects of acculturation on test performances. Between studies, there is diversity in the reliability and validity over the way acculturation and neuropsychological constructs were measured (Table 2.6).

Table 2.6. Key limitations of each study.

Limitations	Study
T-scores for each subtest used different normative references, and these were combined to form several indices. This reduced the reliability of each index (Russell, 2012).	Arentof etal.,1994; Mindt et al., 2014
Unstandardised approach of dividing high and low acculturative groups.	Arnold et al., 1994; Coffey et al., 2005; Razani et al., 2007b
Assumed that high maintenance is tantamount to low adoption.	Kennepohl, et al., 2004; Manly et al., 1998; 2002.
Reliability and validity of the modified or original acculturative scale was unreported.	Nielsen et al., 2012a, 2012b; Razani et al., 2007a, 2007b; Tang et al., 2018
Gold standard to independently identify, exclude or include neurological impairment were not reported.	Simpao et al., 2005; Royal et al., 2003; Tang et al., 2018
Collinearity between acculturation and other cultural constructs (e.g., language of administration, socio-economic status, etc.) were not reported. This potentially confounded the effects of acculturation on testing.	Mungas et al., Faria et al., 2011, Hasson et al., 2019
Comparison of the effects of acculturation on test performances may not have been equivalent between clinical and non-clinical samples, as educational levels between groups differed.	Seaz et al., 2014
Scores of acculturation were low and in a restricted range, thus a lack of variance potentially belied effect on test performance.	Acevedo et al., 2007
Reliability and validity of neuropsychological tests of Caucasian and Japanese Americans may not be equivalent.	Kemmotsu et al., 2013

2.5 Discussion

2.5.1 Adoption and test performances

This review collated a series of quantitative studies to explore the relationship between acculturative measures and neuropsychological tests performance. There is only partial support for the first hypothesis, in which higher adoption toward the dominant culture is generally related to better test performances above the effects of age and education. Such an observation is provisional due to significant methodological differences, like approaches to neuropsychological testing (fixed vs. flexible), along with demographic, ethnic and cultural variation. There are possible contradiction in the data opposing the benefit of adoption on test performances. For example, Seaz et al. (2014) demonstrated that higher scores on the BAS adoption was related to poor performance on the WCST total categories, and more errors on the RFFT. Also, the independent effects of acculturation beyond age and education were only observed in some studies. Precise synthesis of the data was consequently limited, and certain assumptions had to be made in the process. Any synthesis of these data is tentative and based on a presumption that all neuropsychological tests are equally valid for all populations (Sternberg, 2004; Rushton & Jensen, 2005).

2.5.2 Linguistic vs. non-linguistic acculturation

Only two studies used subscales of acculturation in their study. Arentof's et al. (2012) evidenced that cultural knowledge, ethnic identity, and language competency subscales of the AMAS associated with different cognitive indices. However, it was presented that coefficients for language competency appeared marginally stronger. Furthermore, indices that positively correlated with AMAS language competency, also associated with total AMAS adoption scores during the regression analyses. As for Hasson's et al. (2019) study, only language competency on the AMAS predicted WAIS-IV Vocabulary subtest. These studies could suggest that there might be a much larger effect of linguistic aspects of acculturation on test performances. However, methodological differences between these studies may hamper a proper synthesis of these findings. The multi-domain relationship between acculturation and test performances were restricted to correlations without adjusting for confounding variables in Arentof's et al. (2012) study. Mindt et al. (2012) could not replicate findings by Arentof et al. (2012) despite a similar methodology, but these two studies differ in the

usage of norm references. In any case, it seems plausible that language aspects of acculturation could have a stronger association with test performances compared to less linguistically driven domains like ethnic identity.

2.5.3 Heterogeneity across studies.

The independent contribution of ratings of acculturation were observed over a range of verbal and non-verbal tests, but this was largely inconsistent across different studies. Despite this, tests of visuospatial memory, like the Benton Visual Memory Test, and verbal delayed recall, like the RAVLT, consistently did not associate with measures of acculturation in this review. As aforementioned, there is heterogeneity in the level of education, age, and ethnicity that could have prevented a proper synthesis of the data. It seems that the relationship between ratings of acculturation and test performances may depend on specific methodology and sample characteristics within each study. For example, if there is larger variance in educational attainment than acculturation, the former might better account for test performances compared to acculturation (Nielsen et al., 2012b; Seaz et al., 2014).

Studies in this review also demonstrated that there might be other sociocultural demographic variables (i.e., years of residency, generational status, language of administration, etc.) that could also explain test performances. Other cultural variables like social or religious engagement may interact with measures of acculturation (Tang et al. 2018), Kennepohl et al. (2003) theorised that acculturative stress may confound the relation between acculturation and test performances. Additionally, the relationship between measures of acculturation and these sociocultural constructs were not consistent in the literature. For instance, cultural maintenance and adoption was not always related to demographic variables like age, education or socioeconomic status (Kennepohl et al., 2003), and lower educational attainment is not always related to higher adoption (Mindt et al., 2014). Therefore, there appears no clear consensus as to which cultural or demographic variables (including age or education) would interact, confound, or negate the effects of acculturation on testing. These relationships appear to be specific and distinct for each study.

2.5.4 Practical application

This review found that the predictive value of scores on acculturative measures on test performances can permeate both healthy and clinical groups. In any case, recommendations for the use of acculturative scales to aid clinical judgements during routine clinical examination for ethnic minorities were divided among these studies. Four studies advocated the use of acculturative scales during clinical assessments to evaluate cultural bias (Manly et al., 1998; Simpao et al., 2005; Razani et al., 2007b; Arentoft et al., 2012). Even translated tests may not be free from acculturation (Acevedo et al, 2007; Nielsen et al., 2012a), and thus ratings of acculturation can impact decisions regarding the type of tests that should be used during routine examinations.

Kennepohl et al. (2004) suggested that acculturative scales might not be sufficient to demographically 'correct' scores, as this cannot eliminate all sociocultural factors that affect testing. For example, participants achieved significantly lower scores when some tests (i.e. SENAS, CLOX, MMSE) were administered in Spanish compared to English, and this had a greater effect on test performances compared to ratings on acculturative measures (Royal et al., 2003; Mungas et al., 2005; Faria et al., 2011). This demonstrate that accounting for acculturation itself during routine clinical examinations for some ethnic minorities may not necessarily eliminate all cultural factors that confound test performance. Furthermore, Arnold et al. (1995) found that the degree to which test scores differed between acculturated groups were not significant enough (less than 1 standard deviation apart) to justify the use of the ARSMA during clinical examination.

Some of these studies suggests that acculturative factors could have confounded the external validity of existing norm references from one population to another group with culturally dissimilar characteristics. For example, Arentof et al. (2012) and Mindt et al.'s (2014) studies were similar in terms of methodology, but the latter reported ethnic corrected norms and found no significant findings with scales of acculturation. Similarly, Coffey et al. (2005) found that using Spanish-speaking norms eliminated performance differences on the WCST between categorical high and low scorers on the ARSMA. Perhaps the use of appropriate T-score corrections may reduce or eliminate the effects of unidimensional acculturation or adoption on test performances. This suggests that the construct of acculturation may hinder the transmission of test norms between culturally dissimilar populations. In any case, the practical use of acculturative

scales is divided among these studies. Furthermore, heterogeneity across these studies precludes a firm conclusion about the clinical utility of measuring acculturation alongside neuropsychological testing.

2.5.5 Implications for the thesis

Limitations identified among these studies provide valuable direction for future research. Addressing some of these could further clarify the integration between these two concepts. First, most of these studies were conducted in the USA, where American cultural perspective dominated theories and empirical works on the relationship between acculturation and neuropsychological testing. Therefore, conducting research outside North America can provide some cross-cultural evidence for the relationship between the multidimensional acculturation on test performances. Work produced by Nielsen et al. (2012a, 2012b) raised the possibility that the influence of acculturative measures on test performance might be generalizable beyond North American cultural orientations. Below outline more specific recommendations for different aspects of acculturation and neuropsychological testing.

2.5.5.1 Acculturation.

A unidimensional framework of acculturation dominated studies in this review, and assumptions that maintenance was inversely related to adoption were incorrect in three studies (Kennepohl et al., 2003; Manly et al., 1998; 2004). This reinforces the use of a multidimensional view of acculturation, such as evaluating adoption and maintenance separately. One advantage of a bi-dimensional framework is that Berry's four acculturative strategies can be calculated from these two dimensions (see Arends-Tóth & Van De Vivjer, 2006). Additionally, Berry's work on acculturation is highly influential, but sparsely represented among these studies. Therefore, the position of acculturative strategies, or even acculturative stress, on test performance is lacking in the neuropsychological literature.

Many scale development studies presented in this review provided evidence through factor analyses for independent subscales, but only a few studies included subscales in their analyses. This also reiterates the importance of using a multi-domain approach in assessing acculturation, as this is in line with existing theories of acculturation (Arends-Tóth & Van de Vivjer, 2006a, 2006b; Arentof et al., 2012;

Schwartz et al., 2010), and provides a clearer integration as to what aspects of acculturation are related to test performances. Accounting for a wider array of acculturative constructs like these could potentially provide better precision over what particular aspects of acculturation should be relevant for test performances.

Within the construct of acculturation, the domain of language proficiency was disproportionately represented among these scales, skewing the representation of acculturation toward language ability. Consequently, it is important to select scales that contain a variety of domains, and avoid items or domains biased toward language use or proficiency, e.g., ethnic identity assessed in the form of language preference. This is vital to explore a more in-depth relationship between the concept of acculturation and test performances. For instance, linguistic and non-linguistic domains of acculturation can separately form some relationship with different neuropsychological tests (Arentof et al., 2012; Hasson et al., 2019).

Finally, some studies in this review assessed for proxies of acculturation like years of residency, and these accounted for some tests over-and-above ratings on acculturative scales. However, these alone do not account for the multifaceted nature of acculturation, and should be assessed separately (Arends-Tóth & Van de Vivjer, 2006b; Matsudaira, 2006). It is also important to report any relationship between proxies of acculturation, or any other demographic or cultural variable with measures of acculturation (i.e., multicollinearity). This would ensure independent contribution of ratings on acculturative scales on test performances were not confounded by other related constructs.

2.5.5.2 Neuropsychological tests

In this review, there were trends suggesting that the predictive value of acculturative measures can vary depending on the level of assessment. For example, the MAS predicted Total and Forward Digit Span, but not the Backward subtest (Acevedo, Loewenstein, Agron & Duara, 2007), acculturative scales predicted VIQ and the Vocabulary subtest, but not the Similarities subtest (Hasson et al., 2019; Razani et al. 2007a). Therefore, the effects of acculturative measures may differ for different subtests contained within a cognitive index. It is also important to use fixed batteries as these were underrepresented in the data. These involve subtests that are co-normed to form index levels of neuropsychological functions, like the structure of the Wechsler scales.

Doing this allows a wider exploration into how the relationship between concepts of acculturation and test performances change between levels of assessments (subtest vs. index), providing better precision as to what aspects of neuropsychological testing are most sensitive to scores on acculturative scales.

2.5.5.3 Practical application

Most studies reviewed only reported statistical significance for the effects of acculturative measures on test performances but did not offer clinical guidance. Statistical and clinical significance are different concepts, the latter imply real-world practical applications to inform clinical practice, or analyses that directly assess 'costs and benefits' of current clinical services (Ranganathan, Pramesh, & Buyse, 2015). Simpao et al. (2003) reported significant findings for the probabilistic nature of acculturation after adjusting for physical illness (stroke, diabetes, etc.). Such results may therefore inform practitioners that ratings on acculturative scales can negatively affect the likelihood of passing a given threshold and may hold some practical value in this regard (Simpao et al., 2003). As such, a similar methodology was adopted for this thesis, where the probabilistic nature of acculturative scales was assessed to provide better clarity over the practical value of such scales.

2.5.5.4 Methodology

In the wider literature on cross-cultural psychology, it is common to compare tests performances between groups (stratified by ethnicity, language status, etc.), and these can be subjected to analyses of variance or factor analyses (Fletcher-Janzen et al., 2000). These methods attribute bias in testing to nominal variables (Fletcher-Janzen et al., 2000; Fernández & Abe, 2018). In contrast to this, acculturation is better conceptualised as a continuous variable (Kennepohl, et al. 2004; Schwartz et al., 2010). Among scales in this review, it was not common for these to provide standardised classification of 'high' and 'low' scores. Such procedures are also criticised. Categorisation of 'high' and 'low' base on a split of the data is arbitrary and depend on score distributions unique to each sample (Schwartz et al., 2010). As a result, it is better to conceptualise acculturation as a continuum along different dimensions (Kennepohl et al, 2004; Schwartz et al., 2010).

Since investigating the association between acculturative measures and tests could be specific to a given sample, this has a few implications. First, it is important to ensure adequate validity and reliability is achieved for these instruments, but this was rarely done over studies included in this review. Second, it is also important to address any potential confounds that could have altered or confound the relationship between acculturation and test performances (e.g., multicolinearity, interactions, etc.). Beyond age and education, other aspects like ethnicity, or other related constructs such as acculturative stress, might confound the relationship between acculturation and test performances. Finally, these recommendations meant that multiple analyses may be needed on a single data set (e.g., tests for reliability, interactions, comparing different constructs, etc.). Doing so would allow for better consistency in data interpretations and expose limits on generalisability.

2.5.6 Summary and conclusion

In summary, this systematic review found heterogeneity among the included studies, and this dampened efforts to synthesis the data. Tests of visuospatial and verbal delayed recall were not likely to associate with acculturative measures. It is plausible that linguistic aspects of acculturation were more likely predict test performances compared to less-linguistic aspects of acculturation. However, these interpretations were based on comparing non-equivalent studies (methodology, sample, etc.). Additional cultural (e.g., acculturative stress), proxy (years of residency, etc.), and demographic variables may confound or interfere with the relationship between acculturation and test performances, but these confounds appear to be unique in each sample. There were also limitations over the practical value of acculturation in clinical practice. As one of the recommendations were to assess the psychometric properties of tests and scales prior to analyses, this was conducted over the next chapter.

Chapter 3: Instrument selection and psychometric properties

This chapter explores the validity and reliability of main instruments used in this thesis, divided into two sections. Section one introduces a test battery that was used to investigate the association between test performance and acculturation. The methods (3.1.3, participants) were extracted and modified from a published paper by Tan and Burgess (2018). The second section outlines a search for an acculturative and an acculturative stress scale. The reliability and validity of these modified scales are then further explored.

3.1 Section 1. Validating a neuropsychological test

3.1.1 Short Parallel Assessment of Neuropsychological Status

The systematic review highlighted that there may be specific tests within the broader framework of a cognitive domains that are more sensitive to ratings of acculturation. For example, adoption predicted the WAIS-IV vocabulary subtest within the VIQ index (Razani et al., 2007b; Hassan et al., 2019). Only a handful of studies used fixed batteries (Razani et al., 2007b; Arentof et al., 2012; Hassan et al., 2019), therefore associations between acculturation with tests performances while using a co-normed fixed battery has received little attention in the literature. To address this gap, the Short Parallel Assessment of Neuropsychological Status (SPANS) was introduced (Burgess, 2014) was introduced while keeping with the clinical perspective taken by this thesis.

3.1.2 Theoretical basis of the SPANS

The SPANS was designed uniquely to assess acquired brain injury (ABI) for inpatient rehabilitative services and provides information for clinical referrals and multidisciplinary teams (Burgess, 2014). Existing test measures were either too brief (i.e., MMSE, ACE-R, etc.) to extract clinically useful details, or overly extensive for ABI inpatients to tolerate, i.e., WAIS-IV, etc. (Burgess, 2014). The SPANS was developed fill this gap, as a measure to appropriately ‘challenge’ those with ABI without an exceedingly high-test demand (i.e., test length, difficulty, etc.). Consequently, the SPANS do not measure a range of intellectual functioning like the WAIS-IV, but is sensitive and specific to detect cognitive impairment. It was expected that healthy participant would attain high scores (or near maximum) for such tests. This

enables clinical perspectives into whether ratings of acculturation would hinder healthy ethnic minorities from attaining scores are suggestive of non-impairment.

The literature has reported that common impairments include memory, visuo-motor, language, speed of processing, attention, and executive functions in ABI patients (Schapiro & Sachetti, 1993; William, Scott & Adam, 1996). However, neuropsychological sequalae of ABI vary depending on the severity and location of injury (Riggio, 2011). For example, right temporal lobe injuries are usually associated with visual memory, but verbal memory is associated with left temporal damage (Ariza et al., 2006). Consequently, tests should provide a detailed coverage of cognitive functions with specific functions within different cognitive domains (Kreutzer et al., 1993). This formed the guiding principle of the SPANS where 33 different tests are co-normed to form seven cognitive domains: the orientation index (ORI), the attention concentration index (ACI), the language index (LAI), the memory and learning index (MLI), the visuo-motor performance index (VPI), the cognitive flexibility index (CFI), and the efficiency index (ECI).

3.1.3 SPANS index comparison

Relevant assessments were selected from a compendium of tests by Strauss et al. (2006) and from the wider literature to compare with the SPANS. These tests were designed with similar aims and purposes of the SPANS, specifically for the use with clinical populations (Table 3.1). The table suggests processing speeds is least accounted for by other tests, and only a few measure orientations. Generally, the SPANS cover a wide range of cognitive domains, and each contains more subtests than the other batteries. Given that the cognitive presentation of brain injury is substantially heterogeneous (Riggio, 2011), tests that cover a wider range of domains and specific processes (i.e., subtests) is usually preferred (Kreutzer et al., 1993). Therefore, the SPANS display a comprehensive range of neuropsychological skills within each domain or index when compared with other measures.

Table 3.1. Compares different test batteries, indices, and the number of subtests in parentheses.

SPANS	KBNA	NAB	RBANS	ACE-R	MOCA	MMSE	BCoS	OCS
Orientation (2)					Orientation (1)	Orientation (2)		
Attention (6)	Attention (2)	Attention (6)	Attention (2)	Attention/ Orientation (3)	Attention (3)	Attention (2)	Attention (9)	Attention (2)
Language (7)	Verbal fluency (2)	Language (6)	Language (2)	Verbal Fluency (1) Language (6)	Language (3)	Language (6)	Language (6)	Language (3)
Memory (6)	Memory (2)	Memory (4)	Immediate/Delayed recall (2)	Memory (3)	Memory (2)	Recall (2)	Memory (5)	Memory (2)
Visuo-motor processing (8) Processing speed (5)	Spatial processing (1)	Spatial processes (4)	Visuospatial (2)	Visuospatial (5)	Visuospatial (2)	Visuospatial (1)	Praxis (5)	Praxis (1)
Cognitive flexibility (2)	Reasoning (2)	Executive functions (4)			Abstraction (1)		Numbers (3)	Numbers (2)

Notes. RBANS= Repeatable Battery of Assessment of Neuropsychological Status (Randolph, 1998). SPANS= Short Parallel Assessment of Neuropsychological Status (Burgess, 2014). KBNA= Kaplan Baycrest Neurocognitive Assessment (Leach et al., 2000). NAB= Neuropsychological Assessment Battery (Stern & White, 2003). ACE-R = Addenbrookes Cognitive Examination-Revised (Moshi et al., 2006). MMSE= Mini-Mental Status Examination (Folstein et al, 2001). BCoS= Birmingham Cognitive Screener (Humphreys et al., 2012). OCS = Oxford Cognitive Screen (Demeyere et al., 2015). MOCA= Montreal Cognitive Assessment (Nasreddine et al., 2005).

3.1.4 Validating the SPANS

Therefore, the SPANS fit with the overall purposes of this thesis, a) it is a measure with clinical relevance, b) covers an appropriate range of cognitive processes prevalent in a target clinical group, and c) its index vs. subtest structure enables a wider exploration as to what type of tests would be related to what aspects of acculturation. However, the SPANS has not been used on culturally diverse samples. Previous work that tested non-native English speakers (or low proficiency English speakers) were limited by small sample sizes (Burgess, 2014; Hadessley, 2016). Therefore, its validity for culturally dissimilar individuals will be examined using a similar methodology outlined by the manual (Burgess, 2014). This study will use explore the convergent and divergent validity of SPANS indices with well-established tests from the field of clinical neuropsychology. The rational for the selection of these additional tests, and hypothesised relationship with the SPANS is summarises in the methods section.

3.1.5 Methods

Participants. This study adopted the following inclusion criteria: a) individuals with the right to abode in the UK or local nationals; b) above 18 years of age; and c) membership of any ethnic minority group (non-White/Caucasian-British European ethnicity). Exclusion criteria included the following: a) a pre-existing neurological or health condition (head injury, disability, psychiatric illness, etc.) that could affect cognitive functioning or the ability to manipulate test materials; and b) self-identified as belonging to a UK majority group (e.g., European British, White English), or native English-speaking Caucasians from Western countries (e.g., Australia, the US, New Zealand). This study included 228 participants, consisting of a mixture of international students, foreign and immigrant workers, and local British nationals. A majority of these were residing in the East Midlands area. All participants received at least one year of formal education taught in English. None indicated that they had difficulty with test instructions, and all were able to understand the ethical procedures and give consent.

Their ages ranged from 18 to 50 years, with a mean age of 25.77 years (SD= 7.32), and they were 147 females. The total mean years of UK residency was 10.72 (SD= 9.68). The total years of education had a mean of 16.74 (SD= 2.97). The mean non-UK education was 8.63 years (SD= 7.36). The mean of UK-based education was 7.85 years (SD= 6.60), and 11 participants had not received any UK education.

Educational attainment was also recorded, including secondary education (GCSE, A-level or equivalent) (n=104), graduate degree (n=57), and postgraduate degree (n=67). Sixty-eight participants were working adults who were not currently in education.

Ethnicity was assessed by self-identified categories defined by the UK 2011 census. These include: African (13.1%), Arab (4.8%), Afro-Caribbean (3.9%), Bangladeshi (2.6%), East Asian (Chinese, Japanese, Korean, 31.1%), non-British European (4.3%), Hispanic/Latino (1.3%), Indian (8.7%), mixed background (6.1%), Pakistani (3.5%), South East Asian (Thai, Malay, Indonesian, 14.4%), Turkish (5.2%), and Sri Lankan (0.4%). This set of participants will be used for studies in chapters 4, 5, and 6. Additional pre-collected data was introduced in chapter 5. See Appendix B for a full breakdown of ethnic composition.

Short Parallel Assessment of Neuropsychological Status (SPANS). The SPANS have seven cognitive indexes or constructs including, the Orientation index (ORI), Attention concentration index (ACI), Language index (LAI), Memory and learning index (MLI), Visuo-motor performance index (VPI), Cognitive flexibility index (CFI), and Efficiency index (ECI). See Table 3.2. for a detail outline of each subtest and corresponding index. Below details norms, reliability, and validity of the instrument as reported in the manual (Burgess, 2014).

Norms. The SPANS was normed on healthy controls (N= 122) and clinical samples (N= 136), consisting of a mixture of acquired brain injury (ABI, less than one-year post-injury) and those with long term neurological conditions (LTNC). All participants were between 18-74 years of age, healthy participants IQ scores were between 90 to 109, assessed via Weschler Test of Adult Reading (WTAR). All but 12 participants indicated they were either non-native English speakers, did not spend more than 50% of their lifetime in an English-speaking country, or that their primary school education was not taught in English. Participants were recruited from the East Midlands, Greater London, Surrey, and Hertfordshire. Norms were derived through T-score conversions (mean = 50, SD= 10), and comprise of four age groups (1= 18-32 years, 2= 33-50years, 3= 51-64years, 4= 65-74years) for each index.

Validity. First the SPANS was assessed for convergent and divergent validity with measures that are theoretically similar with the SPANS (see Table 3.3 for divergent and convergent validity as reported by the manual, consisting only of clinical

samples). Second, discriminant validity between ABI, LTNC and healthy controls were assessed. All index scores for each group were significantly different from each other, except between LTNC and healthy controls for the CFI.

Reliability. Internal consistency was assessed by combining healthy controls and clinical samples with the following Cronbach's alpha: ORI =0.80, ACI= 0.82, LAI= 0.84, MLI = 0.89, VPI= 0.85, ECI = 0.83, CFI = 0.70. The SPANS consist of an alternate form (SPANS B), and this was used to assess its test-retest reliability with the following coefficients: ORI= 0.93, ACI= 0.88, LAI= 0.97, MLI= 0.95, VPI= 0.89, ECI= 0.88, and CFI= 0.74.

Table 3.2. describes subtests of the SPANS and corresponding indices.

Index	Subtests and descriptions
ORI	Orientation: knowledge of past and present political leaders. Time Estimation: estimate total time taken for the entire battery.
ACI	Digit Span Forward/Backwards: repeat a set number of digits, followed by repeating another set of digits in reverse order. Sustained Attention1/2: Respond to a specific letter from a list of distractors, i.e., respond to the letter J from a list of alphabets. Counting Backwards: verbally count digits backwards in a specified order. Monetary Calculations: mental arithmetic questions of addition and subtraction.
LAI	Repetition: To repeat sentences verbally presented to them. Naming: Asked to name 6 visually presented objects. Yes/No: Answer yes or no to 6 questions, i.e., do you wear shoes on your feet? Follow Directions: Instructed to point to shapes in a specified order. Writing Sentences: To write any sentence, and a predetermined phrase. Reading: To perform physical actions from 2 sentences. Similarities: Asked how two objects are alike i.e., apple and orange are fruits.
MLI	Object recall: Recall objects from the naming subtest. Figures recall: Draw 3 figures from memory as previously presented. List Learning (immediate recall): Verbal memory of a shopping list with 6 items, List Recall (delayed recall): Verbal delayed recall of the shopping list.

	List recognition: To distinguish items on the shopping list from a list of distractors. Symbol Word Pair Association: To read 2 sentences represented by symbols that was previously learnt.
VPI	Object recognition: To recognise objects was presented in the naming subtest from a distractor object. Spatial Decision: To match a visual depiction of scattered dots with an identical one from a list of distractors. Unusual View: To name 4 silhouettes of objects. Figure Copy: Copying 3 figures. Facial expression: Match facial expressions with the appropriate emotion. Letter Number Coding: Given 1 minute to fill in letters that matches a number in a series of blank spaces. Figures recognition: To recognise 3 figures presented in the Figure Copy subtest. 3 in 1 concept: To visually group items based on similar characteristics.
ECI	Sustained Attention 2: Respond to a specific letter from a list of distractors, i.e., respond to the letter J from a list of alphabets. Counting Backwards: verbally count digits backwards in a specified order. Spatial Decision: To match a visual depiction of scattered dots with an identical one from a list of distractors. Monetary Calculations: mental arithmetic questions of addition and subtraction.
CFI	Similarities: Asked how two objects are alike i.e., apple and orange are fruits. 3 in 1 Concept: To visually group items based on similar characteristics.

Notes. ORI=orientation index, LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index. Total score for each index was calculated by adding all subtest scores within that index.

Below summarise the SPANS indices along with theoretical expectations of correlations with additional tests, and internal reliability in parenthesis for this group of culturally diverse participants.

Orientation index (ORI). Items regarding time, place orientation and injury conditions were not used, as all participants were healthy. Two questions about political leadership and one about time estimation were used. This index correlated moderately with WMS auditory immediate and delayed recall (Burgess, 2014). For this study, it was expected that the ORI would correlate positively with tests of immediate and delayed recall, represented by the RAVLT. This index was unrelated to performance on the TMT, WAIS-IV processing speeds, and verbal IQ. For this study, this index was not expected to correlate with tests of verbal fluency, TMT, or processing speeds. (α=0.46).

Attention concentration index (ACI). This index consists of six subtests, measuring multiple aspects of attention, working memory, sustained attention, divided attention, and inhibition. The ACI reported strongest correlations with the TMT-B and tests of working memory (Burgess, 2014). Therefore, it was expected that the ACI would positively correlate with the TMT-B, and the WAIS-IV-digit span as a measure of working memory (Otrosky, 2006). Conversely, this index did not correlate with verbal comprehension and was thus not expected to associate with the COWAT. (α=0.55).

Language index (LAI). This index includes a naming task, repeating sentences, reading, forming superordinate categories, complex understanding of language, and writing sentences. The LAI had strong correlations with the WASI-IV VIQ (Burgess, 2014), but was unrelated to performance on the TMT-A and WAIS-IV processing speed**.** For this study, the COWAT was used to represent language ability, (Strauss et al., 2006; Shao, Janse, Visser & Meyer, 2014; Sauzeon et al., 2011). It was expected that the LAI would correlate positively with COWAT for this study, but not with TMT-A and processing speeds. (α=0.76).

Memory and learning index (MLI). The MLI contains six subtests, consisting of various measures of verbal and visual encoding, retrieval, and consolidation. The MLI had the strongest positive correlations with WMS immediate recall, followed by the TMT-B. Therefore, it was expected that the MLI would positively correlate with a test of immediate recall, the RAVLT (Strauss, 2006), and the TMT-B. It was also expected that the MLI would not correlate with the TMT, COWAT, or a test of processing speeds. (α=0.52).

Visuo-motor performance index (VPI). The VPI is a measure of visuospatial skills, including visuo-motor functioning with eight subtests. It had the strongest

positive correlations with the TMT-B, followed by TMT-A and WAIS-IV processing speed (Burgess, 2014). In this study, the WAIS-IV coding was used as a representation of processing speeds. Therefore, it was expected that the VPI would be significantly correlated with the TMT and the WAIS-IV coding subtest. The manual reported that the VPI was unrelated to WAIS-IV VIQ, and it should therefore not correlate well with the COWAT. (α=0.35).

Efficiency index (ECI). This index measures processing speeds, as all five subtests are timed tasks. This index evaluates overall efficiency in speed of processing, including visuo-motor skills and reacting to time tests. The manual reports strong positive correlations with the TMT-B, TMT-A, and WAIS-IV processing speeds. In this study, it was expected that the ECI would correlate positively with the TMT and WAIS-IV coding. The ECI did not associate with WAIS-IV VIQ, and therefore not expected to associate with COWAT in this study. (α=0.45).

Cognitive flexibility index (CFI). There are only two subtests on this index, these assess concept formation of both visual and verbal material. This index correlated with WAIS-IV PIQ, WMS auditory immediate memory, TMT-B, and verbal comprehension. Therefore, it was expected that the CFI would correlate positively with RAVLT immediate recall, verbal fluency, and the TMT-B. The manual also indicates that tests of working memory and processing speeds are unrelated to this index. (α=0.45).

Additional tests

Below details the procedure for the additional set of neuropsychological tests, with internal consistency for this culturally diverse group in parenthesis.

WAIS-IV Digit Span. Participants were required to repeat a set of digits increasing in length over several trials (Digit Span Forwards), followed by repeating sets of digits in reverse (Digit Span Backwards), and finally they were instructed to re-arrange sets of numbers from the smallest to the largest for the Digit Span Sequence section. Note that the WAIS-IV Digit Span was used instead of the SPANS Digit Span subtest and used to calculate the ACI. (α=0.65).

RAVLT. Participants recalled as many words as possible from a list of 15 word over five trials. After a 20-minute delay, participants were asked to recall as many words as they can from the initial list without any prompts. Total score for five trials (RAVLT-Trials) and total score for the delay trial (RAVLT-D) were measured

separately. The RAVLT demonstrates good convergent validity, for example it exhibits moderate positive correlations with verbal and visual memory on the WMS-R (Johnstone et al., 2000). Strauss et al. (2006) reported that the RAVLT is sensitive to memory deficits in patients, especially for those with left-temporal lobe dysfunction (RAVLT-Trials, α=0.82).

TMT. Participants were first presented with Part A, where numbers one to 24 were randomly scattered on an A-4 sheet. They were instructed to connect the numbers in ascending order as quickly as possible. Part B consisted of numbers one to 13, and letters A to L on an A-4 sheet. Participants were asked to connect the numbers and letters in sequence, i.e., 1-A, 2-B, 3-C, etc. For each part, the total time taken were recorded as the outcome measure. Strauss et al. (2006) reported that the TMT positively correlates with a range of visuo-spatial tests, tests of attention, and processing speeds. Conversely, the TMT did not associate with verbal tests like the Peabody Picture Vocabulary Test (Ehrenstein et al., 1982). Patients with neurological impairment demonstrate significantly slower response times than healthy controls (Strauss et al., 2006). Internal consistency for this group of participants cannot be calculated as this test comprised of two separate single scores.

WAIS-IV Coding. Participants were given two minutes to fill in blank spaces, from left to right, symbols that matches a number. The total number of correct symbols was taken as the outcome measure. Internal consistency cannot be calculated as this test comprise of a single score.

COWAT. Phonetic fluency was assessed by having participants name as many words as they can starting with letters F, A, and S under a minute for each letter. This exclude names of people or places (e.g., Florida, Singapore), and were not allowed to use the same word with a different suffix (e.g., fight, fighting). Semantic fluency was assessed by having participants name as many animals and fruits as they could. Both phonetic and semantic fluency was combined to represent verbal fluency. The COWAT has a strong language component, exhibiting moderate to strong positive correlations with verbal IQ, and the BNT (Strauss et al., 2006). Clinical populations with aphasia, head injury, and dementia have reported producing significantly fewer words than healthy controls (Strauss et al., 2006). (α=0.72)

Procedure

All procedures and protocols were approved by the ethics committee of the University of Leicester. This study was conducted both within the university and with other social organisations such as local churches around Leicestershire. After written informed consent to partake in the study had been obtained, the SPANS was administered. The participants were asked to complete all self-report questionnaires afterwards. The total time spent was approximately an hour, and the participants were compensated for their involvement. This procedure was the same for all subsequent studies in this thesis.

Analysis

All analyses were conducted using SPSS v24. All neuropsychological data were screened for skewness and outliers. Logarithmic or square root transformations were performed on all neuropsychological data if the skewness was > +1 or < -1. Following the validation process outlined by the technical manual, correlations between SPANS and the additional tests indicated convergent validity of the SPANS, whereas non-significant correlations were used to indicate discriminant validity (Burgess, 2014). The strength of convergence between tests was evaluated as low (< 0.3), moderate (≥ 0.3 to ≤ 0.5), or high (> 0.5). Fisher's r-to-z transformations were used to compare correlation coefficients in this study with those reported in the manual, this method can be used to assess systematic bias in neuropsychological assessments (Fletcher-Janzen, et al., 2000). Significantly different correlation coefficients meant that underlying constructs are different between groups (Fletcher-Janzen, et al., 2000). Given that the SPANS do not include the full range of cognitive ability, the coefficient of variation (CV) was used to compare the relative dispersion of scores among different neuropsychological tests. A higher CV indicates higher dispersion and score variance. All analyses in this study adopted alpha levels of 0.01 rather than the usual 0.05 to correct for multiple comparisons and balance between the risks of Type 1 and Type 2 errors.

3.1.6 Results

3.1.6.1 Convergent and divergent validity

For this set of analyses, WAIS-IV Digit span scores were removed from the ACI to prevent confounding results between these two tests. Table 3.3. presents the

descriptive statistics, maximum score, and coefficient of the variation for all raw test scores. Tests that purported to measure similar constructs to the SPANS significantly correlated with their respective correlation's coefficients range between 0.2 and 0.6 (Table 3.4). Fisher's r-to-z transformations indicate that 16 pairs of correlation coefficients, ranging from 0.2 to 0.5, were not statistically different to those reported in the technical manual (Table 3.4). Correlation coefficients were higher in the technical manual (between 0.3 and 0.9) than in this study (between 0.2 and 0.6). Table 3.5 compares the discriminant validity between this study and results from the technical manual indicated by non-significant correlations. Table 3.6. summarises the results of convergence and divergence between SPANS indices with additional tests.

Table 3.3 Descriptive statistics and coefficients of the variation in all tests

Measures	Mean (max score)	SD	CV (%)
SPANS			
ORI	3.41 (4)	0.79	23.08
ACI	41.87 (42)	2.92	6.98
LAI	45.96 (53)	4.74	10.32
MLI	61.59 (67)	3.02	4.91
VPI	65.19 (70)	2.64	4.05
ECI	45.14 (48)	2.69	5.96
CFI	25.57 (28)	2.03	7.94
Additional tests			
Digit span forwards	9.50 (14)	2.17	22.88
Digit span backwards	8.50 (14)	1.93	22.76
Digit span sequence	7.63 (14)	1.42	18.65
TMT-A	31.53	12.34	39.14
TMT-B	64.99	24.19	37.22
Phonetic fluency	38.23	9.52	24.89
Semantic fluency	34.37	7.86	22.88
RAVLT-total	51.61 (75)	7.63	14.78
RAVLT- delay	11.32 (15)	2.38	21.00
WAIS-IV coding	80.74 (135)	19.38	24.01

Notes. SPANS=Short Parallel Assessment of Neuropsychological Status. ORI=orientation index, LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index. RAVLT= Rey Auditory Verbal Learning Test. WAIS-IV= Wechsler Adult Intelligence Scale-IV. TMT= Trail Making Test.

Table 3.4. Comparison of convergent validity (correlations in parenthesis) and Fishers' r-to-z comparison of correlation coefficients in this study and in the technical manual

Current study	Burgess (2004)
ORI	
Verbal fluency (.21)*	WM (.36)*
	Immediate recall (.43)*
	Delay recall (.48)*
LAI	
Verbal fluency (.52)**/+	VIQ (.66)**/+
WM (.28)**	WM (.51)**
TMT-B (.23)**	
ACI	
WM (.30)**	WM (.62)**
Verbal fluency (.27)**/+	VIQ (.43)**/+
Immediate recall (.27)**	Immediate recall (.48)**
TMT-B (.24)**	TMT-B (.75)*
Processing speed (.27)**/+	Processing speed (.35)**/+
	Delayed recall (.46)*
	TMT-A (.56)*
MLI	
Immediate recall (.31)**/+	Immediate recall (.56)**/+
Delayed recall (.30)**/+	Delayed recall (.39)**/+
Verbal fluency (.30)**	
WM (.26)**	

TMT-B (.23)**/+	TMT-B (.55)**/+
VPI	
TMT-A (.32)**/+	TMT-A (.57)**/+
TMT-B (.31)**	TMT-B (.90)*
Processing speed (.3)**/+	Processing speed (.57)**/+
Immediate recall (.23)**/+	Immediate recall (.36)**/+
Verbal fluency (.18)**	
ECI	
Processing speed (.36)**/+	Processing speed (.58)**/+
TMT-B (.33)**/+	TMT-B (.86)**/+
Immediate recall (.28)**/+	Immediate recall (.36)*/+
TMT-A (.26)**	TMT-A (.61)*
WM (.25)**/+	WM (.49)**/+
Verbal fluency (.22)*	
Delayed recall (.17)**/+	Delayed recall (.40)*/+
CFI	
Verbal fluency (.29)**/+	Verbal comprehension (.39)*/+
TMT-A (.20)**	
TMT-B (.21)**/+	TMT-B (.43)*/+

Notes. All p *< 0.01, ** p < 0.05. + Indicates that the correlations coefficients in this study were not statistically different to those reported in the technical manual ($p < 0.01$). ORI=orientation index, LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index, TMT=trail making test, WM=working memory, VIQ=WAIS-IV verbal IQ.

Table 3.5. Discriminant validity (non-significant correlations) of this study and the technical manual

Current study	Burgess (2004)
ORI	
TMT-A (.02), TMT-B (.07)	TMT-A (-.30)

Processing speed (-.05)	Processing speed (.28)
WM (.08)	VIQ (.19)
Verbal memory (.15)	
LAI	
TMT-A (.12)	TMT-A (-.23), TMT-B (-.23)
Processing speed (.01)	Processing speed (.14)
Verbal memory (.09)	
ACI	
TMT-A (.14)	Verbal comprehension (.30)
Delayed recall (-.13)	
MLI	
TMT-A (.12)	TMT-A (-.18)
Processing speed (-.13)	Process speed (.21)
	VIQ (.80)
VPI	
WM (-.15)	VIQ (.33)
Delayed recall (-.17)	
ECI	
NA	VIQ (.37)
CFI	
WM (-.07)	WM (.25)
Processing speed (-.07)	Processing speed (.31)
Verbal memory (.14)	TMT-A (-.26)
	VIQ (.37)

Notes. ORI=orientation index, LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index, TMT=trail making test, WM=working memory (digit span), VIQ=WAIS-IV verbal IQ

Table 3.6. summarises convergence and divergence between additional tests with SPANS indices.

Index	Convergence	Divergence
ORI	NA	TMT, Processing speed, WM, Verbal memory
ACI	WM	TMT-A, Delayed recall
LAI	Verbal fluency	TMT-A, Processing Speed, Verbal Memory
MLI	Verbal memory, verbal fluency	TMT-A, Processing Speed
VPI	TMT, processing speed	Digit Span, Delayed memory
ECI	TMT-B, processing speed	NA
CFI	Verbal fluency	WM, Processing speed, verbal memory

Notes. ORI=orientation index, LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index, TMT=trail making test, WM=working memory (digit span)

3.1.7 Summary of findings

SPANS indices for this group of participants demonstrate a broadly similar pattern of convergent and divergent validity with reports from the technical manual. Exceptions include the ORI, where correlations were trending at the 0.05 level. This could be due to the nature of the ORI, as it includes subtests that were conceptually different to many of the additional tests in this study. There was a weak to moderate relationship between the COWAT and TMT across all SPANS indices in this study. Both these tests assess for a range of executive functions, indicating that this process was broadly involved across these SPANS indices.

Although correlations coefficients were not statistically different between two samples, the strength of these correlations differed substantially. Burgess (2014) used clinical populations to explore the validity of the SPANS, in which a wider spread of variance increases the strength of correlation coefficients (Goodwin & Leech, 2006). Limited variance of scores and ceiling effects on the SPANS for this group of participants could have weakened the strength of the correlations, and adversely affect internal reliability (Traub, 1994). The SPANS do not assess for the full range of

intellectual functioning, consequently the dispersion of scores and internal reliability were larger for the additional tests than the SPANS. Despite this shortcoming, only the LAI was a reliable index.

The manual reports that verbal ability was unrelated to the ACI, VPI, and ECI. Instead, verbal fluency associated with a range of indices in this study. Many participants in this study were non-native English speakers, and thus language skills may be more salient for this group of participants. Many SPANS tests require familiarity with the English language (counting backwards, monetary calculations, etc.). There could also be other cultural factors that confounded the psychometric properties of the SPANS. Perhaps the concept of acculturation could have been inadvertently measured on the SPANS (see Helms, 1995; Nell, 2000). Therefore, this was subjected to further exploration in Chapter 4.

3.2 Section 2. Measures of acculturation

3.2.1 Scales of acculturation in the UK

Few scales of acculturation have been developed for the UK population. Brown, Zagefka, and Tip (2016) reviewed a series of relevant studies, but some of these scales were not be suitable for this thesis. A number of these measures were culture-specific, assessing idiosyncratic constructs in specific groups (Andres-Tóth & Van de Vivjer, 2006a). For instance, items concerning religious traditions in Islamic societies may not be relevant to other cultures (Ghuman, 1997; Palmer et al., 2007; Zagefka, Mohamed, Mursi, & Lay, 2016; Onyigbuo, Alexis-Garsee, & Van den Akker, 2018). Furthermore, this culture-specific approach assumes a stereotypical view of behaviour (e.g., all Arabs are Muslims) (Stadler, 2017). In addition, scales developed with specific cultural references might be restricted to a particular time period as cultural norms or values can shift over time (Stadler, 2017). This contrasts with culture-general approaches, which evaluate elements common to most cultures (Andres-Tóth & Van de Vivjer, 2006b). For example, language, alimentary practices, and ethnic identity exist in almost all cultures. Culture-general methods are not without their limitations, as they may not be able to capture subtle nuances in different cultures (Bezanson & James, 2017; Stadler, 2017). However, the scope of this thesis was to explore the relationship between acculturation and test performances on a wide range of ethnic groups. Therefore, reasonable to adopt a culture-general approach to assess acculturation.

While both composite scores and multiple domains of acculturation have been used in studies on the British population (Brown et al., 2016), the validity of these scales are rarely reported in these studies. Assessing for different domains are important in a British cultural context. Lewin-Epistein and Levanon (2005) found that speaking English was a separate construct (civic identity) from British identity in a nationwide census survey. The latter was characterised by ancestry, social trust, and pride (Lewin-Epistein & Levanon, 2005). In Chapter 2, the multi-domain effects of acculturation on test performances is lacking, but there is a suggestion that language and less linguistically influenced domains of acculturation may form unique associations with different tests. Therefore, to attain a more independent measure of each domains of acculturation, each subscale should not be confounded with each other. As mentioned in Chapter 2, acculturation could be skewed toward the representation of language (e.g., using language to evaluate ethnic identity).

3.2.2 Acculturative stress scales

In Chapter 2, other cultural factors might confound the relationship between acculturation and test performance. Kennepohl et al. (2004) suggests that acculturative stress might be one such variable. Some studies show that perceived discrimination has a negative effect on tests of attention, memory, and processing speed (Nguyen et al., 2012; Thames et al., 2013). Other studies have found that stereotype threat (subjective feeling of being stereotyped based on race or any other background) is deleterious to test performance (Steele & Aronson, 1995; Thames, et al., 2013). Thames et al. (2013) demonstrated that differences in ethnic background between the test-taker and examiner also negatively affect tests performances, attributing this to cultural mistrust of the test-taker. These evidences suggest that discrimination, a subcomponent of acculturative stress (Miller, Kim, & Benet-Martínez, 2011), could affect test performance.

For acculturative stress, there are limited resources for evaluating these scales. Rudmin (2009) highlights that such measures should not contain items concerning psychiatric illness or general well-being. These in themselves are not cultural constructs, but are the result of cultural conflicts and stressors (Rudmin, 2009). Furthermore, the concept of acculturative stress may follow a culture-specific/general principle, where the construct is not necessarily restricted to a particular demographic population (Roysircar-Sodowsky & Mestas, 2000). For instance, some second-

generation minorities may reject their heritage culture, resulting in inter-generational conflict and disagreements within their community, thus forming a source of acculturative stress (Roysircar-Sodowsky & Maestas, 2000). Furthermore, acculturative stress is not always the end product of acculturation, and ethnic minorities may re-contextualise seemingly stressful encounters as way of learning about the host culture (William & Berry, 1991). Therefore, scales should allow generalisability to a wider cultural or demographic population and should not be confounded by items that assess for psychiatric illness.

3.2.3 Method

Two systematic reviews were consulted (Celenk & Van de Vivjer, 2011; Matsudaira, 2006), surveying a total of 59 scales of acculturation. One review compiling 20 published scales of acculturative stress was consulted (Rudmin, 2009). The selected scale was modified, and its reliability and validity further assessed. Finally, further analyses were conducted to produce and explore the independence of Berry's (1997) four acculturative strategies from the selected acculturation scale.

The selection process comprised two stages. Firstly, 59 acculturation scales from two systematic reviews were screened against the following criteria: a) bi-dimensionality; and b) multiple life-domains/subscales, including a language subscale and at least one subscale representing the acquisition of or familiarity with culturally specific knowledge (general knowledge, history, tradition, etc.). For acculturative stress, scales that contained items regarding psychological well-being were excluded, and the concept of perceived discrimination must be included. Finally, unpublished scales were excluded.

In the next stage, all scales were assessed for their psychometric properties, and compared with its original validation study. There is limited literature on how culture-general scales should be evaluated, and few test-developers discuss the generalisability of their scales (test translations, etc.). Nonetheless, the diversity of the sample characteristics used during the validation process were assessed.

Criterion validity for these two scales were assessed following similar methods outlined by from Cheung et al. (2004) and Miller et al. (2011). For the AAMASM, Cheung et al. (2004) correlated the AAMAS with generational stats. This study utilised a proxy of generational status by separating foreign-born (coded as '0', N=157) from

local-born (coded as ‘1’, N=71) individuals, i.e., local-born individuals indicate later generations. For the RASI, Miller et al. (2011) correlated scores with years of US residency, and years of UK residency was used for this study. Further analyses were carried out to assess the degree of correlations between and within these scales to further assess for multicollinearity.

3.2.4 Results

3.2.4.1 Asian-American multidimensional scale of acculturation (AAMAS)

In the first stage of the selection process, three scales were found to meet all inclusion criteria. Table 3.7 presents each scale’s psychometric properties and the characteristics of the sample used for validation. Cultural knowledge was not well defined in the General Ethnicity Questionnaire (GEQ; Tsai, Ying & Lee, 2000). For instance, items regarding traditional customs and engagement in cultural activities were presented under ‘cultural pride’, which could be categorised as a form of ethnic identity (see Arends-Tóth & Van de Vivjer, 2006a). Overall, the GEQ was validated on a culturally homogenous sample of Chinese Americans. As such, this instrument was not selected for this thesis. (See Appendix D. for a decision matrix for all acculturative scales based on two systematic reviews).

The abbreviated multidimensional acculturation scale (AMAS; Zea, Anser-Self, Birman & Buki, 2003) and the Asian-American multidimensional acculturation scale (AAMAS; Chung, Kim & Abreu, 2004) are similar in structure. They measure similar domains of acculturation, with similarities at an item level. For instance, both scales assess spoken and receptive language, historical knowledge, and a sense of ethnic belonging. In terms of sample characteristics, both the AMAS and AAMAS recruited relatively diverse samples. In the wider literature, the AAMAS has been adapted for Arabic populations and South Asians, with adequate reliability over three studies (Aqtash & Van Servellen, 2013; Tailakh et al., 2016; Meghani & Harvey, 2016). One study has reported an adequate factor structure of the AMAS for Japanese Americans (Miyoshi et al., 2017).

Regarding validation processes, the AAMAS was tested in three studies with three different samples (Chung et al., 2004). Both EFA and confirmatory factor analyses yield the same factor structure, with adequate fit statistics (Chung et al., 2004). CFA is rarely seen in the acculturative literature, thus giving the AAMAS an advantage in its

construct validity. The AAMAS also exhibited adequate test-retest reliability (> 0.7). In conclusion, the AAMAS was selected for this study as it exhibits good psychometric properties over a relatively diverse range of ethnic groups.

Table 3.7. The psychometrics and sample characteristics use to validate four acculturative scales

	Scale	Domains	Sample	Validity and reliability
Zea et al., 2004	Abbreviated Multidimensional Acculturation Scale	Language, cultural competency, identity	Latino/Latina. Mexicans, Central, and South American majority. Included a small number of Caribbean Latino/a's, and Spaniards.	Scores on all subscales differentiated local and foreign-born Latinos. Years of US residency correlated positively with US cultural identity and negatively with Latino identity and cultural competency. US language and cultural competency correlated positively with ethnic identity of a multigroup ethnic identity measure. EFA produced three factors for each dimension. All subscales had internal consistency > 0.7.
Tsai et al., 2000	General Ethnicity Questionnaire	Language, social affiliation, activities, pride, exposure, food preference	Chinese American	Composite score of adoption correlated positively with age of arrival in the US, and correlations were negative for the maintenance scale. Subscales differentiated between immigrants who arrived before and after the age of 12. EFA produced six domains for each dimension. Reliability for composite adoption and maintenance score were > 0.7.
Chung et al., 2004	Asian American Multidimensional Acculturation scale	Language, cultural knowledge, identity, food preference	Asian American. East Asian and South East Asian majority; included small number of South Asians and mixed ethnicities	Composite score of maintenance correlated negatively with generational status and positively with maintenance on the cultural identification scale (CIS). Adoption correlated positively with adoption of the CIS. EFA produced four factors for each dimension. Confirmatory factor analyses on a different sample yield the same factor structure with adequate fit statistics. Internal consistency was above > 0.7 for all subscales. Test-retest reliability was > 0.7.

AAMAS modification. The original scale consisted of 15 items each for adoption and maintenance (30 items in total). Minimal changes were made to the AAMAS scale to maintain its theoretical and empirical integrity. Only the responses items on the AMAS scale were modified. In the original response, 'your Asian cultural origin' was replaced with 'your cultural origin', and 'White American mainstream groups' was replaced with 'White British mainstream groups'. The study used a 7-point Likert scale, with a higher rating indicating a stronger endorsement of adoption or maintenance. The exception was reverse scoring for item 15. The term 'modified' was added to this British scale (AAMASM) to distinguish it from the original AAMAS. For further clarity, the AAMAS-European-American was renamed AAMASM-adoption (AAMASM-A), and the AMAS-culture of origin was renamed AAMASM-maintenance (AAMASM-M). For both this study and that of Chung et al. (2004), all internal reliabilities were > 0.7, except for AAMASM-M food consumption in this study (α= 0.55). See Appendix C for all items on the AAMASM.

Language. Items on this subscale ask participants how well they speak, understand, read, and write the two languages. Adoption consist of three items, but a fourth item that asks participants about their media preferences but was used on the maintenance subscale.

Food consumption. Two items make up this subscale: one evaluates food preferences, while the other asks about the frequency of eating food from the two dimensions.

Cultural knowledge. Items on this subscale ask how knowledgeable an individual is about history and traditions and about their level of involvement with cultural practices. Maintenance consist of three items, but a fourth item asking individuals about their media preferences was used for adoption.

Cultural identity. This scale contains six items, asking participants how much they identify with, feel proud of, and associate with people from each dimension.

3.2.4.2 Riverside acculturative stress inventory

Several scales from Rudmin's (2009) review were found to be unsuitable for this study. Some scales contained items specific to refugees, school children, international students, or lack the concept of discrimination (see Appendix F for a decision matrix of acculturative stress scales). The Riverside acculturative stress inventory (RASI; Miller,

Kim, & Benet-Martínez, 2011) met the intake criteria for acculturative stress. The RASI was validated over two studies, with four separate samples (Benet-Martinez & Haritatos, 2005; Miller et al., 2011). EFA and CFA found the same five-factor structure for two studies, with the former involving Hispanic-Americans (Benet-Martinez & Haritatos, 2005) and the latter recruiting a diverse group of Asian-Americans (Miller et al., 2011). The factor structure was unchanged when CFA was performed for two generations of Asian-Americans (Miller et al., 2011). This scale was previously utilised in the UK for a multi-ethnic group, in which in-group marginalisation (individuals were discriminated against within their community) was a significant predictor of scores on the RASI-M (Ferenczi & Marshall, 2016). Therefore, the RASI was selected as an acculturative stress scale.

RASI modifications. The RASI consists of 15 items, with five subscales having three items each. Changes were kept to a minimum, with the terms 'ethnic/cultural background' replacing 'Asian', and 'British' and 'White British' replacing 'American'. This study used a 7-point Likert-scale, where a rating of one indicates 'strongly disagree' and rating of seven indicates 'strongly agree'. The word 'modified' was added to the abbreviation (RASI-M) to distinguish between the two measurements. The five subscales are outlined below, as described in Miller et al. (2011) study. Internal reliability for all subscales and total score in this study and that of Miller's et al. (2011) were acceptable (> 0.7), except for cultural isolation in this study (α= 0.59). See Appendix G comparing the RASI and RASI-M.

Work challenges. This subscale assessed perceived discrimination in the work environment. Participants were asked whether they felt that their ethnicity had been a disadvantage when seeking work and whether they felt that they had to work harder than the White British population.

Language skills. This assessed whether participants felt misunderstood in their daily lives because of a lack of English ability, as well as any difficulties they had in carrying out work due to poor English skills.

Intercultural relations. This assessed whether participants had any disagreements or conflict with peers or family members as a result of abandoning or adhering to customs and traditions of either culture.

Discrimination. This subscale predominantly evaluated level of perceived discrimination and feelings of being stereotyped.

Cultural isolation. This assessed how culturally isolated the individual felt and whether there was sufficient cultural richness and diversity in their surroundings, while residing in the host's culture. This subscale was unreliable, and Cronbach alpha could not be improved with the removal of items.

3.2.4.3 Validity of the RASIM and AAMASM

Based on the findings of Chung et al. (2004), it was expected that AAMASM-M would negatively correlate with foreign born status. This was found for this study, but AAMASM-A also correlated positively with local born status. Those who were born within the UK exhibited higher scores on the AAMASM-A, and lower scores on the AAMAS-M than those born outside the UK (Table 3.8).

Miller et al. (2011) found that only language skills correlated negatively with years of foreign residency. This study found similar results, where language skills demonstrated negative correlations with years of UK residency (Table 3.9).

Table 3.8 Presents means, standard deviations, and range of scores for the RASIM and AAMASM.

		Range	Mean	SD
AAMASM-A	Total adoption	5.23	4.45	1.10
	Language	4.67	5.82	1.22
	Food consumption	6.5	3.95	1.65
	Cultural knowledge	6	4.15	1.31
	Cultural identity	6	3.97	1.37
AAMASM-M	Total Maintenance	4.33	5.44	0.89
	Language	6	4.92	1.57
	Food consumption	4	6.30	0.82
	Cultural knowledge	5.33	5.10	1.23
	Cultural identity	5	5.67	1.07
RASIM	Total score	3.93	3.58	0.89
	Work challenges	6	4.66	1.45
	Language skills	6.67	2.61	1.54
	Intercultural relations	6	3.16	1.44
	Discrimination	6	4.04	1.59
	Cultural isolation	5.67	3.44	1.37

Table 3.9. Correlations between the RASI-M and AAMASM, with years of UK residency and details of foreign vs. local-born individuals

		Foreign vs. local-born	Years of UK residency
AAMASM-A	Total Adoption	.51**	.54**
	Language	.50**	.49**
	Food consumption	.29**	.36**
	Cultural knowledge	.46**	.51**
	Cultural identity	.38**	.38**
AAMASM-M	Total Maintenance	-.33**	-.43**
	Language	-.50**	-.52**
	Food consumption	.01	-.03
	Cultural Knowledge	-.23**	-.37**
	Cultural identity	-.05	-.16*
RASI-M	Total Stress	-.06	-.04
	Work challenges	-.01	.02
	Language skills	-.46**	-.43**
	Intercultural relations	.01	.06
	Cultural isolation	.13	.05
	Discrimination	.16*	.19**

Notes. *$p < 0.05$, ** $p < 0.01$. AAMASM-M= Asian American Multidimensional Acculturation Scale – Modified. RASI-M = Riverside Acculturative Stress Inventory-Modified.

3.2.4.4 Acculturative strategies

A method from Arends-Tóth and Van de Vivjer (2006b) was used to calculate Berry's acculturative strategies. This was achieved by computing the distance between real scores and ideal scores for each dimension on the AAMASM, the formula is presented below. However, there was high multi-collinearity between assimilation and

separation (r (228)=-.91, p < 0.01) and integration and marginalisation (r (228)=-.85, p < 0.01

$$\sqrt{\begin{array}{c}(\text{max score on adoption scale} - \text{real score on adoption scale})^2 + \\ (\text{max score on cultural maintenance} - \text{real score on cultural maintenance})^2\end{array}}$$

3.2.4.5 Inter-correlations between and within AAMASM, RASIM

RASI-M language skills had moderate to high correlation with subscales of the AAMASM, and this was highest for AAMASM-A language (r (228) =.74, p < 0.01). Other than this, correlations between these two scales were weak (Table 3.10). Table 3.11 presents correlations between subscales of the AAMASM. Table 3.12 presents inter-correlations between subscales of the RASI-M.

Table 3.10. Correlations between AAAMASM and RASI-M and their respective subscales.

		RASIM total	Work Challenge	Language Skills	Intercultural Relations	Discrimination	Cultural Isolation
AAMASM-A	Total	-.19**	-.12*	-.50**	-.01	.05	.03
	Language Acculturation	-.11*	.02	-.70**	-.04	.25**	.17**
	Food Consumption	-.16**	-.14**	-.25**	-.02	-.07	.01
	Cultural Knowledge	-.09	-.05	-.42**	.04	.13*	.01
	Ethnic Identity	-.23**	-.19**	-.29**	-.03	-.11*	-.06
AAMASM-M	Total	.08	.12*	.25**	-.02	-.03	-.07
	Language Acculturation	.01	.00	.49**	-.03	-.19**	-.25**
	Food Consumption	.07	.12*	.04	-.01	.08	-.02
	Cultural Knowledge	.13*	.13*	.18**	.11*	.04	-.07
	Ethnic Identity	.07	.15**	-.03	-.08	.05	.14**

Note. * $p < 0.05$, ** $p < 0.01$. AAMASM-M= Asian American Multidimensional Acculturation Scale – Modified. RASI-M = Riverside Acculturative Stress Inventory- Modified

Table 3.11 Intercorrelations between subscales of the AAMASM

	1	2	3	4	5	6	7	8	9	10
1. Total AMASM-A	-									
2. Total AMAM-M	-.32**	-								
3. Language adoption	.70**	-.32**	-							
4. Food consumption adoption	.72**	-.30**	.32**	-						
5. Cultural knowledge adoption	.83**	-.35**	.61**	.50**	-					
6. Ethnic identity adoption	.85**	-.14*	.41**	.57**	.51**	-				
7. Language maintenance	-.44**	.73**	-.56**	-.24**	-.49**	-.18**	-			
8. Cultural knowledge maintenance	-.20**	.75**	-.12	-.25**	-.13*	-.16*	.43**	-		
9. Food consumption maintenance	.11	-.48**	.06	.17**	.04	.10	-.17**	-.31**	-	
10. Ethnic identity maintenance	.08	-.76**	-.03	.20**	.12	.00	-.22**	-.50**	.38**	-

Note. * $p < 0.05$, ** $p < 0.0$

Table 3.12 Interrelations between subscales of the RASIM

	1	2	3	4	5	6
1.Total RASI-M	-					
2. Work Challenges	.74**	-				
3. Language Skills	.37**	.13*	-			
4. Intercultural relations	.60**	.24**	.13*	-		
5. Cultural isolation	.50**	.27**	-.12	.06	-	
6. Discrimination	.76**	.57**	-.06	.37**	.36**	-

Note. * $p < 0.05$, ** $p < 0.01$

3.2.5 Summary of findings

3.2.5.1 Theoretical position of the scales

Regarding its theoretical position, the AAMASM assesses acculturative outcomes (Celenk & Van de Vivjer, 2011). Domains such as language proficiency and cultural knowledge encompass the acquisition of specific skills and familiarity with different cultures, which are indicative of socio-cultural competency/adaptation (Berry, 1997). As a result, the AAMASM is placed under acculturative outcomes in the three-stage model (Celenk & Van de Vivjer, 2011). More specifically, the AAMASM largely comprise of items that assess for acculturative behaviours (Chung et al., 2004), thus it seems appropriate to place this scale under external adjustment.

As for the RASI-M, acculturative stress is also theoretically positioned in the three-stage model as an outcome of acculturation (see Celenk & Van de Vivjer, 2011), though Berry classifies this as a mediating variable (Berry, 1997). Most of the items on the RASI-M assess for negative attitudes toward the host culture, with nuances suggestive of internal adjustment, such as life satisfaction assessed by feelings of isolation. Therefore, the RASI-M primarily measures psychological (affect, attitudes, etc.) aspects of acculturation, and thus could be placed under internal adjustment (Celenk & Van de Vivjer, 2011) or psychological adaptation (Berry, 1997).

3.2.5.2 Reliability and validity

Regarding the concurrent validity, three subscales of the RASI-M subscales did not align with the proxy variables. However, these findings were consistent with those of Miller et al. (2011), where only years of US residency correlated with RASI language

skills. In contrast to the findings of Miller et al. (2001), more years of residency in the UK may expose the individual to more discriminatory encounters. In any case, aside from RASI-M cultural isolation, all other RASI-M subscales were reliable for this group of culturally diverse participants.

Both this study and that of Chung et al. (2004) consistently found that total score for maintenance was associated with generational status. In contrast to the findings of Chung et al. (2004), this study found that more years of residency in the UK and later generations exhibited higher levels of total adoption. Nonetheless, this is consistent with the literature, where longer residency is generally associated with higher adoption (Tropp, Erkut, Coll, Alarcón, & Vázquez García, 1999; Tsai, et al., 2000; Zea, ret al., 2003). Other than food consumption maintenance, the remaining scales of the AAMASM are reliable for this group of participants. Finally, attempts to calculate acculturative strategies via the AAMASM were not successful, given the high multi-collinearity between constructs.

3.2.5.3 Inter-relationships

Inter-correlations for RASI-M language skills and AAMASM-A language were high (> 0.7), and RASI-M language skills correlated with a range of AAMASM subscales. This suggests that the acculturative stress involved in the process of language adoption was largely explained by perceptions of linguistic skill. However, other relationships between these two scales were weak to non-existent. This is consistent with the theoretical framework of acculturative stress, whereby acculturative stress does not always occur during process of acculturation (Williams & Berry, 1991; Berry, 1997). This also meant that these two scales were generally conceptualised separately for this group of participants, and thus should be measured independently.

Aside from the relationship between AAMASM-A cultural knowledge and language, the remaining correlations largely moderate. This suggests that the subscales were not overly dependent on one another. For the AAMASM, this could support a bi-dimensional framework, as strong correlations usually indicate unidimensional models (Arends-Tóth &Van de Vivjer, 2006b). Inter-correlations were mostly weak between the RASIM subscales. Therefore, with strong theoretical support in the literature to measure independent domains of acculturation, it is reasonable to assess these subscales independently.

3.2.6 Conclusions

In summary, most of the SPANS indices associated with an external set of neuropsychological measures that assessed for similar cognitive constructs. Although the correlations and internal reliability were weak, this could be due to a few reasons. Socio-cultural factors like acculturation, ethnicity, or language may have confounded the psychometric properties of the SPANS. Moreover, the limited range of scores on the SPANS could have adversely affected the reliability and validity. Due to a possible lack of variance, the additional set of neuropsychological tests were subjected to further analyses in later chapters of the thesis. The RASI-M and AAMAMSM were selected for this thesis. The results show broadly acceptable reliabilities, and the pattern of association between proxy estimates of acculturation were broadly consistent with the wider literature. The SPANS, additional set of neuropsychological tests, AAMASM, and RASI-M were subjected to further analyses to assess the relationship between acculturation and neuropsychological performance in the next chapter.

Chapter 4: Domains of acculturation predicts neuropsychological test performances

Significant portions of this chapter were extracted and/or modified (where appropriate) from a peer-reviewed published paper by Tan and Burgess (2018). These concern the introduction (4.1), analyses (4.2.3), results (4.3.1), correlations (4.3.2), and discussion (4.4.1, 4.4.2).

4.1 Introduction

The literature on ethnic groups outside the US and with multi-ethnic groups remains limited, though there has been a recent emergence of such studies in Europe. Nielsen and colleagues (2012a; 2012b; 2013; 2016; 2018a; 2018b) have applied measures of acculturation associated with a range of verbal and non-verbal tasks, with multiple ethnic groups across Europe. To date, however, there is no study in the UK investigating the relationship between the construct of acculturation and cognitive testing, despite the rapid growth of ethnic minority communities in the country. As such, it is appropriate to investigate the relationship between acculturative measures and test performance in multi-ethnic groups here in the UK. This could also validate claims that higher levels of adoption are associated with better test performance in the British cultural context.

4.1.2 Rationale for the study

Chapter 2 highlights two studies that showed how different dimensions and domains of acculturation could have different relationships with test performance (Arentof et al., 2007; Hasson et al., 2019). Chapter 1 also suggested that there is theoretical evidence for the importance of linguistic acculturation, and to a certain extent, knowledge acquisition for test performance. However, empirical evidence for this separation of linguistic and non-linguistic acculturation is scarce in the literature. As a result, the representations of acculturation generally lack complexity. For the purposes of this study, the AAMASM was used as a bi-dimensional scale with multiple subscales of acculturation.

The systematic review presented some evidence that the relationship between acculturative scales and neuropsychological tests may change depending on the level of assessment (index vs. subtest). As such, the SPANS was selected as an appropriate

instrument for this ethnically diverse group of participants. It was envisioned that this could provide more clarity over which type of test performance would be more sensitive to what domains within acculturation. One caveat from Chapter 3 is that there is less variance in scores on the SPANS than in the additional set of neuropsychological tests. Therefore, the same analyses should be conducted for this additional set of tests, as these are known to capture a much wider range of ability.

There is literature on the negative effects of stereotype threat (discrimination based on stereotypical assumptions), perceived discrimination, and acculturative stress on test performance (Thames et al., 2013; Ngyuen et al., 2012). However, studies that explore the concept of acculturative stress in relation to test performance are scarce. The existing literature is limited to a restricted range of neuropsychological tests and cultural constructs. For instance, Ngyuen (2012) included just two neuropsychological tests and restricted their sample to Latino migrant workers in the US. While Thames et al. (2013) included a relatively large battery of tests, their range of cultural constructs was narrowed to perceived discrimination in group of African Americans. Therefore, there is a gap in understanding the relationship between acculturative stress and test performance. As there is little empirical work on the relationship between acculturative stress and test performance, this study takes an exploratory approach to the relationship between these two constructs.

4.1.3 Additional considerations

Chapter 2 highlight that proxy variables of acculturation (e.g., years of residency) can also account for test performance. However, this should be assessed separately from acculturation (Arends-Tóth & Van de Vivjer, 2006a; Matsudaira, 2002). Additionally, Chapter 2 highlights spurious results may emerge if the effects of age and education are not accounted for (statistically or otherwise). Within the literature, hierarchical regressions are common, as these allow for statistical adjustment of the different variables. Therefore, this study employed such a technique to explore the independent contributions of various demographic variables (e.g., age, education, years of residency, etc.) and acculturation (AAMASM, RASI-M).

4.1.4 Aims and hypotheses

The relationship between test performances and concepts of acculturation has not been widely explored beyond North American contexts. In fact, this is a first study to date to evaluate the relationship between multidimensional acculturation and acculturative stress on tests performances for a multi-ethnic group in the UK. The hypotheses and aims for the chapter are highlighted below.

- Changes in how the concept of acculturation affects levels of testing (index vs. subtest) are less well understood. Therefore, it could be hypothesised that acculturative measures predict test performance differently in subtest- and index-level assessments on the SPANS. This may reveal whether there are specific neuropsychological tests that are associated with constructs in acculturation.

- Many studies limit their exploration of acculturation to a composite score, despite the importance of its multidimensional nature. Therefore, it was hypothesised that different domains (subscales) of acculturation would uniquely predict performance on neuropsychological tests. Specifically, it was hypothesised that linguistic aspects of acculturation would association with test performances, rather than non-linguistic aspects of acculturation.

- The literature examining the relationship between acculturative stress and cognitive testing is scarce. However, it is hypothesised that subscales of acculturative stress will uniquely predict performance on neuropsychological tests. This may indicate whether constructs in acculturative stress is important for cognitive performance, or if it confounds the relationship between acculturation on test performance.

4.2 Method

Participants. All 228 participants were used for this study. Their demographic characteristics are reported in Chapter 3.

Self-report measures. Acculturation was assessed by the AAMASM, and acculturative stress was measured using the RASI-M. Only AAMASM-M food

consumption and RASI-M cultural isolation were excluded from these analyses, as these scales were not found to be reliable. For clarity, the term 'adoption' refers to the AAMASM-A, and 'maintenance' to AAMAMS-M (e.g., AAMASM-A language = language adoption, AAMAS-M cultural knowledge = cultural knowledge maintenance, etc.).

Cognitive tests. These were the same measures as found in Chapter 3. This included the SPANS, WAIS-IV-digit span, RAVLT, COWA, TMT, and WAIS-IV coding.

4.2.1 Analysis

All analyses were carried out using SPSS v24. Assumptions for regression analysis, such as VIF tolerances, normality of the error distribution, and leverage points were scrutinised post hoc. To prevent issues of multicollinearity, inter-correlations between all variables were inspected. Hierarchical regressions were used to assess the independent contribution of acculturation, acculturative stress, and demographic variables for both indices and subtests.

Preliminary screening of the data revealed high levels of multicollinearity among the demographic and acculturative variables. Years of UK and non-UK education were strongly correlated ($r(226) = .85$, $p < 0.01$). Total years of UK education correlated with years of UK residency ($r(226) = .87$, $p < 0.01$). Therefore, years of UK residency was used, and this also approximated time spent studying in the UK. Educational attainment correlated closely with age ($r(226) = .78$, $p < 0.01$). To reduce the effects of multicollinearity, the sample was divided between postgraduate and non-postgraduate attainment.

AAMASM-A language and RASIM language skills were strongly correlated ($r(226) = .74$, $p < 0.01$). To prevent multicollinearity between these constructs, this was subjected to further exploration. Overall, the correlations revealed that the AAMASM-A language had stronger correlations with SPANS indices than with RASIM language skills. Partial correlations, adjusting for AAMASM-A language, eliminated the relationship between RASI-M language skills and the SPANS indices (see Appendix H). Therefore, the RASI-M language skills were not used for the analyses. RASI-M cultural isolation and AAMASM-M food consumption were also removed due to low reliability and to prevent the overfitting of hierarchical models.

All analyses in this study adopted alpha levels of 0.01, instead of the usual 0.05, to correct for multiple comparisons to balance the risks of Type 1 or Type 2 errors. A priori analysis using G-power indicated that a sample size of 181 was required to detect a medium-effect size with 80% power for 14 variables with a p-value of 0.01.

4.3 Results

4.3.1 SPANS indices and acculturation

Correlations suggested no significant relationships between gender and any SPANS indices, AAMASM-A, or RASIM subscales. To prevent overfitting these models, gender was not included. A five-stage hierarchical regression model was conducted for each SPANS index. The order of the stages was as follows: 1) age, 2) postgraduate education, 3) years of UK residency, 4) AAMASM-A/M (seven subscales), and 5) RASI-M (three subscales). The RASI-M and AAMASM-M did not significantly predict the ACI, ECI, and MLI, these variables were not reported upon. The results for each stage of the analyses and the relevant predictor variables are reported below (Table 4.1.).

Age and education. Age significantly predicted the LAI (R^2= 0.14, F (1, 227) = 36.49, β = -.38, $p < 0.01$). The effects of age were trending for the VPI (R^2= 0.25, F (1, 227) = 6.82, β = -.17, $p = 0.01$). Post-graduate education also uniquely accounted for performance on the LAI (ΔR^2=0.06, F (2, 225) = 27.84, β = -.30, $p < 0.01$).

Years of UK residency. The period of UK residency uniquely predicted performance on the ORI (ΔR^2=0.25, F (3, 227) = 26.09, β = .52, $p < 0.01$), the LAI (ΔR^2=0.06, F (2, 225) = 27.84, β=.54, $p < 0.01$), and the CFI (ΔR^2=0.71, F (3, 227) = 9.24, β= .27, $p < 0.01$).

AAMASM-A. The model was significant for the ORI (ΔR^2=0.32, F (7, 227) = 14.61, p = 0.001) and the LAI (ΔR^2=0.38, F (7, 227) = 42.89, $p < 0.01$).

At this stage, postgraduate education (β = -.21, $p = 0.003$), years of residency (β= .39, p < 0.01), and cultural knowledge (β= 0.32, $p < 0.01$) predicted performance on the ORI. Language acculturation (β= .35, $p < 0.01$) and years of UK residency (β= .34, $p < 0.01$) predicted performance on the LAI.

Table 4.1. Results of the five-stage hierarchical regression for predictor variables and three SPANS indices

SPANS indices	Stage	Predictor	Beta coefficient	R^2
ORI	Stage 3	Education	.14	.26
		Years UK residency	.15	
	Stage 4	Education	.13	.32
		Years UK residency	.01	
		Cultural knowledge	.07	
		Adoption		
LAI	Stage 1	Age	-.43	.14
	Stage 2	Education	-.57	.19
	Stage 3	Age	-.03	.48
		Education	-.28	
		Years UK residency	.05	
	Stage 4	Years UK residency	.03	.57
		Language adoption	.25	
CFI	Stage 3	Years UK residency	.02	.11

Notes. All predictor variables reported in the table have p value of < 0.01. ORI=orientation index, LAI=language index, CFI=cognitive flexibility index

4.3.2 SPANS subtests and acculturation

The relationship between AAMASM, RASI-M, and the subtests of the SPANS were further explored. All subtests were subjected to the same hierarchical regression analyses as the analyses of the SPANS indices. Only nine subtests produced significant findings, these results are summarised below (Table 4.2).

Age and education (stage 1 and 2). Age alone significantly predicted performance on the Digit Span Forwards (R^2= 0.05, F (1, 226) = 11.88, β= -.22, p = 0.001), Repetition (R^2= 0.21, F (1, 226) = 52.48, β= -.45, p < 0.01), Sustained attention 1 (R^2= 0.03, F (1, 226) = 7.31, β= -.18, p = 0.008), Direction (R^2= 0.08, F (1, 226) = 18.56, β= -.28, p < 0.01), Reading (R^2= 0.20, F (1, 226) = 57.61, β= -.45, p < 0.01), Naming (R^2= 0.09, F (1, 226) = 24.15, β= -.18, p = 0.008, and Writing Sentences subtests (R^2= 0.09, F (1, 226) = 21.23, β= -.29, p < 0.01).

Post-graduates performed worse on Reading (ΔR^2= 0.08, F (2, 225) = 43.19, β= -.34, $p < 0.01$), Writing Sentences (ΔR^2= 0.04, F (2, 225) = 15.89, β= -.33, $p = 0.002$), Naming (ΔR^2= 0.09, F (2, 225) = 35.12, β= -.33, $p < 0.01$), and Similarities (ΔR^2= 0.03, F (2, 225) = 12.49, β= -.23, $p = 0.005$) subtests.

Years of UK residency (stage 3). Years of UK residency uniquely accounted for performance on the Political Leadership (ΔR^2= 0.22, F (3, 227) = 22.02, β= .48, $p < 0.01$), Repetition (ΔR^2= 0.18, F (3, 227) = 51.22, β= .43, $p < 0.01$), Reading Sentences (ΔR^2= 0.11, F (3, 224) = 46.17, β= .33, $p < 0.01$), Writing Sentences (ΔR^2= 0.52, F (3, 224) = 15.87, β= .23, $p < 0.01$), Similarities (ΔR^2= 0.10, F (3, 224) = 12.74, β= .33, $p < 0.01$), and List Learning subtests (ΔR^2= 0.03, F (3, 224) = 3.94, β= .03, $p = 0.006$).

AAMASM (stage 4). This model was statistically significant for the Political Leadership (ΔR^2= 0.07, F (7, 227) = 13.53, $p < 0.01$), Repetition (ΔR^2= 0.14, F (7, 227) = 37.34, $p < 0.01$) and Writing Sentences (ΔR^2= 0.10, F (7, 227) = 11.81, $p < 0.01$).

At this stage language adoption predicted Repetition (β= .23, p =0.002), and Writing Sentences (β= .40, $p < 0.01$). Years of UK residency predicted Political Leadership (β= .35, $p < 0.01$), Repetition, (β= .38, $p < 0.01$), and Reading Sentences (β= .22, p =0.001), Writing Sentences (β= .22, $p < 0.01$), and Similarities (β= .27, $p < 0.01$) subtests. Cultural knowledge predicted Political Leadership (β= .35, $p < 0.01$), age (β= -.21, $p = 0.03$) and education (β= -.23, $p = 0.001$) predicted the Reading sentences subtest.

Stage four was statistically significant for the Naming subtest (ΔR^2= 0.06, F (10, 217) = 14.20, $p = 0.002$), however none of these variables were significant. The data was therefore explored via to stepwise regression to circumvent this. All thirteen variables were entered into the model. Statistical significance for entry of all variables were set at 0.01. The model was statistically significant (R^2= 0.39, F (3, 227) = 47.84, $p < 0.01$). Years of UK residency (β= .06, p < 0.01), language adoption (β= .21, p < 0.01), and language maintenance (β= -.18, p < 0.01) predicted this subtest.

RASIM (stage 5). This model was significant for the Yes/No subtest (ΔR^2= 0.05, F (10, 227) = 7.49, $p = 0.003$). However, none of the RASIM subscales were individually significant at the 0.01 level. The data were therefore explored with stepwise regression analyses to select identify a subset of predictors that best describes the dependent variable. Demographic, AAMASM, and RASI-M variables were entered, with statistical significance for entry of all variables set at the 0.01 level. The model was

statistically significant ($\Delta R^2 = 0.19$, F (2, 227) = 26.54, p = 0.003). Language adoption ($\beta = .38$, $p < 0.01$) and RASI-M work stress ($\beta = .18$, $p < 0.01$) were significant predictors of this subtest.

4.3.4 Acculturation and additional tests

The additional set of neuropsychological tests were subjected to the same analyses carried out on the SPANS. Age significantly predicted Digit Span total scores ($R^2 = 0.03$, F (1, 226) = 10.61, $\beta = -.18$, p = 0.008), WAIS-IV Coding ($R^2 = 0.03$, F (1, 226) = 6.93, $\beta = -.17$, p = 0.009), and Semantic fluency ($R^2 = 0.04$, F (1, 226) = 9.01, $\beta = -.19$, p = 0.003).

Stage two of the analyses significantly predicted Semantic fluency, where education was a significant predictor ($\Delta R^2 = 0.28$, ß=-.21, F (2, 227) = 13.03, $p < 0.01$). At stage three, age ($\beta = -.21$, p =0.008) and years of UK residency (ß=.37, $p < 0.01$), predicted performance in this task ($\Delta R^2 = 0.12$, F (2, 227) = 13.03, $p < 0.01$).

Table 4.2. Significant AAMASM-A, RASIM, and demographic predictors from the five-staged hierarchical regression for eight SPANS subtests

SPANS Subtest	Stage	Predictor	B	R^2
Political Leadership	Stage 3	Education	.21	.31
		Years UK residency	.38	
	Stage 4	Cultural knowledge adoption	.29	.08
Digit Span Forward	Stage 1	Age	-.23	.05
Repetition	Stage 1	Age	-.45	.21
	Stage 3	Age	-.23	.54
		Years UK residency	.21	
	Stage 4	Age	.21	.15
		Language adoption	.44	
Sustained attention 1	Stage 1	Age	-.12	.03
Direction	Stage 1	Age	-.28	.08
Reading Sentences	Stage 1	Age	.45	.20
	Stage 2	Age	.25	.27
		Education	.34	
	Stage 3	Age	.21	.42
		Education	.23	
		Years UK residency	.01	
List Learning	Stage 3	Years UK residency	.18	.01
Writing Sentences	Stage 1	Age	-.29	.08
	Stage 2	Age	.21	.12
		Education	-.24	
	Stage 3	Years UK residency	.2	.05
	Stage 4	Language adoption	.29	.12
Similarities	Stage 2	Education	-.23	.04
	Stage 3	Years UK residency	.33	.16

Notes. All p values presented here are < 0.01.

4.4 Discussion

This study set out to explore the relationship between multidimensions of acculturation and acculturative stress on a range of neuropsychological tests performance. Language adoption, cultural knowledge adoption, and years of UK residency predicted performance on three indices when controlling for the effects of age and education. There was no evidence that measures of acculturation were related to the additional neuropsychological test battery. Statistically non-significant results for the VPI with the AMAASM seemed to agree with the extant literature. Several measures of visuospatial ability, such as the Ruff Figural Fluency test, ROCFT, and visuoconstruction tests showed no associations with acculturative scales (Acevedo et al., 2007; Nielsen et al., 2013; Saez et al., 2014).

One additional finding was that years of UK residency predicted the List Learning subtest, but not RAVLT Total trials. These two tests purport to measure immediate recall, using similar administrative protocols and procedures. However, the List Learning subtest is significantly shorter and contain items that are qualitatively different to those in the RAVLT total trials. Differences in the content of word learning tests are known to affect performance (Maj et al., 1993; McDowell et al., 2004). In this study, participants with longer UK residency may have been more familiar with items on the List Learning subtest, thus encouraged processes involved in encoding immediate recall (Kennepohl, et al., 2004). This finding suggests that variation in the way a cognitive construct is measured could change its relationship with cultural variables. A discussion of the findings based on the study's hypotheses is presented below.

4.4.1 Index vs. subtest

Language adoption predicted the LAI index, but not all subtests within this index associated with this domain of acculturation. Tests that require access to the meaning of words or vocabulary knowledge seemed to be most sensitive to language adoption (i.e., naming, writing sentences, yes/no, repetition). This contrasted with tests of language comprehension (Direction subtest) and concept formation (Similarities subtest). These findings were somewhat in alignment with those of Hassan et al. (2019) and Razani et al. (2007b), where measures of acculturation did not predict the WAIS-IV Similarities subtest. However, other tests that require word knowledge and vocabulary,

such as the SPANS Reading subtest and semantic fluency (Sauzeon et al., 2011), were not associated with language adoption.

This index vs. subtest level of association is also seen in the ORI and CFI. For the ORI, only the Political Leadership subtest was predicted by the AAMAMS. It is reasonable that those who have lived in the UK for a longer period will have experienced greater exposure to local media, consequently more aware of the country's political situation. Thus, the relationship between AAMASM-A cultural knowledge and the ORI is explained by the inclusion of the Political Leadership subtest. In addition, those with more years of UK residency are likely to have better English proficiency, either due to UK-based education or general cultural exposure. This could benefit their performance on the verbal concept formation subtest of the CFI. This finding is consistent with Hasson et al. (2019), where years of residency predicted WAIS-IV Similarities. In any case, visual concept formation within the CFI was unrelated by the AAMASM or years of residency.

In summary, there is support for the hypothesis that the relationship for adoption on test performances can change depending on the level of assessment in a test battery. This was evident where domains of acculturation on the AAMASM formed different associations at the subtest levels of assessments within a particular index. Tests that require semantic word knowledge and vocabulary appear to be most strongly related to language adoption, but less so with tests of comprehension and verbal concept formation. However, this was not consistent, as other tests that require lexical knowledge were not associated with the AAMASM.

4.4.2 Domains of acculturation

In this study, it was clear that the predictive value of cultural maintenance on test performance were negligible. Language maintenance and language adoption both predicted the Naming subtest, but it was unclear whether there were statistical artefacts that may have confounded such a finding (multicollinearity, measurement error, bias, etc.). Nonetheless, language adoption was the most salient predictor – followed by cultural knowledge adoption – of test performance in this study.

The association between language adoption and the LAI was unsurprising, given that language adoption was assessed in terms of proficiency (how well participants spoke, understood, and wrote English). Studies have demonstrated that subjective

measures of language dominance are positively correlated with objective tests of picture naming, fluency, and comprehension (Miranda et al., 2007; Sheng et al. 2014). The lack of an association between language adoption and the remaining SPANS indices was unexpected. Some participants in this study were non-native English speakers, with varying levels of English proficiency. Those with lower English ability may find it more difficult to be tested in this language (Jensen, 1976). However, the current findings seem to be in alignment with those of previous works on the SPANS, where English competency measured by historical factors only associated with a co-normed index level of language assessment (Burgess 2014; Haddesley 2016).

To summarise, there was empirical support for the hypothesis that different domains can predict test performance. However, there was no direct support for notions that linguistic aspects of acculturation exhibited a stronger relation with test performance. Although language adoption predicted more tests than cultural knowledge adoption, the relative contribution of these two subscales depended on what was being tested. Cultural knowledge adoption – but not language adoption – predicted tests of orientation. Conversely, language adoption – but not cultural knowledge adoption – predicted tests of language.

4.4.3 Acculturative stress

Theoretical explanations for the association between RASI-M Work Stress and the Yes/No subtest is challenging. There is evidence that experiences of high levels of perceived discrimination, acculturative stress, and occupational stress are associated with low performance on tests of attention, memory, and psycho-motor skills (Nguyuen et al., 2012; Thames et al, 2013; Deligkaris, Panagopoulou, Montgomery, & Masoura, 2014). However, Thames et al., 2013 found no relationship between perceived stress and discrimination and language tests. Therefore, it was unclear why work-related cultural stressors would associate with language ability in a manner specific to the Yes/No subtest.

The relationship between RASI-M Work Stress and Yes/No subtest could be attributed to statistical artefacts (measurement error, response bias, etc.) resulting in this association. In any case, the overall predictive value of the RASI-M on cognitive tests was severely limited. The strength of these correlations was largely weak, and there were fewer associations with tests than seen for the AAMASM scale. Partial

correlations also demonstrated that language adoption was a more important variable than RASI-M language skills for the LAI. This strongly suggests that the association for acculturative stress on testing is substantially less important than that of AAMASM language adoption on the LAI. Combining empirical and theoretical evidence, the hypothesis that acculturative stress can independently predict test performance is not fully supported. This makes it unlikely that the effects of adoption on test performances are confounded by acculturative stress.

4.5 Conclusions

Based on the findings of this chapter, it appears that measures of adoption and years of residency predicts performances on the LAI, ORI, and CFI (including relevant subtests, such as List Learning). For the AAMAMS, language adoption and cultural knowledge adoption are much more important for neuropsychological performance; while the association of cultural maintenance and acculturative stress on these tests were negligible. In addition, the association for adoption differ between levels of testing. Not all subtests within the language and orientation index associated with all subscales of acculturation. More complex understanding of language for instance were predicted by years of residency or age, but not acculturation despite falling under the same index. In the following chapter, these tests are subjected to further assessment, using the normative references (T-scores) found in the SPANS manual. This enables a more pragmatic perspective of acculturation.

Chapter 5: Acculturation predicts false positives on SPANS norms

5.1 Introduction

As presented in Chapter 1, healthy individuals can score below clinical thresholds, and that test norms are generally not transferrable between populations. This problem of false identification of neurological deficit, and inappropriate usage of norms are not restricted to a particular region but are relevant in a UK clinical context (Darker-White, Beattie & Means, 2002; Parker & Philp, 2004; Tuerk & Sauer, 2015). Cultural factors may confound tests interpretations, consequently affecting clinical pathways such as specialist referrals or access to early intervention (Tuerk & Sauer, 2015). Therefore, it is appropriate to explore whether ratings of acculturation may be used to account for the generalisability of existing test norms on a multi-ethnic group of healthy participants residing in the UK. This could support improvements in test instruments and procedures for examining ethnic minorities.

5.1.2 Test norms

One way in which clinicians make decisions about the relative performance of an individual is through comparisons with normative references with similar demographic characteristics, such as age, education, SES, etc. (Gasquoine, 2009; Strauss et al., 2006). This enables a precise estimation of cognitive performance by reducing the chances of detecting a neurological impairment where none exists, known as a false positive. In the neuropsychological literature, the rule of thumb indicates that an acceptable rate of false positives is approximately 16% (Glasdjo et al., 1999). Norms derived from White/Caucasian; English-speaking populations applied to ethnically diverse populations usually result in increased rates of false positives. Manly et al. (1998) reported a wide range of rates of false impairment, with the highest being 65% on the BNT, in a study of healthy African Americans. Hestad et al. (2016) also reported high rates of false impairment (between 18% and 68%), when African American norms were applied to a group of healthy local Zambians in Africa. Inappropriate use of test norms with different cultural groups can lead to an increase in rate of false positives, resulting in high rates of misdiagnosis (Romero et al., 2009; Gasquoine et al., 2009; Puente, 2013).

Most existing norms usually do not account for cultural variability, such as language or ethnicity (Brickman et al., 2009; Puente, 2013; Melikyan et al., 2019). Efforts to reduce rates of false impairment generally entail collecting data sets from specific ethnic or demographic groups (stratified by ethnicity, SES, education, age, etc.). However, creating norms for every known cultural/ethnic group, at all demographic levels (age, education, SES, etc.) would be impossible due to the sheer multitude of cultural groups that exist (Gasquoine, 2009; Brickman et al., 2009).

The systematic review in Chapter 2 highlight that not all ethnic groups are at a disadvantage on these tests. For instance, Japanese Americans perform significantly better than White American Caucasians on visual memory tests (Kemmotsu et al., 2013), and one study found no difference between the scores of Hispanics and White Caucasian Americans on a memory test (Mungas et al., 2005). Two studies reported that rates of false positives were broadly acceptable (i.e., 7% to 18%) when norms were transferred from one population to another for tests of processing speeds and attention (Manly et al., 1998; Hested et al., 2016). Therefore, in some cases, norms can potentially be generalised if there are common characteristics between groups of people (Gasquoine 2009; Strauss et al., 2009; Romero et al., 2009). Given that it is virtually impossible to create norms for every known cultural group, perhaps a more useful approach would be to assess the extent to which existing norms (usually taken from English-speaking, Western populations) can be accurately applied to culturally dissimilar individuals (ethnically diverse populations, non-native English speakers, etc.)

5.1.3 Acculturation, test norms, and false positives

Chapter 2 notes that the relationship between measures of acculturation and test norms is not extensively studied in the literature. Two studies in the systematic literature review raise the possibility that the use of appropriate age and ethnic corrected norms could eliminate the effects of acculturation on test performance (Coffey et al., 2005; Mindt et al., 2014). This suggests that due to the confounding effects of acculturation, norms from one group of people may not be transferrable to another culturally dissimilar group.

In Chapter 2, the practical value of acculturative measures is inconclusive among studies in the literature. For example, acculturation may not be able to encapsulate all cultural variation in an ethnic group (Kennepohl et al., 1998), or

differences between high and low acculturated groups may not be sufficiently large for clinical concern (Arnold et al., 1995). In contrast, Simpao et al. (2005) found that every level increase in language proficiency and social affiliation toward English speaking American culture led to less than a 35% chance of 'failing' the MMSE (i.e., scoring below a clinical cut-off). Royal et al. (2003) evidenced that a larger percentage of those categorised as 'high' on acculturation, 'passed' (scored above a clinical cut-off) on the Clock Drawing test (CLOX), though the confounding effects of age and education were unaccounted for. Nonetheless, these studies exemplify that the likelihood of passing a given cut-off, could be attributed to scores on acculturative measures. This form of investigation would demonstrate the practical value of acculturative scales during routine examinations for ethnic minorities.

5.1.4 Practical position of acculturative measures

Linguistic factors are primarily assessed when routine clinical examination is performed on culturally diverse populations (Romero et al., 2009; Ortiz et al., 2012; Harris et al., 2013). However, Orchiz et al. (2012) criticised the guidelines for the assessment of culturally diverse populations as lacking precision. For instance, some practitioners unsystematically translate tests into other languages, thus changing its meaning (Ortiz et al., 2012; Harris et al., 2013). Harris et al. (2013) posed a question: 'What degree of proficiency or linguistic competency on the part of the examinee is necessary to proceed with a test in English?' (pg. 385). This reflects a lack of consensus on how language factors should be assessed and how this informs clinical decisions in practice. Harris et al. (2013) recommends evaluating perceived levels of language (subjective measures, preferences, comfort levels, etc.) prior to testing, assisting decisions about the appropriate language of administration (in English or the native language). Conversely, other neuropsychologists advocate that both objective (expressive vocabulary tests, etc.) and subjective (comfort levels, usage, etc.) measures ought to be used in tandem (Romero et al., 2009). Since the AAMASM is a self-report measure of acculturation, this should also be tested with objective measures of language to assess the relative importance of both approaches.

5.1.5 Aims and hypothesis

The aim of this study explored the practical value of measures of acculturation in relation to the existing test norms of the SPANS. It was theorised that ratings on subscales of the AAMASM-A could be used to exemplify why healthy ethnically diverse participants do not attain scores suggestive of non-impairment on the SPANS. Chapter 4 highlights that AAMASM-A predicts a range of scores on some tests of the SPANS. Whether such findings would remain significant when a pass/fail or false/true positive dichotomy is applied is yet to be tested. If so, this could provide better evidence for the utility of such scales, while illuminating the external validity of existing norms for culturally diverse populations. In this study, the AAMASM-A was also compared with other measures of language to show its relative importance. The main hypothesises of this study are outlined below. Note that this chapter comprises two sections, each addressing two hypotheses.

5.1.5.1 Section 1.

- Given that existing norms may underestimate the cognitive capabilities of ethnic minorities, it was hypothesised that culturally diverse groups would perform significantly lower than a homogenous English-speaking sample found in the technical manual after adjusting for cultural and linguistic variables.

- It was hypothesised that existing SPANS norms would overestimate rates of false positives (approximately 16%) for this culturally diverse (CD) sample. It was also hypothesised that rates of false impairment would be significantly higher for the CD group than for a healthy, majority English-speaking, normative sample found in the technical manual.

5.1.5.2 Section 2.

- It was proposed that measures of acculturation have probabilistic characteristics, thus predicting the likelihood of passing a given hypothetical threshold. It was hypothesised that higher values on language adoption, years of residency, and cultural knowledge adoption would significantly

decrease the likelihood of passing a given threshold that approximates false positives on SPANS norms.

- The use of subjective and objective measures is debated in the literature. As such, both approaches were contrasted here to highlight the relative importance of subjective measures of acculturation for predicting a given clinical threshold.

5.2 Method

5.2.1 Participants

Culturally diverse sample (CD). All 228 healthy individuals were included for this study (see section 3.1.3 for demographic characteristics). For consistency, educational levels were recoded to fit the additional normative samples. Therefore, 107 participants from the ethnically diverse group had a college or vocational education (A-levels, diploma, BTEC, etc.), and 121 had obtained a university degree. The average cultural quotient (CQT) score for this group was 1.35 (SD= 0.09, maximum score is 3). Of the participants, 109 scored zero for CQT, 16 scored one, 17 scored two, and 86 scored three.

Normative sample (NS). There were 124 age-matched participants, with a range of 18-50 years old (M= 32.01 years, SD= 9.74), with 70 females. Four participants scored a one, five scored a two, and all others scored three on the CQT scale (M= 2.89, SD= 0.41). Thirty-one had a secondary school education (GCSEs), 36 had achieved a college or vocational education (A-levels), and 62 had obtained university degrees. Ethnicity was not recorded for this group of participants. This group of participants were from a pre-existing data set collected during the development of the SPANS (Burgess, 2014). Ethnicity was not recorded for this group of participants.

Clinical group. Ninety-nine participants were age-matched with the ethnically diverse sample, ranging from 18 to 50 years (M= 35.83 years, SD = 9.33), with 74 males. Only one participant scored a zero for the CQ scale, two scored a one, and the remainder scored three (M= 2.94, SD= 0.34). A total of 35 participants had a secondary school education, 50 had a college or vocational education, and 14 had obtained university degrees. Ethnicity was not recorded for this group of

participants. This group of participants were from a pre-existing data set collected during the development of the SPANS (Burgess, 2014). Ethnicity was not recorded for this group of participants.

The average Glasgow Coma Scale (Teasdale & Jennette, 1974) score for the 71 participants was 6.94 (SD = 3.77, max score 15). SPANS assessments were conducted on these participants, with a mean of 90 weeks (SD=136.41 weeks) since the onset of injury for 74 participants. The neurological conditions were as follows: Traumatic Brain Injury TBI (N= 47), anoxic/hypoxic brain injury (N= 14), haemorrhage (subarachnoid/subdural) (N= 9), stroke/other haemorrhage (N= 4), epilepsy (N= 4), Acquired Brain Injury (N= 20), and temporal lobe epilepsy (N= 1).

5.2.2 Materials

Subjective measure. For this study, only the AAMASM-A scale was used to conduct analyses of the CD group. As such, the AAMASM-A was taken as a subjective measure of language proficiency and cultural knowledge/familiarity.

Objective measures. The CQT was recorded for all participants. This consists of three dichotomous (yes/no) questions, asking the following: a) whether English was their first language; b) whether a majority of their primary school education was taught in English; and c) whether they had lived in an English-speaking country (the US, Canada, the UK, Australia, South Africa) for more than 50% of their lifetime. Since years of UK residency predicted several tests in the SPANS, this variable was also included in subsequent analyses. Additionally, verbal fluency (COWAT) was included as an objective measure of language ability.

Neuropsychological measure. The SPANS was used as an outcome measure of neuropsychological performance along with existing norms (Burgess, 2014). Table. 5.1 reports the internal reliability for indices for three participant groups.

Table 5.1. Reports Cronbach's Alpha coefficients for each index across three groups.

	ORI	ACI	LAI	MLI	VPI	ECI	CFI
CD	0.46	0.55	0.76	0.52	0.35	0.45	0.45
NS	0.42	0.46	0.41	0.63	0.39	0.38	0.34
Clinical	0.74	0.81	0.85	0.88	0.85	0.82	0.59

Notes. ORI=orientation index, LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index. CD = Culturally diverse, NS= Normative sample.

5.2.3 Analysis

All analyses were conducted using SPSS v24. Conversion of raw scores to standardised T-scores for all participants followed procedures published in the manual (Burgess, 2004). After T-score conversions, there were no outliers in the data, and skewness for all SPANS indices were between +1 and -1. Consequently, all analyses except the ORI used T-scores instead of raw scores for this chapter. As there are no normative references for subtest levels of the ORI, a separate analysis was conducted to compare performance on the political leadership and time estimation subtests for these three groups. To achieve a cut-off score for ORI subtests, a Receiver Operator Curve/Area Under Curve (ROC/AUC) was used for these two subtests for the NS and clinical groups. An AUC of > 0.7 was taken as an acceptable standard for diagnostic accuracy (Krzanowski, 2009). Youden's index (sensitivity + specificity -1 = *J*) is a common formula for maximising sensitivity and specificity; and, ideally, $J = 1$ indicates a perfect test of true positive and negatives (Krzanowski, 2009).

The data were subjected to hierarchical regression to assess for group differences while adjusting for demographic and cultural variables. Assumptions such as VIF tolerances, normality of the error distribution, and leverage points were re-scrutinised post hoc. To prevent issues of multicollinearity, inter-correlations between all variables were inspected prior to regression analyses. For consistency throughout the thesis, all *p* values were set at 0.01 instead of 0.05. To compare rates of false positives, chi-square analyses was computed with post hoc Bonferroni adjustments corrected for multiple comparisons.

False positives. It is common in the neuropsychological literature for a clinical population to score between 1 standard deviation (T-score < 40) and 2 standard deviations (T-score < 30) below the mean (Goldstein et al, 2004). Judging from the SPANS manual, clinical interpretations consistently suggests that 'low' scores (below 25th percentile, approximate T-score < 43) are usually a cause for clinical concern (Burgess, 2004). However, clinical thresholds can vary, thus a second threshold for the index levels was explored in this study. According to the manual, the next tier below

'low' is 'very low', indicating scores below the 10th percentile (approximately T-scores < 30). Since all participants in this study were healthy, any score within the 'low' or 'very low' range was used as an estimate, broadly representing a false identification of neurological impairment. For convenience, 'false positives', 'failures', and 'false impairment' were used to describe those who scored below these thresholds, while 'true positives' or 'pass' denoted those who scored above these thresholds. These thresholds were applied to all SPANS indices and subtests, except for the political leadership and time estimation subtests. Chi-square tests with post-hoc Bonferroni corrections for multiple comparisons were used to explore the proportion of failures among the three groups.

To assess the likelihood of acculturative variables predicting false positives for SPANS indices and subtests in section two, the data was subjected to binary logistic regressions analyses. Two thresholds were adopted: 'low' scores (< 25th percentile) and 'very low' scores (< 10th percentile). For subtests, the threshold was simplified to a 'low' score (<25th percentile). There was no evidence of multicollinearity between age, education attainment, and CQT score (< 0.7) for all 450 participants. However, for the CD group, language adoption ($r(227) = .7$, $p < 0.01$), and years of residency ($r(227) = 0.71$, $p < 0.01$) were strongly correlated with CQT scores. Due to multicollinearity, a separate model was tested for CQT scores and language acculturation. Variables entered for the logistic regression followed significant findings in Chapter 4. Verbal fluency was entered additionally for all regression models. The predicted probability reference was above the low or very low threshold.

5.3. Section 1. Results

5.3.1 ORI subtests

As there are no normative references for the Political and Time estimation subtests, a separate ROC analysis was conducted between the NS and CD to determine an appropriate cut-off score for these tests. The AUC for Political Leadership between NS and CD was acceptable (.71), but not for Time Estimation (0.62). Based on Youden's index, an optimal cut-off score of ≤ 1 (max score= 2) was taken as an indicator of false impairment for the Political Leadership subtest (See Appendix I).

5.3.2 Results of normative comparisons of SPANS indices

Hierarchical regression analyses were carried out to assess group differences in performance on each SPANS index. This was conducted in two stages: 1) age, gender, educational attainment, and CQT scores, and 2) dummy-coded variables were used for three groups, where the CD sample was the reference group.

Stage 1. The model for the first stage of the analyses was statistically significant for all indexes of the SPANS. At this stage, educational attainment positively predicted the Political Leadership ($\beta = .13$, $p < 0.01$), Time Estimation ($\beta = .17$, $p = 0.001$), ACI ($\beta = .17$, $p < 0.01$), LAI ($\beta = .17$, $p < 0.01$), MLI ($\beta = .21$, $p < 0.01$), VPI ($\beta = .27$, $p < 0.01$), and ECI ($\beta = .35$, $p < 0.01$). CQT scores significantly positively predicted the Political Leadership ($\beta = .41$, $p < 0.01$), LAI ($\beta = .69$, $p < 0.01$), ACI ($\beta = .18$, $p < 0.01$), VPI ($\beta = .18$, $p < 0.01$), and the CFI ($\beta = .39$, $p < 0.01$)

Stage 2. This model was significant for all SPANS indices. At this stage, educational attainment predicted the Political Leadership subtest ($\beta = .40$, $p < 0.01$), VPI ($\beta = .14$, $p = 0.003$) and ECI ($\beta = .18$, $p < 0.01$). Age predicted the MLI ($\beta = .14$, $p = 0.004$). CQ scores predicted the ORI ($\beta = .38$, $p < 0.01$), LAI ($\beta = .59$, $p < 0.01$), ACI ($\beta = .15$, $p = 0.005$), and CFI ($\beta = .31$, $p < 0.01$).

There were no statistically significant differences in scores between the CD and NS group on the ECI, Political Leadership, and Time estimation subtests. The clinical group attained lower scores than the CD for the ECI ($R\Delta^2 = 0.42$, $F(6, 449) = 38.09$, $\beta = -.51$, $p < 0.01$). For all remaining indices and subtests, the NS performed significantly better than the CD, but the CD group performed significantly better than the clinical group. Table 5.2 summarises the findings of the regression analyses.

Table 5.2. Findings from the two-stage hierarchical regression analysis

SPANS	Stage	Predictor	Beta coefficient	R^2
Political Leadership*	Stage 1	Education	.24	.14
		CQT	.2	
	Stage 2	Education	.15	.21
		CQT	.22	
		CD > Clinical	.45	
Time Estimation*	Stage 1	Education	.10	.04
	Stage 2	CD > Clinical	.34	.10

ACI	Stage 1	Education	5.1	.06
		CQT	1.98	
	Stage 2	CQT	1.77	.22
		NS > ED	5.73	
		CD > Clinical	11.74	
LAI	Stage 1	Education	3.54	.41
		CQT	7.96	.55
	Stage 2	CQT	6.86	
		NS > CD	10.02	
		CD > Clinical	6.35	
MLI	Stage 1	Education	3.84	.05
	Stage 2	Age	.2	.25
		NS > CD	7.9	
		CD > Clinical	-10.41	
VPI	Stage 1	Education	4.97	.06
		CQT	1.91	
	Stage 2	Education	2.61	.3
		NS > CD	10.05	
		CD > Clinical	-8.44	
ECI	Stage 1	Education	7.09	.13
	Stage 2	Education	3.73	.34
		CD > Clinical	18	
CFI	Stage 1	CQT	4.28	.14
	Stage 2	CQT	3.36	.29
		NS > CD	8.63	
		ED > Clinical	-6.17	

Notes. All variables reported here have *p* values of < 0.01. *Raw scores were used for Political Leadership and Time Estimation subtest. ACI= Attention Concentration index, LAI= Language index, MLI= Memory and learning index, VPI= Visuo-spatial index, EC= Efficiency index, CFI= Cognitive Fluency index. CD= Culturally diverse. NS= Normative sample. CQT=Cultural Quotient.

5.3.3 Rates of impairment

Table 5.3. presents the ‘low’ and ‘very low’ frequency scores for the indices of all groups and the political leadership subtest. Bonferroni post hoc corrections for multiple comparisons were made for these groups. At all cut-off points, there was a significantly higher percentage of false positives for all tests for the CD group than for the NS, except the ECI. The percentage of failures for the CFI was not statistically different or that of the clinical and CD groups. At a ‘low’ threshold, there were significantly more failures on the LAI for the CD group than for the clinical group

Table 5.3. Comparisons of the proportion of false negatives between all groups

	CD			NS		Clinical		Comparisons
Test	Cut-off	N	%	N	%	N	%	
Political Leadership	< 1.5	68	29.8	7	5.4	40	34.8	Clinical > NS. CD > NS
ACI	< 10%	47	20.61	11	8.94	53	53.54	Clinical > NS, CD. CD > NS
	< 25%	84	36.84	23	18.7	67	67.68	Clinical > NS, CD. CD > NS
LAI	< 10%	123	53.95	7	5.69	42	42.42	Clinical > NS. CD > NS
	< 25%	164	71.93	17	13.82	52	52.53	Clinical > NS. CD > NS, Clinical
MLI	< 10%	47	20.61	10	8.13	55	55.56	Clinical > NS, CD. CD > NS
	< 25%	111	48.68	17	13.82	75	75.76	Clinical > NS, CD. CD > NS
VPI	< 10%	64	28.07	6	4.88	63	63.64	Clinical > NS, CD. CD > NS
	< 25%	132	57.89	19	15.45	75	75.76	Clinical > NS, CD. CD > NS
ECI	< 10%	35	15.35	12	9.76	68	68.69	Clinical > NS, CD
	< 25%	64	28.07	20	16.26	76	76.77	Clinical > NS, CD
CFI	< 10%	98	42.98	7	5.69	45	45.45	Clinical > NS. CD > NS
	< 25%	132	57.89	19	15.45	58	58.59	Clinical > NS. CD > NS

Notes LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index. NS= Normative sample. CD= Culturally Diverse. All comparisons have a p value of < 0.01

5.4 Section 1. Summary and discussion

The results demonstrate that, the culturally diverse (CD) group scored significantly lower than the normative sample (NS). These differences were still present when cultural variables (CQT scores) and other demographic variables were adjusted in the regression analyses. Although the CD group performed significantly better than the clinical group, SPANS norms underestimated the performance of the CD group over a range of indices. This meant that existing norms of the SPANS could generally discriminate between healthy and clinical participants, but its accuracy in doing so for the CD group may be compromised. It was also hypothesised that rates of false impairment would be significantly higher for the CD group. There was partial support for this, as only rates of failure on the ECI were comparable for the CD and NS group. Aside from this index, all others indicated a high percentage of failures for the CD group based on existing SPANS norms. These results suggest that norm references from the technical manual are unlikely to be appropriate for a culturally heterogeneous group.

Not all participants in the CD group were non-native English speakers, and perhaps those within this group with similar characteristics with existing norms could have performed comparably. However, only the CQT was recorded for the normative group, and thus there could be other cultural characteristics that differ between native English speakers of both CD and NS samples. Therefore, additional cultural characteristics (i.e., ethnicity, cultural values, beliefs, etc.) that could have better explained discrepancies in SPANS norms between such groups. Alternatively, differences in sample sizes could also have explained discrepant findings.

The data here therefore partially support the first hypothesis, with the CD group attaining significantly lower T-scores than the normative sample for some tests. The exception to this may have been the ECI and subtests of the ORI, where no significant differences between the CD and NS were detected, and the former outperformed the clinical group. Apart from these tests, differences in false impairment between the NS and CD groups were relatively consistent across two thresholds for a few SPANS indices.

5.5 Section 2. Results

5.5.1 Predictors of false positives at index level

LAI very low. The model was significant (χ^2 (5) =122.85, p < 0.01). Those with more years of residency (B=1.01, Wald= 22.74, OR= 1.11, p < 0.01) and higher scores for language adoption (B= 0.67, Wald=8.12, OR= 1.95, p = 0.004) and verbal fluency (B= 0.10, Wald=22.12, OR= 1.04, p = 0.003) predicted a higher likelihood of scoring above this threshold. Age and education were not significant predictors. A separate model showed that CQT scores (B=1.32, Wald =50.71, OR=3.75, p < 0.01) and verbal fluency (B=0.06, Wald =13.88, OR=1.06, p < 0.01) predicted this threshold.

LAI low. The overall model was significant (χ^2 (5) =102.45, p < 0.01). Only verbal fluency (B=0.06, Wald =15.91, OR=1.07, p < 0.01) and language adoption (B=0.96, Wald =9.51, OR=2.61, p < 0.01) were significant. A separate model showed that CQT scores (B=0.91, Wald =24.91, OR=2.44, p < 0.01) and verbal fluency (B=0.07, Wald =20.52, OR=1.08, p < 0.01) predicted this threshold.

CFI very low. At the 'very low' threshold, years of residency received an odds ratio of 1.06 (B=0.06, Wald = 13.78, p < 0.01). CQT scores were significant at the 'very low' threshold (B=0.41, Wald=13.72, OR=1.49, p < 0.01).

CFI Low. At the 'low' threshold, years of residency were also significant (B=0.02, Wald= 9.78, OR=1.05, p = 0.002). CQT scores were significant at the 'low' threshold (B=0.31, Wald=8.77, OR=1.36, p =0.003). Table 5.4. summarises all regression results for the SPANS.

Table 5.4. Significant predictors for SPANS indices

	Index	Threshold	Predictors	OR	CI (99%)
AAMASM-A	LAI	< 10%	Years UK residency	1.11	1.04-1.17
			Language adoption	1.95	1.07-3.53
			Verbal fluency	1.04	1.07-1.08
		< 25%	Language adoption	2.61	1.17-5.85
			Verbal fluency	1.07	1.02-1.11
	CFI	< 10%	Years UK residency	1.06	1.06-1.09
		<25%	Years UK residency	1.05	0.99-1.08
CQT	LAI	< 10%	CQT	3.17	2.38-6.04
			Verbal fluency	1.06	1.02-1.01
		< 25%	CQT	2.44	1.55-3.71
			Verbal fluency	1.08	1.03-1.11
	CFI	< 10%	CQT	1.36	1.31-1.98
		<25%	CQT	1.01	1.11-1.68

Notes. All values reported has *p* value of < 0.01. LAI=language index, CFI=cognitive flexibility index, CQT= Cultural Quotient. AAMASM-A= Asian American Multidimensional Acculturation Scale Modified –Adoption.

5.5.2 Predictors of false positives at subtest level

Political leadership. Years of UK residency (B=0.13, Wald=19.72, OR=1.13, p < 0.01) and postgraduate-level education (B=-1.41, Wald=12.24, OR=.24, p < 0.01) predicted scoring above this threshold.

When CQ replaced years of UK residency, cultural knowledge adoption (B=0.53, Wald=11.22, OR=1.69, p =0.001), CQT (B=0.59, Wald=10.79, OR=1.68, p < 0.01), and postgraduate education (B=-1.6, Wald=11.42, OR=1.13, p = 0.001) were significant predictors.

Naming. Years of UK residency was the only significant predictor (χ^2 (4) =81.67, p < 0.01, B=.09, Wald = 19.18, OR= 1.09, *p* < 0.01). CQT alone was a significant predictor of this test (B= .97, Wald = 64.46, OR= 2.64, *p* < 0.01).

Repetition. Age (B= -.11, Wald = 13.91, OR = .89, p < 0.01), years of UK residency (B= .09, Wald = 14.34, OR= 1.10, p < 0.01), and language adoption (B= .75, Wald = 17.09, OR= 2.1, p < 0.01) were significant predictors.

For the next model, CQT scores (B= 1.20, Wald =29.82, OR= 3.32, p < 0.01), and age (B= .02, Wald = 3.19, OR= 1.02, p = 0.002) were significant predictors.

Reading. Age (B= -.14, Wald = 12.15, OR= .08, p < 0.01) and years of UK residency (B= .16, Wald = 14.57, OR= 1.17, p < 0.01) were significant predictors in this model. In another model, CQT scores also predicted this test (B= 2.31, Wald = 9.18, OR= 10.06, p = 0.002).

Writing sentences. Only language adoption significantly predicted this test (B= .66, Wald = 9.32, OR= 1.95, p = 0.002).

In another model, verbal fluency (B= .04, Wald = 7.22, OR=1.05 p = 0.007) and CQT scores (B=.69, Wald = 8.41, OR= 1.99, p = 0.004) were significant predictors.

Yes/no subtest. Language adoption (B= .58, Wald = 17.4, OR= 1.80, p < 0.01) and RASI-M work stress (B= .31, Wald = 8.08, OR= 1.36 p =0.004) were significant predictors in the model.

In another model, CQT scores (B= .56, Wald = 19.17, OR= 1.76, p < 0.01) and RASI-M work stress (B= .32, Wald = 8.27, OR= 1.37, p = 0.004) were significant predictors.

Similarities. Only years of UK residency predicted scoring above a threshold for this test (B= .06, Wald = 13.81, OR= 1.06, p < 0.01).

When CQT replaced years of residency, only verbal fluency (B= .27, Wald = 5.60, OR= 1.03, p = 0.008) was significant. Table 5.5. presents a summary of the results, comparing two models – one with the AAMASM (acculturation) and the other with CQT.

Table 5.5. Significant predictors for each language subtest on the SPANS.

Subtest		Variable	OR	CI
Political Leadership	Acculturation	UK residency	1.13	1.07-1.20
		Education	3.30	1.52-7.17
	CQT	CQT	1.61	1.18-2.17
		Cultural knowledge	1.64	1.22-2.22

		Education	3.53	1.62-7.68
Naming	Acculturation	Years UK residency	1.09	1.05-1.14
	CQT	CQT	2.44	1.91-3.11
Repetition	Acculturation	Age	.89	.84-.95
		UK residency	1.09	1.04-1.15
		Language	2.05	1.42-2.97
	CQT	Age	.92	.87-.97
		CQT	3.34	2.18-5.13
Reading Sentences		Age	.86	.79-.94
		UK residency	1.15	1.06-1.25
		Language	2.01	1.26-3.20
	CQT	CQT	10.06	2.26-44.8
		Age	.89	.82-.96
Writing Sentences	Acculturation	Language	1.95	1.27-2.98
	CQT	Verbal fluency	1.05	1.01-1.08
		CQT	1.99	1.25-3.18
Yes/No	Acculturation	Language	1.51	1.10-2.51
		Work Stress	1.41	1.12-1.75
	CQT	CQT	1.76	1.46-2.26
		Work Stress	1.37	1.10-1.71
Similarities	Acculturation	UK residency	1.06	1.03-1.09
	CQT	Verbal Fluency	1.03	1.00-1.05

Notes. All values reported has *p* value of < 0.01. CQT = Cultural Quotient.

5.5.3 Comparisons between chapters

Table 5.6. presents an additional set of results, comparing findings between Chapter 5 and Chapter 4.

Table 5.6. Compares findings between chapters 4 and 5.

SPANS index/subtest	Chapter 4: Relationship between acculturation and neuropsychological tests	Chapter 5: Effects of acculturation on normative references of the SPANS
Political Leadership	Cultural knowledge predicted this subtest	Cultural knowledge was not a significant predictor unless assessed with CQT
List Learning	Years of residency was a significant predictor	Not a significant predictor
Naming	Language adopt and maintenance were significant predictors	Only years of UK residency was a significant predictor
LAI index	Years UK predicted this index	Years UK did not predict a lower threshold for this index

5.6 Section 2. Discussion

The aim of this study was to test the direct relationship between acculturative measurements, and related cultural variables (CQT) on current normative references of the SPANS. The purpose was to explore whether a range of cultural measures could predict the likelihood of passing a given hypothetical threshold. Doing so would provide evidence that existing norms are not appropriate for CD groups because of the confounding effects of adoption or other cultural factors like years of residency. The use of the results of this chapter is restricted to assessing the suitability of existing norms for CD participants, not the psychometric properties of the SPANS assessment. It is clear that existing norms are not valid for this CD group. Cultural factors like language

adoption and years of UK residency appear to confound test norms for tests of orientation, language, and cognitive flexibility on the SPANS.

There were differences between some results given in Chapter 4 and Chapter 5. Years of residency failed to predict a pass/fail dichotomy on List Learning subtest, and the AAMASM-A language did not predict performance on the Naming subtest. The introduction of a pass/fail paradigm – rather than assessing for a range of scores – may change the way in which these factors relate performance on these tests. This could diminish the practical value of the acculturative or cultural measurements for these tests. However, most of these differences between Chapter 4 and Chapter 5 occurred at a subtest level. Therefore, if these measures (CQT, AAMASM, verbal fluency, etc.) were to be used to assess the suitability of existing norms, such decisions should be made for index levels of the SPANS.

5.6.2 Predictors of false positives

There is adequate evidence that scores for language adoption, years of UK residency, verbal fluency, and CQT may have a practical value in clinical context. Higher scores on these scales increased the odds of passing a given threshold on the LAI, CFI, and political leadership subtests. This means that existing SPANS norms are not appropriate for CD populations due to confounding cultural constructs such as language proficiency or years of residency. However, the predictive values of these assessments (CQT, verbal fluency, etc.) were not equivalent. For instance, years of residency may not be a suitable variable for predicting false positives at a higher threshold of the LAI. Additionally, the effects of these measurements on a false positive dichotomy could depend on the index versus subtest level of assessment, a finding that resonates with Chapter 4. This was most striking for verbal fluency, which only predicted two of six subtests on the LAI, despite significantly predicting performance at an index level.

5.6.1 Objective and subjective measures

Although the COWAT significantly predicted passing two levels of cut-offs for the LAI index, it only predicted two of its subtests. Verbal fluency cannot account for historical language experiences (EFL status, time spent learning English, etc.). In some cases, current levels of proficiency and early exposure to English language are

associated differently with tests of attention and language (Razani et al., 2007a, 2007b). Although there is a strong component of language ability in the test of verbal fluency, it also incorporates executive functioning processes (Shao et al., 2014; Whiteside, 2016). This may have reduced its sensitivity as a pure language assessment for this group of participants.

In contrast, years of UK residency and language adoption predicted more than half of the subtests in the LAI. The CQT, on the other hand, consistently predicted almost all subtests of the LAI and two indices over two thresholds. However, the range of scores for CQT (maximum score of three) and AAMASM language (maximum score of seven) is limited, compared to years of residency and verbal fluency, restricting sensitivity to a wider range of language ability. Despite its limited variance, the CQT is a stronger instrument for predicting the odds of passing a given threshold on the SPANS. Therefore, measuring historical aspects of language like the CQT might be a better cultural measurement compared to acculturation, and verbal fluency, for use during clinical examination.

5.6.2 Limitations

There are limitations that are specific to this study. Firstly, the SPANS do not provide a strict cut-off, or a 'clinical' range, but the 1SD and 2SD cut-off is a general guide provided by the neuropsychological literature. Despite no strict cut-off criterion, a binary classification may still be appropriate for tests that use a more scalar approach. For instance, the WAIS-IV provides a range of scores for borderline intellectual disability (FSIQ between 70 and 79), thus binary classifications can be based on a categorical range (i.e., below FSIQ 79, above FSIQ 70, etc.). Consequently, two hypothetical cut-off scores were adopted in this study to approximate a range that is clinically appropriate. In any case, specific cut-offs can be acquired with more precise identifications, by including different sample characteristics (injury variables, demographics, SES, etc.), along with other forms of analyses such as ROC (Strauss et al., 2006). This might provide a more accurate representation of binary classifications of impairment and include a wider range of classifications, such as false/true negatives. This also meant that the introduction of different thresholds could alter the results found in this study.

Secondly, there is a restricted range of variance for some cultural measurements in this study. This is especially the case for the CQT (max score 3), and language adoption (max score 7). Other scales with larger variance, or those which evaluate a wider range of language constructs (time spent learning English, bilingual dominance, etc.), could produce different results if these were subjected to similar analyses. Thirdly, it is less certain whether these results and methodology can be generalised to other tests norms in the wider literature. Differences in test measures, norms, and sample characteristics may alter the predictive value of acculturative measures.

5.7 Conclusions

However, these limitations may not negate the aims of this study. The purpose of the work was to demonstrate whether measures of acculturation (i.e., adoption) and other related constructs – such as years of residency – can predict performance based on a false positive and true negative dichotomy derived from existing norms. Generally, language adoption, CQT (language history and experience), verbal fluency, and years of UK residency appear to provide adequate explanation for why norms cannot be appropriately applied to different cultural groups. Comparatively, however, the CQT might be more effective in predicting rates of false positive for tests of language, orientation, and cognitive flexibility on the SPANS. Therefore, objective and historical accounts of language experiences may have a stronger practical or clinical implication compared to ratings of acculturation. However, the ethnic composition of the sample in this study is heterogeneous; thus, it is uncertain whether this diversity would confound the results produced by this thesis. In the following chapter, ethnic groups were compared to ascertain whether this confounded the results thus far.

Chapter 6: Relationship between ethnicity and acculturation on test performance

6.1 Introduction

Based on the findings of chapter 4, demographic variables such as age, education, and scales of acculturation have limited power to predict test performances. Additional cultural constructs, such ethnicity, could have better explanatory value on test performances compared to ratings of acculturation. It is clear that ethnic groups underperform compared to ethnic majority groups (typically White Caucasian) across a range of neuropsychological tests (Coffey et al., 2005; Mindt et al., 2014; Nielsen et al., 2012a; Mungas et al., 2005; Manly et al., 1998; 2002; Kemmotsu et al., 2013). Adjusting for demographic variables, including language may not attenuated differences, leading researchers to conclude that there might be cultural differences that underlie test performance differences (Jacobs et al., 1997; Taussig et al., 1992; Helms, 1995). As discusses in Chapter 1, a culturalists position argues that cultural differences underlie performance between ethnic groups (Helms, 1995). For instance, Helms (1992) contends that cultural differences primarily underlie discrepancies in test performance between Black and White communities. African Americans more adept at test-taking strategies are also more likely to have greater exposure to White-American culture, resulting in higher levels of adoption (Helms, 1992).

6.2 Acculturation and ethnicity

Some authors even contend that the concept of acculturation, ethnicity, and sociodemographic factors are mere proxies of each other (Flanagan, Genshaft & Harris, 1997; Brickman et al., 2006; Gasquoine, 2009). For instance, Nielsen et al. (2018a) compared performance on a wide range of verbal and non-verbal tests across several ethnic minorities residing in Europe. When ethnicity replaced scores of acculturation, there was no change in the overall results. This means that unidimensional acculturation and ethnic group membership predicted the same set of tests (Nielsen et al., 2018a). Manly et al. (1998) evidenced that, when maintenance was entered as a covariate, group differences between Black and White Americans were attenuated for five-out-of-six verbal and non-verbal tests. These studies suggest that levels of acculturation and ethnic group membership may have some shared characteristics, with similar association with test performance. Conversely, studies that found significant group performance differences between ethnic groups, found no association between test performances and

ratings of acculturation (Kemmotsu et al., 2013; Mindt et al., 2014). Other researchers present acculturation as a distinct entity from variables like SES, education, or ethnicity (Arends-Tóth & Van de Vivjer, 2006a). This appear to be in line with theories of acculturation, in which acculturation cannot be simply inferred from proxies such as years of residency or language.

6.3 Practical implication of ethnicity

Chapter 5 shows that current SPANS norms underestimate the neuropsychological ability of this culturally diverse (CD) group. However, it is unclear if rates of false impairment would differ if the CD group were stratified according to ethnicity. Studies have suggested that clinical thresholds differ such groups. Tests like the MOCA and MMSE show no consistent agreement over a cut-off criterion between different countries (O'Driscoll & Shaikh, 2017; Shim, Yang, Kim, Park, & Kim 2017; Milani et al., 2018; Milani, Marsiske & Striley, 2019). Even within the UK, different cut-off scores had to be used for ethnic minorities for the MMSE and ACE (Richard et al., 2000; Tuerk & Sauer, 2015). However, these studies do not directly consider whether cultural factors like acculturation can also account for these different cut-off scores. In Chapter 5, cultural constructs such as language adoption may undermine the external validity of existing LAI and CFI norms. Perhaps the relationship between ethnicity and test performances may further explain why test norms for the remaining indices could not be transferred to this group of participants. Whether rates of false positives differ between ethnic groups has yet to be explored on the SPANS. However, not that all minorities are disadvantaged for all tests. For example, studies found no differences between minority and majority groups for visuospatial measures (Boone et al., 2007; Kemmotsu et al., 2013). Hestad et al. (2016) found that rates of false positives were moderately acceptable (18%) when African American norms were applied to native Zambians in Africa.

6.4 Aims and hypotheses

The data in this thesis concern a multi-ethnic mix of participants with significant variation in cultural background. Performance differences between ethnic groups could exist within this group of participants, and whether adjusting for acculturation may attenuate these differences has yet to be explored. Doing so also tests the direct

relationship between ethnic group membership with the construct of acculturation. The hypotheses specific to this study are summarised below, and this chapter is divided into two sections.

6.4.1 Section 1.

- It was hypothesised that there would be significant differences in the neuropsychological test scores of the various ethnic groups in this study.

- There is substantially less empirical work on whether constructs in acculturation could underlie test performance differences between ethnic groups. It was therefore hypothesised that adjusting for scores of acculturations would eliminate neuropsychological score discrepancies in between these nominal groups.

6.4.2 Section 2.

- Finally, the data were re-examined to address whether the effects ethnicity confounded the results detailed in Chapter 5, which assessed for rates of false positives. It was therefore hypothesised that rates of false positives would significantly differ for the various ethnic groups in this study.

6.5 Methods

6.5.1 Participants

The ethnic composition of the sample (N=228, demographic characteristics found in Chapter 3) was substantially heterogenous, it was not possible to categorise the participants by self-identified ethnicity, spoken language, or country of origin. This resulted in severely unequal cell sizes (i.e.,70 Chinese, and 11 Arabs, etc.). A second attempt sought to divide the participants by continental origin (Chinese and Indian ethnicities were categorised as Asian, and so on). However, this was not feasible as almost 70% of the participants were of Asian origin, resulting in unequal representation of other continental groups.

A third attempt sought guidance from Lynn (2002) and Rosenberg, et al. (2002). Lynn (2002) created racial clusters based on similarities of IQ scores, guided by genetic

clusters founded by Cavalli-Sforza, Menozzi, and Piazza (1994). Relevant to this thesis, these groups were East Asians (those indigenous to China, Japan, Korea), South East Asians (indigenous to Malaysia, Indonesia, Philippines), East and West Africa (Nigeria, Sudan, Zambia, Afro-Caribbean), South Asia and Middle East (Arabs, India, Sri Lanka, etc.). These roughly corresponded with Rosenberg et al. (2002) study of genetic clusters: Eurasia (Europe, Middle East, Central/South Asia), Africa, East Asia, Americas, and Oceania (Australasia, Pacific Islanders). Although there appears to be no further update on the empirical work of Lynn (2006), these divisions accounts for test performances, and therefore reasonable to adopt as a classification method. Lynn (2002) included a more diverse pool of populations, for instance South East Asians were missing from Rosenberg's et al. (2002) work. Moreover, when Lynn's (2002) taxonomies were adopted, this resulted in cell sizes that were most comparable compared to previous attempts.

As there were no genetic information available for this group of participants, categories were derived from self-reports and thus merely approximated Lynn's (2002) and Rosenberg's et al. (2002) work. Furthermore, Relethford et al. (2009) contend that populations who originate from areas with close geographical proximity typically have similar ethnic features. Therefore, this chapter defined groups as ethnicity rather than race. Below outlines the ethnic composition of each group.

East Asian (EA, N=70). This group consisted of 67 Chinese (British-Chinese n= 29, China n= 15, Hong Kong n= 15, Taiwan n=1, Malaysia n=4, Singapore n= 3), Japanese (n=1), and Korean (n=2). The mean age was 27.01 years (SD= 0.79), and the mean years of residency was 11.62 years (SD= 1.37).

South East Asian (SEA, N= 33). This group consisted of Indonesians (n=13), Malays (n=8), Thais (n=9), and Filipinos (n=3). The mean age was 28.55 years (SD= 1.29), and the average years of residency was 3.15 years (SD= 0.78).

South Asian and Middle East (SAME, N= 60). This group consisted of 14 Arabs (Libyan n= 4, Iraqi n=4, Jordanian n=1, Qatari n=1, Saudi Arabian n= 1, Syrian n= 2, British national= 1), Indian (n=20), Bangladeshi (n=6), Pakistani (n=8), Sri Lankan (n=1), and Turks (n=12). The mean age was 26.42 years (SD=1.07), and the mean years of UK residency was 11.95 (SD=1.22).

Black African (BA, N= 36). This group consisted of British Black Africans (n= 14), British Afro-Caribbean (n= 8), Nigerian (n= 7), Sudanese (n=1), Sierra Leone

(n=1), Jamaican (n=1), Zimbabwe (n=1), Zambian (n=1). Two participants were European citizens who identified as Black African (Ghana, Nigerian). The mean age of the group was 21.91 years (SD= 1.04), and the years of UK residency averaged 14.58 years (SD= 0.97).

There were too few Europeans (N=9), South Americans (N= 3), and mixed ethnicities (N= 14). These participants were excluded from the analyses. Cohen (1988) recommends a rule of thumb, at least 30 participants per cell size for group comparisons.

6.5.2 Materials

As there is little to no evidence that the RASI-M accounted for test performances, and this was not used to avoid overfitting regression models. The AAMASM, SPANS, and additional set of tests were used for this study.

6.5.3 Analysis

All analyses were conducted using SPSS v24. Scores for all neuropsychological data were re-screened to for skewness, outliers, and multicollinearity. The current transformed neuropsychological data achieve skewness between +1 and -1. Internal consistency for each racial group was assessed for the AMAAMS. Assessment of validity and reliability for SPANS was replicated and simplified from Chapter 3 to only include convergent validity. This was taken as positive correlations between: ACI and WAIS-IV Digit SPAN, LAI and COWAT, MLI and RAVLT, ECI and WAIS-IV Coding, VPI and TMT, CFI and COWAT. Chapter 3 demonstrated that the ORI did not correlate well with many tests, and this was also the expectation in this study.

Gasquoine (2009) criticised the use of analyses of covariance by Manly et al. (1998) as statistically incorrect. ANCOVA was originally conceived to remove confounding factors because of random group assignment, thus ‘controlling’ for systematically different factors between groups is meaningless (Gasquoine, 2009; Miller & Chapman, 2001). Instead, Gasquoine (2009) advises the use of other analyses like regression. Therefore, a hierarchical regression was applied to determine the independent effects of ethnicity and acculturation on test performance. Assumptions for regression analyses – such as VIF tolerances, normality of error distribution, and

leverage points – were screened post hoc. There was no change in multicollinearity for this subset of the sample, compared to Chapter 4.

Firstly, group comparisons were made using multivariate analyses of variance (MANOVA) to determine a referent group for dummy coding procedures involved in regression. Where possible, Games-Howell post hoc was employed to circumvent unequal cell sizes. Ethnic groups were entered at the last stage of the hierarchical regression, excluding the referent group.

Separate hierarchical regression analyses assessed the interaction effects of ethnicity and cultural variables. Interacting terms were derived by mean centring relevant variables, then multiplied by ethnic categories, and these were entered at the second stage of the analyses.

To test for the effects of ethnicity on the rates of false positives, transformed scores (T-scores) were compared between groups, normative sample, and clinical sample. The chi-square with post hoc Bonferroni corrections for multiple comparisons was then used to test for differences in proportion of false and true positives for all groups. For parsimony, a cut-off at the 25th percentile was selected based on SPANS norms, with scores below this point used to represent false identification of impairment (defined as a 'fail') and scores above this point indicating a 'pass'.

G-power indicated that to detect a medium effect size with 80% power, a sample size of 196 was required for MANOVA with 10 response variables, and sample size of 174 was needed for regression with 13 predictor variables. As per previous chapters, *p* values were reduced to 0.01 to correct for multiple comparisons and to balance the risk of Type 1 or Type 2 errors.

6.6 Section 1. Results

6.6.1 Reliability and validity

Only the AAMASM-M cultural identity and food consumption subscale were unreliable for all racial groups ($\alpha < 0.7$). These subscales were not included in subsequent analyses. For the SPANS, different indices were correlated with different neuropsychological constructs for each group (see Table 6.1). The ORI as a construct differs from these additional tests and thus did not correlate with any additional tests. This lack of significant correlation between the ORI and additional tests was reflective

of results in Chapter 3, which also demonstrated weak correlations. Table 6.2. presents internal reliability (Cronbach's Alphas) for each index according to ethnic groups.

Table 6.1. Concurrent validity of the SPANS according to ethnic group

ACI - Digit Span	LAI - Verbal fluency	MLI - RAVLT Total trials	ECI - WAIS Coding	VPI - TMT-A/B	CFI - Verbal fluency
SEA (.42)	SEA (.44)			SEA (.55)	SEA (.48)
	BA (.43)		BA (.44)	BA (.46)	BA (.56)
SAME (.36)	SAME (.66)	SAME (.38)	SAME (.37)	SAME (.36)	
	EA (.47)	EA (.51)			

Notes. SEA=South East Asian, SAME= South Asian and Middle East, BA= Black African, EA= East Asian. LAI=language index, ACI=attention concentration index MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index. All correlations presented have a *p* value of < 0.01.

Table 6.2. presents the internal reliability for each SPANS index according to each ethnic group.

	BA	SEA	SAME	EA
ACI	0.46	0.32	0.52	0.21
LAI	0.26	0.69	0.77	0.68
MLI	0.56	0.51	0.36	0.44
VPI	0.14	0.16	0.42	0.16
ECI	0.22	0.34	0.54	0.25
CFI	0.38	0.20	0.33	0.37

Notes. SEA=South East Asian, SAME= South Asian and Middle East, BA= Black African, EA= East Asian. LAI=language index, ACI=attention concentration index MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index.

6.6.2 Ethnicity and SPANS test

A one-way MANOVA revealed significant effects of ethnicity on SPANS indices, $F (21, 546.13) = 4.39$, Wilks' $\Lambda = .63$, partial $\eta^2 = .14$, $p < 0.01$. Test of between

subjects revealed significant effects of ethnicity on the ORI (F (3, 196) = 12.14, p < 0.01, partial η^2 = .16), LAI (F (3,196) = 8.25, p < 0.01, partial η^2 = .11), and the ECI (F (3, 196) = 1.70, p < 0.01, partial η^2 = .03).

Games-Howell post hoc corrected for multiple corrections showed that, for the ORI, SEA (M=2.69, SD= 0.15) attained lower scores than EA (M=3.55, SD=0.0.8, p < 0.01), BA (M=3.68, SD=0.09), and SAME (M=3.51, SD= 0.09, p < 0.01). For the ECI, EA (M= 46.02, SD= 2.26) attained significantly higher scores on this index than on the SEA (M=44.36, SD= 2.31, p < 0.01) and SAME (M=44.55, SD= 2.86, p=0.007). BA (M=48.91, SD=0.38) achieved higher scores than EA (M=45.22, SD=0.55), SEA (M=43.78, SD=0.81), and SAME (M=45.61, SD=0.77) on the LAI (see Table 6.3).

Table 6.3. Ethnic group mean differences on the SPANS indices

SPANS index	EA	BA	SEA	SAME	Groups comparisons
ORI	3.55(0.25)	3.68(0.23)	2.68(0.25)	3.51(0.25)	BA, EA, SAME > SEA
LAI	45.22(0.78)	48.91(0.52)	43.78(0.77)	45.61(0.62)	EA, SAME, SEA > BA
ECI	46.02(0.29)	44.97(0.30)	44.36(0.24)	44.55(0.28)	EA > SEA, SAME

Notes. SEA=South East Asian, SAME= South Asian and Middle East, BA= Black African, EA= East Asian. ORI=orientation index, LAI=language index, ECI=efficiency index. All *p* values presented have a value of < 0.01. SD = standard deviation.

6.6.2 Predictors of SPANS indices

A five-stage hierarchical regression was carried out for these three indices. The variables entered in successive stages were as follows: a) age, b) education, c) years of residency, d) AAMASM (six subscales), and e) ethnic categories. The referent groups were excluded: ORI –SEA, LAI- BA, and ECI –EA (see Table 6.4.).

ORI. In stage three (F (3,189) = 21.80, ΔR^2=.25, p < 0.01), years of UK residency predicted this index (β=.41. p < 0.01). Stage five was also significant (F

(12,187) = 8.57, ΔR^2=.04, p = 0.007). Years of UK residency (β=.27. p < 0.01), cultural knowledge adoption (β=.28. p < 0.01), EA (β=.17. p = 0.001), and SAME (β=.16. p = 0.005) were significant predictors in the model.

LAI. The fourth stage of the model was significant (F (7.189) = 11.78, ΔR^2=.10, p < 0.01). Educational attainment (β=.20. p < 0.01), years of UK residency (β=.28. p < 0.01), and language adoption (β=.36. p < 0.01) predicted this index.

ECI. Only the fifth stage was significant for this index (F (10, 189) = 3.32, ΔR^2=.11, p < 0.01). Educational attainment predicted this index (β=-.25. p =0.007). The model predicted that EA would perform significantly better than BA (β=-.28. p < 0.01), SAME (β=-.36. p = 0.001), and SEA (β=.24. p= 0.002).

Interaction effects. The variables were entered into the model for the ORI were as follows: the first stage included cultural knowledge and years of UK residency, with SEA as the referent group; and the second step included all interacting terms for ethnicity × cultural knowledge adoption, and ethnicity × years of UK residency. For the LAI, the first stage included language adoption and years of UK residency, with BA as the referent group; and the second stage included all interacting terms for ethnicity × language acculturation, and ethnicity × years of UK residency. The models for the second stage of the analyses were not statistically significant for both models (F (7.39) = 22.7, ΔR^2=.03, p = 0.012), (F (0.45) = 8.51, ΔR^2=.01, p= 0.69). Therefore, no interaction effects were found.

Table 6.4. Results of the five-stage hierarchical regression for predictor variables and three SPANS indices

SPANS indices	Stage	Predictor	Beta coefficient	R^2
ORI	Stage 3	Years UK residency	.15	.5
	Stage 5	Years UK residency	.08	.6
		Cultural knowledge	.06	
		Adoption		
		EA > SEA	.17	
		SAME > SEA	.17	
LAI	Stage 1	Age	.04	.25
	Stage 2	Education	.78	.24
	Stage 3	Age	.02	.47
		Education	.43	
		Years UK residency	.04	
	Stage 4	Years UK residency	.36	.56
		Language adoption	.23	
		Education	.36	
ECI	Stage 5	Education	-.17	.11
		EA > SAME, BA, SEA	.2	

Notes. All *p* values are < 0.01. SEA=South East Asian, SAME= South Asian and Middle East, BA= Black African, EA= East Asian. ORI=orientation index, LAI=language index, ECI=efficiency index.

6.6.3 SPANS subtests

Six subtests were subjected to further analyses: political leadership, sustained attention 2, money calculations, counting backwards, letter number coding (LNC), and spatial decision. The same five-step hierarchical regression was applied to each of these subtests to achieve consistency in data interpretation (see Table 6.5.).

Political leadership. Stage three was significant ($F (3, 195) = 6.33$), $\Delta R^2 = .02$, $p < 0.01$), with years of residency predicting this subtest ($\beta = .47$. $p < 0.01$). At stage four

(F (12, 186) = 7.33), ΔR^2=.08, p =0.002), cultural knowledge adoption (β=.18, p < 0.01) was also a significant predictor. At the fifth stage (F (3, 195) = 6.33), ΔR^2=.05, p < 0.01), BA (β=.53, p = 0.002), SAME (β=.43, p =0.003) and EA (β=.29, p =0.002) produced higher scores than SEA. No interactions were found for years of UK residency, AAMASM-A cultural knowledge, or ethnicity for this subtest.

Money Calculations. The fifth stage was significant for this subtest (F (12, 187) = 2.66), ΔR^2=.09, p < 0.01). SAME (β=-1.17. p < 0.01), and SEA (β=-.85. p= 0.008) were significant predictors.

Counting backwards. The fifth stage of the model was significant (F (12, 187) =3.62, ΔR^2=.06, p = 0.005). Dummy-coded variables for racial group membership revealed that EA performed better than BA (β=-.30. p= 0.001).

Table 6.5. Significant AAMASM-A, ethnicity and demographic predictors from the five-stage hierarchical regression for SPANS subtests

SPANS Subtest	Stage	Predictor	B	R^2
Political Leadership	Stage 3	Years of residency	.03	.19
	Stage 4	Years of residency	.02	.28
		Cultural knowledge adoption	.17	
	Stage 5	Cultural knowledge adoption	.16	.33
		SEA < BA, SAME, EA	.20	
Monetary Calculations	Stage 5	EA > SAME	1.14	.06
		EA > SEA	.84	
Counting Backwards	Stage 5	EA > BA	.93	.13

Notes. SEA=South East Asian, SAME= South Asian and Middle East, BA= Black African, EA= East Asian. *P* values for all findings are < 0.01.

6.6.4 Additional tests – group comparisons

A one-way MANOVA was performed, with significant effect of ethnicity on these tests, F (30, 549.55) = 4.47, Wilks' Λ = .53, partial η^2 = .19, p < 0.01). There were significant effects of ethnicity on Digit Span forwards (F (3, 196) = 4.15, p = 0.007, partial η^2 = .06), Digit Span Backwards (F (3, 196) = 11.14, p = 0.008, partial η^2 = .06), TMT-A (F (3, 196) = 11.14, p < 0.01, partial η^2 = .14), TMT-B (F (3, 196) = 8.22, p <

0.01, partial η^2 = .06), RAVLT-Total Trials (F (3, 196) = 12.14, p =0.009, partial η^2 = .06), and Coding (F (3, 196) = 18.13, p < 0.01, partial η^2 = .21).

Games-Howell post-hoc multiple comparison revealed that EA performed better than BA on Digit Span Forwards, but this was trending at the 0.01 level (p=0.01). EA also performed significantly better on Digit Span Backwards compared to SEA, however, observe power was low (< 0.8). EA performed significantly better on the TMT-A, and Coding compared to all other groups, but only performed significantly better than SEA and BA on TMT-B (Table 6.6.).

Table 6.6. Groups means (SD) for four neuropsychological tests

Test	Group				Group comparisons
	EA	BA	SEA	SAME	
Digit Span Backward	8.87 (1.87)	8.88 (2.52)	7.61(1.47)	8.34(1.9)	EA > SEA
Coding	92.64(17.75)	76.00(18.28)	75.12(20.43)	71.61(14.78)	EA > BA, SAME, SEA
TMT-A	26.18(8.75)	34.52 (16.49)	35.15(13.30)	35.18(7.27)	EA > BA, SAME, SEA
TMT-B	56.00(20.47)	65.44(23.83)	66.48(20.51)	75.09(28.73)	EA > SEA, BA

Notes. P values for these findings are < 0.01. SEA=South East Asian, SAME= South Asian and Middle East, BA= Black African, EA= East Asian. TMT=Trail Making Test.

6.7 Section 1. Discussion

This section compares the neuropsychological test performance of four ethnic groups. The first hypothesis was partially supported, East Asians (EA) attained higher scores compared other groups on the ECI, and visuo-spatial tests, with no influence from ratings of acculturation. There is some evidence in the literature, where EA perform more efficiently on mathematical skills (Geary, Salthouse, Chen & Fan; 1996; Mullis, Martin, Foy & Arora, 2012; Wang & Lin, 2009) and demonstrate better fine motor skills and processing speeds (Lonneman et al., 2017; Luo, Jose, Hutsinger &

Pigott, 2010; Kail, McBride-Chang, Ferrer, Cho & Shu, 2013) compared to other ethnic groups. However, no such performance differences were detected for on the visuospatial index of the SPANS. Perhaps the VPI was not sufficiently capturing constructs related to visuo-motor performance for EA participants, evidenced by its lack of convergent validity. There could also be underlying cultural differences that might further explain differences found in these results. For instance, EA value perceptive and motor skills as part of intelligent behaviours (Cocodia, 2014). This may in turn reinforce visuo-motor performance on tests of processing speeds.

Results from the LAI suggests that language adoption underlies performance differences rather than ethnic group membership. Black African participants (BA) performed significantly better than all three groups on the LAI, but the significance of ethnicity was redundant after adjusting for cultural variables (AAMASM, years of UK residency). Moreover, there was no interaction between ethnicity and acculturation. This could support the culturalists claims that underlying cultural differences are more important toward language tests compared to ethnicity itself. Only on the Political Leadership subtest was adjusting for measures of acculturation insufficient to eliminate group differences. However, it was less clear why differences on this test were specific to SEA. Perhaps there could be additional constructs or characteristics specific to this group of people that would better explain this result. In this study, SEA had the fewest years of UK residency, compared to other groups. Consequently, SEA in this study could be collectively less interested in politics in the UK.

In summary, there was no strong evidence to suggests that ethnicity itself is an important predictor for test performance. Findings of faster performance by EA appears more robust for the TMT and WAIS-Coding than the ECI. However, there could be other pertinent cultural characteristics that differ between these groups that underly these differences. For the second hypothesis, however, there appears to be only partial support. Language adoption could account for ethnic group differences in tests of language, meaning ethnicity has no independent prediction above-and-beyond language adoption. This was not the case for Political Leadership subtest, but it was unclear whether this was purely an effect of ethnicity, or whether other cultural constructs were accounting for performance differences. In any case, there was no interaction between ethnicity and measures of acculturation in this study.

6.8 Section 2. Results

6.8.1 Rates of impairment

Table 6.7. compares the rates of false negatives between ethnic groups, normative sample, and the clinical sample. SEA attained significantly more rates of false impairment compared to all groups on the Political Leadership subtest. SAME also had more rates of false impairment compared to EA and SEA on the ACI. EA exhibited significantly more rates of false impairment than the clinical group for the LAI.

Table 6.7. Proportion of false positives between all ethnic groups, normative sample, and clinical sample.

SPANS index/subtest	SEA (%)	BA (%)	SAME (%)	EA (%)	NS (%)	Clinical (%)	Comparison
Political Leadership	66.7	0.08	26.2	22.8	0.05	40	Clinical > BA, NS SEA > all groups SAME, EA > NS
ACI	51.5	27.8	49.2	20	17.8	67.7	Clinical > BA, EA, NS. SAME > EA, NS SEA > NS
LAI	84.8	61.6	68.9	78.6	13.2	52.2	EA > Clinical 4 ethnic groups > NS
MLI	57.6	44.4	49.2	47.1	13.2	75.6	Clinical > 4 ethnic groups 4 ethnic groups > NS
VPI	69.7	61.1	65.9	48.6	14.7	75.7	Clinical > 4 ethnic groups 4 ethnic groups > NS
ECI	39.4	36.1	39.3	14.3	17.1	76.7	Clinical > 4 ethnic groups
CFI	72.7	66.7	57.4	52.9	14.7	58.7	Clinical > 4 ethnic groups 4 ethnic groups > NS

Notes. All values have a p value of < 0.01. LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index. SEA=South East Asian, SAME= South Asian and Middle East, BA= Black African, EA= East Asian. NS= Normative Sample.

6.8.2 Comparisons between chapters

This additional set of results compares results of Chapter 5 and Chapter 6. The table below outlines prominent differences between the rates of false impairment in these two chapters (Table 6.8).

Table 6.8. Differences in rates of false impairment between chapter 5 and chapter 6.

Test	Chapter 5: False impairment rates between CD and samples on the SPANS	Chapter 6: Ethnic differences in the rates of false impairment when compared to the normative sample.
MLI, VPI, CFI	Clinical > CD	No change
	CD > NS	No change
ECI	Clinical > CD	No change
Political Leadership	Clinical > NS	Clinical > BA, NS
	CD > NS	SEA > all groups
LAI	CD > NS, clinical	EA > clinical, NS
ACI	Clinical > CD, NS	Clinical > BA, EA, NS.

Notes. LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index. SEA=South East Asian, SAME= South Asian and Middle East, BA= Black African, EA= East Asian. NS= Normative Sample.

6.9 Summary and discussion

This section re-examined the rates of false positives noted in Chapter 5, stratifying the data according to ethnicity. In this chapter, all four ethnic groups equally produced higher rates of false impairment than the NS over three indices (MLI, VPI, and CFI). The rate of false impairment also did not differ between the four groups across the four indices (MLI, VPI, CFI, ECI), thus the rates of false positives for these indices were consistent with Chapter 5. However, there were differences for two indices and one subtest in these two chapters. The CD group attained more false positives than the NS on the political leadership subtest, but stratified by ethnicity, only SEA produced significantly higher rates of false positives. This was also seen for the LAI, where only EA participants attained significantly higher rate of false positives among the CD group. For the ACI, South Asian and Middle Eastern participants (SAME) produced higher

rates of false positives compared to EA and NS participants. Stratifying the data according to ethnic group membership changed the rates of false positives for some indices, compared to analysing the CD group as a whole.

The data in this chapter potentially highlight discrepancies in statistical and clinical significance, as reported in previous chapters. First, multivariate analyses found no significant differences between racial groups on the ACI. However, rates of false impairment differed for SAME and EA on the ACI. This was also the case for the ECI. Despite EA attaining better scores on the ECI, rates of false impairment did not differ between these racial groups. Therefore, analyses using a range of scores differ from T-scored divisions of false positives, where the latter is more representative of clinical situations.

6.10 Limitations

The most pertinent limitation was the stratification method of ethnicity. Although the formation of these ethnic groups was questionable, the cultural composition was so disparate that attempts at other means of subdivision (e.g., spoken language, country of origin) violated statistical assumptions. Stratifications provided by Lynn (2002) did improve cell sizes for this study, but the validity of these could be weakened due to a genetic assumption. As mentioned in Chapter 1, there is more genetic variation within racial groups than between such groups. For instance, many SEA populations have EA ancestry (HUGO Pan-Asian Consortium, 2009). Genetic variation also occurs over a gradient rather than discrete categories. Moreover, the cultural distinctness of each ethnic group was not compared, and thus uncertain how much cultural heterogeneity existed within each group. Each ethnic group in this study also consist of a unique blend of local and foreign residences, and each may have distinctive cultural experiences (language, beliefs, traditions, country of origin, etc.). Therefore, the socio-cultural uniqueness of each ethnic groups cannot be confirmed. This meant that there might be additional cultural diversity not accounted for in these groups that could have better explained results in this study.

In this study, rates of false positives for EA on ACI and ECI did not differ from the existing norms in the technical manual. Superficially, existing norms from these two indices might be valid for EA populations, though these are limited to well-educated individuals below the age of 50. A wider variety of demographic variables of age and

education, as well as larger sample sizes, are needed to confirm the generalisability to this population. As such, it is not recommended that these existing norms are simply transferred in such a manner. Furthermore, the validity of these two indices for this racial group are questionable. Another limitation was that the validity of the SPANS differed when the data were stratified by ethnicity. This negatively affected the strength of the findings, especially concerning the ECI and, to a certain extent, rates of false impairment. This made it less clear whether differences detected between groups were due to differences in ability in that particular cognitive skill or differences in the underlying construct.

6.11 Conclusions

In summary, it cannot be concluded that ethnicity is more 'salient' in predicting test performances than acculturative variables. The associative value of each cultural construct generally affects different sets of tests. Only in tests of political knowledge did ethnicity appear to contribute independent of cultural knowledge. It remains a possibility that language adoption is more important toward language tests compared to ethnicity, providing some support for the culturalists position. It is also plausible that the relationship between ethnic group membership could be restricted to EA on tests of visuospatial ability. Regarding norms, the introduction of ethnicity appears to alter the proportion of false positives from that given in Chapter 5. This highlighted discrepancies between statistical and clinical significance. Although differences between ethnic groups were detected, but it cannot be confirmed whether this is due to ethnicity itself, some other cultural construct, or confounded by methodological and psychometric issues. This chapter also concludes that ethnicity may not necessarily confound the results for the relationship acculturation and test performances. Rather, each construct independently predicts performance on orientation and language tests.

It must be acknowledged that the purpose of this study was not to argue for the superiority or inferiority of any particular ethnic group. Despite EA attaining higher scores on processing speeds, many other areas of cognitive functioning are equal for all groups. Instead, one aim of this study was to explore whether the effects of ethnicity confounded or interacted with ratings of adoption, as per the findings in previous chapters of this thesis. Also, it is plausible that other cultural or non-cultural factors unaccounted for, could have better explained differences in test performances instead of

ethnic composition alone between groups. In the next chapter, a further investigation over underlying mechanisms involved in the process of language and cultural knowledge adoption was explored.

Chapter 7: Individual differences predicts two domains of acculturation

7.1 Introduction

Results from Chapter 4 suggests that within the construct of acculturation, adoption in language and cultural knowledge have a significant impact on test performance. Berry (1997) and Kosic (2006) theorised that personality characteristics and individual differences (i.e., five-factor personality traits, self-efficacy) also govern how the process of acculturation occur or manifest in the individual (Berry, 1997; Kosic, 2006). However, findings between such factors and acculturation is equivocal in the literature (Berry, 1997; Kosic, 2006). Therefore, it is important to confirm whether there are underlying mechanisms that might associate with the process of acculturation. This also provide clarity over how pre-acculturative conditions (three stage model) or pre-existing factors (Berry's 1997 model) can be integrated into this thesis. Below present's plausible cultural constructs and factors of individual differences that are known to be associated with acculturation.

7.2 Five factor model of personality

There is a body of research exploring the relationship between the five-factor model of personality (Big Five; Costa & McCrea, 1992) and its association with cultural changes and experiences (Schmizt, 1994; Ward & Chang, 1997; Ones & Viswesvaran, 1999; Ryder, Alden & Paulhus, 2000). These include extraversion (gregarious, warm, socially active); agreeableness (trusting, compliant, modest); openness (open to new experiences, ideas, behaviours, etc.); conscientiousness (competent, self-disciplined, achievement oriented) and emotional stability (anxious, impulsive, self-conscious, this was previously labelled neuroticism).

Ethnic minorities with higher levels of agreeableness usually form better relations with the local community (Berry, 1997; Kosic, 2006), while those who are extroverted are likely to initiate contact with the dominant society (Ward & Chang, 1997). Those who are willing to relocate, and experience a different way of life typically exhibit higher levels of openness, which is also a predictor for successful adaptation into a different culture (Ones & Viswesvaran, 1994). On the contrary, marginalisation, maladaptive adjustment, and a desire to return to their country of origin for some immigrants is related to lower levels of emotional stability (Caligiuri, 2000). In one study, conscientiousness positively explained a large amount of variance over

how well immigrants in the US adapt to their working environment (Ones & Viswesvaran, 1999). Ryder, et al. (2000) reported associations between lower emotional stability and higher conscientiousness with higher cultural maintenance, and higher adoption associated with higher extraversion and openness. Generally, these five dimensions of personality could form a relationship with sociocultural adaptation into a new cultural environment (Berry, 1997; Kosic, 2006).

7.3 Self-efficacy

Colloquially self-efficacy is described as 'believing in oneself', which is the belief in one's ability to perform a required task to achieve a particular goal (Wright et al., 1995). Practically, this is assessed in terms of optimistic beliefs about one's ability to cope with a variety of demands in life (Wright et al., 1995). Typically, low self-efficacy is indicative of lower health and well-being (Abu-Rayya, 2006; Khan & Waheed, 2006) and social integration (Schwarzer & Scholz, 2000; de Saissy, 2009). De Saissy (2009) surveyed Chinese university students in Northern Ireland, in which self-efficacy positively correlated with adoption. In a sample of ethnically diverse university students in Australia, Fan and Mak (1998) found that foreign born immigrants exhibited lower self-efficacy than later generations (Australian born students). Those with lower self-efficacy may find it harder to adjust to the dominant society, studies show that self-efficacy is related to employment status (Pinquat, Juang & Silberesien, 2003) and academic achievement (Pajares, 1996). Therefore, self-efficacy could predict how well an individual adapt toward the dominant society, thus affecting later processes of acculturation.

7.4 Cultural intelligence

Ang and Dyne (2015) proposed that cultural intelligence (CQ) is the ability to successfully function or adapt to a new cultural setting. CQ is also described as a form of intelligent behaviour with the ability to reason and act appropriately over a diverse range of cultural settings. CQ evaluates the ability of the individual to direct resources to adapt to a foreign culture (Ang & Dyne, 2015). As such, this is theoretically distinct from personality characteristics like the five-factor model (Ang & Dyne, 2013). CQ is a multidimensional construct, consisting of: a) meta-cognitive – awareness of cultural settings and ability to adjust accordingly; b) cognitive – the ability to understand

cultural norms and patterns; c) motivational – refers the confidence to engage with different cultures; and d) behavioural – the appropriate use of a repertoire of culturally specific behaviours (Ang & Dyne, 2015).

Although there are few empirical studies and theories that relate CQ to constructs of acculturation, Ang and Dyne (2015) provided a model of CQ suggestive that it could be a precursor to factors similar to adaptation. Higher overall CQ is theorised to be associated with better inter-cultural communication, and understanding of cultural norms (De Leersnyder et al., 2011; Ang et al., 2007). This is due to an awareness and knowledge of nuances in cultural differences, thus modifying behaviour to be culturally appropriate (Ang et al., 2007). This facilitates adjustment, by decreasing inter-cultural stressors (Ang et al., 2007; Ang & Dyne, 2015). Sharma and Hussain (2019) showed that metacognitive and motivational CQ positively correlated with integration and assimilation for a group of minorities in India. Whereas marginalisation and separation were unrelated to any CQ construct (Sharma & Hussain, 2019). Despite some theoretical inference that CQ could be a pre-acculturative factor, there is little empirical work to support this. Therefore, this study attempts to fill this gap by exploring whether CQ could be an additional mechanism that predicts adaptation or socio-cultural competencies (i.e., acculturative outcomes).

7.5 Aims of the chapter

Generally, empirical to support the effects of individual differences on acculturative processes are lacking in the literature (Berry, 1997; Kosic, 2006). Despite this, there are theoretical grounds to implicate personal characteristics like the five-factor model, self-efficacy and CQ as pre-existing factors for acculturation. However, it is less clear how these constructs associate with different domains of adoption. It is also uncertain how the inclusion of these multiple constructs would simultaneously predict subscales of adoption. In this thesis, only two domains of adoption, language and cultural knowledge, predicted test performance. Subsequently, this chapter explores whether CQ, self-efficacy, and dimensions of the Big Five could predict these domains on the AAMASM. Therefore, this study aims are exploratory, and set to identify a group of predictors would significantly account for two domains of adoption on the AAMASM.

7.6 Method

7.6.1 Participants.

The procedure, inclusion and exclusion criteria in this study was the same as Chapter 4. Another data set was sampled for this study, consisting of 217 participants. The mean age is 20.31 years (SD= 4.01), with a mean of 14.55 years of UK residency (SD= 6.57). Twenty-two participants received post-graduate education, while the remainder were undergraduate students. The sample consist of the following ethnicities, Middle Eastern (1.4%), Afro-Caribbean (5.5%), Black African (14.3%), South Asian (33.6%), East/South East Asian (12.4%), European (18%), and Mixed background (14.7%). Among this sample, 19.4% were male and 65.9% identified as native English speakers. See Appendix B for a full break down of ethnicity.

7.6.2 Self-reports

Brief version of the Big Five inventory (BF-10) (Rammstedt & John, 2007). The BF-10 consists of ten items, with two items measuring five dimensions of personality traits each. Each item was rated on a 7-point Likert scale from 1 (strongly agree) to 7 (strongly disagree). Items 1, 3, 4, and 5 were reverse scored. The BF-10 exhibited good criterion validity with the lengthier 44 item Big Five inventory (Rammstedt & John, 2007), with correlations as between 0.7 to 0.8. Convergent validity for the BF-10 also produced five factors, and these also loaded alongside the five personality traits on the NEO Personality Inventory (Rammstedt & John, 2007). Test-retest reliability was also acceptable (> 0.7) (Rammstedt & John, 2007).

The five dimensions include: a) extraversion – items here assess for how outgoing, sociable, or how reserved an individual is; b) agreeableness – two items evaluate how trusting and how much one finds fault with others; c) openness – this include asking participants their level of artistic interest and their level of active imagination; d) neuroticism – how well participants handle stress, and how easily nervous they are; and e) conscientiousness –this ask participants whether they feel that they are lazy, and how thorough a job they do. Eisinga, Grotenuis, and Pelzer (2013) stated Spearman Brown (split half-reliability) should be used for two-item scales. However, the reliability was low (< 0.6) for all dimensions for this group of participants (see Appendix J for items on this scale).

Cultural Intelligence (CQ) (Ang & Dyne, 2015). The CQ is a 20-item questionnaire, using a 7-point Likert scale (1= Strongly Agree to 7= Strongly disagree). Previous validation using CFA on an undergraduate population produce adequate fit statistics for four latent factors, and invariance across two samples from the US and Singapore (Ang & Dyne, 2013). All subscales of the CQ were reported to be above 0.7 (Ang & Dyne, 2013). The CQ also exhibited good discriminant validity, where each component of the CQ was distinctive from emotional intelligence, and cognitive ability (Ang & Dyne, 2015). For this study, all subscales of the CQ displayed good internal reliability (> 0.8). Below summarises each subscale of the CQ (see Appendix J for items on this scale).

Metacognitive CQ. Four items how well an individual adjust one's behaviour according to culturally specific knowledge when interacting with different cultural groups of people. This also assess for cultural awareness behaviours during these interactions.

Cognitive CQ. Six items specifically evaluate how well verse an individual is toward cultural norms, practices, and conventions in various cultural settings.

Motivational CQ. Five items how much interest, energy, and resources are directed at understand cultural differences. This dimension also evaluates intrinsic motivation to adapt to different cultural settings.

Behavioural CQ. Five items evaluate the appropriate use of verbal and non-verbal behaviours when interacting with different cultural backgrounds.

General self-efficacy scale, GSES (Wright et al., 1997). This consists of 10 items, assessing participants own perceptions of beliefs in their capability to handle demands across various life situations. This study used a 7-point Likert scale (1=Not at all true, 7= Exactly true), all 10 items are summed as a total score. Scholz, Gutiérrez Doňa, and Schwarzer (2002) reported internal consistency between 0.7 and 0.9 for longitudinal studies across several countries. Criterion validity assessed that the scale correlate positively with optimism, achievement, social integration, while correlations were negative with depression, anxiety, and helplessness (Schwarzer & Scholz, 2000). For this group of participants, the internal reliability was acceptable (Cronbach's alpha = 0.93). (See Appendix J for items on this scale).

Asian American Multidimensional Acculturation Scale-Modified (AAMASM). Two subscales of the AAMASM-A were used for this study. Internal consistency was acceptable for language adoption (0.83), but not for cultural knowledge (0.65).

7.6.3 Analyses

All analyses were carried out using SPSS v24. Assumptions for regression analysis, such as VIF tolerances, normality of the error distribution, and leverage points were scrutinised post hoc. Inter-correlations between all variables were inspected, with no evidence of multicollinearity (< 0.7). As this is an exploratory study, aimed to identify a subset of predictors that best describes the dependent variable, stepwise variable selection method was chosen. Additional exploratory analyses were conducted to assess inter-correlations between all scales, and this also served to assess multicollinearity in the data. All analyses in this study adopted alpha levels of 0.01 instead of 0.05, to correct for multiple comparisons to balance the risks of Type 1 or Type 2 errors. Entry for Alpha criteria for F-statistic for the regression model was set at < 0.001. A priori analysis using G-power indicated that a sample size of 160 was required to detect a medium-effect size with 80% power for 10 variables with a *p*-value of 0.01. Table 7.1 presents means and standard deviations for all scales used in this study.

7.7 Results

7.7.1 Predictors of adoption

Variables entered the equation include, age, years of UK residency, gender, four CQ subscales, GSES, and five subscales of the BF-10. The model was significant for language adoption (F (3, 213) = 50.09, R^2= 0.41, p = 0.006) and cultural knowledge adoption (F (2, 214) = 19.32, R^2= 0.15, p = 0.007). Years of residency predicted language adoption (β=.39, p < 0.01), and cultural knowledge (β=.35, p < 0.01). Age predicted language adoption (β=-.35, p < 0.01). Motivational CQ predicted language adoption (β=.15, p =0.006), and Cognitive CQ predicted cultural knowledge (β=.17, p =0.007).

7.7.2 Inter-correlations

Table 7.2. presents inter-correlations between four dimensions of the CQ, GSES, BF-10, AAAMSM-A language, and cultural knowledge. Correlation coefficients were low to moderate (0.15 to 0.51). Between these scales, correlations for self-efficacy ($r(217)= .37$, $p < 0.01$) and motivational CQ, self-efficacy and openness ($r(217)=.40$, $p < 0.01$) were amongst the highest coefficients.

Table 7.1 Presents means and standard deviation of the BF-10, CQ, AAMASM-A, and the GSES.

		Mean	SD
	AAMASM-A language	6.69	0.67
	AAMASM-A Cultural knowledge	4.92	1.13
CQ	Meta Cognitive	20.27	4.94
	Cognitive	26.34	6.34
	Motivation	26.63	5.04
	Behavioural	23.34	5.90
BF-10	Agreeableness	9.88	2.67
	Extraversion	7.41	2.44
	Conscientiousness	8.80	2.48
	Neuroticism	8.49	2.79
	Openness	9.18	2.39
	GSES	49.41	10.96

Notes. CQ= Cultural intelligence. BF-10= Brief Big Five inventory. GSES= General self-efficacy scale. AAMASM-A= Asian American Multidimensional Acculturation Scale-Modified.

Table 7.2 Inter-correlations between AAMASM-A language, cultural knowledge, CQ, GSES, and BF-10.

	1	2	3	4	5	6	7	8	9	10	11	12
1. AAMASM Language adoption	-											
2. AAMASM Cultural Knowledge	.31**	-										
3. Meta Cognitive CQ	-.06	.03	-									
4. Cognitive CQ	-.04	.11	.42**	-								
5. Motivation CQ	.09	.07	.51**	.42**	-							
6. Behavioural CQ	-.07	.07	.45**	.41**	.34**	-						
7. Extraversion	-.02	.07	-.08	.03	.08	.04	-					
8. Agreeableness	.00	.09	.05	.04	.19**	-.02	.18**	-				
9. Conscientiousness	.15*	.06	.24**	.16*	.25**	.15*	.17**	.20**	-			
10. Neuroticism	.07	-.14*	-.03	-.17*	-.12	-.11	-.26**	-.15*	-.10	-		
11. Openness	.01	.03	.18**	.18**	.25**	.16*	.14*	.07	.24**	.07	-	
12. Self-efficacy	.08	.05	.30**	.23**	.37**	.15*	.13	.19**	.29**	-.40**	0.12	-

Notes. * $p < 0.05$, ** $p < 0.01$.

7.8 Discussion

The purpose of this chapter was to explore mechanisms that could predict domains of acculturation relevant to neuropsychological test performances. This study also attempts to expand the scope of this thesis by exploring whether a range of factors (CQ, personality, GSES) could be characterised as acculturative conditions (Three-stage model), or contextual factors (Berry's model). Among factors included in the analyses, only dimensions of the CQ emerge as significant predictors of adoption. However, years of UK residency remain the most salient predictor of these two domains of adoption for both this chapter and previous chapters in this thesis. A longer time spent in the UK usually facilitates proficiency in English fluency, this fosters interaction with the local society resulting in the acquisition of culturally specific knowledge.

7.8.1 Motivational CQ and language adoption

Ang and Dyne (2013) theorised that that motivational CQ may be involved in language acquisition. For example, foreigners who are proficient in English are usually more confident, and motivated to initiate conversations with local communities than those who are less fluent in the language. Learning a new language itself can be a means to an end, termed 'extrinsic' motivation (Deci and Ryan, 1985; Vallerand, 1997). Non-native English-speaking individuals, who desire career advancement, or better social integration typically have more extrinsic motivation to learn the host's language (Rubenfeld, Sinclair & Clement, 2014). Alternatively, learning a foreign language can be 'intrinsically' motivating, regarded as a genuine interest in the language not necessarily instrumental in itself (Deci and Ryan, 1985; Vallerand, 1997). Therefore, individuals with a greater investment and motivation to adapt to different cultures are more likely to have better language proficiency in the host culture.

However, a large proportion of participants in this study were native English speakers. In the current data, the GSES received moderate positive correlations with motivation CQ. Ang and Dyne (2015) explained that part of the construct of motivation on the CQ also involved some elements of self-efficacy, but this is assessed in the context of cross-cultural adaptation. These include nuances of how one would deal with culturally mediated stressors, like facing uncertainty, confidence in socialising with different culture, and confidence in adapting to new way of life. Perhaps for this group

of majority native English speakers, their self-efficacy in a cross-cultural context, as measured by motivational CQ, is most related to language adoption.

7.8.2 Cognitive CQ and cultural knowledge adoption

The relationship between cognitive CQ and cultural knowledge is perhaps most expected, given that both constructs are defined in a similar manner. The AAMASM-A cultural knowledge is defined as familiarity, knowledge, and engagement with culturally specific practices. The cognitive CQ is also described as an 'individual's knowledge of norms, practices, and conventions in different cultural settings' (Ang & Dyne, 2015, pg. 17). However, the difference appears to be the direction of these culturally specific knowledge. The AAMASM-A is specific to the British culture, whereas the CQ assess for generic knowledge of different cultures. It is reasonable however that those who are aware of their own cultural practices, could also be more sensitive to practices and customs of different ethnic groups. However, the internal consistency of the AAMASM-A cultural knowledge was low, and thus the reliability of this finding might be questionable.

7.8.3 CQ as pre-existing factors of acculturation

Although the relationship between CQ and theories of acculturation was not explicit in the literature, a model produced by Ang and Dyne (2015) is suggestive that CQ is an antecedent of sociocultural adaptation. Kosic (2006) proposed that highly motivated individuals are more likely to seek emigration, allowing them to meet challenges associated with social or career achievements. Consequently, motivation was proposed as a determinant for the process of acculturation in general. Motivational CQ is not only signified by confidence to adapt to different environment, but also drives achievements and accomplishments in cross-cultural settings (Ang & Dyne, 2015). Individuals who are confident in dealing with novel cultures (motivational CQ) are more likely to favour accomplishments after successful implementations of new skills in the cultural environment (Ang et al, 2007; Ang & Dyne, 2015). Subsequently, this facilitates socio-cultural adaptation.

As for cognitive CQ, this involves a conscious awareness of different cultural norms, which can influence behavioural interactions with different cultures (Ang & Dyne, 2013). For example, an American may find it easier to adapt to Western oriented

or English-speaking countries due to familiarity with these cultures (similarities in language, beliefs, values, norms, etc.). Pre-existing knowledge, and awareness of cultural similarities and distance are likely to affect the process of acculturation (Berry, 1997; Miller, et al., 2011). Therefore, despite no explicit mention of acculturation in theories of CQ, two dimensions of CQ significantly predicted two domains of adoption. Causation cannot be implied from these analyses, but the significance of CQ in this study, conceptualised as pre-existing factors for adaptation could be inferred based on existing models of acculturation.

7.9 Limitations

This study is not without limitations, primarily it cannot be confirmed that these personal characteristics like CQ, the five-factor model, and self-efficacy are related to neuropsychological testing. In one study, the CQ scale was unrelated to a reasoning test of cognitive ability (Ang & Dyne, 2015). As for the five-factor model of personality, studies produce weak to moderate correlations (positive and negative) between each of the five dimensions with IQ tests (Ashton, Lee, Vernon & Jang, 2002; Wolf & Ackerman, 2005; Poropat, 2009), with some studies producing no significant findings (Ackerman & Heggestad, 1997; Austin et al., 2002). Self-efficacy also produced no significant relationships with IQ in one study (Smith, 2005).

Another limitation is that some scales used in this chapter were not reliable. The BF-10 produce poor reliability, despite a report by Remmstedt and Bierlein (2014) stating that its content should be heterogeneous enough to produce sufficient variability and reliability. As a result, it cannot be certain that the five dimensions of personality traits were accurately represented in this study. Furthermore, cultural knowledge adoption was also not a reliable scale for this group of participants.

Another limitation involves the direction of influence between these variables and acculturation. Ang and Dyne (2015) did briefly state that cultural experience could modify CQ, but this was not included in their theoretical model. However, in keeping with existing CQ framework and results in this chapter, CQ can be conceptualised as predictors of acculturative outcomes or adaptation. For the five-factor model of personality, it is debated whether culture changes personal characteristics, or whether personality influences the experience of culture (Kosic, 2006). Studies that include self-

efficacy usually employ correlational analyses, or group comparisons, and thus the direction of influence is uncertain.

7.10 Conclusion

Despite these limitations, this chapter expands on models of acculturation, by exploring whether there are pre-contextual mechanisms that could predict process of two domains of adoption. Among variables included, motivational CQ predicts language adoption, while cognitive CQ predicted cultural knowledge adoption. It is also possible to conceptualise these two CQ dimensions as pre-acculturative factors. Individuals with greater motivation, and awareness of cultural differences in practices or norms are more likely to exhibit higher levels of language and knowledge adoption. At the same time, years of UK residency remained that most salient factor, and this was also the case in previous chapters in this thesis. In the next chapter, all findings from this thesis is discussed with theoretical implications and future directions.

Chapter 8: General Discussion

Cultural perspectives explain that test instruments themselves are a measure of a 'Western' style of thinking. As a result, it was theorised that the construct of acculturation ought to be associated with test performances. However, the integration of the concept of acculturation and neuropsychological tests is hindered by weak and inconsistent definitions of these two constructs. This thesis operationalised acculturation in manner that is consistent with two theoretical models of acculturation. Neuropsychological assessments were defined from a clinical perspective in which tests are developed, used, and normed on clinical populations. Additionally, a fix battery approach was taken due to the clinical relevance of including different domains and subtests. Consequently, the practical value of acculturative measures in relation to test performance was also examined in this thesis. Below highlight more specific contributions from each chapter.

8.1 Summary of key findings

Chapter 2*: *A systematic literature review. Trends in the current literature on acculturation and test performance were unclear and unsystematic. This literature review provides an original contribution, systematically collating and synthesising 20 quantitative studies on the relationship between acculturative measures and test performance. The primary findings include the following: a) higher adoption was generally related to better performance; b) the language domain of acculturation might have a larger association with test performance than non-linguistic aspects of acculturation. However, these findings are tentative due to substantial heterogeneity in methodology and sample characteristics. Another significant contribution to the literature concerned the clinical implications and recommendations for future research.

Chapter 3: Instrument selection and psychometric properties. This chapter assessed the validity and reliability of the primary measures used in this thesis. The pattern of convergent and discriminant validity of the SPANS (Burgess, 2014) was broadly similar with those reported in the manual. However, the validity and reliability were weak for this set of participants except for the LAI. Next, a literature search found that the AAMAS and RASI were suitable scales for this thesis. These scales were modified for a culturally diverse group residing in the UK, with broadly adequate scale

reliability. This chapter contributes to the literature by reporting the generalisability, and psychometric properties of scales and test instruments for culturally dissimilar individuals residing in the UK.

Chapter 4: Acculturation and neuropsychological test performance. This chapter details the first UK study to explore the relationship between multidomain construct of acculturation and acculturative stress on test performance. One novel finding from this chapter is that language and cultural knowledge adoption predicts tests of language and orientation separately. Additionally, the relations between of adoption on test performance may depend on the level of assessment (index vs. subtest). However, it was less clear which specific aspects of testing would be associated with adoption. Not all tests of lexical knowledge associated with language adoption, and tests of complex understanding of language were only predicted by years of residency or age. There was little-to-no evidence that cultural maintenance or acculturative stress associated with test performance.

Chapter 5: Acculturation, test norms, and false positives. Chapter 5 assessed the practical value of acculturative scales. This was achieved by assessing whether ratings of acculturation were sufficient to explain why existing norms were unsuitable for culturally dissimilar populations. The results were clear that the CD sample had significantly lower T-scores and higher rates of false positive than a group of homogenous, English-speaking participants, as reported in the technical manual. This CD group performed better than a clinical group, suggesting that existing norms of the SPANS may not accurately represent neurologically healthy CD populations. This chapter provides an original contribution by comparing objective and subjective cultural and language measures. The results showed that an objective measure of language history was a stronger predictor of passing a given threshold than self-rated measures of adoption.

Chapter 6: Ethnicity, acculturation, and test performance. Findings indicate that ethnicity and acculturation did not interact, and each predicted different types of tests. Language adoption was the most salient predictor for language tests above-and-beyond ethnicity. Whereas ethnicity predicted tests of visuo-motor processes, and tests

of orientation. Stratifying the data into four groups changed the rates of impairment on two indices and one subtest. The proportion of false positives differed between these groups for the ACI, but no differences were found when multivariate analyses were conducted on a range of scores. This demonstrates that statistical findings can differ from practical/clinical significance. However, it cannot be certain what factors distinguished between groups and these results could be due other cultural factors that were unaccounted for. Furthermore, the validity of the SPANS differs between each ethnic group.

Chapter 7: Individual differences and acculturation. This chapter broadened the scope of the thesis, exploring pre-existing factors that could associate with the later stages of acculturation. One novel finding was that two dimensions of cultural intelligence (CQ) predicted two domains of the AAMASM, but not self-efficacy and the five-factor model of personality. Individuals who are motivated to adapt to cultural differences, and their pre-existing awareness of cultural practices, predicted language proficiency and cultural knowledge adoption respectively. Although there are limitations to this study, this contributes to the literature because acculturative conditions have received less empirical attention.

The remaining sections of this chapter synthesise these findings by relating them back to the relevant gaps in the literature introduced in Chapter 1. In the latter parts of this chapter, the limitations of this work and directions for future research will be presented.

8.2 Integrating acculturation and neuropsychological test performance

This section addresses the gap in the literature around which aspects of acculturation ought to be influenced by which type of test performance. The section below is subdivided into sections separated by the field of neuropsychological testing and acculturation.

8.2.1 Neuropsychological tests

In Chapter 1, some authors have concluded from scholastic and aptitude tests (Helms, 1992; Nell, 2000) that there is a general effect of culture, including acculturation, on a wide range of test performance. This contrasts with Horn and

Blankson (2005), that only language tests on the WAIS-IV (i.e., Verbal IQ) would be associated with acculturation. However, the literature review in Chapter 2 found no conclusive evidence that acculturation was related to all subtests found within the VIQ. Chapters 2 and 4 show that tests of complex understanding of language, such as verbal concept formation or language comprehension, are predicted by proxy measures of acculturation, such as years of residency rather than ratings of acculturation.

Discussions from Chapters 2 and 4 suggest that scales of acculturation may not consistently associate with all tests that theoretically come under a single cognitive construct. Not all tests of word knowledge and vocabulary equally associated with ratings of acculturation. Educational attainment, age, and years of residency were more meaningful than acculturative measures in explaining performance on the BNT (Kemmotsu et al., 2013; Manly et al., 2002) and verbal fluency (Acevedo et al., 2013; Kemmotsu et al., 2013). Similarly, Chapter 4 concludes that years of UK residency predicted scores in reading, verbal concept formation, and verbal fluency, but not measures of acculturation. Cultural knowledge only predicted the Political Leadership subtest of orientation, but not Time estimation. Therefore, there might be an overall association between adoption and the cognitive indices of language and orientation, but this may not be present for all types of test that theoretically fell under these domains.

Another finding was that tests that purport to measure the same construct, may associate differently with proxy estimates of acculturation (years of residency). Chapter 4 found that the effect of years of residency only predicted the List Learning subtests, but not RAVLT total trials, despite both purporting to measure immediate recall. This provides theoretical support for the contention that variability in test performances seen across different studies, could be attributed to the way in which cognitive constructs are measured (Fernandez & Abe, 2018; Sternberg, 2004). It seems that changes in the way a construct is measured (e.g., test length, items, procedures, etc.), rather than what is being measured, could affect its association with cultural constructs like years of residency. This adds complication to the relationship between concepts of acculturation and neuropsychological testing, making it less clear how ratings of acculturation relate to what type of neuropsychological tests.

8.2.2 Dimensions of acculturation

It was hypothesised that higher adoption predicted better performance on tests. One study contradicted the direction of this influence, where higher adoption was related to worse performance on tests (Seaz, et al., 2014). Apart from this, there is a broad consensus in Chapters 2 and 4 that high scores on adoption (or estimates of this via higher scores on unidimensional scales) are generally related to better performance. Evidence for the effects of adoption on test performance may provide support for cultural perspectives on neuropsychological testing. This refers to authors who theorise that greater familiarity, immersion, or adaptation to the dominant mainstream culture is beneficial for test performance (Helms, 1992; Nell, 2000; Ardila, 2005). However, this is based on a synthesis of non-equivalent studies (clinical vs. non-clinical samples, different tests, ethnic groups, etc.), and thus this is likely a general conclusion.

It is less clear whether cultural maintenance can be related to testing, as this dimension is underrepresented in the wider literature. Assessing for acculturative strategies (marginalisation, integration, separation, and assimilation) requires an evaluation of both inter-cultural contact and cultural maintenance (Berry, 1997). Two studies have found that language proficiency significantly predicts assimilation, separation, and integration strategies, but not marginalised strategies among ethnic minorities (Berry, 1987; Lu, Samaratunge & Hartel, 2016). It remains plausible that tests of language ability may associate with marginalised strategies, but high collinearity between each acculturative strategy prevented further analyses to be conducted in this thesis. In any case, there was no strong evidence for the predictive value of cultural maintenance on test performance in this thesis. Therefore, it remains uncertain how each of these four strategies can be incorporated into neuropsychological performance.

8.2.3 Domains of acculturation

In Chapter 4, language adoption only predicted language tests on the SPANS, similarly, Hasson et al. (2019) found that only language adoption predicted the WASI-IV Vocabulary subtest. In Chapter 2, studies that introduced language factors in their analyses (WRAT Reading ability, language of administration, etc.) demonstrated diminished variance of acculturative measures on verbal and non-verbal tests. When another measure of language is introduced in these analyses, the overall effect of

acculturation on test performances may have been ‘partial-out’. Colloquially, the language domain of acculturation might be the ‘bridge’ between concepts of acculturation and test performance.

This thesis produced evidence that knowledge of the dominant culture’s traditions, history, and customs predicts the Political Leadership subtest. It was less clear how this result can be compared to the wider literature, as few studies included subscales of acculturation and tests of orientation. Only Kennepohl et al. (2004) included a test of orientation, but this did not report which aspects of maintenance associated with this test of orientation. It was also less clear whether other less linguistically driven domain (cultural knowledge, ethnic identity) would associate with other forms of tests. Arentof et al. (2012) reports weak associations between cultural competency and ethnic identity adoption in tests of processing speed, but this study could not be replicated (Mindt et al., 2014). In contrast, Hasson et al. (2019) found no evidence that these less linguistically driven domains predict performance on the WASI-IV. In any case, the reliability of the AAMASM-A cultural knowledge scale was inconsistent across two samples in this thesis. Therefore, while cultural knowledge can predict tests performance, the predictive value of language adoption on testing is comparatively more reliable.

8.2.4 Theories of acculturation

Language and cultural knowledge adoption may also have implications for theories of acculturation. This agrees with the Horn and Blankson (2005) operationalisation of ‘acculturative knowledge’. Each of these concepts involves the acquisition of culturally specific concepts, skills, language, and knowledge via exposure to the current cultural milieu (education, residency, etc). This suggests that neuropsychological test performance can be positioned on socio-cultural competency (adoption) or adaptation for models of acculturation. To exemplify this, in Chapter 3, both the RASI-M and AAMASM were assessed under the acculturative outcomes of the three-stage model. The difference was that the AAMASM was described as a measure of acculturative behaviours and socio-cultural competency (external adjustment), whereas the RASI-M was more inclined towards acculturative attitudes or psychological adaptation (or internal adjustment). The predictive value of the RASI-M

on test performance were negligible and the AAMASM had a larger association with tests in this thesis.

Conceptualising the relationship between acculturation and test performances on models of acculturation, socio-cultural competency of adoption (see Fig. 8.1), and socio-cultural adaptation (see Fig. 8.2) ought to be most relevant for tests performances. However, this does not necessarily mean that acculturative outcomes cause a change in neuropsychological performance. Interpreting Fig. 8.2 and Fig 8.1 meant that socio-cultural competencies (i.e., language skills, cultural familiarity, and knowledge) in adoption has a more substantial association with test performances, compared to psychological adjustments (i.e., wellbeing, distress, sense of belonging, etc).

Findings from Chapter 7 suggests individuals who are motivated to learn about cultural differences, and who are aware of nuances in custom and practices are more likely to have higher socio-cultural competencies. Therefore, one's innate ability to function and adapt effectively in different cultural settings can contribute to socio-cultural adoption and adaptation. However, it cannot be affirmed that such factors are in fact related to neuropsychological tests. Further caution must also be taken, as characteristics may differ between two samples in this thesis, limiting generalisability. Nonetheless, pre-existing factors of cultural intelligence (CQ) could explain how socio-cultural adaptation manifests. This suggests that CQ is a potential candidate to be conceptualised as acculturative conditions (Three stage model), or pre-existing factors of acculturation (according to Berry's model).

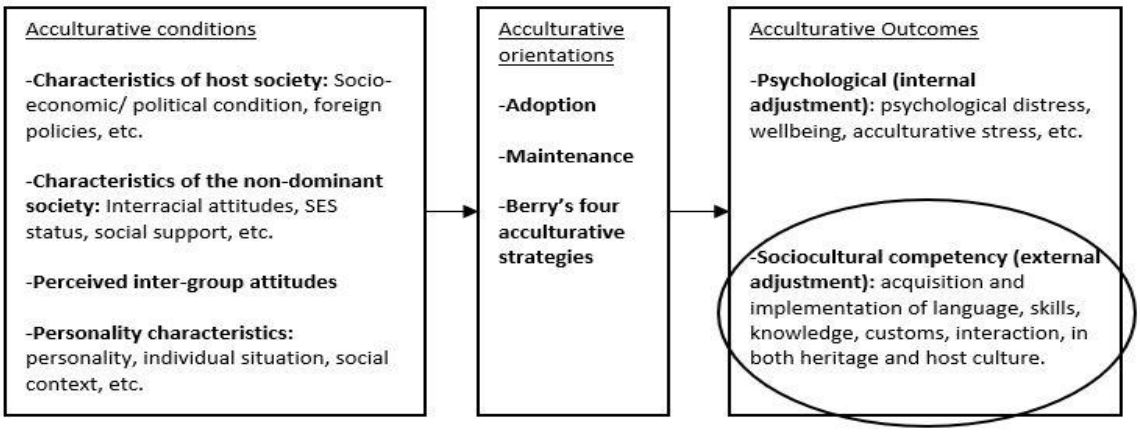

Figure 8.1. The position of neuropsychological test performances (circled) on the three-stage model of acculturation.

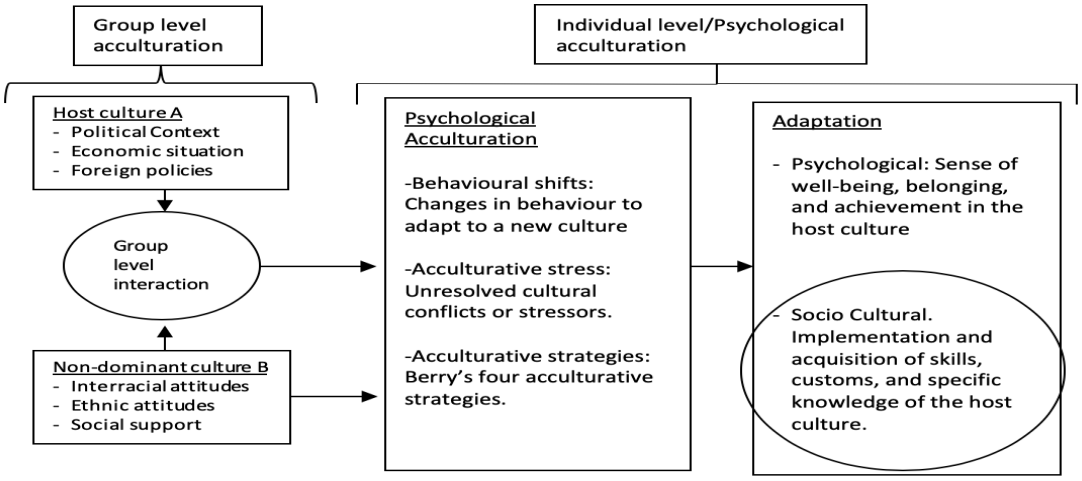

Figure 8.2. The position of neuropsychological testing (circled) in Berry's framework of acculturation.

8.2.5 Ethnicity and neuropsychological tests

Some authors propose that cultural differences may underlie variation in test scores over-and-above the effects of race or ethnicity (Helms, 1992; Nell, 2000). There was some evidence for this in Chapter 6, where adoption and years of residency predicted language tests above-and-beyond ethnicity. To a certain extent, this supports the conclusions of Helms (1992) that cultural difference ought to be more important than ethnic differences in test performance, but this is more likely to be specific to tests of language. Adjusting for cultural knowledge adoption and years of UK residency did not change the predictive value of ethnicity on tests of orientation. There was also some relationship between ethnicity and tests of visuo-motor processing, but limitations preclude a firm conclusion whether this is solely because of the construct of ethnicity. However, the importance of language adoption on language tests persisted over-and-above Lynn's (2002) purported taxonomies. Furthermore, there was no interaction between ethnicity and adoption, indicating these were separate constructs. Despite limitations outlined in Chapter 6, it seems less likely that ethnicity and adoption are interchangeable. This is more aligned with theories of acculturation, in which socio-demographic characteristics are insufficient to represent constructs within acculturation (Arends-Toth & van de Vivjer, 2006a).

8.3 Summary of theoretical contributions to the literature

In summary, there is no clear consensus on which type of neuropsychological tests would associate with acculturative measures. This thesis presents evidence that adoption broadly predicts tests of orientation and language, but this effect is not homogenous for all types of subtests that theoretically fall into these indices. Furthermore, changes in the way a cognitive construct is measured could yield different associations with cultural constructs. The only consistent finding here is that tests of visuospatial memory and verbal delayed recall are unlikely to associated with ratings of acculturation. As for which aspects of acculturation associated with different tests, there is some broad consensus that adoption predict test performance. Due to a lack of representation of cultural maintenance, it remains unclear whether this and Berry's acculturative strategies would form a relationship with test performance. This thesis concludes that the predictability of language in adoption is more reliable for language tests, than cultural knowledge adoption on tests of orientation. In any case, the relevance of these two domains suggests that the position of test performances should be under socio-cultural competency adoption or adaptation in theories of acculturation. Finally, motivation and cognitive CQ are potential pre-existing factors that could affect the process of adoption in sociocultural competency and adaption. Despite the limitations in Chapter 7, this is still a novel contribution due to a lack of attention given to acculturative conditions in the process of acculturation (Matsudaira, 2006; Calenk & Van de Vivjer, 2012).

8.4 Clinical recommendations and test norms

One practical application in this thesis explores how ratings of acculturation are used in relation to existing norms. The literature review found that the use of acculturative measurements during clinical examinations was inconclusive. Simply accounting for the construct of acculturation is insufficient to 'correct' for all confounding factors that may arise during test performance. This is broadly supported in this thesis, where ratings of the AAMASM were not found to predict a hypothetical 'failure' threshold on four SPANS indices (ACI, MLI, ECI, and CFI). Binder, Iverson, and Brooks (2008) explain that such 'low' scores (false positives, scores 1SD or 2SD below the mean) are common and expected in healthy adults. Less culturally related factors – such as measurement errors, test length, motivation, diet, nutrition, and fatigue

among healthy individuals – may negatively affect test performance (Binder et al., 2009; Tenner-Eggen, Balzer, Perrig & Gutbord, 2015). Perhaps such factors could have confounded the transferability of existing norms between populations.

The use of acculturative scales to assess the suitability of norms is limited, but this does not completely rule out its value in clinical practice. AAMASM-A language, knowledge, and years of residency did predict the odds of passing a given threshold for the language index (LAI), cognitive flexibility index (CFI), and Political Leadership subtest. Perhaps existing norms for the LAI and CFI may be biased toward these domains of acculturation. However, Chapter 5 showed that the cultural quotient (CQT) has equal or better predictive value for detecting false positives. This meant that the practical value of measuring adoption is limited compared to the CQT, as an assessment to account for cultural confounds during testing on the SPANS. Therefore, it is recommended that practitioners measure historic accounts of language factors, like ESL, or time spent learning English, etc. (Ortiz et al., 2012), as oppose to ratings of acculturation for the SPANS. This should provide better clarity over the appropriate use of existing test norms for culturally diverse populations.

8.4.2 Ethnic/race-based norms

There is controversy over the use of race-based norms, as these may not account for all socio-cultural or demographical variability within each racial group (Flanagan, Genshaft & Harris, 1997; Brickman et al., 2006; Gasquoine, 2009; Melikyan et al., 2019). Intriguingly, rates of false impairment were higher for SEA on the ORI. Despite equal rates of false impairment for EA and the normative sample on two indices, the data were restricted to a limited range of demographic variables, thus existing norms for these indices may not be transferrable to all EA populations. Furthermore, when the data was stratified according to ethnicity, rates of false impairment changed. These 'failures' as seen when the data was presented as whole on some of the SPANS indices, could be due to the inclusion of particular ethnic groups. However, there is socio-cultural variability within these ethnic categories that was not accounted for. There could be additional factors (e.g., motivation, test-wiseness, fatigue, SES, etc.) that could better explain why participants were performing below expectations based on existing SPANS norms. Until a broader spectrum of cultural and non-cultural variables is

accounted for, this thesis cannot confirm whether future utilisation of ethnic/race-based norms is a clinically significant variable for the SPANS.

In summary, the practical value of acculturative scales used to assess the suitability of existing norms during routine examination is limited. Other non-cultural factors – such as, test length, and fatigue – should be also considered during routine clinical examinations. This can help rule out the possibility of cultural factors confounding test performance, and further explain the suitability of test norms. Accounting for these additional factors may diminish the value of acculturative measures to predict rates of false impairments. However, these clinical suggestions could be limited to SPANS norms in this study. For this group of participants, the value of adoption in the AAMASM on the SPANS mostly reside in its theoretical relevance. As for the use of normative references, this thesis cannot confirm whether race- or ethnic-based norms is a suitable methodology to eliminate cultural confounds that may affect clinical judgement. Despite this, the use of demographic and ethnically corrected norms to reduce rates of false positives prevails as a gold standard for clinical practice in the wider literature (APA, 2016; BPS, 2018).

8.5 Limitations

The relationship between the construct of acculturation and test performance is likely to be dependent on the distinct characteristics of each sample and each study's methodology. Findings from one study may not be generalisable to another, as it cannot be certain that sample characteristics and methodology are equivalent for different studies. This means that conclusions on the effects of acculturation on test performances are likely to be restricted to the unique characteristics of the participants in this thesis.

8.5.1 Sample characteristics

The ethnically diverse group in this study were relatively young (under 50 years old) and highly educated. A greater range of test scores is typically observed among those with fewer than 12 years of education (Ardila et al., 2000) and older than 50 years due to age-related cognitive decline (Ardila et al., 2000; Ferraria et al., 2015). High levels of formal education may attenuate the relationship between acculturation neuropsychological testing (Berry, 1997; Seaz, et al., 2014). There are also cultural characteristics unique to ethnically diverse samples in this thesis that might hinder

generalisability. For instance, the data consisted of a substantial number of participants who are studying in the UK. Therefore, years of residency and scales (AAMASM, RASI-M, CQT, CQ, etc.) are likely biased toward educational experiences in the UK, as oppose to other demographic characteristic, like the work life culture in the UK.

Furthermore, external forces such as national policies, attitudes of the dominant society toward minorities, and level of diversity also affect the process of acculturation (Berry, 1997). Traditionally, policies in the UK have generally encouraged a pluralistic society (Ashcroft & Bevir, 2018), with efforts to embrace multiculturalism. Cities in the Midlands and London are known to be culturally and ethnically diverse (UK census, 2011); thus, levels of adoption, maintenance, and acculturative stress may differ in less diverse areas in the UK. Furthermore, individual differences like cultural intelligence may affect the process of acculturation. Such personality characteristics may exert a unique influence on acculturative outcomes for different populations, hindering generalisability between studies. In sum, a combination of a reduced range of scores on some neuropsychological tests and distinctive cultural experiences in this group of participants may have attenuated the relationship between multiple dimensions of acculturation and test performance. Subsequently, this may limit the generalisability of findings in this thesis to other populations.

8.5.2 Test measures

The SPANS is a relatively new development, its use and applicability has not been fully established in the literature. Also, the dispersion of SPANS scores is low, and thus may lack variance. This could have led to weak psychometric properties, but only the LAI appear to be a reliable index for most participants in this study. The SPANS may have some clinical utility as it discriminated between healthy and clinical samples, but its accuracy may be compromised for this group of diverse participants. Finally, it must reiterate that the SPANS offer no specific ‘cut-off’ score. However, without this, there are limited means for evaluating the probabilistic and practical nature of acculturative measurements. Nonetheless, two thresholds are hypothesised, and these represent a range into which false positives could fall and which is consistent with the wider literature.

Another main limitation is that this thesis did not account for the relationship between theories of intelligence or neuropsychological assessments with acculturation.

Conclusions in this thesis is limited to test performance and norms in clinical context, and thus may not be generalised to theories that underlie the construction of different types of tests. Furthermore, despite efforts to capture a wide range of neuropsychological ability, and there may be other areas of cognitive function that were not represented (auditory processing, general intelligence, syllogistic reasoning, etc.). Therefore, findings from this thesis might be limited to specific types of tests reported in this thesis, and not be transferrable to all neuropsychological tests.

8.5.3 Scales of acculturation

Although the reliability and validity of these measurements were assessed, there were nonetheless limitations in this area. Since efforts were made to ensure that the scales used in this thesis were culture-general, they may lack specificity for measuring acculturative constructs. Participants from different backgrounds could have understood questions differently due to a unique definition of culture, leading to measurement errors. Some evidence of this is presented in Chapter 6, where the reliability of the AAMASM-M cultural identity was not adequate for all racial groups. Furthermore, the reliability of the AAMASM-A cultural knowledge scale was inconsistent across two samples, perhaps due to differences in age and other sociodemographic factors. Therefore, significant associations between testing and this subscale may be limited to unique sample characteristics found in Chapter 4.

8.5.4 Clinical limitations

It must be reiterated that evidence for the clinical utility of acculturative measures are largely restricted to SPANS norms, and clinical studies reported in Chapter 2. Furthermore, there was no culturally diverse clinical group to match the healthy diverse sample, limiting generalisability to wider clinical populations. Another limitation pertains to the prevalence of dysfunctional executive processes in the clinical population, especially for those with brain injury (Schapiro & Sacchetti, 1993). However, executive function is an umbrella term consisting of different executive processes (Gilbert & Burgess, 2008; Diamond, 2013). These are associated with different brain regions and measured using different tests (Gilbert & Burgess, 2008; Diamond, 2013). This thesis found no evidence for the relationship between acculturation with several components of executive functioning, mainly task switching

(TMT), updating (Digit Span), and executive control (COWAT). However, it cannot ascertain whether this non-significant relationship would have clinical significance if an index of executive functioning were included.

8.6 Future research

This thesis has identified some areas for future research. These were divided into five research areas, along with suggested research methodologies.

8.6.1 Theories and measures of acculturation

The first research agenda concerns the direction for acculturative measures. It is false to assume that scales developed for multi-ethnic groups are generalisable across different populations. As evidenced in this thesis, subscales of AAMASM produce different reliabilities across different samples and ethnic groups. Therefore, it is vital for future studies to confirm the psychometric properties of acculturative scales before its utilisation. Future studies should validate the AAMASM or RASI-M across different populations. For example, the AAMASM can be administered to the British Asian population and subjected to confirmatory factor analyses to assess its construct validity.

As for theories of acculturation, this study provided preliminary evidence that CQ predicted subscales of the AAMASM. Future studies should confirm this association with larger sample sizes with a wider range of demographic variables (i.e., SES, age, ethnicity, etc.). Moreover, longitudinal data could be employed to assess whether CQ can be considered a pre-existing factor toward adaptation. This allows researchers to assess changes in acculturation and CQ simultaneously across time, providing evidence for the direction of causality (VanderWeele, Jackson & Li, 2016). This would therefore ascertain how CQ can be incorporated into theories of acculturation, such as Berry's model.

8.6.2 Multidimensional acculturation and test performance

Another research agenda concerns the relationship between specific constructs within acculturation and neuropsychological tests performance. Cultural maintenance and acculturative strategies should be assessed as these are underrepresented in the wider literature. Findings from this thesis suggests that future studies may concentrate on the domain of language, and domains that involve familiarity, engagement with, and

the acquisition of culturally specific knowledge. Out of these two domains, language adoption is more likely to associate with language tests in general. It is also important to separate 'internal' and 'external' aspects of acculturation, as these are conceptually distinct. Findings from this thesis indicate that 'external' adjustment (language competency, cultural knowledge) is more likely to be associated with neuropsychological performance. This meant that the direction for future work should at least utilise a) bi-dimensional framework of acculturation, b) include the domains of language and knowledge, c) ensure that internal and external constructs of acculturation are measured separately, and d) Berry's four acculturative strategies to confirm its association with test performances.

8.6.3 Context of acculturation and test performance

Importantly, chapter 2 concluded that there may be specific sample characteristics which could affect the way acculturative variables associate with tests performance. Meaning, findings for one study may not be replicated on a different set of participants. Therefore, studies within this thesis should be replicated on a wider range of demographics (i.e., SES, age, targeted ethnic groups, etc.). Results from chapter 2 found that studies that include adolescents and those from lower the demographic strata were scarce. Therefore, future studies may concentrate on these two groups.

Furthermore, other socio-cultural factors can impact test interpretations (Hill-Briggs, Evans & Norman, 2004; Rivera-Mindt et al., 2010), and perhaps mediate the relationship between acculturation and test performance. One way to account for these factors is to directly measure pre-acculturative conditions in the dominant and/or non-dominant society on the target sample (Berry, 1997). However, scales that assess acculturative conditions are rare with little information on their reliability and validity (Celenk & Van de Vivjer, 2011). Instead, future studies may measure other sources of pre-acculturative factors, such as individual differences (e.g., personality, CQ, self-efficacy), attitudes toward migration, etc. These factors could serve as mediators or moderators between acculturation and test performance. Alternatively, complex models such as path analyses can be conducted to ascertain the simultaneous effects between several variables on test performances.

8.6.4 Neuropsychological tests

Acculturative measures may not homogenously associate with all types of tests within a cognitive domain, therefore future studies should repeat their analyses at both levels (index vs. subtests) if a fixed battery is used. In addition, future research questions could explore whether the association between acculturative measures and test performance change depending on different types of tests that purport to measure the same construct. One example from this thesis concerns how subtle differences between the RAVLT total trials and List Learning subtests changed the association with years of residency. Another area of research involves incorporating the concept of acculturation with theories of intelligence or neuropsychological assessments. For example, structural equation models can be used to explore how different dimensions of acculturation map onto different models of intelligence and neuropsychological theories.

Another potential research question could explore whether the association between acculturation and test performances change, depending on whether tests are translated or adapted. This could remove the confounding effect of language of administration, or item familiarity, thus providing a clear relationship between ratings of acculturation and neuropsychological performance. However, Chapter 2 presented that translated tests are not necessarily free from the impact of acculturation (Acevedo et al., 2007; Nielsen et al., 2012a). Finally, it is important for future studies to assess the psychometric properties if these tests for their target population to strengthen their findings.

8.6.5 Clinical or practical relevance

Future researchers should consider the statistical and clinical significance of their results (Ranganathan et al., 2015). This meant that future studies exploring a practical approach to the effects of acculturation, should do so within clinically related methods, such as the use of norms in chapter 5. It was clear that existing norms are not generalisable to culturally diverse populations. However, studies in chapter 2 demonstrated that using appropriate norms may eliminate the confounding effects of acculturation. Therefore, one possible direction for future clinical work can explore whether the ratings of acculturation would associate differently according to what

norms are used. This would inform clinical practices about standardised procedures during testing.

As for the predictive value of acculturative measures, methods outlined in Chapter 5 can be confirmed with clinical samples, on a wider range of test batteries, with different norms, to ascertain the generalisability of these findings. Another future direction can involve ascertaining more concrete recommendations based on the probabilistic nature of acculturative measures. Studies can employ ROC analyses, exploring plausible cut-off scores for measures of acculturation on clinical and non-clinical samples. For example, certain tests may not be appropriate for patients who score below a certain cut-off score on such cultural measures. This is because tests norms cannot decipher whether a low performance or false positives are due to impairment or cultural characteristics (Harris et al., 2013; Ortiz et al., 2012). Other areas of research can explore whether other cultural factors (generational status, years of residency, etc.) and non-cultural factors (test-wiseness, fatigue, motivation, test length, personality, etc.) can better explain rates of false positives, or whether these mediate the relationship between acculturation and test performance.

It is less clear how ratings of acculturation can be used for test development and validation. Typically, neuropsychological tests are assessed for systematic errors within a cultural group, and or that specific items within a test are assessed for equivalency of meaning between different ethnic groups (Fletcher-Janzen et al., 2000). However, constructs in acculturation are mostly conceived as continuous variables (Arends-Tóth & Van de Vivjer, 2006a).

8.7 Critical Reflections

This section covers a short summary of significant contributions of knowledge, and self-reflections on a personal level. Acculturation (and culture) is broad and multifaceted, and perhaps heterogeneity in the relationship between acculturation and test performance is simply a reflection of its fluid nature. On hindsight, the thesis could have been improved in several ways. First, including an ethnically comparable clinical sample could have explored whether acculturation is more salient for clinical groups compared to healthy individuals. Next, the selection criteria for the target population could have been more clearly articulated. This would help gain a clearer working definition of acculturation relevant to a given population. This thesis could have

included intelligence tests and incorporate theories of intelligence and neuropsychological tests to extend the scientific contribution of this thesis. Finally, different approaches, such as qualitative methods could have been undertaken, besides a psychometric one to explore wider issues pertinent in acculturation and culture.

Despite these limitations, the highlight of the thesis revealed that acculturation is the least understood factor in the context of neuropsychological testing. The findings indicate new insights into the relationship between acculturation and test performances which should spur future research. One important learning point was that statistical and clinical significance can differ and thus, empirical work may not directly translate to practical day to day activities of a clinician. In sum, it highlights important aspects of clinical testing that is pertinent given the current socio-cultural climate.

8.8 Conclusion

In conclusion, this thesis provided a range of original contribution to the literature on the relationship between constructs of acculturation and test performances. In the wider literature, differences in methodology, sample characteristics, operationalisation of acculturation and neuropsychological testing hinder a clear integration between these two fields. Despite such challenges, this thesis managed to uncover two aspects acculturation that is empirically and theoretically important toward test performances. Out of these two, the importance of language adoption on tests of language might be a more reliable finding than the association between cultural knowledge adoption and orientation tests. Also, cultural intelligence was identified as a potential precursor to these two domains of acculturation. Other areas of acculturation, such as cultural identity, maintenance, attitudes, and acculturative stress were not likely to associate with test performances. Furthermore, the construct of ethnicity and acculturation are not interchangeable, as each has separate associative value with different types of tests. It is also less clear what type of neuropsychological tests would have any bearing different domains of acculturation. Language and knowledge domains on acculturative scales may not necessarily hold a practical value during routine clinical examination compared to assessments of previous language experience. Based on these findings, it is important for future studies to clearly articulate what aspects of acculturation was used, make specific references to specific theories, and consider the wider cultural context which can influence the process of acculturation.

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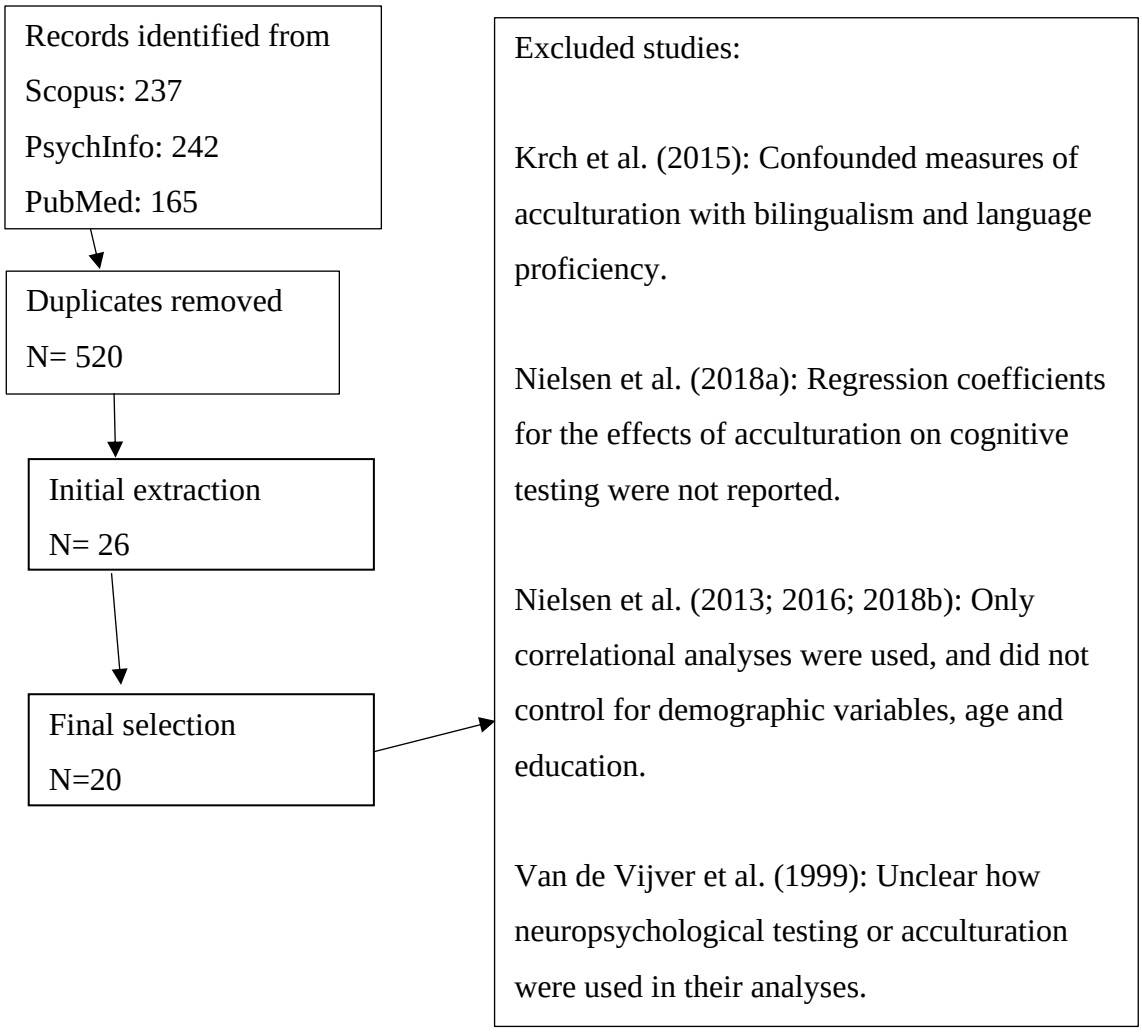
Appendix A.

This presents a flowchart of include and excluded studies, and a breakdown of a number of studies from databases.



Appendix B.

Below presents a full breakdown of the ethnic composition of 228 participants in chapter three and four. There were 97 local British nationals, covering 11 ethnicities. These were African (n=14), Afro-Caribbean (n=8), Arab (n=1), Bangladeshi (n=6), Chinese (n=30), Filipino (n=3), Indians (n=14), Pakistani (n=6), Sri Lankan (n=1), Turks (n=2), and 10 who were of mixed ethnicity. The remaining participants were nationals from 35 different countries. These were: Albania (n=1), Algeria (n=1), Austria (n=1, Nigerian), Azerbaijan (n=1), Bulgaria (n=1), Canada (Nigerian and Japanese), China (n=14, Hong Kong, n=13), Colombia (n=1), Cyprus (n= 2), Greece (n=1), India (n=3), Indonesia (n= 15), Iraq (n= 4), Italy (n=5), Jamaica (n=1), Jordan (n=1), Kazakhstan (n=1), Korean (n=2), Libya (n=4), Malaysia (n= 11), Mexico (n=2), Nigeria (n= 5), Pakistan (n=3), Poland (n=1), Portugal (n=1, African), Qatar (n=1), Saudi Arabia (n=1), Singapore (n= 4), Sudan (n= 1), Syria (n=2), Taiwan (n=1), Thailand (n=11), Turkey (n=8), United Arab Emirates (n=2), Zambia (n=1), and Zimbabwe (n=1).

Below presents ethnic breakdown for 217 participants as found in chapter 7.
The sample comprises of: Afghani (n=1), African (unspecified, n=8), Afro-Caribbean (n=12) , Bangladeshi (n=5), Bulgaria (n=1), Chinese (n=14), Congolese (n=1), Cypriot (n=1), non-British European (n=23), Filipino (n=1), Gambian (n=1), Ghanaian (n=5), Indian (n=47), Iranian (n=1), Italian (n=2), Latin American (n=1), Lithuanian (n=1), mixed background (n=32), Nigerian (n=10), Asian (unspecific, n=9), Pakistani (n=21), Polish (n=6), Romanian (n=2), Slovakian (n=1), Somalian (n=3), South African (n=1), Spanish (n=2), Sri Lankan (=2), Sudanese (n=2), Thai (n=1).

Appendix C.

Presents all scales from two systematic reviews. Only bi-dimensional and multi-domain scales were included in the selection process.

	Scale	Bidimension	Multidomain
De La Cruz et al., 2000	A Short Acculturation Scale for Filipinos	No	
Zea et al., 2003	Abbreviated Multidimensional Acculturation Scale	Yes	Yes
Sam et al., 1995	Acculturation Attitudes Scale	Yes	No
Ward et al., 1999	Acculturation Index	No	
Van de Vivjer et al., 1999	Acculturation Questionnaire for Children	No	
Deyo et al., 1985	Acculturation Rating Scale for Mexican Americans	No	
Cuellar et al., 1995	Acculturation Rating Scale for Mexican Americans II**	Yes	Yes
Ghumman et al., 1991	Acculturation Scale	No	
Ngyuen et al., 2002	Acculturation Scale for Vietnamese Adolescents	No	
Ugner et al., 2002	Acculturation, Habits and Interests	No	
Vinokurov et al., 2002	Acculturative Hassles	No	
Surez et al., 2007	Acculturative Stress Inventory for Children	Yes	No
Salgado et al., 1987	Acculturative Stress Scale	No	
Swaidan et al., 2006	Adopt and Keep Scale	No	
Landrine et al., 1994	African American Acculturation Scale-Revised	No	
Cotes et al., 2003	American Puerto Rican Acculturation Scale	Yes	No
Flannery et al., 2001	Asian American Acculturation Inventory	Yes	No
Chung et al., 2004	Asian American Multidimensional Acculturation scale	Yes	Yes
Kim et al., 1999	Asian Value Scale	No	
Benet-Martinex, 2006	Benet- Martínez Acculturation Scale	No	
Benet-Martinex et al., 2005	Bicultural Identity Integration Scale	No	
Szapocnik et al., 2009	Bicultural Involvement Questionnaire	No	
Marin et al., 1996	Bidimensional Acculturation Scale for Hispanics*	Yes	Yes
Meredith et al., 2000	Brief Acculturation Scale	No	
Marin et al., 1996	Brief Acculturation Scale for Hispanics	No	
Martinez et al., 1984	Children’s Hispanic Background Scale	No	
Franco, 1983	Children's Acculturation Scale	No	
Rudmin et al., 2001	Cultural Attitudes Scale	Yes	No
Mendoza, 1989	Cultural Lifestyle Inventory	No	
Spradely et al., 1972	Cultural Readjustment Rating Questionnaire	No	
Inman et al., 2001	Cultural Values Conflict Scale	NA	
Mumford, 1998	Culture Shock Questionnaire	No	
Zimmerman et al., 1996	Enculturation Measure for Native American Youth	No	
Wolfe et al., 2001	European American Value Scale for Asian Americans	No	
Tsai et al., 2000	General Ethnicity Questionnaire	Yes	Yes
Harris et al., 1996	Greek-American Acculturation	No	
Hishinuma et al., 2000	Hawaiian Culture Scale Adolescent Version	No	

Shin et al., 1999	Homesickness and Contentment Scale	No	
Kwan et al., 1997	Internal-External Ethnic Identity Measure	No	
Laroche et al., 2005	Italian Ethnic Identity Measure	No	
Ramirez et al., 1986	Media Acculturation Scale	No	
Leung et al., 2010	Multicultural Experience Survey	No	
Jibeen et al., 2010	Multidimensional Acculturative Stress inventory	No	
Rodriguez et al., 2002	Multidimensional Acculturative Stress Scale	No	
Cuellar et al., 1995	Multiphasic Assessment of Cultural Constructs-Short Form	No	
Rezentes, 1993	Na Mea Hawai'i Scale	No	
Garrett et al., 2000	Native American Acculturation Scale	No	
Berry, 2010	Perceived Discrimination	No	
Tropp et al., 1999	Psychological Acculturation Scale	Yes	No
Rissel, 1997	Scale of Acculturation	No	
Wallen et al., 2002	Short Acculturation Scale for Hispanics	No	
Ward et al., 1994	Sociocultural adaptation scale	No	
Stephenson et al., 2000	Stephenson Multi-group Acculturation Scale	Yes	No
Suinn et al., 1992	Suinn-Lew Asian Self-Identification Acculturation	No	
Cheng et al., 1995	Taiwan Aboriginal Acculturation Scale	No	
Solomn et la., 1999	Traditional Behaviour Scale	No	
Ryder et al., 2000	Vancouver Index of Acculturation	Yes	No

Notes. * Scale is biased toward language proficiency and usage, thus excluded. ** This scale does not contain any items regarding cultural knowledge and thus excluded.

Appendix D.

Presents the AAMASM-A/M.

AAMASM-A	AAMASM-M
Language 1. How well do you speak the language of 2. How well do you understand the language of 3. How well do you read and write in the language of - English Food consumption 5. How much do you like the food of 6. How often do you eat the food of -White mainstream British groups Cultural knowledge 7. How knowledgeable are you about the history of 8. How knowledgeable are you about the culture and traditions of 9. How much do you practice the traditions and keep the holidays of 4. How often do you listen to music or look at movies and magazines from -White mainstream British groups Cultural identity 10. How much do you identify with 11. How much do you feel you have in common with people from 13. How much would you like to interact and associate with people from 12. How much do you interact and associate with people from 14. How proud are you to be part of 15. How negative do you feel about people from -White mainstream British groups	Language 1. How well do you speak the language of 2. How well do you understand the language of 3. How well do you read and write in the language of 4. How often do you listen to music or look at movies and magazines from -Your own cultural origin Food consumption 5. How much do you like the food of 6. How often do you eat the food of -Your own cultural origin Cultural knowledge 7. How knowledgeable are you about the history of 8. How knowledgeable are you about the culture and traditions of 9. How much do you practice the traditions and keep the holidays of -Your own cultural origin Cultural identity 10. How much do you identify with – 11. How much do you feel you have in common with people from 13. How much would you like to interact and associate with people from 12. How much do you interact and associate with people from 14. How proud are you to be part of 15. How negative do you feel about people from -Your own cultural origin

Appendix E

Presents all published scales from Rudmin (2009). Scales that did not contain mental health items, discrimination, or limited to particular demographic group were excluded.

	Scale	Mental health	Discrimination	Limitations
Vinokurov et al., 2002	Acculturative Hassles	No		Scale better suited for adolescents and children.
Noh et al., 1996	Acculturative Stress Index	Yes		
Suarez-Morales et al., 2007	Acculturative Stress Inventory for Children	No		Scale better suited for adolescents and children.
William Flournoy et al., 1996	Acculturative Stress Scale	Yes		
Sandhu et al., 1994	Acculturative Stress Scale for International Students	No		Scale better suited for international students.
Salgado et al., 1987	Acculturative Stress Scale	No		Scale predominantly ask for child welfare practices, and financial burdens.
Tomas-Sabado et al., 2007	Barcelona Immigration Stress Scale	Yes		
Sodowsky et al., 1997	Cultural Adjustment Difficulties Checklist	No	No	
Mumford et al., 1975	Culture Shock Inventory	Yes		
Mumford et al., 1998	Culture Shock Questionnaire	Yes		
Nywana et al., 2004	Expatriate Adaptation Inventory	Yes		
Shin et al., 1999	Homesickness and Contentment Scale	Yes		
Rodriguez et al., 2002	Multidimensional Acculturative Stress Inventory	Yes		
Lay et al., 1998	Outgroup Hassles and Ingroup Hassles	No		
Tsytsarev et al., 2000	Perceived Culture Shock Inventory	Yes		
Nwadiora et al., 1996	Refugee Acculturative Stress Inventory	No		Validity of scale specific to refugee experience.
Benet-Martinez et al., 2003	Riverside Acculturation Stress Inventory	No		
Padilla et al., 1985	SAFE Acculturative Stress Measure Padilla	No	Yes	Scale better suited for sojourners, or new immigrants
Ward et al., 1999	Sociocultural Adaptation Scale	No		Only measures adaptation

Appendix F.

Compares the RASI with the RASI-M

RASI-M	RASI
1. Because of my ethnic/cultural background, I have to work harder than most white British people. 2. I feel the pressure that what I do will be seen as a representation of my ethnic/cultural group's abilities. 3. In looking for a job, I sometimes feel that my ethnic/cultural background is a limitation. 4. It's hard for me to perform well at work because of my English skills. 5. I often feel misunderstood or limited in daily situations because of my English skills. 6. It bothers me that I have an accent (in English or another language). 7. I have had disagreements with those from my ethnic/cultural groups (e.g., friends or family) for favouring British customs or ways of doing things. 8. I have had disagreements with white British people for favouring my own ethnic/cultural customs or ways of doing things. 9. I feel that my ethnic/cultural practices have caused conflict in my relationships. 10. I have been treated rudely or unfairly because of my ethnic/cultural background. 11. I have felt discriminated against by some British people because of my ethnic/cultural background. 12. I feel that people very often interpret my behaviour based on their stereotypes of what people of my ethnicity/culture are like. 13. I feel that there are not enough people of my ethnic/cultural background in my living environment. 14. I often feel different or isolated when no one else in the room/place is from my ethnic/cultural background. 15. I feel that the environment where I live is not multicultural enough; it does not have enough cultural richness.	1. Because of my Asian background, I have to work harder than most Americans. 2. I feel the pressure that what I do will be seen as representative of Asian people's abilities. 3. In looking for a job, I sometimes feel that my Asian background is a limitation. 4. It's hard for me to perform well at work because of my English skills. 5. I often feel misunderstood or limited in daily situations because of my English skills. 6. It bothers me that I have an accent (in English or an Asian language). 7. I have had disagreements with other Asians (e.g., friends or family) for liking American customs or ways of doing things. 8. I have had disagreements with Americans for liking Asian customs or ways of doing things. 9. I feel that my particular practices (Asian or American) have caused conflict in my relationships. 10. I have been treated rudely or unfairly because of my Asian background. 11. I have felt discriminated against by Americans because of my Asian background. 12. I feel that people very often interpret my behavior based on their stereotypes of what Asians are like. 13. I feel that there are not enough Asian people in my living environment. 14. When I am in a place or room where I am the only Asian person, I often feel different or isolated. 15. I feel that the environment where I live is not multicultural enough; it does not have enough cultural

Appendix G.

Partial-correlations, between the relationship of SPANS indices with RASI-M language skills while adjusting for AAMASM-A language.

Control variable	SPANS indices	RASI-M Language Stress
AAMASM-A language	ORI	-.03
	ACI	-.06
	LAI	.13*
	MLI	.0
	ECI	-.03
	VPI	-.05
	CFI	.09

Notes. * $p < 0.05$. AAMASM-A= Asian American Multidimensional Acculturation Scale- Adoption. RASI-M= Riverside Acculturative Stress Inventory- Modified. ORI=orientation index, LAI=language index, ACI=attention concentration index, MLI=memory and learning index, VPI=visuospatial index, ECI=efficiency index, CFI=cognitive flexibility index.

Appendix H.

Cut-off scores based on ROC/AUC analysis for the Political Leadership subtest between healthy participants and a clinical sample. Optimal cut-off score for Political Leadership is > 1.

Subtest	Score	Sensitivity	1 - Specificity	Youden's J
Political Leadership	-1.00	1.00	1.00	-1.00
	0.25	0.99	0.87	0.24
	0.75	0.99	0.76	0.74
	1.25	0.96	0.60	1.21
	1.75	0.88	0.48	1.63
	3.00	0.00	0.00	2.00
Time Estimation	-1.00	1.00	1.00	-1.00
	0.50	0.98	0.88	0.48
	1.50	0.93	0.71	1.43
	3.00	0.00	0.00	2.00

Appendix I

Big Five inventory (BF-10).

I see myself as someone who
1. is reserved
2. is generally trusting
3. tends to be lazy
4. is relaxed, handles stress well
5. has few artistic interests
6. is outgoing, sociable
7. tends to find fault with others
8. does a thorough job
9. gets nervous easily
10. has an active imagination

Neuroticism, 4, 9. Agreeableness, 7, 2. Extraversion, 1, 6. Openness, 5, 10, Conscientiousness, 8, 3.

General Self-efficacy scale

1.I can always manage to solve difficult problems if I try hard enough.

2. If someone opposes me, I can find the means and ways to get what I want.

3.It is easy for me to stick to my aims and accomplish my goals.

4. I am confident that I could deal efficiently with unexpected events.

5.Thanks to my resourcefulness, I know how to handle unforeseen situations.

6. I can solve most problems if I invest the necessary effort.

7. I can remain calm when facing difficulties because I can rely on my coping abilities.

8. When I am confronted with a problem, I can usually find several solutions.

9. If I am in trouble, I can usually think of a solution.

10. I can usually handle whatever comes my way.

Cultural intelligence scale

Metacognitive CQ
1.I am conscious of the cultural knowledge I use when interacting with people with different cultural backgrounds.
2. I adjust my cultural knowledge as I interact with people from a culture that is unfamiliar to me.
3. I am conscious of the cultural knowledge I apply to cross-cultural interactions.
4. I check the accuracy of my cultural knowledge as I interact with people from different cultures.

Cognitive CQ
5.I know the legal and economic systems of other cultures.
6.I know the rules (e.g., vocabulary, grammar) of other languages.
7.I know the cultural values and religious beliefs of other cultures.
8.I know the marriage systems of other cultures.
9.I know the arts and crafts of other cultures.
10. I know the rules for expressing nonverbal behaviors in other cultures.

Motivational CQ
11.I enjoy interacting with people from different cultures.
12.I am confident that I can socialize with locals in a culture that is unfamiliar to me.
13.I am sure I can deal with the stresses of adjusting to a culture that is new to me.
14.I enjoy living in cultures that are unfamiliar to me.
15.I am confident that I can get accustomed to the shopping conditions in a different culture.

Behavioural CQ
16.I change my verbal behavior (e.g., accent, tone) when a cross-cultural interaction requires it.
17.I use pause and silence differently to suit different cross-cultural situations.
18. I vary the rate of my speaking when a cross-cultural situation requires it.
19.I change my nonverbal behavior when a cross-cultural situation requires it.
20. I alter my facial expressions when a cross-cultural interaction requires it.