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THE RELATIONSHIP BETWEEN BI/MULTILINGUALISM AND COGNITIVE FUNCTIONING IN SOUTH AFRICAN GRADE 3 LEARNERS

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MARCH 2020

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ABSTRACT

In South Africa, the language of learning and teaching (LoLT) in the foundation phase (grades 0-3) can be any of the 11 official languages of the country. From grade 4 onwards, however, the LoLT is English. This language policy is highly contested particularly as it relates to the relationship between the LoLT and the academic performance of learners for whom English is an additional language. Framed by Threshold Theory and Interdependence Hypothesis Theory (Cummins 1976, 1979), the aim of this study was to determine the relationship between bi/multilingualism, language proficiency and cognitive processing among grade 3 learners in a South African context. A total sample of 111 grade 3 learners, from two isiZulu and two English LoLT schools, completed *proficiency* (Sentence Repetition), *reading* (EGRA), and *cognitive* (NEPSY and AWMA) assessments to determine 1) the impact of language proficiency on modes of cognitive processing (specifically executive control and working memory), and 2) the possible influence of LoLT on the level of language proficiency in both the Home Language (HL) and the First Additional Language (FAL) of participants. The results of the study show that there is a significant relationship between language proficiency and cognitive processing in terms of the clocks and inhibition subscales of the NEPSY assessment and the Digit Recall subscale of the AWMA. However, the results align with more current research regarding bilingualism, indicating that there is no bilingual advantage and further brings into question the influence of Cummins' Threshold and Interdependence theory. Learners considered as balanced bilinguals using proficiency thresholds did not show increased cognitive control over the less proficient bilinguals. As expected, LoLT played a significant role in levels of language proficiency in both English and learners' HL. This indicates the larger issue remains the impact of the LoLT on learners' proficiency which has implications for the foundations of their academic futures. Interestingly, socioeconomic status (SES) showed signs of increased relevance as discussed in more current international research. Based on the above

and the fact that this research used alternative cognitive assessments than those commonly used, a large sample size, a more complicated context and the use of a lower SES population group, it is suggested that this research be replicated on an even larger scale to develop comparable/standardized norms for the overall South African learner population and international research.

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CHAPTER 1

INTRODUCTION AND RATIONALE

The following chapter briefly outlines the study and discusses how language has become a significant concern within the education system and how it influences achievement outcomes. It argues that the Language in Education Policy (LiEP) is creating emergent bilinguals who are not sufficiently proficient in either their Home Language (HL) or English (as an additional language) to successfully progress through the schooling system. This is done by highlighting the impact language proficiency has on cognitive processing, which is an active requirement for learning and academic success. The chapter breaks down how this will be investigated and the questions the research hopes to answer, before discussing the chapters to follow.

1.1 PROBLEM STATEMENT: POOR ACADEMIC ACHIEVEMENT

There is a perceived weakening of academic standards and performance, globally and within South Africa (Bell, 2009; Evans & Cleghorn, 2012; Ouane & Glanz, 2010). Poor academic performance has previously been attributed to poor quality of education, low socio-economic status (SES), under-resourced schools, poor nutrition, ill health and child headed households (Evans & Cleghorn, 2012; Phurutse, 2005). Although these are significant contributors to low academic performance (especially within poorer developing countries), there is not sufficient research investigating other factors, such as the influence of psycholinguistic contributions in the weakening the South African education system. Linguistic factors have become a highly contested issue in educational research, with the most fervent disputes surrounding how the Language of Learning and Teaching's (LoLT) impacts on academic performance. Contributions from research such as Alexander (2000); Cummins

(1979); Heugh (2000); Ouane & Glanz (2010) have shown that poor academic performance should be tackled at the source, instead of continuously battling the symptoms, with an increased focus on LoLT.

1.2 WHY FOCUS ON BI/MULTILINGUALISM?

Concerns around the impact of linguistic contributions on achievement scores have increased due to global mobility, which has led to vast distributions of languages worldwide (Bialystok, Craik, Green & Gollan, 2009). The resulting multilingualism raises issues in the education sector because the school environment is generally the first exposure many learners have to English (as an internationally recognized language), impacting the learners' proficiency as they are in essence being taught in a foreign language. This is particularly evident in developing counties, such as South Africa (Ouane & Glanz, 2010) The United Nations Educational, Scientific and Cultural Organization's (UNESCO) 2010 report, suggests that only five to 15% of learners are actually familiar with or exposed to English (not accounting for proficiency levels) before entering the school system (Ouane & Glanz, 2010). South Africa as a context, not only has to struggle with a previously segregated education system, poorly implemented language and curriculum policies, lack of resources and poor quality of education, it now also has to battle with the confounding influence of a foreign language as a LoLT (Heugh, 2000; Heugh, 2009). LoLT is a particular concern in South Africa because of the implementation of the Language in Education Policy (LiEP) (DoE, 1997), which proposes that learners are taught in their Home Language (HL) from grades 1 to 3 and transition to English as the medium of instruction thereafter. However, given that South Africa has 11 official languages and learners have little access to English before entering the education system, determining which HL/LoLT to use and in which areas becomes significantly complex. This is further exacerbated by schools and parents opting for the straight to English approach with

HL as the additional language (Balfour, 1999, Brock-Utne, 2010). Given such language diversity, minimal exposure to English from birth and the basic human right of access to education, it is important to examine the influence language has on educational outcomes, to improve the quality of education in South Africa and to ensure the necessary cognitive and academic growth (de Sousa, 2016).

As a result of the LiEP, South African learners enter schools with basic HL proficiency and are exposed to an additional language (English) for the first time, within the classroom. Learners who acquire a second language in a more formal setting, such as an education setting, are often referred to as Emergent bilinguals (de Sousa, 2016; Verhoeven, 2007). Defining bilingualism alone is complex as there are diverse ways of acquiring additional languages. However, bilingualism according to Garrat and Kelly (2008) is defined as individuals who have developed the necessary skills to listen, speak, read, and write in two languages proficiently. As in the case with this study, the sampled isiZulu-English bilingual learners are Emergent bilinguals, as their initial language input is orally through their HL (isiZulu) and their second (or for most third/fourth) language is introduced and acquired through the schooling system (de Sousa, 2016; Wilsenach, 2013 Verhoeven, 2007). Furthermore, they are expected to be able to listen, speak, read and write proficiently in both languages. Emergent bilingual learners' acquisition of English (L2) is subsequent to their HL/L1 and often the L2 relies on the development of the L1 to improve acquisition (Cummins, 1992; 2008). As the initial exposure to English is done within the classroom and over approximately 3 years, learners often exhibit limited language proficiency in both languages (de Sousa, 2016). In addition, emergent bilinguals are also described as sequential bilinguals, as their acquisition of another language occurs after the acquisition of their HL, unlike simultaneous bilinguals (who acquire both languages in the home at the same time) (de Sousa, 2016; Uchikoshi, 2012). These Emergent

bilinguals not only have to acquire English, but they have to become proficient in English as an academic language by the end of grade 3, in order to achieve the necessary outcomes for the remainder of their schooling career. There is however, a significant difference between the language proficiency required in a social and in an educational context. The variations in language proficiency are usually defined by distinguishing whether learners are only able to communicate in a language for simple social interactions or whether they are more proficient in academic language proficiency. Cummins categorized language proficiency into two conceptually distinct constructs; Basic Interpersonal Communicative Skills (BICS) and Cognitive Academic Language Proficiency (CALP). BICS and CALP develop from birth through social interactions, whereas CALP differentiates from BICS during the early stages of formal education (Cummins, 2008, 2009; Cummins & Yee-Fun, 2007). CALP/academic language is effectively the language that is deemed necessary to achieve and progress through schooling (Cummins, 1979; Cummins, 2008; Cummins & Yee-Fun, 2007, Jordaan, 2011b).

Why is it important to discuss the levels of language proficiency in Emergent bilinguals? As mentioned, the LiEP states that learners should be taught in their HL (which they are assumed to be most proficient in), whilst acquiring English as a First Additional Language (FAL). This is done between grades 1-3 where they then transition to English as the LoLT from grade 4 onwards (DoE, 1997). This is stated simply and does not include the complexities of a straight to English approach (explained in chapters to follow). This research argues that the transition to English as the medium of instruction in grade 4 is premature as learners are not sufficiently proficient (academic language proficiency) in English to ensure academic development and success. This impacts achievement as poor language proficiency influences cognitive processing/higher order functioning, according to Cummins (2008). Cummins' Interdependence Hypothesis and Threshold theories are used to theoretically ground

the study. The Interdependence Hypothesis theory is unique as it takes into consideration the variations in bilingual learners' profiles and explains how the differing levels of proficiency (with a focus on academic language) between the learners L1/HL and L2/FAL impacts cognition. Cummins (2008) argues that languages are interdependent and the learner's L2 development relies on the successful development and competence of their L1. The more proficient a learner is in their L1, the easier the acquisition and competence in their L2 will be (Jordaan, 2011b). Therefore, the level of proficiency achieved by a learner in their L2 relies on their L1 as a solid foundation. This is important, as Cummins argues that the increased proficiency in L1 allows for the increased development of L2 and the increased proficiency in both languages improves the ability to transfer linguistic processing skills between the two (Baker, 2001; Cummins, 2008; 2009). The improved linguistic proficiencies and transferability contributes to the development of conceptual skills such as thinking, evaluating, theorizing and analysing in both languages (Cummins, 2008; Cummins & Yee-Fun, 2007; Fanson, 2009; Roessingh & Kover, 2003*).* Thus*,* the transferability is not only of linguistic skills, but conceptual knowledge of multifaceted academic constructs and cognitive higher order thinking skills, necessary for learning and academic progression (Cummins, 2009). The interdependence theory begins to demonstrate how bilinguals' language proficiency and development in both languages has implications for both linguistic and cognitive processing. These implications are further elaborated on in Cummins' Threshold Theory, which argues that in order to ensure the best transferability of skills, both languages need to reach optimal proficiency levels, above a certain "threshold". The threshold theory does not exactly tell the reader where and how to determine a "specific" threshold or cut off point, to determine proficiency, but it does highlight the repercussions of not becoming appropriately proficient in both languages. This theory states that particular language proficiency thresholds or degrees of bilingualism, will impact on a learner's cognitive processing in either a negative, neutral, or

positive manner. Cummins distinguishes between two thresholds (low and high) a bilingual individual needs to attain in order to have any sort of cognitive impact (Cummins, 2001; Coetzee-Van Rooy, 2010). Below the first (low) threshold, the individual is labelled a limited bilingual as academic proficiency in both languages is insufficiently developed, lending itself to negative cognitive effects. Between the first and second threshold, the individual is identified as being sufficiently competent in one of their two languages, but not in both, and will therefore experience neither negative nor positive cognitive effects (neutral). Above the second (higher) threshold, the individual moves towards balanced bilingualism and becomes proficient in both languages, lending itself to cognitive advantages (Baker, 1993, 2001; Cummins, 2001).

Researchers such as Bialystok and her colleagues have used such theories to illustrate that the more proficient in each language, the more likely the learner will experience cognitive advantage. Initial studies suggested that bilinguals have a cognitive advantage, specifically in Executive Functioning (EF), over their monolingual counterparts *(*Bialystok & Barac, 2012; Luk & Bialystok, 2013; Kroll & Bialystok, 2013*).* EF is considered a command and control centre that is made up of core interrelated components and is situated in the prefrontal cortex. These components include inhibition, selective attention, working memory and cognitive flexibility, which allow for higher order processing such as reasoning, problem solving and planning (Collins & Koechlin, 2012; Miyake, Friedman, Emerson, Witzki, Howerter & Wager, 2000; Paap, Johnson & Sawi, 2014). More recently though, Bialystok's work has expanded to compare bilinguals with varying levels of language proficiency. These results indicate that bilinguals who are fully proficient in both languages (balanced bilinguals) show a cognitive advantage over their less proficient bilingual counterparts (Luk & Bialystok, 2013; Kroll & Bialystok, 2013). Reflecting back to Cummins, Bialystok's work shows that bilinguals who have achieved a certain language proficiency threshold in both languages, will demonstrate

positive cognitive effects (Baker, 1993, 2001; Cummins, 2001). However, researchers such as Paap and his colleagues (2014, 2018, 2019) have begun dismantling the "bilingual advantage" theory. Studies by Paap (2019) and Lehton et al. (2018) conducted meta-analyses of studies on bilingual advantages across six executive functioning domains and all developmental ages. Their results actually showed that there were very small effect sizes across studies and when variables such as publication bias were taken into account, there was almost no effect size to show bilingual advantage. Furthermore, Donnelly, Brooks and Homer (2020), completed a multiverse analysis across 80 studies and when corrected for publication bias, actually found negative effect sizes, once again suggesting bilinguals do not in fact show cognitive advantage over their monolingual or less proficient bilingual counterparts. These researchers argue that the lack of control of confounding variables such as context, educational systems, culture, socioeconomic status, publication bias and sample size are the reasons for such conflicting results (Paap et al., 2014; Vivas et al., 2017).

With much controversy around LoLT in South Africa and the current debate about bilingual advantage, the current study aims to investigate

"What are the factors that affect the relationship between bilingualism and cognitive functioning, in grade 3 isiZulu-English emergent bilingual learners in a quintile 3 South African context?".

More specifically the study aims to look at how varying levels of language proficiency impact cognitive processing through the lens of executive function and working memory. The research distinguishes levels of proficiency in both communicative and academic language and LoLT is investigated to determine whether it really influences language proficiency to the

extent researchers have argued. The analysis controls for variables such as age, mother's level of education and SES, to determine whether any of these factors contribute to a change in language proficiency and cognitive processing. Finally, although Cummins' theories are used as theoretical framework for the current study, his research has often only been done in High SES developed countries. Therefore, the study aims to consider whether the theories are relevant in poorer developing countries, such as South Africa.

This was done using a sample of 111 grade 3 emergent bilingual learners, from four schools. Two are isiZulu (HL) LoLT, with English as FAL and the other two are English LoLT, with isiZulu as FAL. These schools are within comparable/similar contexts and are all quintile 3 schools, with 80% of the learners having isiZulu as their HL. The learners' levels of language proficiency were tested in both languages using Sentence Repetition (SR) for communicative proficiency and the Early Grade Reading Assessment (EGRA) toolkit for academic language. The SR has previously been used as a psycholinguistic marker to determine linguistic proficiency and in diagnosing disorders such as Specific Language Impairment (SLI) and other language disorders, or profiling other language difficulties (Redmond, Thompson &Goldstein, 2011). The EGRA has been standardised for all South African languages and assesses literacy skills, including letter recognition, reading of simple words, oral reading fluency and the comprehension of sentences, all of which are measured in a systematic way in an oral assessment that was developed for multiple countries and in multiple languages (EGRS, 2017).

Using the above language and literacy assessments, 4 separate categories were defined based on Cummins Threshold theory (Cummins, 2008; 2009). These included

1. Proficient in both English and isiZulu.
2. Proficient in English and not proficient in isiZulu.

3. Proficient in isiZulu and not proficient in English.
4. Not proficient in either English or isiZulu.

It is important to establish these categories as Cummins and Bialystok (Bialystok & Barac, 2012; Luk & Bialystok, 2013; Kroll & Bialystok, 2013) argue that learners who are considered proficient in both languages (referred to as balanced bilinguals) will present with improved literacy skills and achieve academically, but also show increased executive functioning and working memory abilities compared to those who are less proficient or only proficient in one of the two languages. To test learners' cognitive processing, the NEuroPSYchological assessment (NEPSY) was used to determine Executive Functioning and the Automated Working Memory Assessment (AWMA-2) was used to assess Working Memory (WM). The executive functioning is framed by Miyake's (Miyake et al., 2000) integrative model of interrelated, yet dissociable suitable theoretical framework, also referred to as the ''unity and diversity" EF model, and WM was framed using Baddeley's (2003) multi-componential model of working memory. Both these are further discussed in the chapters to follow.

Given that the LoLTs vary, the general assumption is that learners will show varying levels of language proficiency in both English and isiZulu and will therefore show either a positive, null or negative impact on cognitive processing (EF and WM). This argument would then assist in determining whether language proficiency impacts cognitive processing and further discussions can occur regarding the implications for academic achievement.

1.3 CONTRIBUTION TO KNOWLEDGE

This study hopes to add to and improve on studies focusing on second language learners as well as the implications of LiEP on language proficiency and higher order thinking. The hope is to help policy makers understand the effects and improve educational outcomes in South Africa. This is done through the lens of Language of Learning and Teaching's influence on academic language proficiency, rather than looking at issues already covered such as quality of education, SES, child headed households and malnutrition. This research will have important implications for improving language teaching and its implications for policy and practice in South Africa. With empirical evidence, the aim is to improve the quality of learning to ensure cognitive and academic growth, in such a unique context such as South Africa and other similar developing countries. This study can shed light on whether levels of language proficiency do in fact show cognitive advantage or whether factors such as SES and quality of education outweigh the impact on cognition. With the complexities and multilingual context of South Africa, it is important to explore all avenues, to give the youth of this country the best opportunities afforded to them. The youth of today are the future of tomorrow and there is already significant evidence to show the economic and social benefits of empowering and uplifting them.

1.4 SUMMARY OF CHAPTERS TO FOLLOW

The chapters to follow discuss the complexities within South Africa and its education system and explores the Language in Education Policy (LiEP) and the struggles regarding LoLT and Home Language (HL) education. This is linked to bilingual research in chapter 3, which focuses on improving language proficiency (in both languages) to strengthen cognitive abilities as a way of improving academic achievement. In chapter 4 the research is grounded by Cummins' Interdependence Hypothesis and Threshold Theory, which allows for the

development of a strategic approach to investigate language proficiency and cognitive processing in South African learners explored in Chapter 5. Chapters 6 and 7, dissect the results and allow for an interesting discussion and conclusion section.

CHAPTER 2

LANGUAGE HISTORY, POLICIES AND THE SOUTH AFRICAN EDUCATION SYSTEM

Language policy and the Language in Education Policy (LiEP) is no different to any other policies implemented in South Africa. Researchers, academics and politicians discuss policy change and the effect is will have on the greater systemic environment. These policies and language ideals are developed and implemented by political parties, mainly of a western belief, and who have minimal interaction or consultation with the communities at a grass roots level. Many of these political figures have never experienced the reality of young South African learners, and do not fully comprehend how these policies will impact their lives and their education. This increases the gap between policy and practice, a gap between good intentions and lack of outcomes, especially within the education system. The youth of a country are key to its economic growth and every effort should be made to assist them, and address their needs.

This chapter contextualizes the research by presenting the historical background of language policies and the education system within South Africa. Due to its diversity, South Africa is unique, complex and contextually challenging. Its population comprises different ethnicities, cultures, religious beliefs, and an array of languages across socioeconomic clusters (Evans & Cleghorn, 2012). The education system is therefore just as complex, and has been significantly impacted by the socio-political history of the country. Although there have been numerous interventions to rectify previous injustices, the education system continues to be characterised by poor achievement scores and high dropout rates (Brock-Utne, 2010; Prinsloo, Rogers & Harvey, 2018; Taylor & von Fintel, 2016).

2.1 THE HISTORY OF LANGUAGE IN SOUTH AFRICA

South Africa's history is extensive, intense, and often distressing. However, for the sake of brevity, only those aspects pertaining to language and its impact on the education system will be summarily highlighted in this section.

Historically, laws and policies were implemented to endorse the political ideologies of the ruling government party. Policies set out and enforce a particular stance on a matter, which guides actions, goals and the distribution of resources (Evans & Cleghorn, 2012). From the time of British rule, through to the Great Trek and the Soweto uprising, language policy within the education system was always highly publicised, politicized and contested (Evans & Cleghorn, 2012). The most defining era for the country was the Apartheid era, where policies were implemented to enforce segregation based on race (Jordaan, 2011a; Howie, van Saden, Tshele, Dowse & Zimmerman, 2012). One of the ways in which this exclusion was entrenched, was through the inequality of education, both via resources and access to language. In 1953, The Bantu Education Act was legalised and became one of the most disputed policies, and the language of instruction at the centre the controversy (Alexander, 1997). This act saw African learners taught in their Home Language (HL)/Bantu languages, with little to no access to English. Although Bantu Education had rather strong educational foundations, it was considered to be yet another policy implemented to divide and rule the African population, and to further deny them access to English as the language of prosperity and wider communication (Alexander, 1997). Home languages were used as the Language of Learning and Teaching (LoLT) for African learners for the approximately seven to eight years of their primary education. They were then to transition into Afrikaans as the medium of instruction in senior levels. This meant that examinations at the end of grade 7 had to be written in Afrikaans instead of their HL, and learners were ill equipped for this. At no point was there a transition to English,

as it was considered the language of power and status, and was therefore limited to the white population group only. Afrikaans was all that remained for the far larger African population. Even to this day, Afrikaans is seen as the language of the oppressor. It does, however, still have the widest distribution of speakers, especially within the Coloured community (Brock-Utne, 2010, Evans & Cleghorn, 2012).

The Bantu Education Act was opposed by the people through the African National Congress (ANC), and it was argued that home language instruction should only continue to grade 4, that there should be a transition to dual medium instruction, and access to English. The government refused these requests, and it was only after the Soweto uprising on the 16th of June 1976, that the government agreed to amend the Act. The Bantu Education Act of 1979, saw the reduction of HL (African) instruction until grade 4, followed by Afrikaans/English as the medium of instruction (Brock-Utne, 2010; Evans & Cleghorn, 2012; Howie et al., 2012).

Interestingly, during the period of Bantu education where HL was used for the full duration of eight years, there was an improvement in academic results, with a pass rate of 83.7%. While the Bantu Education Act noted improvements in academic scores, the reason for oppression and segregation cannot be excused. The apartheid government was using this policy to ensure fragmentation of the majority of the population who were a threat to their political power (Brock-Utne, 2010). After the implementation of The Bantu Education Act of 1979, the majority of African learners showed a significant decline in academic results, leaving a pass rate of approximately 44% by 1992 (Brock-Utne, 2010).

2.1.1. The Language in Education Policy (LiEP)

The disbandment of the Apartheid era saw a period of reformulation of the education system and numerous policies therein, which aimed to improve the access to quality education and equity within the system for those previously marginalized (Evans & Cleghorn, 2012). This led to political negotiations and the constitutional decision to declare the nine Bantu (African) languages as official languages of the country, resulting in 11 officially recognised languages (with sign language to soon be the 12th). Additionally, there were fewer constraints on movement within the country, and parents were able to decide in which educational institute they wished to enrol their children (Alexander, 2000). For these reasons, South African classrooms became even more linguistically and culturally diverse, making the previous education and language policies practically null and void. The linguistic diversity within the classroom complicated communication, pedagogical practices, and instruction on a daily basis (Alexander, 2000; Evans & Cleghorn, 2012). Therefore, the South African education system had the daunting task of adapting teaching practices and policies.

Between the periods of 1993 and 1997, the new democratic government undertook to change policy and structure, and collaborated with numerous agencies to assist in this dilemma. Conferences were held to discuss the processing of legislation, consulting institutional structures to support new education dispensations, and to devise a national language plan (Evans & Cleghorn, 2012). At the helm were the issues of language equity, the inclusion and recognition of African languages, and the role language would play within the education system and the wider South African community. The larger aim was to develop cohesion within the South African population. The Language Plan Task Group (LANGTAG) (1996), suggested that any language policy implemented within the education system should facilitate equity and access to education for all learners, promote a bilingual/multilingual culture, encourage the

acquisition of more than one African language, and equip all learners with the necessary language skills to ensure meaningful participation in the workforce and South African Economy.

Based on the above recommendation and consultation with other stakeholders, 1997 saw a new and more progressive Language in Education Policy (LiEP) develop. The South African Department of Education's (DoE) Language in Education Policy (LiEP) "aims to maintain home language(s) while providing access to and effective acquisition of additional language(s)" (DoE, 1997, p. 1). This policy aimed to promote HL, in order to redress the system and better incorporate the needs of previously disadvantaged learners, through the idea of additive bilingualism (Evans & Cleghorn, 2012, Taylor & von Fintel, 2016). Additive bilingualism is implemented in classrooms with the hope of allowing for better communication in the learners' HL while strengthening English proficiency. It is suggested that this approach would increase learners' access to knowledge through their HL, and develop their English language skills for their imminent transition to English as the LoLT in grade 4. This approach is used to integrate curriculum content through HL as the initial LoLT, and then to transition to English as the medium of instruction and the universal language of the country. This is based on the belief that additive bilingualism is linguistically and culturally sensitive and has shown positive results across Africa (Evans & Cleghorn, 2012). Brock-Utne (2010), however, argues that this LiEP is a replication of the Bantu Education policy implemented by the apartheid government and is not as progressive as some are lead to believe. She suggests that the policy maintains segregation through language and does not support unity of the population.

2.1.2. Language Policy: Success or Failure?

The South African government believes it has formulated a strong and enabling policy, but it has not been effectively implemented and many barriers remain. The implementation of the policy has been disorganised and fragmented, as the system and the implemented processes were not sufficiently prepared for the fundamental role language plays in education (Jordaan, 2011b) and it has therefore not reached its intended aims and objectives (Jordaan, 2011a). We see further limitations arise in the Foundation Phase as the "education for all" and the Bill of Rights "everyone has the right to basic education" initiatives come increasingly to the fore. These saw an increase in access to education and an influx of learners into the system, but it did not, however, see all learners being able to actively participate in the education process or within the classroom (Evans & Cleghorn, 2012). It has become increasingly difficult for the government and their language policy to promote bilingualism or multilingualism in a system that allows for diversity of 11 official languages. The LiEP assumes the use of a single HL, with a steady exposure and progression in a First Additional Language (FAL) namely English, with the expected result of high levels of proficiency within both the HL and FAL (Evans & Cleghorn, 2012; Taylor & von Fintel, 2016). The expectation is for learners to be able to read several thousand words in English (FAL) and have the necessary competency to move solely into English as the LoLT in grade 4.

These expectations are unrealistic and it appears that the LiEP, is failing the learners in the system. Many of the learners cannot be taught in their HL, because of (among other factors) the significant language diversity in the classroom. This results in some/majority of learners being taught in their third or fourth language rather than in their own HL.

2.2. IMPACT ON SOUTH AFRICAN ACHIEVEMENT SCORES

These above mentioned LiEP and LoLT language concerns seem to be some of the most defining factors impacting the South African achievement scores. As previously discussed, South Africa has been characterised as having a low-quality education system with poor achievement scores, and there is little chance of improvement in sight. This is a feature of many education systems in developing countries with large social inequalities and a variety of cultures and ethnicities (Prinsloo et al., 2018; Taylor & von Fintel, 2016).

Despite further interest and increased investment in the quality of the education system, poor achievement scores remain, as can be seen in the recent release of large-scale international surveys such as the Progress in International Reading Literacy Study (PIRLS), and Trends in International Mathematics and Science Study (TIMSS) results. South Africa's language concerns remain an influencing factor, evident in the poor literacy levels reported in both PIRLS 2011 and 2015 studies (Howie et al., 2012; Howie, Combrick, Roux, Tshele, Mokoena & McLeod Palane, 2017). PIRLS focuses on reading literacy for the purpose of "reading for literary experience and reading to acquire and use information" (p. xv). The majority (71%) of the grade 4 South African learners, who were tested in all the African languages, achieved the lowest international benchmark of 400 points (with a centre point of 500) and only 6% of learners were able to read at an advanced level above 625 points. The grade 5 learners, tested in English and Afrikaans, showed that there was no overall improvement in the 4-year period between 2006 and 2011, and remained below the international standards. 43% of learners were unable to reach the low international benchmarks, and a dismal 4% of South African learners were able to achieve the advanced international benchmark on a test a grade level below them (Howie et al., 2012). The most recent PIRLS report (2016) indicates that there has been no significant progress in the national literacy scores since 2011. In this study, a population

representative sample of 12 810 grade 4 learners were assessed in all 11 languages. The results showed that 80% of the grade 4 learners could not read for meaning, and fell well below the lowest internationally recognised level of literacy. This means that learners would not be able to engage adequately with the curriculum and succeed in grade 4 and onwards into the higher grades. However, results showed that less than half of the learners tested in either English or Afrikaans as their HL were considered unable to read, a significant difference compared to African HL learners. Interestingly, there was a substantial gender difference within the literacy scores - the second highest in the world - with the girls scoring significantly higher than boys (Howie et al., 2017). Prinsloo et al., (2018) and Howie, Venter and Van Staden (2008) have attributed these meagre results to language-related issues such as language proficiency, the LoLT, LiEP, and their poor implementation.

The TIMSS study compares South African national learner mathematics and science achievement scores for Grade 9 learners, against other international countries at a grade 8 level. In the TIMSS 2011 (Reddy, Prinsloo, Visser, Arends, Winnaar, Rogers, Janse van Rensburg, Juan, Feza, & Mthethwa, 2012), report South Africa's average score for mathematics was 352, and 332 for science, which is well below the international centre point of 500. These Grade 9 scores are not directly relevant to the current research, however, the show the continued lack of academic achievement throughout the system. In the TIMSS 2015 study, grade 5 learners were assessed for the first time in South Africa, and results were compared against their Grade 4 international counterparts (a total of 48 countries participated at this level). It was no surprise that South Africa was among the five lowest performing countries, which included Jordan, Saudi Arabia, Morocco, and Kuwait (tested at the Grade 4 level). South Africa had an average score of 375 points, with 61% of the learners falling between the 325 (not achieving) and the low benchmark of 400 points. Shockingly, 33% of the learners fell below the 325-point

benchmark. These results indicate that the majority of the Grade 5 learners do not exhibit the basic knowledge and competency necessary at this level (Reddy, Visser, Winnaar, Arends, Juan, Prinsloo & Isdale, 2016). These scores do not demonstrate an education system with a successful achievement trajectory. Prinsloo et al. (2018) investigated the relationship between language proficiency and the science achievement scores. Their findings showed a significant relationship between the two, and they argued that the South African TIMSS science scores would increase (by approximately 52.47 points) if learners were taught in their HL and (by approximately 42.80 points) if their LoLT (English) was spoken more often at home. Increased socioeconomic factors would only increase achievement scores between 22-30 points, once again highlighting the importance of language factors and LoLT concerns.

On a national level, the Department of Basic Education (DBE) run annual assessments known as the Annual National Assessments (ANA). These assessments are currently under review and consideration, as questions are being raised about their reliability and credibility (Fredericks *(iol)*, 2016). However, the available results (see tables below) indicate higher scores than those represented in the more standardised and internationally valid and reliable PIRLS and TIMSS studies. The department considers test scores higher than 50% as acceptable levels of competency, and aligned with the CAPS curriculum. These results do however indicate especially low language proficiency levels in learners' FAL (English), which as discussed, is the LoLT from grade 4. These results once again bring into question the transition to English at such an early grade, given the levels of proficiency or language capabilities.

Table 2.1. Annual National Assessment (ANA) results for Home Language and First Additional Language by grade (DBE, 2014, p. 9)

Summary Table for Home Language in 2012, 2013 and 2014

GRADE	HOME LANGUAGE 2012	HOME LANGUAGE 2013	HOME LANGUAGE 2014
1	58	61	63
2	55	57	61
3	52	51	56
4	43	49	57
5	40	46	57
6	43	59	63
9	43	43	48

Summary Table for First Additional Language in 2012, 2013 and 2014

GRADE	FIRST ADDITIONAL LANGUAGE 2012	FIRST ADDITIONAL LANGUAGE 2013	FIRST ADDITIONAL LANGUAGE 2014
4	34	39	41
5	30	37	47
6	36	46	45
9	35	33	34

Table 2.2 Annual National Assessment (ANA) results for Mathematics by grade (DBE, 2014, p. 9)

Summary Table for Mathematics in 2012, 2013 and 2014

GRADE	MATHEMATICS AVERAGE PERCENTAGE MARK		
	2012	2013	2014
1	68	60	68
2	57	59	62
3	41	53	56
4	37	37	37
5	30	33	37
6	27	39	43
9	13	14	11

2.3. FACTORS THAT IMPACT POLICY IMPLEMENTATION AND THE EDUCATION SYSTEM

There is no simple relationship between language, education and achievement. Although the focus of the current research is on language proficiency and its impact on cognitive processing, South Africa remains a developing country with many other factors that

need to be acknowledged. The following section gives a brief overview of other factors that also impact the quality of education, language-related conditions and achievement scores, but remain beyond the scope of this study. Some of these factors include socioeconomic status, teachers, stakeholders, and English as the language of prosperity (LoLT).

2.3.1. Quality of education and Socio-economic status

As with Language of Learning and Teaching (LoLT), access to quality education has been a contentious and difficult battle. Quality of education is one of the most significant issues within the education system and has inescapable influence on language and its implications for teaching and learning (Taylor, Vinjevold & Muler, 2003). Socioeconomic factors deeply influence the quality of education in South Africa and has historic foundations. The majority of the South African population reside within a low SES context, which is characterised by systemic underdevelopment and a disconnection from the global economy. Most of this population is unable thrive, given their circumstance (Jordaan, 2011a). Of the above-mentioned population, a significant proportion of their schools are within the lower 3 quintiles and attended by black disadvantaged learners (Jordaan, 2011a). But to separate the population and quality of education between high and low SES groups like this, is merely an over simplification of the reality and historical struggle learners continue to battle.

In a chapter “Inequality in Education: What is to be done?”, Jonathan Jansen (2019) takes the reader through the complexities and historical background of the differences in the quality of education experienced by the South African population and the disparities experienced by learners. Jansen (2019) argues that even after two decades of democracy (post-Apartheid), education institutions accessed by the majority of the population are dilapidated and the quality of schooling provided to the learners show significant inequalities. These

inequalities are often only taken into account in research focusing on learning outcomes and their comparisons with well-resourced schools, shining a light once again on resources as its only foundations. However, given the numerous interventions implemented by government and other institutions hoping to reduce inequality throughout the 27 000 South African public schools across all provinces, through increased allocation of resources, the redress of educational inequality has failed. Motala and Carel (2019) argue that the inequality gap between the poorest and wealthiest schools have in fact increased. Spaull and Pretorius (2019) believe that the South African education system remains unequal and is in fact two tiered, with 20% of well-resourced and high performing schools on one end of the spectrum and the remaining 80% lower performing under resourced schools on the other end. This is once again an over simplification and given the classification of schools using the quintile system (1-5), there remain a large portion of schools that lie in the middle of the spectrum, showing moderate stability and reasonable achievement scores (with respect to what remains an overall low performance in achievement assessments) (Jansen, 2019). It appears that despite increased expenditure and allocation of resources into the education system, the South African government has been unable to translate increased resources to increased achievement outcomes (Reddy, 2019).

Unlike most other service delivery issues, communities no longer protest against the inequality in education and have simply accepted that it is due to lack/limitations of government resources. However, 80% of government's budget allocation is for teacher salaries, and when protests do occur, it is because teachers are complaining about low salaries and poor working conditions (Janson, 2019; Pattillo, 2012). Even with the increased expenditure on human capital, there is still no improvement on quality of education and unequal learning outcomes remain (Jansen, 2019). Jansen (2019), believes that this is because learners from

disadvantaged schools, enter weaker universities and receive and inadequate teaching qualification. These teachers then enter schools where they are unable to offer quality learning and adequate curriculum coverage, resulting in another hindrance in the much-needed progress in the education system. It is also noted that there remains an inequality in the distribution of "competent" teachers between privileged quintile 5 schools and the most disadvantageed quintile 1 schools (Taylor, 2019). To date, there are numerous arguments as to what is needed to improve the quality of the education system, when in fact we know more about the inequality of achievement outcomes, than the opportunity to quality education. Researchers need to stop focusing on the outcomes and realign their focus on the underlying mechanisms that sustain inequality within a developing country such as South Africa. Studies need to get to the root of social inequality which lies beyond the schooling system, before redress within the education system can occur (Jansen, 2019).

Based on the above, the current study acknowledges the overarching impact the quality of education has on achievement scores, but the study of such a discourse is beyond the scope of the study. Nevertheless, the next section discusses socioeconomic status (SES) (which is a factor of inequality) and its effects on, the previously mentioned research on achievement outcomes.

2.3.2. How Socioeconomic Status (SES) continues to influence academic achievement

In developing countries like South Africa, there are many realities that impact the efficacy and implementation of policies, and the quality of education. Cultural and SES influence a learner's learning experience as well as the quality of their language input, which influence their literacy and language proficiency (de Sousa, 2016). Due to the lack of, and accessibility to resources, the education system is not always able to supply the best quality of

education to all learners. This is reiterated by teachers who have said that they lack the support and materials necessary to implement the LiEP within the classroom (Balfour, 1999; Evans & Cleghorn, 2012). Language in education is a major concern, and its application is diluted with concerns such as teacher: pupil ratios, nutrition, and sanitation, all of which are related to the socioeconomic circumstances the learners and the schools they find themselves in. There are continued discrepancies between the quality of education offered to the majority of the population and those that remain below the breadline. The individual's right to choose their LoLT, is further hindered by practicality, resources, vicinity, available space in schools and the need for at least one meal per day (Balfour, 1999). Balfour (1999) discusses the link between income or higher SES levels, and how access to resources improve literacy skills. This is supported by PIRLS results, where they found that grade 4 learners residing in rural or remote areas and townships had the lowest literacy scores (Howie et al., 2017).

It is easy to imagine the impact of learning a "foreign" language while residing in a developing country with minimal resources and support (Prinsloo et al., 2018). What has also been noted is that the lower the SES classification, the higher the number of learners (approximately 45) in a single classroom, many of whom have little to no access to English (Howie et al., 2017). Similar SES results were indicated in the TIMSS report, where they used parents' level of education as one the SES indicators, suggesting increased access to resources and therefore higher achievement scores. The TIMSS study found that increased SES indicators - higher maternal education, increased number of books a family has in their home and how often the language of testing (English in this case) is spoken in the home - increases learners' achievement scores. For example, the learners who reported having only a few resources, scored an average of 348 points, whereas those that reported having many, scored an average of 599 points (Reddy et al., 2012, Reddy et al., 2013). Similar results were found by Prinsloo

et al. (2018). Their results showed that HL and LoLT alignment, as well as speaking the LoLT more often in the household, (all factors consistent with an increased SES) showed a greater science improvement.

Taylor & Coetzee (2013) agreed that the medium of instruction is critical, but that socioeconomic factors throughout the education system serve as severe constraints to improving the quality of education and increasing achievement and literacy scores. Therefore, the government faces a conundrum of knowing the importance of literacy and its impact on the development of cognitive skills (Balfour, 1999), and translating that into a functioning system with the current economic concerns and lack of basic resources. With such socioeconomic and diversity concerns, one questions the feasibility of having 11 official languages and trying to implement them all as mediums of instruction. The economic and educational resources in South Africa require extensive consideration when it comes to undertaking the implementation of the language policy, educational needs, and maintaining effective education (Balfour, 1999). Note, the influence of SES on language development and language acquisition are discussed in more detail, in the following chapter.

2.3.3. Teachers

Teachers are a critical resource and play a key role in the quality of education. As briefly discussed above, teachers in lower quintile schools (lower SES) are under resourced, have double the number of learners in their class, and are expected to use language to build the foundations for subjects (Evans & Cleghorn, 2012). This scenario is further complicated by asking teachers to use a language which they themselves are not proficient in. Although many teachers are considered multilingual, research has showed that only 8.2%of the South African population are proficient in English, and many teachers are teaching in an African language,

that is not their HL (Evans & Cleghorn, 2012), suggesting their proficiency and understanding of the language has limitations. The education system is holding teachers accountable for language acquisition and learner achievement, when they have to overcome the language (and resource) barriers themselves. Therefore, the language in education concerns are not only impacting the learners, but their teachers too (Evans & Cleghorn, 2012). This once again highlights the disparity in quality between education in lower income communities and those in higher income ones, as well as continued language concerns.

2.3.4. Policy Makers

The influence of the stakeholders in the political sector further impact the system. Although research findings are disseminated to politicians and key stakeholders, they are not forced to adopt and implement the results (Brock-Utne, 2010). In order for HL instruction in education to succeed, it requires more than just a mention in the constitution, but rather constant investment and endorsement (Balfour, 1999). By placing emphasis on 'English as power' and the 'ideology of the previous government', segregation is maintained in the current "democracy" and most learners continue to be neglected (Balfour, 1999). The DoE argues that the LiEP encourages multilingualism, cultural diversity and the building of a non-racial country (Language policy in Education, 1996). One then questions the need for the transition to English, and the contradictory idea of English being the language of advancement. Under the Apartheid government, Afrikaans became the only voice to be recognised, and now the same is being said for English. Is it that English is now the language of the oppressor, preventing inclusion, social mobility and access to resources? (Brock-Utne, 2010). There does not have to be a segregationist idea, of each "group" having its own language and being taught in that language (Balfour, 1999), but more the idea of capabilities and the importance of proficiency, which will allow the acquisition of English (and other languages) through HL instruction. Even though

policy makers and stakeholders argue that English is preferred over other mediums of instruction, as indigenous languages do not exhibit the necessary linguistic complexities for scientific terminology (Balfour, 1999), South Africa needs to find the best method to ensure quality education with a transition to English at the appropriate level, to encourage language proficiency in both English and the learner's HL (Brock-Utne, 2010, Prinsloo et al., 2018).

2.3.5. LoLT and English is Power

The sections above have continually highlighted the importance of language, and the concerns regarding the mismatch between a learner's HL and their LoLT. Language has been used as a tool for segregation since 1953 during Apartheid and some (Brock-Utne, 2010) suggest it continues to be used to supress the majority. English is still considered the language of prosperity (the universal language) and has therefore resulted in parents ignoring the guidance of the LiEP (favouring a HL as the LoLT) and opting for a straight to English approach (Taylor & von Fintel, 2016). They are rejecting the evidence showing the benefits of HL education and choosing to immerse their children into English education from as early as grade R (Evans & Cleghorn, 2012, Taylor & von Fintel, 2016). English continues to be linked to liberation, and the conflict surrounding language and the Apartheid government. This has created a paradox between equity and equality and thus allows for the dominance of English over previously marginalised African languages (Balfour, 1999). Education in an African language is associated with a poor quality of education whereas English is associated with transformation, improved labour market returns and power (Taylor & von Fintel, 2016). English continues to receive support from the Western world policy makers and is seen as necessary for the introduction into business and political endeavours (Balfour, 1999). It is understandable that parents grow impatient and ignore research arguing for HL education as they believe that English immersion will bring prosperity and a better future for their children.

Researchers argue that more work needs to be done to promote the ideas within the LiEP advocating for HL teaching, in order to achieve a bilingual system in which the learners are able to become literate and proficient in both their HL and English, and succeed within the education system (Balfour, 1999; Evans & Cleghorn, 2012, Prinsloo et al., 2018). As mentioned in the SES section, English is very seldom heard in more rural areas and is not used for communication (Brock-Utne, 2010), therefore immersion in English has detrimental effects over and above those of resource concerns. With the majority of learners entering secondary education with very limited literacy competencies in English, the question remains: is it still worth transitioning to English as the LoLT if it is partially taught and hinders the learning experience (Balfour, 1999)?

These sociocultural practices and beliefs are currently ruling the decisions on the use of HL as the LoLT, determining what is considered the most acceptable or desired way of talking, reading and knowing (Prinsloo et al., 2018), and this is mostly in favour of English and a Western viewpoint. The aspiration to learn and acquire English through the education system from the earliest grade possible compromises the foundation of the language, and inevitably affects academic achievement and literacy skills. Prinsloo et al. (2018) argues that the continued misalignment of a learner's HL and their LoLT will result in the underdevelopment of their HL as well as English, and learners will continue to fall behind academically. They suggest that learners be competent in the language they are taught in, and that any transition to an additional language be done at a stage when the learner is sufficiently proficient to do so, which could be after 6-8 years according to Cummins (2008). Prinsloo et al. (2018) recommends that government work on the bias against being taught in an African language, and encourage learners (and parents) to change their mindset for the wellbeing of the learner

and their academic success. Furthermore, the language policy should increase exposure, and extend the number of years learners are taught in their HL, while strengthening their FAL/English proficiency and increasing language materials and resources in both languages. The circumstances we are finding in this country are mirrored throughout the world and South Africa could be the change so many education systems need. Should the country successfully implement a LiEP that is progressive and democratic, it would receive international acknowledgment and support (Brock-Utne, 2010).

2.4. DBE SCHOOL BASED INTERVENTIONS

The average South African learner is influenced through three significant systems; the home, the school, and their classroom environment. All of these contribute to the learner's experience and acquisition of language. By the age of five, learners are expected to have a sophisticated grasp of their HL, which should increase upon entering the education system as learners begin to master reading (van Staden & Howie, 2012). This seemingly simple process is complicated in the South African context by learner's having more than one obvious primary language, as well as exposure to other languages with a variety of dialects. These typical exposures cause learning difficulties and interference, and exacerbate concerns surrounding second language learning (Heugh, 2000; van Staden & Howie, 2012). Deciding on a single LoLT is seemingly impossible under such divergent circumstances and variances within a language (Taylor, 2012).

This being said, the Department of Basic Education (DBE) have responded to the debate and the empirical research, by implementing the Early Grade Reading Study (EGRS). This study acknowledges the developmental challenges South Africa faces, especially regarding literacy and reading for meaning in the foundation phase of primary education. The

DBE believes that the root cause of poor academic achievement in the schooling system is due to weak literacy foundations. As it will take many years to bring about significant transformation of the poor socioeconomic situation, the focus of this initiative is to work within the schools, classrooms and communities (EGRS, 2017). In summary, the intervention targeted quintile 1-3 schools, starting at the grade 1 level (and moving to grade 2-3)-, to improve reading outcomes in learners' HL. The EGRS uses the Early Grade Reading Assessment (EGRA), the same used in this current research, to evaluate three focused interventions and a control group. The "training" intervention focuses on equipping teachers with daily lesson plans aligned with the curriculum, as well as additional reading material and training workshops twice a year. The "coaching" intervention not only included the above materials, but provided teachers with support through on-site coaching and smaller group training sessions. Lastly, the "parental involvement" intervention invited parents to weekly meetings at the school, to highlight the importance of reading in early grades and give them training on the tools necessary to assist them in their child's literacy development. During the assessment of learners using the Setswana EGRA, additional grade appropriate Mathematics and English as FAL were added since they are considered main learning areas (EGRS, 2017).

The EGRS found the "coaching" intervention had a considerable positive impact and the learners assessed in this group achieved significantly higher in the overall assessment (EGRA, Mathematics & FAL) than the control group and the other two interventions. More specifically, the learners in the coaching intervention were regarded as being approximately "40% of a year" ahead of the learners in the remaining categories. The "training" and "parental" interventions did however show a minimal positive impact in comparison to the control group (EGRS, 2017). With regard to the EGRA literacy assessment, learners in the coaching group ranged between 24%-35% of a year ahead of the other learners, within the different subscales,

with an average of 29% of a year ahead. Other findings aligned with previous studies, showed that learners whose parents had matric, scored higher and girls achieved significantly higher than boys in literacy scores (EGRS, 2017). Some relevant findings include a positive effect on English with the increase of literacy in Setswana, which was attributed to the improvement of underlying language ability obtained through the learner's HL. Urban township schools showed better results than rural schools and finally, the mid-top performing learners seemed to have benefited the most from the interventions with small changes seen in the lower performing learners. Some of the recommendations put forward from the analysis of the EGRS intervention include: implementing more coaching programmes in priority schools (using in-service training) on a temporary basis, determining what works better in rural areas, developing an EGRS for English as a first additional language, and developing standardised reading norms in the African Languages for the EGRA (EGRS, 2017).

2.5. SUMMARY

In Summary, South Africa remains a complex country which has been plagued by language issues and poor academic achievement. The LiEP, although developed with the best intentions of reformation and transformation, has had its difficulties and its implementation has been fragmented. Socioeconomic status continues to play a vital role within the education system, and is correlated with access to resources, quality of education, language proficiency and making informed decisions regarding LoLT. The chapter emphasises the importance of LoLT and being taught in a HL for as long as possible, with significant exposure to a learners FAL (English) to ensure proficiency and necessary literacy capabilities, before transitioning to English as the LoLT in grade 4 (or even later).

CHAPTER 3

LANGUAGE AND COGNITIVE PROCESSING

Globalisation is what characterises our societies. Populations are fashioned by various ethnicities, cultures, and languages. The use of two or more languages has become one of the most common phenomena in the world, with over half the world's population being multilingual (Bialystok, 2017; Vivas, Ladas, Salvari & Chrysochoou, 2017).

3.1. LANGUAGE AND BILINGUALISM

Language is one of the most constant and unifying ways in which people experience the world, think, and engage with one another. Language is at the centre of human behaviour and with such a vast majority of the world being bilingual or multilingual, it is no surprise that this socio-political factor has seen so much research devoted to it. Defining bilingualism is challenging. It is a multifaceted, multidimensional construct and not a mere categorical variable (Bialystok, 2017; Luk & Bialystok, 2013). Previous definitions of bilingualism have been rather simplistic, for example, Bloomfields (1933) considers bilingualism as being fully fluent in two languages, and Grosjean (1989) defined bilinguals as being able to function in both languages according to their needs (in Bialystok, 2001), while Garrat and Kelly (2008) define bilinguals as individuals who have developed the skills to listen, speak, read, and write in two languages.

For such a multifaceted construct, the above definitions are not all encompassing and do not account for all the possible variations/degrees of bilingualism. Bilinguals and multilinguals are not simply individuals who speak more than one language, and not all of them have the same capabilities to speak, read and write in all their languages. Bilingualism is a

consequence of experience and not all experiences are the same, thus resulting in degrees of bilingualism which have their own functioning and processing outcomes. Some of the contributing experiences resulting in bilingual variations are context and environment related. Some individuals are born into a bilingual family and learn both languages from birth, others aspire to be proficient in two or more languages throughout their lifetime, and others have access to varying levels of quality in language education (Bialystok, 2001; Bialystok, 2017; Fricke et al., 2019; Kroll & Bialystok, 2013). Other factors include migration and residence in another country, formal education in another language, or as with the South African context, there are a variety of official languages that individuals are exposed to (Bialystok, 2001; Bialystok, Craik, Green, & Gollan, 2009; Evans & Cleghorn, 2012; Taylor & von Fintel, 2016). Therefore, bilingualism is considered an experiential consequence with interrelated factors, where the age of language acquisition, the magnitude of the exposure and duration of language use, determines individuals' language capabilities in each language. Increased language capabilities result in increased proficiency in the different languages and strengthens the "level"/degree of bilingual or multilingualism (Bialystok, 2017; Fricke et al., 2019; Kroll & Bialystok, 2013; Luk & Bialystok, 2013).

3.1.1. Emergent Bilinguals

It is noted that many South African learners are exposed to more than one language throughout their development and are therefore considered multilingual. However, based on the discussed language policies and education concerns between the use of HL and English as LoLT, this study focuses on these two languages and grounds them in bilingual research.

In South Africa, there are various factors influencing the acquisitions of languages and the ability to use the languages proficiently, it is not simply a case of being bilingual and being

able to speak 2 languages. Languages are acquired in either a social context (at home) or in an educational context (such as the classroom). As discussed in depth in Chapter 2, the Language in Education Policy (LiEP) stipulates that learners should be taught in their Home Language (HL) in grades 1-3 and transition to English as the Language of Learning and Teaching (LoLT) in grade 4. A vast majority of learners' parents opt for a straight to English approach (Taylor & von Fintel, 2016). For many learners, their initial exposure to English as a L2 only occurs when entering the educational system and these learners are referred to as Emergent Bilinguals. Emergent bilinguals acquire their first language (L1/HL) within the home environment to allow for more of a social interaction and exposure to English usually only occurs within the educational environment as a First Additional Language (FAL) or is used as the medium of instruction. The theory is that emergent bilinguals use their L1 as foundation to acquire and develop their L2 (de Sousa, 2016; Verhoeven, 2007). Uchikoshi (2012), has also referred to this as sequential bilingualism, however, sequential bilinguals only acquire a second language after successfully developing their L1, with the ability to use both languages for pedagogic instruction. Within a South African setting, one cannot simply assume that learners have a significant grasp of their L1, before being exposed to English as their FAL in an educational setting, let alone having it used as a LoLT (de Sousa, 2016). Because both languages are acquired in different contexts and for different purposes, the decision of which language to use as a means of educational instruction once again comes into question as well as its impact on academic achievement (de Sousa et al,. 2010). As the learners' initial encounter with their L2 is only within an educational setting, they often present with limited oral language proficiency and the inability to read and write adequately in their L2 (de Sousa, 2016; Verhoeven, 2007).

As emergent bilinguals acquire their L1 and L2 in vastly different contexts, it is important to understand how this influences the development of the languages and possible

implications for higher order functioning. A child usually acquires a L1 from birth, in a home environment to allow for basic interpersonal communication in a social setting. In an ideal world, this language would continue developing within an educational environment to allow for more sophisticated use. Although this is discussed in detail in the following chapter, this distinction between language use was originally made by Cummins (1979). Cummins (Cummins, 1979, 2008, 2009; Cummins & Yee-Fun, 2007) refers to the initial development of L1 and its use in a social setting as Basic Interpersonal Communicative Skills (BICS), this language in theory should be developed further and transition to its use within an educational setting and is defined as Cognitive Academic Language Proficiency (CALP). CALP is important for academic achievement as it focuses on the learners increased literacy and their abilities to interpret multifaceted academic concepts using higher order cognitive processing (Cummins, 2008, 2009; Cummins & Yee-Fun, 2007). This transition from BICS to CALP should ideally occur in a learner's L2 as well. Unfortunately given emergent bilinguals' exposure to language, often with poor L1 proficiency and a brief transition to English, it is unreasonable to expect these learners to have achieved the necessary CALP development in either L1 or L2 (Cook, 2007; Paradis, 2009).

3.1.2. Academic Language

The section discussed emergent bilinguals, who acquire their second language in an educational setting with the hope of achieving Cognitive Academic Language proficiency to improve higher order functioning, for teaching and learning purposes. But what is Academic Language?

Academic language is vital for academic success, as not only does it contribute to literacy skills, but it allows for meaningful engagement within the classroom and with the

curriculum. Language for basic communication and for academic achievement are fundamentally different, however, there is not a single definition for academic language, and it varies for second language learners (Jordaan, 2011a; Valdes, 2004). In general, academic language is usually measured as the learner's ability to speak, read, and write proficiently in a language used within an educational setting. With second language learners, academic language is often defined by the learner's basic ability to process and comprehend academic constructs in both verbal and written forms, to achieve academically (Valdes, 2004). For South African bilingual learners, this is seldom possible in their L1, let alone their L2, which they will then rely on for the remainder of their academic career. Instructional practices are important contributors to developing academic language proficiency to a threshold which allows for meaningful academic engagement. In L1 educational settings, grades R-3 are used to develop learners' basic language abilities, to build a "sturdy" L1 foundation for the further development of academic language proficiency necessary for academic achievement (Jordaan, 2011a; Scarcella, 2011). This academic language would include more sophisticated academic vocabulary and use of linguistic skills, to comprehend the increasing complexities and demands of the academic curriculum, including the conceptualization of more abstract ideas/knowledge. It takes approximately 5-7 years (after achieving BICS) to achieve academic language proficiency in well resourced, developed countries (Cummins & Yee-Fun, 2007; Jordaan, 2011a; Scarcella, 2011).

Unfortunately, studies have shown that learners in developing countries like South Africa often do not develop this basic L1 or English language foundation, which negatively impacts the advancement to academic language proficiency. As discussed in chapter 2, this lack of language development is often due to the LiEP with an early transition to English as LoLT or the straight to English approach. Regardless of the medium of instruction, the overall

quality of language education is poor and negatively impacts language development in both languages (Brock-Utne, 2010; Evans & Cleghorn, 2012; Taylor & von Fintel, 2016). The assessment of L1 (English) academic language abilities and educational outcomes generally align with South African standardized, age-appropriate evaluations. The assessment of second language abilities and the standardization of these measures varies significantly and are often considered unreliable (Reagan, 2009). Therefore, these assessments do not adequately reflect language skills and display a superficial understanding of academic language proficiency in South Africa and do not appropriately distinguish between a learner's BICS and CALP proficiencies. Language assessments do not sufficiently reflect a learner's ability to think and reason in their second language, as needed to understand, and cope with the increasingly complex academic curriculum (Jordaan, 2011a; Reagan, 2009; Scarcella, 2011).

3.1.3. Language acquisition and development

For the education system to cope within a bi/multilingual context, it is important that their policies align with how language is acquired and what is needed to develop academic language proficiency in both HL and L2. Second language acquisition is complex and as this study focuses on emergent bilinguals, who acquire their second language during the ages of 6-9 years (the first three years of formal education), it is imperative to understand how language acquisition varies. Language acquisition in emergent bilinguals is important as is relies on the development of a learner's HL first, before they are exposed to English as a second language for the first time in an educational setting (Cook, 2007; Cummins, 2000; Paradis, 2009). Second language acquisition in the current study is framed by Cummins' Interdependence Hypothesis Theory (Cummins, 2008; Cummins & Yee-Fun, 2007; Fanson, 2009; Roessingh & Kover, 2003), which will be discussed in detail in the chapter to follow. This theory follows on from the discussion of BICS and CALP, where L1 interpersonal communication skills continue to

develop and with increased proficiency transition to academic language proficiency. The same needs to occur for both languages in emergent bilinguals. The Interdependence theory argues that second language acquisition relies on the solid foundation of L1 development. Therefore, basic communication skills and academic language competency of a learner's L2 relies on their competency in L1. A poorly developed L1, makes it even more complicated to acquire a second language and slows down the process significantly. For emergent bilinguals, the learners HL/L1 proficiency levels when entering the education system are incredibly important, given their first encounter with English as L2 occurs at the same time. It takes a second language learner twice as long to reach language proficiency in their L2 as it would monolingual learners, which is then further complicated in a South African context by low SES and poor quality of education (Cummins, 2008; 2009; Cummins & Yee-Fun, 2007). If a learner's L1 is not adequately developed before the acquisition of a learner's L2, subtractive bilingualism may occur. Subtractive bilingualism is when both languages regress or proficiency is not achieved in either language (Cummins, 2000; Genesee, 1999).

Language processing at a level of academic proficiency draws on extensive cognitive resources. As the learners becomes more proficient and fluent in a language, the more automated the cognitive processing becomes and therefore, requires less cognitive resources. For second language learners who are struggling to acquire the L2 due to a poor L1 foundation and proficiency, the ability to automate cognitive processing becomes increasingly difficult when their L2 is used as the medium of instruction (Hulstijn, 2007; Jordaan 2011a; Myles, 2010). The Interdependence theory suggests that as learners become more proficient in both languages, the more likely they are to access acquired academic knowledge in both languages, reducing the draw on cognitive resources, which suggests a positive effect. For there to be a seamless/automated transfer of information between the two languages, the learners must reach

a specific academic language proficiency threshold in both languages. Cummins uses the Threshold theory to explain how varying levels of language proficiency influences cognitive processing (Cummins, 2008; Cummins & Yee-Fun, 2007; Fanson, 2009; Roessingh & Kover, 2003). Cummins uses two basic thresholds; low and high, to categorize bilinguals (limited and balanced) and explains how proficiency in both languages influences cognitive processing. If a learners L1 and L2 language proficiencies fall below the low threshold, they are considered limited bilinguals, which has a negative cognitive effect. If a learner falls between the low and the high threshold, there is a neutral cognitive effect, as the learner is adequately competent in one of the two languages. If both language proficiencies lie above the high threshold, learners are categorized as balanced bilinguals which results in cognitive advantages (Baker, 1993, 2001; Cummins, 2001).

From the above discussions, it becomes clearer that not all bilinguals are the same and there are degrees of bilingualism based on language proficiency, which influence cognitive processing in various ways. The ideal level of bilingualism is to be considered a balanced bilingual, which is to become sufficiently proficient in both languages (Bialystok, 2001; Bialystok & Barac, 2012; Cummins, 2001). Cook (2007) and Paradis (2009), argue that it is unlikely emergent bilingual, second language learners will reach academic language proficiency levels, expected of L1 monolingual learners. Luk and Bialystok (2013), Kroll and Bialystok (2013) and Bialystok (2017), have done significant research to determine which factors influence language proficiency and the degrees of bilingualism, to reach balanced bilingualism. They discovered a strong correlation between the age of second language (L2) acquisition (the age at which individuals become bilingual), the frequency of use of each language (bilingual usage), and the relative levels of L2 to L1 proficiency. They maintain that in order to reach optimal proficiency levels in both languages, individuals should acquire a

second language at a young age and actively use both languages on a daily basis over a significant duration of time (Bialystok, 2017; Kroll & Bialystok, 2013; Luk & Bialystok, 2013).

3.2. COGNITIVE PROCESSING

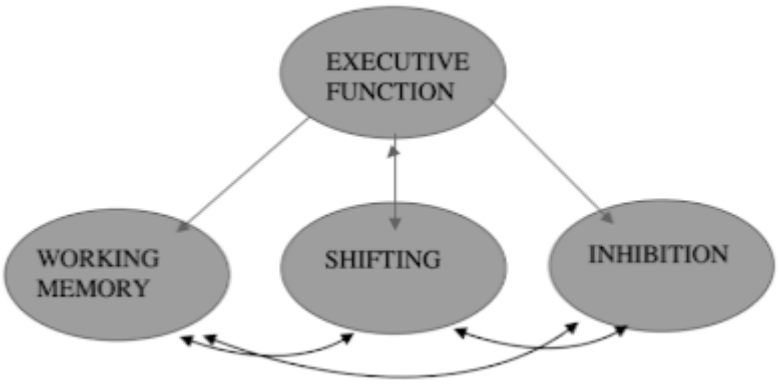
As this research focuses on the education system and factors that may lend themselves to improving academic achievement, language and its influence on cognitive processing becomes an important consideration.

After a brief reflection on academic language proficiency, BICS/CALP, the Interdependence and Threshold theory which all highlight language and its influence on cognitive ability. Cummins (1998) argues that through increased HL instruction, results show there is continued improvement in learner's linguistic, cognitive, and academic outcomes. The relationship between language context and cognition dates to Vygotsky's sociocultural cognitive perspective, which argues that cognitive development is influenced by sociocultural contexts, such as the education system (Vygotsky, 1987). A sociocultural perspective incorporates the influence of both language and cultural aspects on cognitive development. Cognitive processing is important for academic growth, which requires higher order functioning. For learners to comprehend the curriculum, not only do they require the necessary literacy skills, but they have to have the ability to think, evaluate, analyse and integrate the information that is presented to them. Cognitive processing allows learners to assimilate the knowledge they have required to cope with the increasing curriculum demands (Cummins, 2008; Cummins & Yee-Fun, 2007; Fanson, 2009; Roessingh & Kover, 2003). Such higher order functioning is often associated with Executive Functioning (EF) and Working Memory (WM).

3.2.1. Executive functioning

In short, executive control (also referred to as executive functioning) is considered a command-and-control centre that is made up of core interrelated components and is situated in the prefrontal cortex. These foundational components include inhibition, selective attention, working memory and cognitive flexibility, which allow for higher order processing such as reasoning, problem solving and planning (Best & Miller, 2010; Collins & Koechlin, 2012; Miyake, Friedman, Emerson, Witzki, Howerter & Wager, 2000; Paap, Johnson & Sawi, 2014). EF development begins during the first few years and becomes more established throughout childhood and adolescence. The development of the underlying EF constructs also differentiated during the stages of development between the ages of 8- 13 years, depending on the cognitive demands (Best & Miller, 2010). The current research uses Miyake and Friedman's "unity and diversity view" to frame executive functioning. Miyake and Friedman (Miyake et al., 2000) believe that EF consists of components which are distinct entities but interrelated (see figure 3.1.). This study measures EF with a developmental NEuroPSYchological (NEPSY) assessment which covers the be below EF components.

Figure 3.1. The Unity and Diversity Model



(Miyake et al., 2000)

3.2.2. Inhibition

Inhibition is often considered the foundation of EF in Miyake and Friedman's model. Inhibition usually begins as early as three years of age, strengthens rapidly into middle childhood, and stabilizes at approximately the age of 13 years. Neural imaging using fMRI shows inhibition is more localized in the Prefrontal Cortex (PFC) (Best & Miller, 2010). Inhibition is the ability to maintain or change an automated response, through monitoring, reasoning, and self-regulation using selective or sustained attention (Korkman et al., 2007). The ability to inhibit dominant or automated responses measures an individual's impulse control and so EF is also known as the inhibitory control center. This cognitive ability contributes to shifting, planning, reasoning, working memory and goal setting, which is vital for language acquisition and for academic purposes (Best & Miller, 2010; Korkman et al., 2007; Miyake et al., 2000).

3.2.3. Shifting

Shifting (attentional flexibility/selective attention) is the ability to unconsciously shift attention between one or more tasks, rules, or even mental states. This construct feeds into the broader aspect of cognitive flexibility. Shifting relies heavily on both EF and WM. For learners to be able to shift efficiently, they need to be able to inhibit automated activation and maintain a WM response. This suggests that learners shifting ability is present at a young age but stabilizes later in development at approximately 15 years of age (Miyake et al., 2000).

3.2.4. Working Memory (WM)

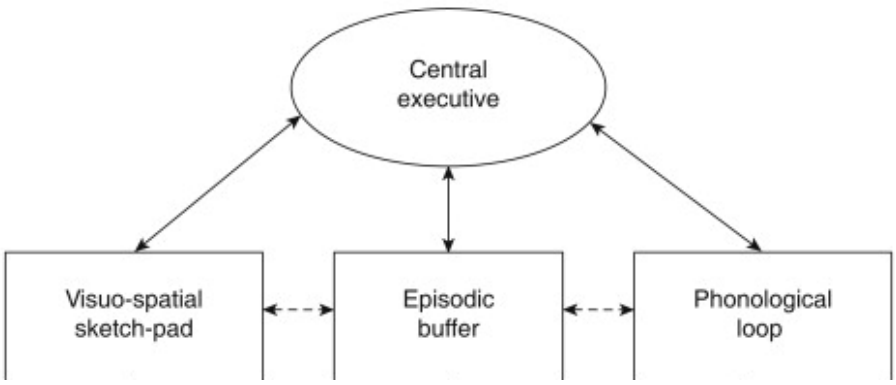
WM allows for the maintenance and manipulation of information over a period of time. WM activates the frontoparietal, dorsal and ventral parts of the PFC. It also has a linear developmental trajectory, starting as early as the age of four and stabilizing at approximately

15 years of age. WM is important for academic achievement and cognitive processing, as it is central to language processing and language acquisition (Jordaan, 2011a; Miyake et al., 2000). During childhood, learners rely heavily on attention and WM. Executive Functioning as a whole, including WM, enable learners to process and manipulate stored information to allow for other higher order cognitive tasks including reasoning, comprehension, problem solving and planning (Baddeley & Logie, 1999; Jordaan, 2011a; Paap et al., 2014).

3.2.5. Multi-Componential Model of Working Memory

Although Working Memory (WM) forms an integral part of Miyake's EF model, this study measures it as a separate component using the Automated Working Memory Assessment (AWMA). The AWMA uses the Baddeley's multi-componential model of WM (Baddely, 2003; De Sousa, 2016). The initial WM model presented by Baddeley and Hitch (1974) consisted of only three elements; the phonological loop and visuo-spatial sketchpad which are modality/domain specific (short term storage) and the third component, the central executive is defined as a domain general control system (Baddeley, 2000; De Sousa, 2016; Jordaan, 2011a). Baddeley's more recent models (Baddeley, 2000, 2003) includes a fourth component, the episodic buffer.

Figure 3.2. The Multi-Componential Model of Working Memory



(Baddeley, 2000, 2003)

1. The Central Executive: is a domain general control system that drives the entire system. By allocating information to the different subcomponents, it allows for higher order processing such as reasoning, language processing, problem solving and comprehension of information.
2. The Phonological Loop: is responsible for temporarily storing and rehearsing verbal information. This is the phonological short-term memory and is critical to language acquisition and use. The phonological loop is divided into 2 subcomponents, the phonological store which holds active verbal information and the articulatory loop, which allows for the repetition of this information in a cycle for a limited period of time.
3. The Visuo-Spatial Sketchpad: is a modality sensitive domain that stores visual and spatial information. This is a non-verbal WM aspect of Baddeley's model.
4. The Episodic Buffer: communicates between both long term and short-term memory, which allows for the integration of all information from the different sub-components. By combining all the information from the different channels or separate entities, the buffer presents the information, and the individual perceives the information as a whole (Baddeley, 2000, 2003; De Sousa, 2016; Jordaan, 2011a).

3.3. BILINGUALIMS AND COGNITIVE PROCESSING

At this point, the chapter has covered academic language, language acquisition, emergent bilingualism with varying levels of language proficiency, and the importance of cognitive processing for academic achievement. Given most South African learners are bilingual/multilingual and are currently underachieving academically, this section investigates the relationship between bilingualism and cognitive processing. Initial studies focused on the comparison between monolingual and bilingual individuals to determine cognitive differences.

These studies suggested that bilinguals outperformed monolinguals on cognitive processing tasks, specifically nonverbal executive control. Eventually, studies transitioned to comparisons between bilinguals with varying levels of language proficiency, where learners with increased proficiency in both languages showed cognitive advantage (Bialystok, 2017; Bialystok & Barac; 2012; Luk & Bialystok, 2013; Kroll & Bialystok, 2013). More recently, meta-analyses studies have shown that there may in fact be no bilingual advantage at all (Donnelly et al., 2019; Lehtonen et al. 2018; Paap et al., 2014; Paap et al., 2015; Paap et al., 2017; Paap, 2019; Vivas et al., 2017).

3.3.1. Bilingual Advantage

Initial bilingual studies investigated metalinguistic processing differences between monolinguals and bilinguals, which showed there was a significant difference between them. When studies confirmed that these findings were consistent across all developmental stages, research expanded beyond metalinguistic processing into nonverbal cognitive functioning. Most of the initial research regarding bilingualism and cognitive functioning has been carried out by Ellen Bialystok and her colleagues, and their studies form part of the current research framework. A significant portion of their research explored the difference between monolingual and bilingual cognitive processing using a variety of cognitive measures. Within these studies, the most consistent findings were that bilinguals outperformed monolinguals in two specific domains, metalinguistic awareness, and nonverbal executive control (Bialystok & Barac, 2012; Luk & Bialystok, 2013; Kroll & Bialystok, 2013), and showed that there is in fact a strong relationship between language processing and executive control (Fricke et al., 2019).

Bilinguals showed enhanced executive functioning (compared to monolinguals) in the areas of concept formation, symbolic development, classification, analogical reasoning, visual

spatial skills, and metalinguistic abilities (Bialystok et al, 2009; Bialystok & Craik, 2010; Bialystok et al., 2010; Bialystok, 2011 Diaz & Klingler, 1991; Garrat & Kelly, 2008; Gathercole, Thomas, Jones, Guasch, Young & Hughes, 2010).

With such consistent findings, these researchers began to hypothesise about why bilinguals specifically showed such increased cognitive performance compared to monolinguals, especially in the areas of executive control. In addition, what was so unique about the relationship between language and cognitive functioning, which allowed for improved cognitive outcomes, Diaz and Klingler (1991), and Bialystok (2009) and her colleagues argue that bilinguals show a higher degree of cognitive control, which is necessary to efficiently manage language performance between two languages, which has a positive effect on other non-linguistic aspects of cognitive functioning. The uniqueness comes from how bilinguals process language. It is believed that the two languages always remain active and bilinguals have continuous access to both. Therefore, the parallel activation of both languages creates competition between them, and a robust mechanism is required to ensure such interference does not impact the fluency and processing of the languages (Kroll & Bialystok, 2013). This continuous language activation is thought to be part of domain general cognitive processing, and consistent selection between the two languages is argued to not only strengthen its linguistic domain, but other non-verbal processing too (Bialystok, 2017).

In short, bilinguals have two competing languages, and the systems need to function without interference, requiring selection and inhibitory control from the executive functioning networks (Kroll & Bialystok, 2013). Therefore, bilingualism as a linguistic experience has consequences for both language processing and overall nonverbal cognitive processing (Kroll & Bialystok, 2013). The difference in cognitive capabilities between monolinguals and

bilinguals is due to bilinguals' increased abilities for conflict resolution, as they are able to inhibit competing information and increase cognitive flexibility by continuously switching back and forth between languages, therefore strengthening their cognitive processing over that of monolinguals (Paap et al., 2014). Bialystok (2011) suggests that the more complex the task and context, the more proactive the languages become in assisting with processing. Bilinguals show an advantage by processing information with both languages, especially when there are conflicting and complex concepts, with a large proportion of executive control being activated (Bialystok et al., 2009; Bialystok & Craik, 2010; Bialystok et al., 2010; Bialystok, 2011).

3.3.2. Why, Where and How?

With many of the early influential studies indicating bilinguals outperform their monolingual counterparts in executive functioning tasks, researchers turned to identifying which specific executive control components are impacted most. Studies of executive functioning have used assessments such as Task switching, the Stroop task, the Flanker task, the Simon task, the Embedded Figure task, Luria's tapping task, and reverse categorization to explore the advantages of bilingual processing (Luk & Bialystok, 2013; Kroll & Bialystok, 2013). These tasks were initially interpreted as tests of inhibition (due to the idea of inhibiting language interference), however, research from infant studies and preverbal children began to challenge the view that inhibition is the only area of executive functioning which is affected (Bialystok, 2017).

With the development of the Attention Network Task (ANT) in 1974, which was later adapted in 2002, studies were able to distinguish between other executive functioning aspects, focusing on attention networks. Once again comparing monolinguals and bilinguals, the ANT showed that bilinguals outperformed their counterparts with both speed and accuracy in

executive control, alerting and orientating. These tasks required more than simple inhibition, but rather more selective attention and control (Bialystok, 2017). Yet selective attention has also been described as processes such as saliency, automaticity and parallel processing (Kroll & Bialystok, 2013). Then, Baddeley's (1986) working memory model suggested the central executive component is similar to executive function and working memory is moderated through selective attention. It proposed that working memory and attention work in combination for broader cognitive processing and was therefore inseparable and generally labelled as executive attention. Miyake and colleagues further diversified the executive functioning model, categorising three main areas; shifting, working memory (includes updating) and inhibition. The notion of selective attention reported using the ANT was once again categorised as a form of inhibition (Bialystok, 2017). Other studies have characterised executive functioning constructs as flexibility, switching and monitoring, all of which include Miyake's inhibition, updating and shifting concepts. Given the lack of consensus and the interrelatedness of the executive functioning constructs, researchers have been unable to reduce bilingual advantage to specific sub-processes or sub-constructs. Executive functioning as an overall part of cognitive functioning seems to have an interdependence of constructs which are unable to be isolated (Bialystok, 2017).

Studies have now come full circle, with early research explaining cognitive differences between monolingual and bilinguals as simply inhibitory control, with other researchers attempting to reduce the outcomes to specific executive functioning components and discovering that it is a more complex multifaceted, multidimensional construct than anticipated, and reducing it to a single component resulted in reductionist error. In conclusion, studies are unable to do one-to-one mapping of bilingualism and executive functioning

constructs, but merely describe an overall cognitive processing as an advantage in outcomes or increased cognitive flexibility (Kroll & Bialystok, 2013).

3.3.3. Specific Bilingual Factors that Increased Advantage

From the discussions so far, we have unpacked some of the early bilingual research findings, monolingual comparative studies, to trying to isolate the exact executive functioning components impacted by bilingualism. What is less known is how the degrees of bilingualism, or the variations of language proficiency, influences the amount of cognitive advancement in bilingual individuals. As mentioned earlier on in the chapter, not all bilinguals share the same experiences, contexts, or language proficiency levels (Bialystok, 2001; Bialystok, 2017; Fricke et al., 2019; Kroll & Bialystok, 2013). Research showing cognitive advancement has used bilinguals who are considered balanced bilinguals and are proficient in both languages (Bialystok, 2001; Bialystok, 2017), most of which are as a result of acquiring two languages from birth. It is therefore difficult to determine at which point bilinguals diverged from monolingual participants, and what specific experiences result in favourable outcomes (Bialystok & Barac, 2012).

It is agreed that balanced bilingualism is the ideal level of processing (to ensure increased cognitive abilities), but it is by no means the norm (especially in South Africa) and it is important to determine the consequences of bilingual diversity and what factors would contribute to reaching such an optimal level of language proficiency. The idea is that language processing needs to reach a certain level of metalinguistic processing, for it to then spill over and impact nonverbal cognitive functioning (similar to that of Cummins threshold theory, discussed further in the next chapter). To do so, more recent studies are taking a different approach, moving away from simple monolingual versus bilingual analyses and focusing on

the relationship between the varying degrees of bilingualism (Bialystok, 2017; Fricke et al., 2019; Kroll & Bialystok, 2013). The hypothesis is that varying levels of proficiency would impact the executive functioning demands required and therefore may not always show increased cognitive skills (Kroll & Bialystok, 2013).

Some of the studies (Bialystok, 2017; Fricke et al., 2019; Kroll & Bialystok, 2013; Luk & Bialystok, 2013) have shown that bilingualism is an accumulation of experience and there are certain factors that contribute the most to the development of proficiency levels in both languages. These factors result in variations of bilingualism and its effects (Bialystok & Barac, 2012). Listed below are the most salient factors:

1. The ages of bilingual activation (the age of L2 acquisition)
2. The duration of active bilingualism
3. Active use of bilingualism (daily basis)
4. Level of L2 to L1 proficiency
5. Context (formal bilingual education)
6. Exposure to languages (Tri/multilingualism)

The results suggest that in order to reach the optimal goal of being considered a balanced bilingual, it is important that children acquire a second language as early as possible. It is not merely the acquisition of another language, but the active use of this bilingualism over an extended period that will increase the proficiency in both languages. This is influenced by context, where access to quality, formal bilingual education and increased exposure to languages strengthens knowledge, proficiency, and processing (Luk & Bialystok, 2013). This builds on the discussion of South African emergent bilinguals whose L2 language acquisition

only occurs when entering formal education, there is a short period of language use before transitioning in grade 4 and the level of L1 to L2 language proficiency is poor.

Other factors not listed above include metalinguistic experience, where increased language knowledge and skills allow for a specific level of linguistic proficiency to be reached in order to impact nonverbal cognitive domain processing (Bialystok & Barac, 2012). As always, not all bilinguals are the same and not all contexts that develop bilinguals are considered equal. Not all language environments require the same cognitive resources and other bilinguals have merely adapted to significantly more demanding environments (Fricke et al., 2019). Executive functioning and working memory as separate components from language are in themselves experience dependent (plasticity). Increased use and activation of these cognitive components through experience and formal education results in further development and strengthening of their capabilities (Fricke et al., 2019). Overall, language proficiency is moderated by context and experience. The age of onset of active bilingualism shows effective cognitive outcomes more than the simple acquisition of an L2 alone. Finally, these early studies believe highly proficient balanced bilinguals have better executive functioning control over monolinguals, less proficient bilinguals, and bilinguals with a single dominant language (Luk & Bialystok, 2013).

3.4. CONFLICTING RESEARCH

The bilingual advantage premise comes from over a decade of research, however, more current research has conflicting evidence and suggests that bilingual advantage is not as consistent as previously argued. The varying results and scepticism have brought into question the design of studies and their replicability across different populations (Vivas et al., 2017). Studies from authors such as Duñabeitia et al. (2014), Antón, Fernández García, Carreiras, and

Duñabeitia (2016), Paap et al., (2014), Hilchey, Saint-Aubin, and Klein (2014), Pelham and Abrams (2014), and Schroeder and Marian (2012) argue that the lack of control of confounding variables such as context, educational systems, culture, Socioeconomic Status (SES) and small sample size are the reasons for such conflicting results (Paap et al., 2014; Vivas et al., 2017).

To date most of the bilingual/multilingual research has focused on more developed countries with higher socioeconomic levels. From the above discussions, these studies have found that higher SES has a more positive effect on executive control function. However, few studies have investigated the impact of bilingualism in poorer developing countries such as South Africa (Cockcroft, Itz & Liversage, 2017; Coetzee-Van Rooy, 2010). In these countries SES remains one of the largest confounding variables, and research has begun to investigate the effect of SES on cognitive functioning and its long-term impact on educational achievement, health and economic success (Bialystok, 2017).

Vivas et al. (2017), revisited the idea of bilingual advantage using Greek-Albanians in a low SES context. Here they found that when carefully controlling for SES in a homogenous bilingual sample, there was no evidence of bilingual advantage on cognitive performance. The details of how SES specifically modifies or impacts cognitive processing is less clear (than the convincing evidence on its cognitive effects), however, it could be because there may be fewer opportunities to engage in cognitively demanding activities (cognitive stimulation), reduced access to recourses, and the significant impact on factors such as health, nutrition, prenatal stressors, and education (Bialystock, 2017; Howie et al., 2017; Vivas et al., 2017). The fact remains, there is a significant underlying difference between low and high SES groups, regardless of bilingual/language factors.

Paap et al. (2014) took a more constructive approach to investigating the impact of bilingualism by replicating and disentangling the findings by Bialystok and her colleagues discussed in section 3.3., with a focus on age of L2 acquisition, relative language proficiency in L2 and finally the number of languages used (trilingualism/multilingualism). They believe that there is insufficient data currently (only five studies have been conducted to date) to determine how these variables in fact affect cognitive processing and claim replication is necessary. Furthermore, they argued that to ensure accurate and reliable results, they would test the effect across 12 measures for four different nonverbal executive functioning tasks. The hypothesis is that if there are actual bilingual advantages, they should reflect across all the different measures. They used a sample of 384 participants, comparing monolingual and proficient (active and balanced) bilinguals and found no bilingual advantage.

Paap et al.'s (2014) findings were as follows: for the category of early bilinguals, the study found no advantage over monolingual and later bilinguals. They report that similar findings have been presented by Humphry and Valian (2012) and Kapa and Colombo (2013). Interestingly, early bilinguals presented with larger interference effects compared to the usual smaller interference/increased inhibitory control results. Their study also failed to replicate monitoring and mental flexibility advantages, with analyses showing no effects for age of acquisition. Regarding L1/L2 proficiency levels, 10 of the 12 measures used showed no language group differences across the varying levels of proficiency groups. Contradicting the findings that more proficient (balanced) bilinguals showed increased performance compared to less proficient bilinguals (Bialystok, 2017; Kroll & Bialystok, 2013; Luk & Bialystok, 2013). Finally, participants considered trilingual were assessed, and they too showed no advances compared to their monolingual and bilingual counterparts. Their conclusion states that it is irrelevant whether participants are early or late bilinguals, proficient or not in either language

or are multilingual, bilinguals do not significantly differ from monolinguals on measures of executive functioning (Paap et al. 2014).

Besides the above research findings, Paap et al.'s (2014) more general concerns included the reporting of underpowered bilingual advantages, based on small sample sizes and their use of single measures to determine the effects. Previous bilingual research is dominated by smaller sample sizes which is considered a more efficient way of generating significant findings and creating a confirmation bias. Current studies, like those of Paap and his colleagues, show that research with larger sample sizes are less likely to report bilingual advantages. Paap et al. (2014) list several studies with larger sample sizes, which do not indicate bilingual advantages. These are: Duñabeitia et al. (2013) which compared Spanish monolinguals (n = 252) to Basque-Spanish bilinguals (n = 252); Antón et al. (2014) who compared a group of 180 Basque-Spanish bilingual children with a group of 180 matched monolinguals, and Gathercole et al. (2014) who examined results for dimensional card sorting (N = 650) and Simon task (N = 557). Therefore, research indicating bilingual advantage should be interpreted with great care, and replication with larger samples is vital.

A Multiverse Meta-analysis was conducted by Donnelley, Brooks and Homer (2019) used 80 studies (of individuals 4 years and older) to compare monolingual and bilingual non-verbal processing skills. The meta-analysis was used to determine effect sizes when studies were moderated by age, age of second language acquisition and specific tasks. They used global reaction time (RT) and interference cost as measures on interference control tasks. Their findings suggested that global RT showed a small significant effect size of bilingual advantage, which became non-significant when corrected for publication bias. They concluded that the multiverse meta-analysis showed there was no evidence of bilingual advantage on non-verbal

interference tasks (Donnelley et al., 2019). Studies that looked at publication bias on bilingual studies which used task switching and interference control tasks, found that 63% of abstract submissions were published compared to 36% arguing there is no bilingual advantage (Donnelley et al., 2019; Paap, Johnson & Sawi, 2015). Paap (2019), conducted a meta-analysis on 100 published articles, which presented results showing bilingual advantage in executive functioning. The idea is that bilinguals show advantage by completing interference control tasks faster (RT) and more accurately than their monolingual counterparts. The analysis separated EF components into separate categories and completed approximately 125-174 statistical test. For children between the ages of 5-16 only 15% of the inhibition/interferences scores showed small significant bilingual advantage and 81% of the scores had null results. For monitoring using global RT, only 17% showed small bilingual effects and 81% yielded null results. Finally, working memory small effect sizes and mostly null results with the author concluding that there is no compelling evidence to suggest that bilinguals exhibit EF advantage (Paap, 2019). Paap et al., (2014, 2015) further propose that these significant results are possibly due to alternative factors such as small sample sizes, unreliable interpretations of results, context, educational systems, and varying SES. Lehtonen et al. (2018) carried out a similar meta-analysis using participants 18 years and older and examined EF and bilingual advantage across various EF domains. Their analyses showed non-significant effects sizes for monitoring (RT), inhibition (including interference cost), interferences control tasks and Working Memory (WM) (Lehtonen, Soveri, Laine, Järvenpää, de Bruin & Antfolk, 2018). The meta-analyses all support the same conclusions that bilingual advantages in EF are either overstated, are restricted to a small number of studies with undetermined variables, but overall they all argue that there is no bilingual advantage in EF (Donnelley et al., 2019, Lehtonen et al., 2018; Paap, 2019).

3.5. SOUTH AFRICAN RESEARCH FINDINGS

The results presented above are generally studies carried out in higher SES, developed countries, with better quality education. In developing countries such as South Africa, there are many more social and cultural dimensions to take into consideration. While language, bilingual and cognitive research is currently limited in the country, it is gaining traction. This section will discuss some of the research findings from relevant studies that include South African languages and learners within a similar age range.

South African studies have determined that the acquisition of a second language in poorer, developing countries follow a different developmental progression and are much more sensitive to learners' environmental factors, including SES (Cockcroft et al., 2019; De Sousa, 2016; Heugh, 2002; Taylor & von Fintel, 2016). Furthermore, most South African bilingual studies concentrate on isolated components of language skills and as the focus is generally on reading as the basis for educational achievement, many studies emphasize phonology or orthography. For those that do language proficiencys' influences on cognitive abilities, this is often only on working memory.

De Sousa (2016, 2017) conducted a study using approximately 300 grade 3 learners (average sample age=9), focusing on literacy development and cognitive processing skills. The sample was comprised of monolinguals, emergent isiZulu-English bilinguals and Afrikaans-English bilinguals. Measures examined reading, vocabulary, phonological awareness and working memory. The results indicated that the isizulu-English emergent bilinguals demonstrated weak language skills and were considered as partial bilinguals. It was argued that inadequate language proficiency in both languages led to the poor literacy skills. Poorer working memory scores were attributed to the lower language proficiency and literacy skills,

as framed by the central hypothesis theory. The study also found that when comparing these emergent isiZulu bilinguals to both monolingual and biliterate Afrikaans-English learners, the Afrikaans-English group outperformed both the monolingual and emergent bilingual groups. De Sousa (2016), attributed these results to Bialystok's findings (Bialystok, 2017; Fricke et al., 2019; Kroll & Bialystok, 2013; Luk & Bialystok, 2013), that balanced bilinguals outperform monolinguals and less proficient bilinguals. One of the most significant findings of the study focused on reading scores, where De Sousa (2016, 2017) argues that the isiZulu emergent bilinguals presented with lower scores in comparison to the monolingauls and biliterate Afrikaans-English groups, because each group had different educational and linguistic contexts and these factors are better predictors of English reading capabilities. Similar school level language proficiency's impact on reading comprehension studies have been conducted by De Sousa and Broom (2012), Vokel et al. (2016) and Webb (2002), all of which indicate that poor language proficiency (in one or both languages), results in poor literacy achievement and influences academic achievement.

Researchers such as Broom (2004), Jooste (2003) and Heugh (2009) have focused more on the medium of instructions' influence on the acquisition of English as a First Additional Language (FAL). These studies argue that by grade 3 learners being taught in their second language were still not achieving academically due to poor English proficiency and these negative influences continued to impact their academic achievement long after grade 3. They continue to make the argument that the transition to English as the medium of instruction in grade 4 is premature, especially for learners in rural and township schools, and learners should continue to be taught in their Home Language (HL) for an extended period of time to ensure better academic and language development (Broom, 2004; Heugh, 2009; Jooste, 2003). Wilsenach (2013), completed a study with 50 emergent bilingual Northern Sotho grade 3

learners. Similar to the current study, the learners were separated into 2 groups, those that are taught in their Home Language (HL) and those taught in English. Although this study focused on the relationship between phonological skills and reading abilities, it used Cummins' Interdependence theory to explain complications with language acquisition. Wilsenach (2013) suggests there is a correlation between phonological skills and reading ability, and the group of learners who were taught in their HL outperformed their English medium counterparts. They further suggested that not being taught in one's HL causes the stagnation of literacy and phonological skills in the learner's HL. Wilsenach (2013), argues that the limitations in the English LoLT group is because there is a lack of competence in English (as the L2) to automatically access literacy skills acquired in the learner's HL, which would occur in the underlying central operating system (Cummins, 2000; Wilsenach, 2013).

3.6. SUMMARY

This chapter covered numerous findings across bilingual research. Some key aspects are that bilingualism is a complex and multidimensional construct, which is a consequence of cumulative experience. Although initial findings suggested a bilingual advantage over monolinguals, more recent research has been criticising their design and methods, disproving bilingual advantage. In a developing context such as South Africa, most learners will have varying exposure to different languages, quality formal bilingual education and much of the population reside in lower SES bands, all of which are likely to result in varying degrees of bilingualism, with different language processing capabilities. With the use of Cummins' theories (discussed in the chapter to follow), the research hopes to unravel previous research findings and develop a more context appropriate understanding of bilingualism and its influence cognitive processing, to make well informed recommendations.

CHAPTER 4

THEORETICAL FRAMEWORK

The relationship between language abilities and academic success remains controversial, and its link to cognitive processing even more so. Cummins' theories were considered a step in the right direction for institutional change, as he focuses on the importance of strengthening language capabilities and draws attention to the challenges second language learners face within the education system, like those seen in South Africa (Cummins, 2008; Sibanda 2017).

Although the link between Cummins and language was briefly discussed in chapter 3, this chapter delves deeper into the link between second language learning, bilingualism and its influence on cognitive processing. This section will highlight reasons why his theoretical contributions have been used to change policy and practices related to L2 learners by pointing out the unrealistic expectations education systems have on bilingual learners who are not taught in their HL (Cummins, 2008; Sibanda, 2017). For these reasons and others to be discussed, Cummins' BICS/CALP matrix, Interdependence Hypothesis and Threshold Theory will be used as the theoretical framework to ground the current research.

4.1. BICS/CALP

From the very beginning, Cummins (1979) argued that poor academic achievement was a result of poor language proficiency and focused on non-native, marginalized bilingual learners. Similar to Brock-Utne (2010), Evans and Cleghorn, (2012) and Howie et al. (2012), Cummins maintains that in order for bilingual learners to obtain academic success, they should first grasp the basic fundamentals and foundational knowledge in their HL, to create a platform

on which a second language can develop and forge a path for future academic achievement (Baker, 2001; Cummins, 1992; Fanson, 2009). The belief is that low levels of language proficiency (in both languages) results in learners' inability to cope with the higher order cognitive demands in the schooling system, resulting in poor academic performance and eventual school dropout (Alexander, 2000; Ouane & Glanz, 2010). As discussed in chapter 2, South African researchers suggest that learners should be taught in their HL, increasing their foundational skills and strengthening language proficiency in both languages, before transitioning to their L2, English, as their LoLT (Evans & Cleghorn, 2012; Heugh, Benson, Bogale, & Yohaness, 2007; Howie et al., 2017; Prinsloo et al., 2018). The results of the Programme for Institutional Student Assessment [PISA] (2006) and UNESCO (Ouane & Glanz, 2010) results echo this sentiment, indicating that learners taught in their HL have significantly better understanding of foundational concepts and achieve better results across all academic subjects, including English.

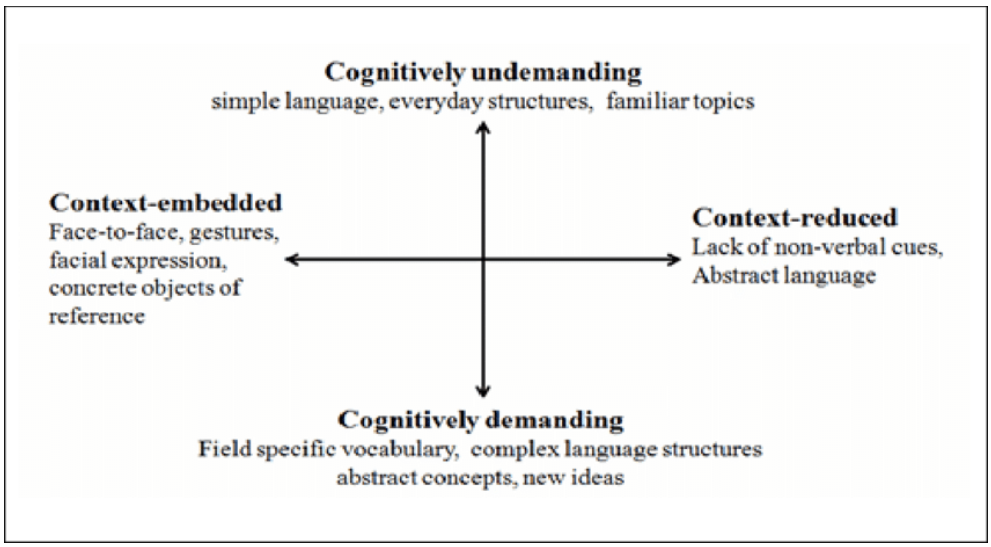
In order to unpack this relationship between language and academic achievement, Cummins categorized language proficiency into two conceptually distinct constructs; Basic Interpersonal Communicative Skills (BICS) and Cognitive Academic Language Proficiency (CALP). Each of these constructs respond differently to instructional practices and have separate trajectories. BICS and CALP develop from birth through social interactions, whereas CALP differentiates from BICS during the early stages of formal education (Cummins, 2008, 2009; Cummins & Yee-Fun, 2007). BICS is a primary discourse and refers simply to face to face, conversational language. BICS contributes to a small fraction of the language used within the classroom, and includes high frequency vocabulary and simple grammar, while CALP is a secondary discourse and refers to academic language proficiency. CALP is specific to social institutions such as the education systems and is effectively the language that is deemed

necessary to achieve and progress through schooling (Cummins, 1979; Cummins, 2008; Cummins & Yee-Fun, 2007, Jordaan, 2011b). More specifically, CALP refers to one's ability to understand and interpret complex academic concepts and ideas, which are both conceptually and cognitively demanding. Therefore, learners require an increased command of their academic language, both oral and written (Cummins, 2008, 2009). CALP is associated with higher order functioning such as thinking and evaluation skills, hypothesizing, inferring, analysing, integration, reasoning and generalizing (Cummins, 2008; Cummins & Yee-Fun, 2007; Fanson, 2009; Roessingh & Kover, 2003). In order to synthesize such higher order functioning skills to cope with increased curriculum demands, learners must become sufficiently proficient in academic language (Cummins, 2008; Cummins &Yee-Fun, 2007). There are however several years gap between the attainment of communicative fluency (BICS) and academic proficiency (CALP), where it takes a minimum of five years (or more) of language experience to reach grade norms in a learners HL alone. Therefore, learners who have successfully acquired conversational fluency in English as their FAL at a grade 3 level, still have a long way to go before achieving academic language proficiency (Cummins, 2008; 2009; Cummins & Yee-Fun, 2007). Cummins (2009) describes this as second language learners chasing an ever-moving target.

Cummins (2008) makes a further distinction between BICS and CALP by placing them on an intersecting continuum (figure 4.1.), based on cognitive demands and the contextual support available. As a simple conversational interaction, BICS is thought to be context embedded and cognitively undemanding, which receives instant feedback from visual or verbal cues (Baker, 2001; Cummins, 1984; 2008; Cummins & Yee-Fun, 2007). CALP on the other hand, has increased cognitive demands, with a focus on higher order cognitive skills, as learners are required to interpret, analyse, and evaluate abstract academic concepts. Academic

proficiency is therefore labelled as context reduced and cognitively demanding (Baker, 2001; Cummins, 2008; Cummins & Yee-Fun, 2007).

Figure 4.1. BICS/CALP Matrix



(Cummins, 1984, p. 139; Baker, 2001, p. 172)

As with any theory, there are some criticisms and considerations. Some theorists have argued that these language distinctions are over-simplified and the dichotomous division does not account for the multiple variables which impact language development and proficiency levels. With regard to the implementation of these constructs, they are thought to have limited practical value as they are not operationalized into specific teaching aids, which educators can use in constructive ways to develop learners' academic language in their HL/L1 or FAL/L2 (Cummins, 2008). Additionally, what is considered "cognitively demanding" and "context embedded" will differ depending on the learner, the environment, and access to resources, and these variations have not been sufficiently contextualized across developing countries (Cummins, 2008). Cummins (2000, 2008) has responded to these critiques by reiterating that BICS/CALP and academic proficiency are theoretical constructs which have not been standardized with any empirical data as they are merely a means to understand and

operationalize the differences between language proficiencies. Finally, the BICS/CALP distinction was not formulated as any form of educational tool, but a way of viewing a specific phenomenon, and does not discount other principles. Some theories are more appropriate for certain contexts or to address specific questions (Cummins, 2008).

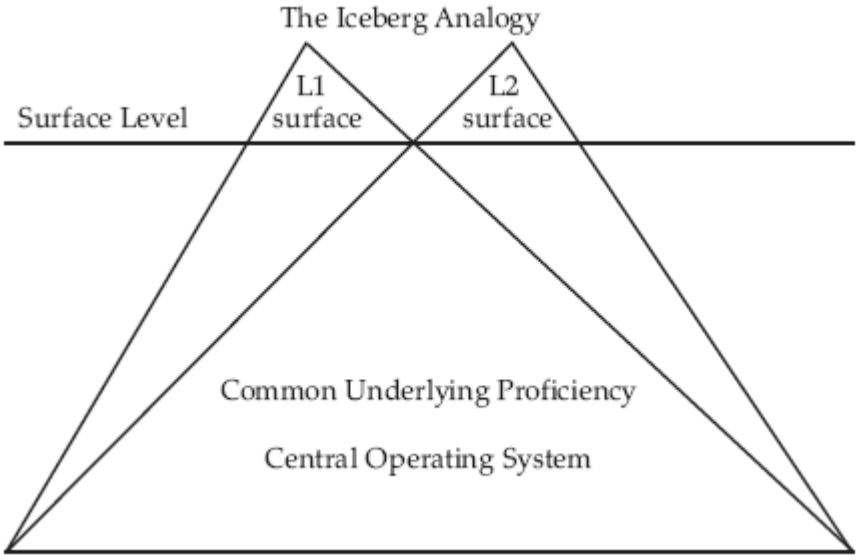
For the purpose of the current study, the distinction between BICS/CALP remains relevant and is used to frame the concept of academic language proficiency in South Africa. Unfortunately, at the primary school level, L2/English language ability is conceptualized using relatively superficial conversation skills. This is far removed from the academic proficiency required for educational purposes, thus leaving the learners ill-prepared to cope with the academic load and increasingly complex curriculum demands throughout the grades (Cummins & Yee-Fun, 2007). Until educators recognize the importance of developing academic language proficiency, and its involvement in higher order cognitive processing, learners will continue to struggle in their endeavour for academic success (Cummins &Yee-Fun, 2007). Furthermore, Cummins argues that the length of time it takes to advance to academic proficiency in a learner's HL alone is approximately five years (excluding their L2/FAL) and agrees that a transition to L2 as a LoLT in grade 4 is premature and detrimental (Cummins, 2009; Prinsloo et al., 2018; Sibanda, 2017). This timeframe is based on knowledge from developed countries and has not been significantly applied to a South African context, where the development of academic proficiency in both HL and English is questionable. Researchers are not entirely convinced that African languages even have the vocabulary for academic concepts to allow for the development of CALP in their HL, let alone have it become a scaffold for language transferability to learners L2/FAL (Sibanda, 2017).

4.2. INTERDEPENDENCE HYPOTHESIS

The Interdependence Hypothesis theory is unique as it takes into consideration not only how the development of a learner's L2 depends on the development and proficiency of their L1, resulting in various language proficiencies in both languages, but how the variations in bilingual learners' profiles (with a focus on academic proficiency) impacts cognition. This theory uses the analogy of an iceberg to explain its various components, as depicted in Figure 4.2. On the surface level, L1 and L2 are considered separate entities, with minimal cognitive demands, context embedded and basic interactional language (BICS). Below the surface, the language begins to evolve (BICS and CALP diverge), with increased linguistic and cognitive demands and further development of language proficiency. Initially this increase in academic proficiency occurs in L1, the improved linguistic proficiency contributes to the development of conceptual skills such as thinking, evaluating, theorizing and analysing (Cummins, 2008; Cummins & Yee-Fun, 2007; Fanson, 2009; Roessingh & Kover, 2003). As the learners become more proficient in their L2 (using L1 as a foundation), the same occurs in that language and advances "below the surface", allowing for the transfer of linguistic processing skills between the two languages (Baker, 2001; Cummins, 2008, 2009). It is important to reiterate that the development of a learner's L2 is dependent on the level of academic language development in the learner's L1. Meaning, there is an interdependence between academic language proficiency in L1 and L2 and requires the development of a Common Underlying Proficiency (CUP) (similar/equal proficiency) to allow for transferability of skills. However, it is not only linguistic elements that are transferred in the CUP, but a sharing of conceptual knowledge of multifaceted academic constructs in both languages, and a transfer of metacognitive strategies and higher order thinking skills (Cummins, 2009). The CUP forms part of the central operating system, which is where learners access cognitive processing, literacy skills and other higher order functioning abilities, which are vital for academic success. The skills are only accessible

in both languages, as long as they have common academic proficiency levels (Cummins, 1992; Fanson, 2009).

Figure 4.2. Cummins Interdependence Theory



(Baker, 1993; Cummins, 1979, 1992; Fanson, 2009)

The following points summarized in Baker (1993, 2001) are considered the most relevant to the South African context and explains the possible lack of academic achievement. Firstly, irrespective of the number of languages, all thoughts are processed through the same cognitive operating system. As languages feed through the same cognitive operating system, information processing skills and knowledge can be stored and developed through one or more languages, on condition they are proficient in those languages. For this reason, learners need to be academically proficient in both their HL and in English, as the Language of Learning and Teaching (LoLT) post grade 3, in order to successfully process the increasing demands within the curriculum. If learners are forced to process in a language that is underdeveloped, the underlying operating system will not function optimally, and the quality and the quantity of the information gained will be poor. Learners will therefore perform poorly and both languages

will remain insufficiently developed to cope with the given and future curricula materials. Based on their interdependence, if one or both languages are not fully developed, cognitive functioning and academic performance will be negatively impacted.

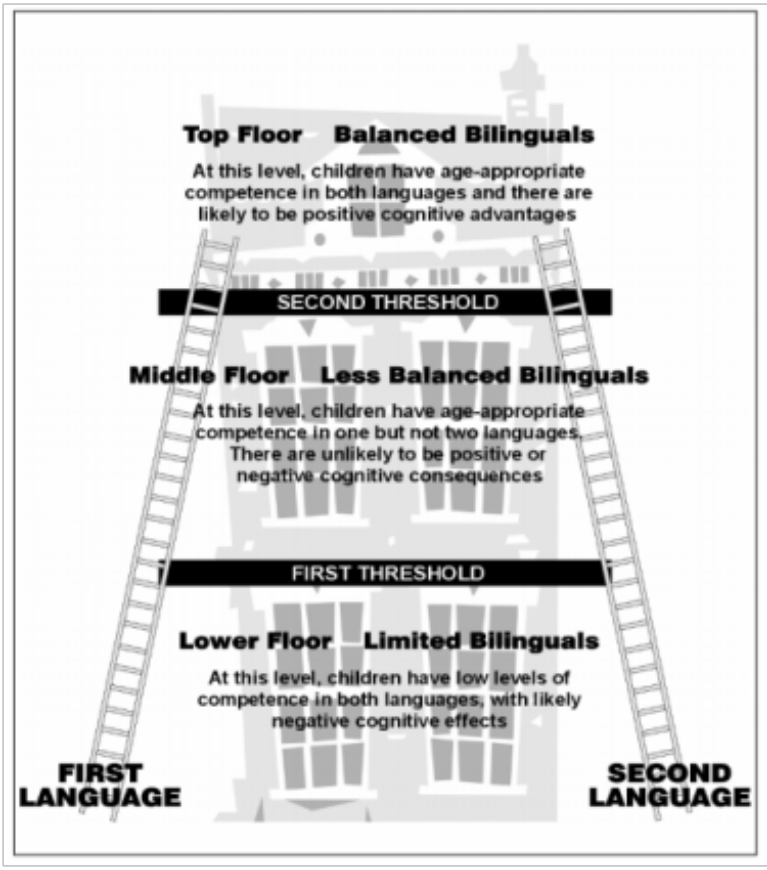
4.3. THRESHOLD THEORY

The interdependence theory demonstrates how bilinguals' language proficiency development in their L2 is reliant on their L1 capabilities and in order for there to be a transfer of cognitive skills in the central operating system, learners have to become "proficient" in both languages. Therefore, learners have to reach a specific language threshold in both languages, to allow for optimal cognitive processing. However, this language proficiency threshold is not specifically defined in the Interdependence Theory, but is elaborated on in the Threshold Theory, which also explains the influence of varying levels of bilingualism. Cummins' Threshold theory contributes to our understanding of Bialystok's findings of the cognitive advantages portrayed by balanced bilinguals.

This theory states that particular language proficiency thresholds or degrees of bilingualism, will impact on a learner's cognitive processing in either a negative, neutral, or positive manner. Cummins distinguishes between two thresholds (low and high) a bilingual individual needs to attain in order to have any sort of cognitive impact, as seen in Figure 4.3 (Cummins, 2001; Coetzee-Van Rooy, 2010). Below the first (low) threshold, the individual is labelled a limited bilingual as academic proficiency in both languages is insufficiently developed, lending itself to negative cognitive effects. Between the first and second threshold, the individual is identified as being sufficiently competent in one of their two languages, but not in both, and will therefore experience neither negative nor positive cognitive effects (neutral). Above the second (higher) threshold, the individual moves towards balanced

bilingualism and becomes proficient in both languages, lending itself to cognitive advantages (Baker, 1993, 2001; Cummins, 2001). This is the optimal point for learners to engage with complex curricular material in either language to ensure positive academic achievements and success. Therefore, the Threshold theory relates language to not only cognitive processing, but to academic achievement. It further demonstrates how low levels of academic proficiency limits learners' ability to cope with curriculum demands and emphasizes the importance of being taught in a language that is fully developed (Baker, 1993, 2001).

Figure 4.3. Depiction of the Threshold Theory



(Baker, 2001, p. 168)

The Threshold theory's categorization of bilingualism (limited, less balanced and balanced) is utilized within this study, to organize learners into the following groups:

1. Proficient in both languages (cognitive benefits),
2. Proficient in L1 and Not L2 (neutral),
3. Proficient in L2 and Not L1 (neutral),
4. Proficient in neither language (negative cognitive influence)

These categorisations of bilinguals will then be used to determine their influence on cognitive processing, with a focus on Executive Functioning (EF) and Working Memory (WM) as part of the central operating system/cognitive processing.

4.4. CENTRAL PROCESSING HYPOTHESIS

The Central Processing Hypothesis is not directly part of Cummins' theories listed above but is one of the primary theories in bilingual research and is used to substantiate some of the beliefs around academic language proficiency, cognitive processing and the development of literacy abilities required for academic achievement. Briefly explained, this theory is used to argue against the belief that different orthographies across various languages in bilingual learners are the reason for poor academic achievement. The Central Processing hypothesis believes that literacy (CALP) abilities across different orthographies is mainly influenced by the common underlying cognitive processes, or in terms of Cummins, the common underlying proficiency/central operating system (Baker, 1993; Cummins, 1979, 1992; Fanson, 2009). The Central processing theory argues that these common underlying cognitive and linguistic processes are responsible for the development of literacy in both L1 and L2 languages and studies have shown that bilingual learners with literacy deficiencies (regardless of orthographies) in their L1, will face similar difficulties in their L2 (Geva & Siegel, 2000; Gholamain & Geva, 1999). For this reason, the nature/manner of the language instruction does not matter, but what is important is that learners develop a common underlying academic language proficiency in both L1/L2 languages, to allow for optimal cognitive and

metalinguistic functioning (Geva & Siegel, 2000; Wilsenach, 2013). If this does not occur, regardless of orthographies, learners will continue to struggle throughout their academic career.

4.5. CONTRIBUTIONS AND CRITIQUES

Cummins' theories have a few downfalls that need to be taken into consideration. Firstly, his theories focus primarily on bilingual educational settings in high SES developed countries. Just like bilingualism is considered a multifaceted and complex construct, so are bilingual educational settings, especially those in under-resourced developing countries such as South Africa. Researchers need to be cautious with the application of these theories and over generalizing the findings across contexts (Aukerman, 2007; Coetzee-Van Rooy, 2010; Sibanda, 2017). Secondly, there are a few concerns regarding CALP as a concept, including the fact there is no single definition for academic language proficiency, no guideline on how to quantify it and at what exact threshold. In South Africa for example, there are no official standardized language assessments for all the African languages (across developmental age groups) that could investigate concepts such as academic proficiency (Coetzee-Van Rooy, 2010). Furthermore, with context playing a vital role within research (including this one), the ability to investigate academic proficiency out of context (decontextualized) is questionable (Aukerman, 2007). Finally, there is no explicit point or defined academic proficiency threshold stipulated to determine when linguistic transfers in the central operating system will occur, or when positive cognitive processing is activated. Thresholds may also vary depending on the educational context and its curriculum demands on learners (Coetzee-Van Rooy, 2010; Sibanda, 2017).

Although there are no quick fixes to the above-mentioned concerns, this study hopes to begin the exploration of these theories in low SES and developing contexts, such as South

Africa. By using under resourced schools in poorer communities, the research hopes to determine how SES as a construct influences language and cognitive abilities and whether this outweighs the impact of language proficiency. As discussed, standardised tests across all languages are scarce in South Africa, nevertheless, the Department of Basic Education (DBE) has developed a literacy assessment (across all 11 official languages) called the Early Grade Reading Assessment (EGRA), which they are actively using in language interventions across the country. This assessment is discussed in the method section; however, as it is a new assessment it too has no official standardised scores across the different languages, but it is a step in the right direction for literacy assessments. The problem remains, there are no definitive thresholds to determine proficiency cut offs, so any results that come from the four proficiency categorisations in the current study should be replicated in other studies to determine their validity. This research does not intend on being able to answer all questions, but make large strides in improving educational and language research in South Africa.

4.6. SUMMARY

The current research uses the notion of BICS/CALP to differentiate between basic communicative and academic language and focuses on the importance of concepts such as academic proficiency to investigate influences on academic achievement. The use of the Interdependence hypothesis highlights the relationship between bilingual's L1 and L2 and reiterates the importance of developing strong language proficiency foundations in a learners L1 to allow for the development of L2 proficiency. This is relevant in the argument against the current LiEP, where learners are initially taught in their HL and then prematurely transition to English (L2) as their LoLT before sufficient proficiency has been attained in both languages. This not only negatively impacts the development of the languages but influences learners' ability to adequately comprehend the increasingly complex curricular and achieve

academically. The Threshold theory is significant in the argument of how bilingualism and the varying degrees of language proficiency influences cognitive processing (in the central operating system) and guides the research in its categorisations of learners into language proficiency categories. Finally, the use of Cummins' theories in a more developing, lower SES country such as South Africa, begins to open up questions regarding its relevance in such contexts and begins to explore the divide between the impact of language proficiency versus SES.

CHAPTER 5

RESEARCH METHOD

5.1. RESEARCH QUESTIONS

This research took the relevant literature into account, designed a study and collected the pertinent data to answer the broad research question:

"What are the factors that affect the relationship between bilingualism and cognitive functioning, in grade 3 isiZulu-English emergent bilingual learners in a quintile 3 South African context?"

More specifically

- What is the relationship between the level of Academic Language proficiency (in isiZulu and English) and Executive Functioning (EF)?
- What is the relationship between the level of Academic Language proficiency (in isiZulu and English) and Working Memory (WM)?
- What is the relationship between Communicative Language proficiency (in isiZulu and English) and Executive Functioning (EF)?
- What is the relationship between Communicative Language proficiency (in isiZulu and English) and Working Memory (WM)?
- How do learner contextual factors such as Socioeconomic Status (SES) influence the relationship between bilingualism and cognitive functioning (for both EF and WM)?
- What is the impact of Language of Learning and Teaching (LoLT) on Literacy scores?

5.2. HYPOTHESES

- Learners with higher levels of Academic Language proficiency in both isiZulu and English will have increased EF scores.
- Learners with higher levels of Academic Language proficiency in both isiZulu and English will have increased WM scores.
- Learners with higher levels of Communicative Language proficiency in both isiZulu and English will have increased EF scores.
- Learners with higher levels of Communicative Language proficiency in both isiZulu and English will have increased WM scores.
- Learners with higher levels of Academic Language proficiency in both isiZulu and English will have increased literacy scores.
- SES contextual factors will negatively impact both language proficiency and cognitive processing (EF and WM) scores.
- Language of Learning and Teaching (LoLT) will influence levels of Literacy, where English as LoLT will show poorer results.

5.3. DESIGN

The current quantitative study made use of a cross-sectional, between and within groups, ex-post facto design. This design allowed for replicable systematic experimental procedures and infer effects, without manipulating the independent variable or randomly assigning groups (Whitley, 2002). As this study is a cross-sectional study and does not include a randomised sample selection that is representative of the entire South African population, any conclusions made are not explicitly causative and should be interpreted with caution. To ensure the validity of the results, the researcher suggests the study is replicated to include a

sample representative of all 5 South African Quintile schools, however, this is beyond the scope of the current study.

5.4. SAMPLE

Convenience sampling was the selection strategy used for the current study. The study relied on selected schools, in specific areas, with pre-selected languages of instruction and was further dependent on the key stakeholders granting access.

The sample consisted of Grade 3 (Foundation phase) learners in Gauteng, South Africa. Foundation phase was selected as it is considered the most important phase in education, as it builds learners' educational competence and foregrounds their literacy skills (acquisition of English, reading and writing), which in turn prepares them for their transition into Intermediate phase and beyond. Furthermore, according to the South African Language in Education Policy (LiEP), the medium of instruction for learners in Foundation Phase (grades 1-3) should be their Home Language (HL) and English should be taught as a First Additional Language (FAL) (DoE, 1997). For those learners who have not mastered the foundational skills and/or improved their proficiency in English, the transition to Intermediate phase with a more conceptually demanding curriculum and where English is the only medium of instruction, may be considered a daunting task. Based on the importance associated with the Foundation phase and the variations in the medium of instruction, it is important to determine what impact these factors have on the cognitive processing of these learners and how they could possibly influence decision making within the education system. For the above reasons and the selection of grade 3 learners, the average age of learners at the time of testing were 9 years of age. The linguistic and cognitive implications of this age group are discussed in chapter 3.

As the study is defined as a cross-sectional design, the sample was not observed over several years but rather a point in time. As 111 learners were sampled and 6 time consuming and cognitively demanding assessments were used during the testing, the question of feasibility came into play. A cross-sectional design on the number of learners sampled allowed for sufficient data to be analysed to allow for confident results. A monolingual group was not included in the selection of the sample because given the context of the learners and the exposure to language within the community and schooling system, finding "pure" monolingual learners was deemed impractical.

5.4.1. Selecting Schools

Four quintile 3 schools were selected based on the following categorisation:

I. Urban or sub-urban: These schools are located in cities and are within the lower to middle Socioeconomic Status (SES) band. Children in these schools were found to be bi/multilingual, given the diversity of languages in the Gauteng region. Schools were selected where the LoLT within the classrooms were either isiZulu or English. As the learners had varying backgrounds and experiences, they exhibited different proficiency levels, therefore allowing for appropriate comparisons.

II. Learners were selected from two educational contexts:

    1. Where isizulu is used as the LoLT for Foundation phase and English as the FAL.

    2. Where English is used as the LoLT for Foundation phase and isiZulu as the FAL.

isiZulu was selected as the African language of choice because according to Census (2011) results, 22.7% of the South African population spoke isiZulu as their HL and only 9.6% had English as their HL. In Gauteng, a representative sample selected for TIMSS 2011 (Reddy

et al., 2012), showed the largest number of learners (20.7%) spoke isiZulu as their HL in Gauteng and 13.3% spoke English. Furthermore, Webb (2010) reported the breakdown in HLs in Gauteng to be majority isiZulu (27.2%) and English at 13.8%.

It is impossible to completely rule out or control for quality of education through identically matching schools. Sampled schools with similar demographics were selected in an attempt to reduce extraneous variables impacting the results. These include SES and differences in quality of education (which cannot be excluded entirely). The influencing factors would be more prominent in very low SES/rural and upper SES/private schools, for this reason, the researcher chose the lesser of 2 evils and used quintile 3 schools.

In the final sample, four schools were selected (two isiZulu and two English LoLT) and depending on the size of the school, one or two classes per school were made available. This resulted in a range of 22-35 learners per school and a total learner sample of 111. The average age of the learners was nine and the ratio of male to female learners was 41:68. These demographics were dependent on the composition of the schools and classes sampled for the study.

5.4.2. Exclusion Criteria

Learners were excluded from the study if they had a history of learning deficits, suffered serious head injuries or any other neurological difficulty, such as hearing or visually impairment. These factors were determined through a parent-completed background questionnaire (see appendix 5) and further verified by the learners' teachers. Exclusion criteria were set to prevent any further extraneous variables, other than those previously mentioned, impacting the results of the study.

5.4.3. Detailed description of Schools, Teachers and Learners

5.4.3.1. School Demographics (School Environment)

The following section will discuss the demographics of the sampled schools, mainly focusing on the school facilities (SES) and teacher: learner ratios. The schools were initially selected based on DBE data with the hope of selecting schools in similar circumstances in order to prevent extraneous variables influencing the research scores. The following data is however, based on self-reports from the school principals and are reflective of schools within the quintile 3 category. These include basic frequency, mean and cross tabulation analyses of descriptive data.

All schools reported that they were ranked as quintile 3 schools, all belonged to the government's feeding scheme programmes, and were in low income communities. All of the schools had electricity, running water and basic security. None of the schools reported having school halls as a facility.

School A

Primary School A uses isiZulu as the Language of Learning and Teaching (LoLT) and had the highest self-report rating of all the schools. The principal reported that the school facilities, buildings and classrooms were in good condition. The learner and staff bathrooms were in very good condition, offering sufficient sanitation, as well as a staffroom in very good condition. This school also had a good functioning library and both learner and staff computers.

School B

Primary school B uses English as the LoLT and rated their facilities as being between poor and in average condition. The principal reported that their buildings, classrooms, staffroom and sanitation facilities were in poor condition. The school did however, have staff and learner computers in average condition and were the only school to have a sports field, even if reported to be in poor condition.

School C

Primary school C uses isiZulu as their LoLT and had an average to good rating overall for their facilities. They had good permanent buildings, classrooms and bathrooms. The school had a staffroom and library, although only reported as being in average working condition. Although the school has teacher computers, they were in poor condition with little security for the school and learners.

School D

Primary school D uses English as their LoLT and out of all the schools, reported that most of the facilities were lacking or in very poor condition. More specifically, the buildings and learner sanitation facilities were in very poor condition. They had no staffrooms, library, staff computers or storerooms.

5.4.3.2. Teacher Demographics and Learner Teacher Ratios

There was a total of eight teachers across all four schools, however only five teachers consented to completing contextual questionnaires and the following section discusses the information received. All five teachers were female with an age range of between 41-50 years. Four of the teachers reported having at least a degree and one teacher had a teaching diploma.

Although some of the teachers had numerous years of teaching experience, on average they only had four years teaching experience at a grade 3 level. Out of the five teachers, only two reported having isiZulu as their home language (none had English) however, all the teachers scored their language capabilities for English and isiZulu (speaking, reading and writing) as well enough to very well.

The below table used information obtained from the principal questionnaire and reflects learner teacher ratios in each of the schools.

Table 5.1. Learner Teacher Ration

Primary School	Number of Grade 3 Learners	Number of Grade 3 Teachers	Learner Teacher Ratio
A	99	2	50:1
B	138	3	46:1
C	32	1	32:1
D	81	2	40:1

Primary school B had the largest number of grade 3 learners and the most grade 3 teachers, with an average of 46 learners to each teacher. Although school A reported having the best facilities, they had the highest learner teacher ratio, with an average of 50 learners to each teacher. Primary schools C and D had what is considered the average learner to teacher ratio in South Africa.

5.4.3.3. Learner and Parent Demographics (Home Environment)

This section uses frequency and mean analysis to summarize descriptive demographics of the learners and their caregivers, giving the reader a basic understanding of the home environment of the learners.

A total of 111 learners were tested in the study, of which 41 were boys and 68 girls (three missing) with an average age of nine years old. Parents reported that 79.3% of the learners had isiZulu as their home language, 9% had isiXhosa and then the remainder were made up of other African languages. The learners attended schools where isiZulu was either the HL or the FAL. What is important to note here is that approximately 20 percent of the sampled learners were taught in two foreign languages, as they did not have isiZulu as their HL. This number is likely even more in other schools, as these schools were specifically sampled to reduce the impact of such extraneous variables. Such language discrepancies are merely one of the reasons academic achievement scores across south Africa are so poor.

Self-reported parental data was obtained through a demographic questionnaire and completed by the learner's caregiver. It is unsurprising in the South African context that the majority of the paternal information is missing, as many of the learner's fathers are absent and they are primarily raised by a maternal caregiver. This is reflected in the data with 84% of the data available for the maternal caregiver and only 16% of the data for the paternal caregiver. For this reason, the results will mainly reflect the maternal data as seen in tables 5.2 – 5.6 to follow.

Table 5.2. Maternal Caregiver Age

Maternal Caregiver Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**<20**	5	4.5	4.5	4.5
	20-30	20	18.0	18.2	22.7
	31-40	46	41.4	41.8	64.5
	41-50	27	24.3	24.5	89.1
	51-60	8	7.2	7.3	96.4
	60+	4	3.6	3.6	100.0
	Total	110	99.1	100.0	
Missing	**No response**	1	.9		
Total		111	100.0		

Table 5.3. Maternal Education

Maternal Education		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**No school**	3	2.7	2.9	2.9
	Primary school	12	10.8	11.5	14.4
	Grade 8 or 9	12	10.8	11.5	26.0
	Grade 10 or 11	28	25.2	26.9	52.9
	Grade 12 / Matric	39	35.1	37.5	90.4
	Diploma/Degree	10	9.0	9.6	100.0
	Total	104	93.7	100.0	
Missing	**No response**	7	6.3		
Total		111	100.0		

Table 5.4. Maternal Home Language

Maternal HL		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Afrikaans**	1	.9	1.0	1.0
	isiNdebele	2	1.8	1.9	2.9
	English	1	.9	1.0	3.8
	Xitsonga	1	.9	1.0	4.8
	isiXhosa	14	12.6	13.3	18.1
	isiZulu	69	62.2	65.7	83.8
	Sepedi	1	.9	1.0	84.8
	Sesotho	3	2.7	2.9	87.6
	Setswana	6	5.4	5.7	93.3
	Siswati	5	4.5	4.8	98.1
	Other	2	1.8	1.9	100.0
	Total	105	94.6	100.0	
Missing	**No response**	6	5.4		
Total		111	100.0		

Table 5.5. Maternal Home Language and English Abilities

Maternal HL	Not at all	Only a little	Well enough	Very well
Speak	0	1.8	27	64
Read	0.9	8.1	15.3	53
Write	1.8	9	17.1	50.5
Maternal English	**Not at all**	**Only a little**	**Well enough**	**Very well**
Speak	3.6	19.8	27	39.6
Read	5.4	9.9	22.5	42.3
Write	4.5	11.7	22.5	43.2

Table 5.6. How Often the Mother Speaks English at Home

How Often Mother Speaks English at home		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Never**	8	7.2	8.1	8.1
	Rarely	11	9.9	11.1	19.2
	Sometimes	67	60.4	67.7	86.9
	A lot	13	11.7	13.1	100.0
	Total	99	89.2	100.0	
Missing	**No response**	12	10.8		
Total		111	100.0		

The above tables show that 41.4% of the maternal caregivers were between the ages of 31-40 and 24.3% were between 41-50 years old. Approximately 35% of the maternal caregivers had completed grade 12 and only 9% reported having a degree or diploma. This reflects previous research on levels of maternal education in similar low-income communities. The majority (62.2%) reported isiZulu as their HL and 12.6% had isiXhosa, which they all reported as being able to speak (64%), read (53%) and write (50.5%) "Very well". Of the paternal data available, 42.3% reported having isiZulu as their HL and 6.3% Xitsonga. In comparison, maternal caregivers reported lower confidence levels in being able to speak (39.6%), read (42.3%) and write (43.2%) "Very well" in English, with only 11.7% speaking English "A lot".

Approximately 80% of the learners' parents reported isiZulu as their child's home language. Below, caregivers were asked to report their child's ability to speak, read and write in their HL, isiZulu and English. These questions were posed to get a sense of the caregivers' thoughts on their child's level of language capabilities and proficiency. The majority reported that their child could speak their HL "Very well" and read and write "Well enough". Caregivers seemed confident in their child's isiZulu ability, reporting the majority could speak, read and write "Very well" in this language. However, they thought their child's English abilities were not as strong, and varied between "Only a little" and "Well enough". These self-report questionnaires are subjective and do not give an accurate indication of the learners' abilities, the results in the following chapter show that learners do not have such high proficiency/literacy capabilities. As discussed in Chapter 2, parents need to be made aware of such discrepancies in order to make informed decisions about the language in which their children receive and education.

Table 5.7. Learner Home Language, isiZulu and English Abilities

Learner HL	Not at all	Only a little	Well enough	Very well
Speak	0.9	9.9	37.8	44.1
Read	5.4	24.3	25.2	26.1
Write	5.4	24.3	27	26.1
Learner isiZulu	**Not at all**	**Only a little**	**Well enough**	**Very well**
Speak	0	10.8	30.6	45.9
Read	0.9	21.6	28.8	33.3
Write	1.8	17.1	32.4	32.4
Learner English	**Not at all**	**Only a little**	**Well enough**	**Very well**
Speak	0.9	36	36	21.6
Read	2.7	27	33.3	20.7
Write	0.9	32.4	30.6	20.7

5.4.3.4. SES Report of the Home Environment

Caregivers were given a list of resources and asked whether they were present or absent. Where the resources were absent, the score was given a zero and one for present, therefore allowing for a total and the use of a mean score. Note that although the below table 5.9 reflects such comparisons, the resources discussed are basic human necessities such as access to flushing toilets, running water, electricity (please refer to appendix 5 for the listed items).

These tables are reflective of a low-income community in South Africa and indicates that many individuals still do not have access to basic sanitation and resources. This information was compared to the levels of education reported by the maternal caregiver. Research suggests that higher levels of education often reflects higher socioeconomic levels and access to resources, which seems to be evident in the table with increasing mean scores for SES.

Table 5.8. School SES Mean

Primary School	Mean	N	Std. Deviation
A	9.0000	24	3.23029
B	11.3810	21	3.45653
C	10.3158	19	2.00146
D	10.3437	32	2.73106
Total	10.2292	96	2.98586

Table 5.9. SES Mean Scores by Maternal Education

Maternal Education	SES Mean	N	Std. Deviation
No school	7.6667	3	4.04145
Primary school	7.4000	10	3.06232
Grade 8 or 9	9.3750	8	2.82527
Grade 10 or 11	9.8400	25	2.54427
Grade 12 / Matric	10.9714	35	2.79164
Diploma/Degree	12.5556	9	2.69774
Total	10.1667	90	3.05106

5.5. INSTRUMENTS

The instruments were administered in two languages based on the selected Languages of Learning and Teaching (LoLT) in the schools and classes selected. 1) English and 2) isiZulu.

5.5.1. Background/Demographic Questionnaires

This questionnaire was used to determine: age, sex, ethnicity, number of languages present, age of exposure to languages, exclusion criteria, parent/guardian information, SES, and also to obtain the parent(s) perspective on their child's proficiency levels in their L1 and L2. These documents were constructed in English and translated into isiZulu (by an individual who is proficient in isiZulu and sensitive to the vernacular in the urban areas). Further isiZulu verification was conducted by a third party. The researcher ensured that the language used within the questionnaire was appropriate for the selected audience, to ensure that should parents

be partially illiterate they would be able to understand and complete the questions. An agreement was made with the schools and teachers, that should parents be unable to complete these questionnaires independently, they would make time to assist the parents. The Background Questionnaires were six pages in length and consisted of 28 questions. These variables were used to describe the demographics of the learners, in analyses for the contextual factors influencing language and cognitive relationships and further ad hoc testing.

5.5.2. Proficiency Tests: Sentence Repetition (SR)

Sentence Repetition was one of the measures used to determine the level of proficiency of the languages in both isiZulu and English and allowed for further categorization of the learners into Communicative Proficiency groups (similar to BICS). Learners were categorised into four categories based on the Threshold theory and learners' proficiency levels in their L1 (isiZulu) and L2 (English). These were 1) low proficiency levels in both languages, 2) high levels of proficiency in L1 and low levels in L2, 3) high levels of proficiency in L2 and low levels in L1 and 4) high levels of proficiency in both L1 and L2 (balanced bilingualism). A standardised English version was utilised, which consisted of 12 similarly structured sentences with approximately 10 words, each sentence consisting of 10 - 14 syllables, with an equal number of active and passive sentences. The sentences are presented in fixed order and scored as: 2 (correct), 1 (three or fewer errors), or 0 (more than four errors or no response), with a total possible score of 24. It was not deemed necessary for any of the words or sentences to be nationally adapted further.

As with most South African assessments, there are no standardised results, however, a developmental longitudinal study was published in 2011. This study used the same SR assessment in a similar South African educational context, focusing on 134 learners in the first

three grades of the foundational phase (Jordaan, 2011a). This descriptive study has invaluable SR data across grades 1 to 3 and will be used for comparative purposes, to determine whether the scores of the current study are within range.

This version of the SR test was translated into isiZulu (by an individual who is proficient in isiZulu and sensitive to the vernacular in the urban areas) to fit the nuances of the language and match the length and complexity of the English test. This isiZulu translation was then back translated by a third party, back to English to ensure the reliability of the test and its translation. The isiZulu test was scored in the same manner as the English SR assessment, with a maximum score of 24. As this instrument was not piloted first, a cronbach's score is not available and this is noted as a limitation in the study.

The learners were instructed in English and isiZulu that sentences were going to be read out to them (an assessment for each language) and they had to repeat what they heard back to the assessor to the best of their ability. The learners were not given access to the SR assessments and were not able to read off the pages. The English SR was administered first and then the isiZulu. Some may question that as the assessments are direct translations of each other and a period (of days) should have been allocated between the assessment to reduce bias and learners being prompted by the initial SR assessment. This option was not feasible as it would impact the learner's already limited teaching time and given the low scores across both languages, it is unlikely the learners we positively influenced by the order of the assessments.

In order to categorise learners using "thresholds", the collected raw data was modelled. This involved analysing the distribution curves for normality to determine whether the mean

or the medium is the best measure of central tendency and then the Standard Deviation was used to calculate the percentiles/cut-off points for calculated levels of proficiency.

5.5.2.1 The usefulness of SR as a measure in a South African Context:

Sentence Repetition (SR) [also known as sentence recalling or elicited imitation] (Conti-Ramsden, Bottin & Faragher, 2001; Riches, Loucas, Baird, Charman & Simonoff, 2010) has previously been used as a psycholinguistic marker to determine linguistic proficiency and in diagnosing disorders such as Specific Language Impairment (SLI) and other language disorders, or profiling other language difficulties (Redmond, Thompson & Goldstein, 2011). SR emerged in the 1960s based on the assumption that if individuals could repeat a sentence with a large word span, that they were not relying solely on their working memory, but were tapping into their long-term memory by chunking the words and linking them to previous representations and knowledge to facilitate recall. If the words/sentence exceeds the learner's working memory capacity, the learner is required to comprehend the sentence to ensure correct repetition and if this is not done, divergence from the original stimuli will be evident (Redmond et al., 2011). Previous research has found it to be sensitive, accurate, and useful as a marker to determine language impairments in children by differentiating between effects of task demands, processing deficits and linguistic abilities including the child's syntactic competence. Learners with different language impairments (from typical development) score at varying levels on the SR tasks (Conti-Ramsden et al., 2001; Redmond et al., 2011; Riches et al., 2010). Memory plays a prominent role in sentence repetition tasks and should any processing capacity limitations exist (atypical or rapid decay in a learner's memory) it impacts the assessment and is further evidence of the learner's language difficulties. Although the combination of different non-word repetition and sentence recalling tests improves sensitivity and accuracy, it is unnecessary as it does not significantly alter the results found by sentence repetition alone

(Conti-Ramsden et al., 2001; Riches et al., 2010). What is more impressive is that the SR task places few demands on the phonological component of language, and what is further significant about the sentence repetition task is that it is largely independent from IQ, and therefore allows for the identification of difficulties in language, separately to learning difficulties. Further advantages of SR are its practical advantages and the simplicity of its scoring methods, because the SR task is open-ended it allows for the learners to make a variety of errors (adding, subtracting, transposing or omitting words as well as changing the syntactic structure). It can provide an abundance of useful data and qualitative information regarding the underlying difficulties experienced (Conti-Ramsden et al., 2001; Riches et al., 2010). Therefore, SR makes optimal use of resources and avoids the overly extensive and strenuous diagnostic language assessments, as it only requires approximately 10-15 minutes to administer (Redmond et al., 2011). It also incorporates previous language knowledge/base of a learner which resides in long term memory, and with the inclusion of other working memory batteries, researchers would be able to isolate the different working memory limitations from the findings on the SR (Conti-Ramsden et al., 2001; Riches et al., 2010).

SR involves numerous cognitive processes, and analysis using sentence repetition may allow for the identification of several underlying skills within the different aspects of memory (short term, long term and links to the central executive), cognitive processing and knowledge abilities of learners. Redmond and colleagues (2011) confirmed previous studies' findings and believe that SR demonstrates "strong diagnostic integrity" and motivated for the inclusion of this assessment in future studies to ensure treatment effectiveness (p. 110). Alternative approaches such as these, which reveal factors underlying language difficulties, are important in assessment and studies such as this, as it aids researchers and therapists in identifying working memory, processing skills or language difficulties, and implementing interventions in

education (Conti-Ramsden et al., 2001). Jordaan (2011a) conducted a study in South Africa, using Foundation phase learners. The research found that sentence repetition was highly sensitive to different levels of language proficiency and further correlation reconfirmed this relationship as well as its use as a working memory assessment. As there is a strong correlation between the SR and Working Memory, there are some limitations in comparing the scores of the SR assessment and the results on the AWMA. These are discussed in further detail in Chapter 7.

5.5.3. Cognitive Processing: Executive Control Functioning (EF)

The Executive functioning test is a standardized test which assesses higher order functioning skill and processing abilities. Although the test is standardized in English, the instructions were translated into isiZulu (by an individual proficient in isiZulu and sensitive to the vernacular in the urban areas) it was then back translated into English by a second party, to ensure the validity and reliability of the translations. Please note, only the instructions were translated and not the assessment. This was done to ensure that the reliability and validity of the assessment remained. During the assessment of learners, appropriately trained isiZulu HL assistants were used to give the instructions to the learners, in both English and isiZulu, to ensure the learners understood what was expected of them and to ensure lack of understanding due to English instruction would not negatively impact the scores.

The NEPSY "A Developmental NEuroPSYchological assessment" second edition was used for this purpose. This is a neuropsychological instrument used to assess development in preschool and school-going-aged children. Results obtained from this battery of tests is generally used to diagnose any childhood disorders and gives a comprehensive breakdown of an individual's cognitive strengths and weaknesses. This assessment is tailored across six

different cognitive domains and tests children between the age ranges of 3-16 years. (Korkman, Kirk & Kemp, 2007). This product provides a broad pattern of a child's neuropsychological processes and identifies any cognitive deficits. By using the NEPSY, researchers or clinicians no longer have to administer numerous tools to assess specific functionalities or disorders as the NEPSY has integrated subtests. Because of its flexibility, by selecting a few of its subtests, one is able to focus on specific cognitive aspects relevant to the individual, which remains valid and reliable, and decreases the time of testing (Korkman et al., 2007).

The six areas of assessment that the NEPSY covers include Executive functioning and Attention, Language, Memory and Learning, Sensorimotor functioning, Visuospatial processing, and Social perception. For the purpose of this research only the Executive Functioning and Attention sub-tests were administered, which assessed inhibition of learnt and automated responses, monitoring and self-regulation, selective and sustained attention, the ability to establish, maintain and alter a response set, non-verbal problem solving, planning and organization (Korkman et al., 2007).

This was achieved though the following sub-tests;

- Clocks: this assessed planning, organization, visuoperceptual and visuospatial skills, using the concept of time (possible max total: 78).
- Design fluency: this assessed behavioural productivity and the ability of the child to generate unique designs by connecting either structured or random dots (possible max total: 70).
- Inhibition: this assessed the ability to inhibit automated responses for more novel responses and assesses the ability to switch between the different response types. This is done using shapes, arrows and names (possible max total 240).

Garrat and Kelly (2008) reported that the NEPSY correlated well with academic achievement, in its standardized English format, they argued it was relatively insensitive to cultural factors and bilingualism. The translation of the instructions assisted with some of the language issues and assisted with the implementation in the South African context.

5.5.4. Cognitive Processing: Working Memory (WM)

Learners' Working Memory (WM) was assessed as part of the cognitive processes covered in this study. WM refers to the short-term storage of information for manipulation while processing additional information. The positive aspect of WM is that it is not strongly impacted by an individual's previous experience or their environment but informs us about their ability to learn. WM is assessed in this study because of its strong association with performance, especially in Literacy. Learners with WM impairments struggle within a classroom setting as they are unable to maintain information, instructions, and suffer with place-keeping errors during complex tasks and therefore struggle to maintain developmentally appropriate learning rates, resulting in failure or poor academic progress rates (Alloway, 2008). Undiagnosed WM impairments in the early years of schooling will result in poor academic achievement in subsequent years of education (Alloway, 2012).

For the purpose of this study, the Automated Working Memory Assessment (AWMA-2) was used. The AWMA-2 has previously been translated into 10 different languages (not an African language) and used internationally and has proven to be a practical and convenient tool used to assess and screen for WM problems in individuals between the ages of 5-79 years (Alloway, 2012). The administration (including testing sequence) and the scoring of this tool are standardized and fully automated, using a computer programme. This is an efficient method

of assessment and scoring as it minimizes the risk of experimenter/human error, resulting in more reliable scores. Furthermore, this is a valid and trustworthy diagnostic measure of WM, validated by a high classification in accuracy using the WISC-IV working memory index (Alloway, 2008; Alloway, 2012). For the purposes of this study ONLY the instructions were translated into isiZulu (by an individual who is proficient in isiZulu and sensitive to the vernacular in the urban areas). It was then back translated to English to validate the reliability of the translation. During assessment of the learners, an appropriately trained isiZulu HL assistant from the specific urban areas was tasked in giving the instructions to the learners, after they were adequately trained on the testing procedures. The translation of instructions and any further explanation in isiZulu was to ensure the learners understood what was expected of them, and to reduce the bias experienced if they were only tested in English.

The AWMA-2 provides measures on both verbal and visuospatial short-term memory and working memory. The tests used to measure these aspects involve tasks that require simultaneous storage and processing of information. For example, the verbal short-term memory (phonological loop) tasks include digit and letter recall and the visuospatial (sketchpad) short-term memory involves dot matrix and block recall. The verbal working memory uses both listening and processing letter recall and the visuospatial working memory includes the backwards dot matrix (Alloway, 2012). The more complex memory tasks are designed to assess the ability of the central executive control aspect of working memory and generally require the ability to process and store increasing amounts of information until recall errors are made (Alloway, 2008). In this research, the verbal subtests of WM were excluded in an attempt to reduce any possible language/cultural bias, as these are assessed in (standardised western??) English. Results from Jordaan (2011a) argued that the AWMA was biased towards L2 English learners and the AWMA was more likely tapping into language processing rather

than WM alone. This does however influence the overall validity of the entire assessment and therefore, only raw scores were used in the analyses of the AWMA subtests used. Furthermore, as the SR has previously been used as a WM assessment in a similar context, further investigation into WM abilities can be determined through these results (in both English and isiZulu).

5.5.5. Literacy Skills

Literacy skills are an important component of learning, as it is necessary for the transition through education. As discussed in the literature, in order to cope with the academic demands within higher grades, learners require a certain level of language proficiency in their L1 and L2. Literacy in this case is considered a measure of their Cognitive Academic Language Proficiency (CALP) as defined by Cummins in the theoretical framework section. To determine the learners' proficiency, they were assessed using the Early Grade Reading Assessment (EGRA) toolkit.

The Millennium Development Goals (MDG), as well as the Education for All campaign, saw an increased number of learners being enrolled in primary education. However, student learning, especially in lower income countries, continued to lag behind. Most international and national achievement assessments are unable to determine whether poor achievement scores were because of lack of knowledge or the lack of reading and literacy skills (RTI international, 2009). Without the basic fundamentals of literacy, learning and achievement throughout one's schooling career will be stagnated and increase the number of drop-outs or failures. This toolkit was developed as a simple and effective means to assess the foundations of student learning, more specifically, the ability to read (RTI international, 2009). Some of the basics assessed are letter recognition, reading of simple words, oral reading

fluency and the comprehension of sentences, all of which are measured in a systematic way in an oral assessment that was developed for multiple countries and in multiple languages. Rigorous studies and assessment of early reading assists governments in their goal to improve the quality of education, learner outcomes, and policy change. Each country reviews the applications and vocabulary, and reviews are made to ensure the assessment is country and context appropriate, thereby reducing any possible biases (RTI international, 2009). The official English and isiZulu EGRA assessments, reviewed and standardized by the Department of Education (DoE, 2011), were used within this study.

The EGRA is divided into several sections (these are equivalent for both English and isiZulu assessments):

5.5.5.1 Letter Sound Assessment

This section assesses the learner's ability to adequately pronounce a number of letters (presented in table form and read from left to right). Learners were presented with their own separate sheet and instructed, in both English and isiZulu, to sound out as many letters as they could in one minute. As they pronounced the letters, the research assistants discreetly marked off the incorrectly pronounced letter sounds. The learners were instructed when they had completed a minute of the task, asked to stop and a bracket (]) was placed where they had finished. The number of correctly pronounced letters was tallied and recorded as a total. Possible max total of 25 for isiZulu and 25 for English.

5.5.5.2. Familiar Word Reading Assessment

This section assesses the learner's ability to adequately pronounce/read a number of what would be is considered familiar words (as determined by the RTI and DoE teams), which

are age and grade appropriate (presented in table form and read from left to right). Learners were presented with their own separate sheet and instructed to read out as many words as they could, in one minute. As they read the words, the research assistants discreetly marked off the incorrectly pronounced words or if the learner did not know what the words were or how to pronounce them. The learners were instructed when they had completed a minute of the task, asked to stop and a bracket (]) was placed where they had finished. The number of correctly pronounced words was tallied and recorded as a total. Possible max total of 50 for isiZulu and 50 for English. If the learners were unable to read out the entire first row, they were asked to stop and they did not go on to complete the rest of the assessment, i.e. the remainder of the familiar words and reading/comprehension assessment. The researcher and research assistants were very mindful not to increase the learners' anxiety or cause any distress. Although, not many of the learners were able to fully complete this section in both languages, they were congratulated for their effort and positively reinforced.

5.5.5.3. Reading Assessment

Many of the learners were unable to progress to this section however, those that did, were asked to read the passage presented to them out loud. If the learners did not know a word, the research assistants told them the word in order for them to continue reading. As the learners read the passage, the research assistants discreetly marked off the incorrectly pronounced words or if the learner did not know what the words were or how to pronounce them. The learners were instructed when they had completed a minute of the task, asked to stop and a bracket (]) was placed where they had finished. The number of correctly pronounced words was tallied and recorded. Possibly max total of 35 for isiZulu and 111 for English. If the learners were unable to read out the entire first row, they were asked to stop, and they did not go on to complete the rest of the assessment. Those that were able to complete the passage,

were asked some questions relating to the passage, to determine whether they were able to comprehend what they had read. This comprehension section was marked with a possible max total of five for isiZulu and five for English, for all the questions they answered correctly. Therefore, learner totals were used for comparative purposes and not the individual subtests, with a possible overall total of 191 for English and 115 for isiZulu.

5.5.6. Contextual School and Teacher Questionnaires

Although quality of education is beyond the scope of this study, the principal of the selected schools and the teachers within the sampled classrooms were asked to complete a contextual questionnaire. This was in an attempt to gather further information about the school, the teachers and their backgrounds, to control for any possible extraneous teacher variables that may impact the learner findings. As the number of sampled principals and teachers were too small to be representative, their data was only valid when discussed at the learner level. Therefore, this contextual information was only used on a simple descriptive level and to control for or determine which factors have effects above and beyond what was focused on in the study. Some of the information gathered for the school context included resource availability, quintile ranking and other SES contributors, student teacher ratios, perceptions on the quality of education, and the income level of the surrounding community. The teacher questionnaires included: age, gender, ethnicity, number of languages spoken (HL and additional), highest qualification levels, and their subject specializations. These questionnaires were only in English, based on the assumption that principals and teachers should be proficient in this language through their education and as a requirement of teaching. These were approximately two pages/one page back and front.

5.6. PROCEDURES

Ethical clearance was obtained from all relevant parties (see ethical section), up to and including DBE, teachers, principals, parents and students. All participants received and completed information sheets and consent documents, written in the appropriate style and language for each recipient (see appendix 1-4). After ethical consent was provided by the learners and their parents the following procedures were followed.

The parents, principals and teachers were asked to complete contextual questionnaires. From the contextual questionnaires, the research could determine if any of the learners had learning difficulties, previous head injuries, sight- or hearing- difficulties and these learners were excluded from the study. In some instances, the teachers offered further assistance with those learners who they believed had learning difficulties but, due to SES circumstances, were never formally diagnosed, and they were also excluded from the sample. Following the exclusion process, each student was called into a quiet room provided by the school to complete the testing. The assessments were conducted during school periods selected by the educators, so as not to impact on the students' academic work. All tests were completed under the supervision of the researcher at all times. All necessary materials and writing tools were provided to the pupils by the researcher and no costs were incurred by the school or the participants. The assessments were done in one session in the following order: Sentence Repetition (English then isiZulu), EGRA (English then isiZulu), NEPSY and AWMA, with short rest periods in between to minimise fatigue. After the completion of all the assessments, the documentation for each learner was bound together along with their consent and demographic forms and placed in a sealed envelope. The scores for each test was checked by the researcher, all raw data was coded, captured and cleaned. Scoring and coding procedures

were done according to test guidelines and manuals provided with each assessment, to ensure validity and reliability of the data.

5.6.1. Ethical Considerations

Permission was obtained from the Department of Basic Education (DBE) in Gauteng, as this was where the study was conducted. Clearance was also sought through the University of Witwatersrand Human Research Ethics Committee as this is where the research is registered in order to obtain the post graduate degree. The headmasters and School Governing Bodies (SGB) of the selected schools were approached and informed of the research via an information sheet as well as an interview for further questions regarding the research (see appendix 1). Once consent was obtained from these individuals, teachers within the available classes were approached and informed of the research via the same information procedures (see appendix 4). This process was necessary to obtain permission from them to not only complete the teacher questionnaire, but to also approach their students and conduct the research within their class. The learners and their parents/ guardians then received information sheets attached to consent forms (see appendices 2 and 3). All forms were placed in envelopes and asked to be completed and returned sealed to the class teachers, to ensure all completed documentation remained private. The only personal details required on the demographic sheets were the names of the parents and their child. These sheets were assigned numbers, which were correlated with numbers placed on their assessments. Information pertaining to the subjects were kept strictly confidential, with access only available to the researcher and supervisor(s).

Should parents request it, a single page summary on the overall research findings will be released to the participant's educator on conclusion of the research. The instruments and techniques utilised were non-invasive and considered harmless to the individuals. No

individuals were offered any form of incentives to participate in the study and were able to leave the study at any point with no consequences. If it was deemed by the researcher that a learner seemed uncomfortable or got a little anxious with any of the testing procedures, it was discussed with them in their own language as to whether they wanted to continue participating or return to class, without any negative consequences. Because of the age of the individuals, it was important to ensure that they were always comfortable and reminded that all results were private and teachers or principals had no access to the results. The learners and their wellbeing remained a priority throughout the testing.

5.7. DATA ANALYSIS

The above sections are indications of basic descriptive analyses (across schools, parents and learners) using frequency and mean scores. In the results section to follow, more complex statistical analyses were run to determine the impact levels of language proficiency has on cognitive processing and the influence of LoLT on literacy scores. These include:

a) Comparisons across schools used means to determine average scores for language, literacy and cognitive processing assessment. T-Tests were then used to determine whether there was any significant difference.
b) Language proficiency scores: mean scores were used for both isiZulu and English for SR and EGRA assessments. In order to categorize learners using "thresholds", the collected raw data was modelled. This involved analyzing the distribution curves for normality to determine whether the mean or the medium is the best measure of central tendency and then the Standard Deviation was used to calculate the percentiles/cut-off points for calculated levels of proficiency. These were placed on scatter plots and adjusted by the distribution/range of scores to develop the four proficiency categories. Pearson's

correlation was also used to determine the relationship between SR and EGRA and also as a means of determining the validity of the assessments.

c) To examine the relationship between proficiency categories (SR and EGRA) and cognitive processing, Multivariate Analysis of Covariance (MANCOVA's) were used to control for covariates/extraneous variables (such as age, SES, maternal education etc). MANCOVAs allow for the control of a number of independent variables (or extraneous variables) to measure the effect on different dependent variables/subscales. The models with the highest statistical power and which accounted for most of the change within the analyses were used to discuss the relationship between proficiency scores and cognitive processing outcomes. Furthermore, correlations were run separately for each of the proficiency assessments (SR and EGRA) on cognitive processing outcomes (NEPSY and WM), to determine the strength and direction of their interaction. Box's M test was used to check the equality of multiple variance-covariance matrices and Levene's test was used to assess the equality of variances for a variable calculated for two or more groups (Test of Equality of Error Variances).

d) To investigate the influence of LoLT on language, literacy and cognitive scores, a variety of analyses were used. T-Test analyses were used to determine the statistical significance between LoLT and combined or separated language/literacy scores (in isiZulu and English) as well as the effect of matching LoLT and HL languages. Correlations were run to determine the strength and direction of the interaction between LoLT and SR/EGRA scores respectively. To compare LoLT and developed proficiency categories, chi-squared analyses were used for both SR and EGRA categories. Finally, MANOVAs were used to compare the effect of LoLT on cognitive processing scores.

e) Statistical significance was decided as either $P<0.05$ or $P<0.01$.

5.8 SUMMARY

This study aimed to examine the relationship between bi/multilingualism and cognitive functioning, using 111 grade 3 learners in a South African context. Four quintile 3, urban/sub-urban schools were sampled, where the LoLT was either isiZulu or English. The following proficiency and cognitive functioning instruments were used: Sentence Repetition, EGRA, NEPSY and AWMA. Analyses (discussed further in the following chapter) assisted in determining the relationship between language proficiency and cognitive processing as well as the possible impact of other contextual factors.

CHAPTER 6

RESULTS

This chapter begins to unpack the different results and analyses, starting with a simple glance at the average scores across the four measures, and then delving deeper into how language proficiency possibly impacts Executive Functioning (EF) and Working Memory (WM) scores. Keeping in mind the significant interest around Language of Learning and Teaching (LoLT) and its impact on Literacy skills, the final section investigates how these were related within the current study.

6.1. BASIC SCHOOL ACHIEVEMENT SUMMARY SCORES

This section shows a basic representation of language and cognitive scores across schools and are discussed in a more descriptive manner, rather than in a causative fashion. Below, schools are labelled A-D and indicate the Language of Learning and Teaching (LoLT) for each school. From the literature and the selected isiZulu sample, we expect the learners to have higher isiZulu Communicative language scores (using the Sentence Repetition assessment) given it is their Home Language (HL). From here, the Academic Language scores (assessed using the Early Grade Reading Assessment) are expected to vary across schools and their LoLT. As these are quintile three schools in poorer communities, results are likely to mimic previous studies and poor literacy abilities (Howie et al., 2012; Howie, Combrick, Roux, Tshele, Mokoena & McLeod Palane, 2017). Although the results in tables 6.1-6.4 are discussed in an explorative manner, their significance becomes more apparent when they are used in section 6.2 to determine the cut off points/thresholds in the development of bilingual proficiency categories.

Table 6.1. Literacy Scores using Sentence Repetition (SR) as a measure of Communicative language skills

School (and LoLT)	English SR Total				isiZulu SR Total			
	Raw Score (Total 24)	Percentage	Std. Dev	Range	Raw Score (Total 24)	Percentage	Std. Dev	Range
A (isiZulu)	6.79	28.29	4.94	0-20	11.45	47.71	3.86	1-20
B (English)	8.24	34.33	4.94	0-17	10.16	42.33	5.31	0-18
C (isiZulu)	7.73	32.21	5.31	0-15	11.73	48.88	3.71	6-18
D (English)	9.71	40.46	5.94	0-23	9.09	37.88	4.19	1-17
Total Mean Scores	**8.23**	**34.29**	**5.4**	**0-23**	**10.47**	**43.62**	**4.38**	**0-20**

Table 6.2. Literacy Scores using Early Grade Reading Assessment (EGRA) as a measure of Academic Language skills

School (and LoLT)	English EGRA Total				isiZulu EGRA Total			
	Raw Score (Total 191)	Percentage	Std. Dev	Range	Raw Score (Total 115)	Percentage	Std. Dev	Range
A (isiZulu)	118.45	62.02	58.84	0-184	82.31	71.57	33.52	9-115
B (English)	131.20	68.69	54.12	13-187	50.04	43.51	34.64	3-108
C (isiZulu)	159.96	83.74	21.61	101-185	97.05	84.39	14.06	55-110
D (English)	118.03	61.80	65	1-187	36.09	31.38	32.23	0-100
Total Mean Scores	**129.41**	**67.75**	**56.35**	**0-187**	**63.39**	**55.12**	**38.8**	**0-115**

In general, learners scored higher in isiZulu Sentence Repetition (SR), than in the English SR. Out of a possible total of 24, learners scored an average of 10.47 in isiZulu and 8.23 in English, which is an average of 43% for isiZulu and 34% for English. As anticipated learners with isiZulu as a HL present with higher communicative language scores. What is unfortunate to see, is that after three years of formal education these language proficiency scores are particularly low, although seemingly indicative of language abilities in a South African context. Schools which had isiZulu as their LoLT, reflected higher isiZulu SR scores,

with similar English comparisons for English LoLT schools. These results suggest that learners can "better" communicate within the classroom based on their specific medium of instruction, however, with such low scores it is difficult to determine to what extent they are able to do so and comprehend the information. Nevertheless, there is no statistically significant difference between isiZulu and English LoLT schools.

When focusing on Academic Language abilities, Table 6.2 shows that learners scored an average of 129.41 in the English EGRA (out of a total of 191) resulting in an average of 67.75%. The mean for the isiZulu assessment was 63.39 (out of a total of 115) resulting in an average of 55%. Three points of interest here, first overall literacy scores are higher than anticipated given the PIRLS results (Howie et al., 2012; Howie, Combrick, Roux, Tshele, Mokoena & McLeod Palane, 2017), secondly English Academic literacy scores are higher than isiZulu scores and finally, the overall scores for both languages are higher than their above-mentioned communicative language scores. Although there are higher English scores, significant testing (using two tailed tests) showed that only learners taught in isiZulu performed significantly better in isiZulu than those taught in English LoLT schools ($p= 0.000$ and $p= 0.01$). Being taught in English did not display any statistical advantages in scores. This begins to suggest that being taught in a learners HL improves literacy ability in that language (L1), which is important for the development of L2 English language proficiency.

The effects of Socioeconomic Status (SES) start to present themselves in Table 6.2. where School C has the best EGRA scores for both English and isiZulu (83.74% and 84.39% respectively). In Chapter5, School C was reported as having the highest SES score and from the researcher's experience a good quality of education. As the LoLT is isiZulu, questions arise regarding the level of English exposure these learners had before entering formal education or

whether this difference is due to good HL quality education which could improve the acquisition of English as First Additional Language (FAL).

Table 6.3. Basic Description of Cognitive Scores using the NEPSY and AWMA

Primary School	NEPSY Clocks	Std. Dev	NEPSY Inhibition	Std. Dev	NEPSY Design	Std. Dev
Possible totals	78		240		70	
A (isiZulu)	64.14	5.642	53.45	39.733	13.41	4.777
B (English)	67	5.831	43.04	44.551	14.24	5.060
C (isiZulu)	64.77	4.471	35.68	37.813	14.36	3.898
D (English)	65.37	7.248	61.74	44.597	15	4.406
Total Mean Scores	**65.3**	**6.054**	**50.2**	**42.680**	**14.29**	**4.546**

Table 6.4. Basic Description of Cognitive Scores using the NEPSY and AWMA

Primary School	AWMA Digit recall	Std. Dev	AWMA Dot Recall	Std Dev	AWMA Spatial	Std. Dev
A (isiZulu)	22.59	4.247	16.34	3.528	13.55	4.800
B (English)	23.92	3.108	18.96	3.910	15.32	6.129
C (isiZulu)	24.82	4.031	18.64	3.485	14.45	4.637
D (English)	23.77	4.923	17.46	3.526	12.94	4.905
Total Mean Scores	**23.7**	**4.229**	**17.74**	**3.702**	**13.94**	**5.142**

The above tables (Table 6.3 and 6.4) break down the mean scores by school and is a basic description of overall scores for learners. The results suggest that primary school A scored the lowest out of all the schools, with primary schools B and C achieving similarly across the subscales. 2-tailed significant testing, suggested there was not significant difference between schools and cognitive scores. Further inference on cognitive scores cannot be made at this point and are analysed in detail in section 6.3.

6.1.1. Normality Testing

Table 6.5. SR and EGRA Normality Testing

SR and EGRA test for normality									
		Range				Skewness		Kurtosis	
	N	Min	Max	Mean	Std. Dev	Statistic	Std. Error	Statistic	Std. Error
Eng SR Total	111	0	23	8.23	5.40	0.263	0.229	-0.520	0.455
isiZulu SR Total	111	0	20	10.47	4.38	-0.313	0.229	-0.427	0.455
Eng EGRA Total	111	0	187	129.41	56.35	-1.165	0.229	0.198	0.455
isiZulu EGRA Total	111	0	115	63.39	38.80	-0.260	0.229	-1.553	0.455
Valid N (listwise)	111								

Table 6.6. NEPSY and AWMA Normality Testing

NEPSY and AWMA test for Normality							
				Skewness		Kurtosis	
	N	Mean	Std. Dev	Statistic	Std. Error	Statistic	Std. Error
Clocks Raw	111	65.30	6.05	-0.639	0.229	0.316	0.455
Inhibition total	111	50.20	42.68	1.092	0.229	0.338	0.455
Design Total	111	14.29	4.55	0.310	0.229	-0.055	0.455
AWMA Digit Recall	111	23.70	4.23	0.025	0.229	0.189	0.455
AWMA Dot Matrix	111	17.74	3.70	0.272	0.229	0.011	0.455
AWMA Spatial Recall	111	13.94	5.14	0.347	0.229	0.596	0.455
Proc score Spatial Recall	111	34.32	18.24	0.403	0.229	-0.440	0.455
Valid N (listwise)	111						

6.2. DEVELOPMENT OF LANGUAGE SCORES INTO PROFICIENCY CATEGORIES

At this point, learners are put into bilingual categories, focusing on varying levels of language proficiency in each language. These bilingual proficiency categories are then used to

determine whether varying levels of language proficiency impacts cognitive processing in EF and WM. From the literature (Bialystok, 2001; Bialystok, 2017; Fricke et al., 2019; Kroll & Bialystok, 2013), it is assumed that learners who are proficient in both isiZulu and English will show increased cognitive abilities. To conduct these analyses, the learners are placed into language proficiency categories using Cummins' Threshold Theory (Baker, 1993, 2001; Cummins, 2001; Coetzee-Van Rooy, 2010) to determine whether they are proficient in that language or not.

The above SR and EGRA sores were used to develop the following proficiency categories

1. Proficient in both English and isiZulu.
2. Proficient in English and not proficient in isiZulu.
3. Proficient in isiZulu and not proficient in English.
4. Not proficient in either English or isiZulu.

The greatest difficulty experienced when determining which learners were proficient and not proficient using these two assessments, is that there are no standardised norms for the tests in South Africa and/or for their translations. Therefore, a mean split was used for isiZulu and English to categorise learners into the 4 proficiency groups, for both communicative and academic language proficiency. If the learners' scores were above the mean of the distribution, they were considered proficient and if their scores were below the mean of the distribution, they were considered not proficient. These language scores are considered relative to the range of scores in each language assessment. Below is a depiction of the distributions and mean cut offs. Once divided into the different language proficiency groups for each assessment (SR and EGRA), they could be easily categorized into the four groups listed below (See table 6.7 and

6.8). These categories were then used in further analyses to determine whether levels of proficiency in English and isiZulu influence cognitive processing.

A few concerns arose during the categorisation of learners. Firstly, the communicative/SR assessment scores were particularly low, with an average of 34.29 % for English and 43.62 % for isiZulu. Although these scores are representative of the South African context, it makes it even more difficult to consider learners above the mean as proficient and interpretation of the results should keep this in consideration. As for the Academic Language proficiency categories using the EGRA assessment, these mean scores were surprisingly higher than anticipated with a mean of 67.75% for English and 63.39% for isiZulu. Once again, without a larger sample and no standardised scores, the researcher cannot say for certain that learners are sufficiently proficient. To ensure such certainty, further research and replication of this study needs to be conducted, however, it is helpful to have a foundation to work from and limitations to overcome to ensure more generalisable results.

Graph 6.1. Proficiency Distribution for SR Scores (isiZulu/English)

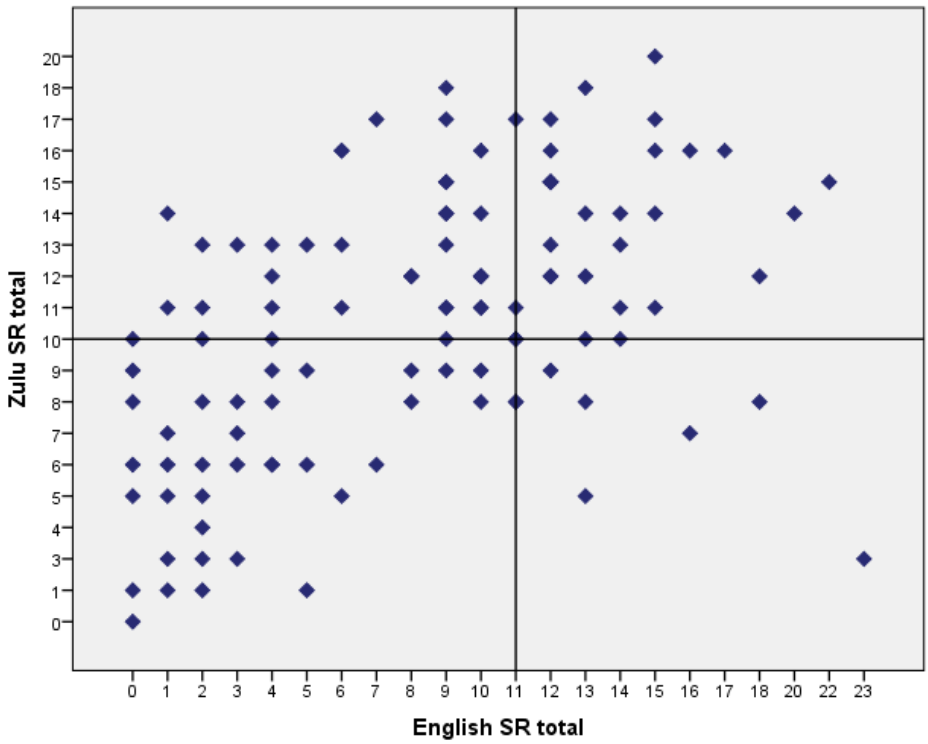


Table 6.7. SR Language Proficiency Categories

SR Proficiency categories		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Proficient in both English and isiZulu**	35	31.5	31.5	31.5
	Proficient in English and not in isiZulu	17	15.3	15.3	46.8
	Proficient in isiZulu and not in English	16	14.4	14.4	61.3
	Not proficient in either language	43	38.7	38.7	100.0
	Total	111	100.0	100.0	

Graph 6.2. Proficiency Distribution for EGRA Scores (isiZulu/English)

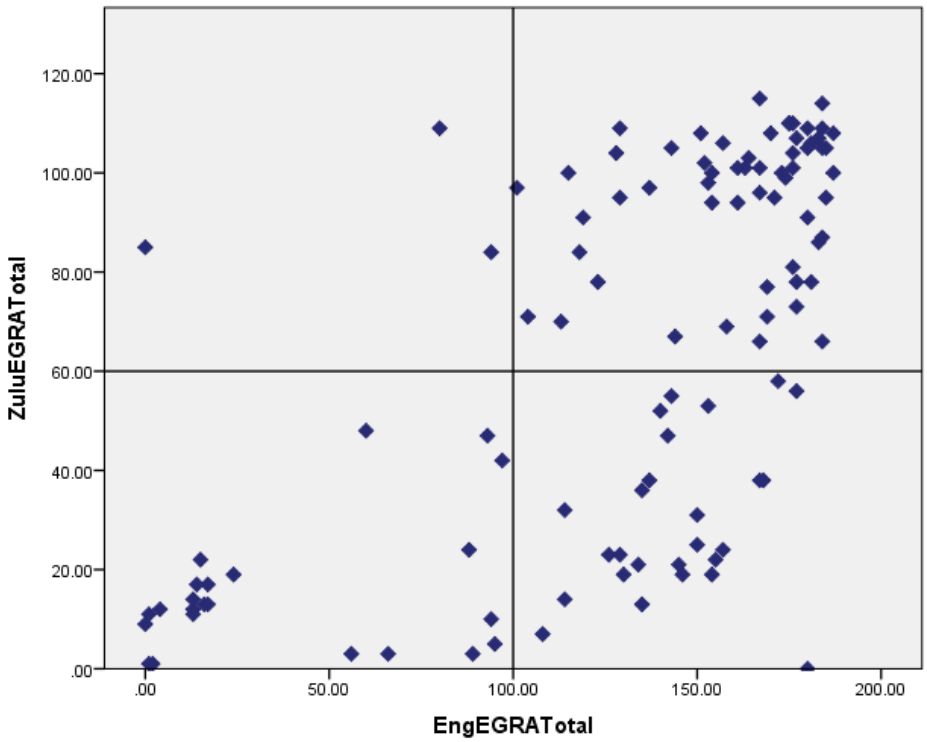


Table 6.8. EGRA Literacy Proficiency Categories

EGRA Proficiency categories		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Proficient in both English and isiZulu**	28	25.2	25.2	25.2
	Proficient in English and not in isiZulu	21	18.9	18.9	44.1
	Proficient in isiZulu and not in English	13	11.7	11.7	55.9
	Not proficient in either language	49	44.1	44.1	100.0
	Total	111	100.0	100.0	

The proficiency categories developed for both the SR and EGRA scores, show that most of the learners fall within the "not proficient in either language" category falling below the mean scores of the sample. This result is similar to research within the South African

context and a typical/expected outcome (Howie et al., 2012; Howie, Combrick, Roux, Tshele, Mokoena & McLeod Palane, 2017).

Initial Pearson correlations were done between SR scores and EGRA scores, which showed a positive relationship ($r= 0.34$, $p= 0.01$) but also indicates that they load on different constructs. Additional correlation analyses were done on the developed proficiency categories, which indicates that the SR and EGRA proficiency categories are positively correlated, with a score of $r= 0.481$ ($p=0.01$). This further shows a positive relationship between the two language constructs, but as they assess different aspects of language abilities, a higher correlation was not to be expected.

6.3. THE EFFECT OF PROFICIENCY CATEGORIES ON COGNITIVE PROCESSING

This section begins to explore the influence bilingual language proficiency has on cognitive processing, focussing on EF and WM. According to literature presented by Bialystok (Bialystok, 2001; Bialystok, 2017; Fricke et al., 2019; Kroll & Bialystok, 2013), learners who are proficient in both languages (balanced bilinguals) will present with higher cognitive scores. She also suggests that the most important contributors in developing balanced bilinguals are the ages of bilingual activation (the age of L2 acquisition); the level of L2 to L1 proficiency and context (formal bilingual education). As an alternative Paap and his colleagues (Paap et al., 2014; Vivas et al., 2017) argue that there is in fact no bilingual difference and one of the most salient factors to consider when comparing bilingualism and cognitive processing is the influence of SES. Therefore, the MANOVA analyses will take age, SES (which represents educational context too) and mother's level of education (as a further construct of SES) into

consideration in analysing the influence varying levels of bilingual language proficiency has on cognitive processing abilities.

6.3.1. Executive Functioning

Table 6.9. SR Proficiency Categories and NEPSY Subscales

SR Proficiency categories		Clocks	Inhibition	Design
1. Proficient in both English and isiZulu	Mean	63.40	61.03	13.66
	N	35	35	35
	Std. Deviation	5.658	41.378	5.488
2. Proficient in English and not in isiZulu	Mean	67.53	48.59	14.76
	N	17	17	17
	Std. Deviation	6.992	41.841	3.898
3. Proficient in isiZulu and not in English	Mean	64.88	36.25	12.81
	N	16	16	16
	Std. Deviation	4.470	34.099	4.167
4. Not proficient in either language	Mean	66.12	47.21	15.16
	N	43	43	43
	Std. Deviation	6.208	46.050	3.964
Total	Mean	65.30	50.20	14.29
	N	111	111	111
	Std. Deviation	6.054	42.680	4.546

The table above shows the difference in mean scores for the NEPSY subscales within the different SR proficiency categories. The MANCOVA run (appendix 8), shows that when you control for SES, SR proficiency significantly impacts NEPSY cognitive scores (p= 0.048). However, further analysis indicates that only Clocks subscale scores are significant (p= 0.011) with a high observed power of 0.816. When controlling for SES, proficiency accounts for 11.5% prediction in the model. Being proficient in both languages (1), is only significantly comparable to category 2 (P= 0.011), both with good confidence intervals [-10.545; -0.897]. However, being proficient in both languages did not have the largest mean score and may suggest there is no bilingual advantage.

Controlling for Mothers' education and SES shows 18.9% prediction in the model. However, the observed power is less (0.776) and therefore controlling only for SES is a better representation.

Table 6.10. EGRA Proficiency Categories and NEPSY Subscales

EGRA Proficiency categories		Clocks	Inhibition	Design
1. Proficient in both English and isiZulu	Mean	61.93	64.11	13.46
	N	28	28	28
	Std. Deviation	6.863	40.841	4.509
2. Proficient in English and not in isiZulu	Mean	66.71	59.05	15.19
	N	21	21	21
	Std. Deviation	6.034	50.369	4.781
3. Proficient in isiZulu and not in English	Mean	64.23	57.08	14.00
	N	13	13	13
	Std. Deviation	5.688	53.286	5.431
4. Not proficient in either language	Mean	66.90	36.63	14.45
	N	49	49	49
	Std. Deviation	4.879	33.489	4.267
Total	Mean	65.30	50.20	14.29
	N	111	111	111
	Std. Deviation	6.054	42.680	4.546

Table 6.10 shows the difference in means scores for the NEPSY subscales within the different EGRA proficiency categories. The MANCOVA run (appendix 9), shows that when you control for age, EGRA proficiency significantly impacts NEPSY cognitive scores (p= 0.01). However, further analysis indicates that both Clocks (p= 0.001) and inhibitions (p= 0.029) scores are significant, with a high observed power of 0.94 and 0.714, respectively. When controlling for age, EGRA proficiency accounts for 15.2% change in the model. Being proficient in both languages (1) within the Clocks subscale is only significantly different to scores in category 2 (p= 0.017) and category 4 (p= 0.002). For the inhibition subscale, proficient in both languages is only significantly comparable to category 4 (p= 0.041). In both subscales, being proficient in both languages does not have the best mean scores.

The analysis indicates that there is a large confidence interval for category 4 (not proficient in either), and this might be due to the large sample in that category. Although the Levene's test indicates that inhibition violates the assumption, we are unable to remove it from the model as it will change the construct, and the model accommodates and combines the separate scales. When controlling for age and SES, the model only accounts for 13.1% of the change, with a lower observed power, thus the best predictor of the model is when controlling for age only.

6.3.2 Working Memory

Table 6.11. SR Proficiency Categories and AWMA Subscales

SR Proficiency Categories		AWMA Digit Recall	AWMA Dot Matrix	AWMA Spatial Recall	Proc score Spatial Recall
1. Proficient in both English and isiZulu	Mean	21.26	17.77	13.23	31.37
	N	35	35	35	35
	Std. Deviation	3.320	4.109	6.222	20.347
2. Proficient in English and not in isiZulu	Mean	25.94	19.00	14.18	35.59
	N	17	17	17	17
	Std. Deviation	4.437	3.674	5.399	19.258
3. Proficient in isiZulu and not in English	Mean	23.13	17.00	15.25	39.19
	N	16	16	16	16
	Std. Deviation	3.538	4.033	5.196	19.576
4. Not proficient in either language	Mean	25.02	17.49	13.93	34.42
	N	43	43	43	43
	Std. Deviation	4.126	3.217	4.008	15.523
Total	Mean	23.70	17.74	13.94	34.32
	N	111	111	111	111
	Std. Deviation	4.229	3.702	5.142	18.238

Table 6.11 shows the difference in mean scores for the AWMA subscales within the different SR proficiency categories. The MANCOVA run (appendix 10), shows that when controlling for age, SR proficiency significantly impacts AWMA scores ($p = 0.005$). Further

analysis indicates that only digit recall scores are significant (p= 0.000), with a high observed power of 0.994. Controlling for age, proficiency accounts for 20.2% prediction in the model. Proficient in both languages (1) is only significantly different to scores in category 2 (p= 0.000) and category 4 (p= 0.000), with good confidence intervals of [-7.764; -1.646] and [-6.204; -1.481], respectively. Once again, being proficient in both languages does not indicate higher mean scores.

Controlling for age and SES accounts for 22% change in the model, and digit recall (p= 0.013) has an observed power of 0.979. Proficient in both languages (1) is only significantly different to scores in category 2 (p= 0.001) and category 4 (p= 0.002), with good confidence intervals of [-8.418; -1.594] and [-6.307; -1.063], respectively. Controlling for mother's education does not significantly change the model, therefore, controlling for age and SES is the best predictor of the model.

Table 6.12. EGRA Proficiency Categories and AWMA Subscales

EGRA Proficiency Categories		AWMA Digit Recall	AWMA Dot Matrix	AWMA Spatial Recall	Proc score Spatial Recall
1. Proficient in both English and isiZulu	Mean	22.79	17.46	12.68	29.21
	N	28	28	28	28
	Std. Deviation	3.938	3.415	4.714	17.629
2. Proficient in English and not in isiZulu	Mean	24.38	18.43	13.10	32.76
	N	21	21	21	21
	Std. Deviation	3.398	4.057	5.924	21.675
3. Proficient in isiZulu and not in English	Mean	21.23	17.31	16.00	37.92
	N	13	13	13	13
	Std. Deviation	3.898	4.662	7.234	19.504
4. Not proficient in either language	Mean	24.59	17.71	14.47	36.96
	N	49	49	49	49
	Std. Deviation	4.527	3.500	4.209	16.424
Total	Mean	23.70	17.74	13.94	34.32
	N	111	111	111	111
	Std. Deviation	4.229	3.702	5.142	18.238

Table 6.12 shows the difference in mean scores for the AWMA subscales within the different EGRA proficiency categories. The MANOVA run (appendix 11), shows that when not controlling for any covariates, EGRA proficiency significantly impacts AWMA scores (p= 0.035). When controlling for covariates, EGRA proficiency categories do not significantly impact AWMA scores (Age covariate, p= 0.05, slightly missing significant effect). Although there is no significant difference, it is important to note that being proficient in both languages does not show a cognitive/working memory advantage.

As SR has been previously been associated with Working Memory, and based on the EGRA proficiency categories not showing any significant impact, additional correlations we run to further investigate the relationship. Tables 6.13 and 6.14 show separate correlations for English and isiZulu SR scores and AWMA subscales. These suggest that there is a correlation between SR (in both languages) and WM, more specifically the Digit Recall subscale.

Furthermore, English SR has a stronger correlation (0.54) with Digit Recall, than isiZulu (0.3) at a 0.01 significance level. This not only suggest that SR and WM are directly correlated, but it also infers a language bias in favour of English for the AWMA.

Table 6.13. Correlation between English SR Scores and AWMA Subscales

		English SR total	AWMA Digit Recall	AWMA Dot Matrix	AWMA Spatial Recall
English SR total	Correlation Coefficient	1	0.547**	0.163	0.11
	Sig. (2-tailed)	.	0	0.088	0.252
	N	111	111	111	111
AWMA Digit Recall	Correlation Coefficient	0.547**	1	0.18	0.220*
	Sig. (2-tailed)	0	.	0.059	0.021
	N	111	111	111	111
AWMA Dot Matrix	Correlation Coefficient	0.163	0.18	1	0.402**
	Sig. (2-tailed)	0.088	0.059	.	0
	N	111	111	111	111
AWMA Spatial Recall	Correlation Coefficient	0.11	0.220*	0.402**	1
	Sig. (2-tailed)	0.252	0.021	0	.
	N	111	111	111	111

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 6.14. Correlation between isiZulu SR Scores and AWMA Subscales

		isiZulu SR total	AWMA Digit Recall	AWMA Dot Matrix	AWMA Spatial Recall
isiZulu SR total	Correlation Coefficient	1	0.299**	0.018	0.04
	Sig. (2-tailed)	.	0.001	0.848	0.674
	N	111	111	111	111
AWMA Digit Recall	Correlation Coefficient	0.299**	1	0.18	0.220*
	Sig. (2-tailed)	0.001	.	0.059	0.021
	N	111	111	111	111
AWMA Dot Matrix	Correlation Coefficient	0.018	0.18	1	0.402**
	Sig. (2-tailed)	0.848	0.059	.	0
	N	111	111	111	111
AWMA Spatial Recall	Correlation Coefficient	0.04	0.220*	0.402**	1
	Sig. (2-tailed)	0.674	0.021	0	.
	N	111	111	111	111

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

6.4. HOW DOES THE LANGUAGE OF LEARNING AND TEACHING (LoLT) INFLUENCE LANGUAGE PROFICIENCY AND LITERACY SCORES?

As per the literature, Language of Learning and Teaching (LoLT) is a contentious issue within South African research, with many varying views on the necessity to be taught in a Home Language (HL) versus the use of English. The following section investigates the impact LoLT has on Literacy scores and its implications for language proficiency.

6.4.1. LoLT and EGRA Literacy Scores

In section 6.1 analyses showed that there was a significant difference in EGRA results across schools, specifically schools that taught in isiZulu. This section begins to unpack the impact of LoLT on Literacy scores further. T-Test analyses were run to determine the effect LoLT (isiZulu and English) has on the EGRA literacy assessment scores. In the first analysis

(Table 6.15) both English and isiZulu total scores were combined, and it was found that there is a significant difference between English and isiZulu LoLTs (P= 0.000) with isiZulu LoLT showing higher mean scores. As many of the learners are multilingual, the research looked at the effect when HL matched the LoLT on the combined EGRA scores. The T-Test (Table 6.16) shows there is a significant difference (p= 0.001) where matching HL and LoLT of isiZulu resulted in higher mean scores. When separating the EGRA score and looking at the English and isiZulu literacy scores separately, the T-Tests (Table 6.17) revealed that being taught in isiZulu did show higher achievement scores for both isiZulu and English, however it was not statistically significant for English.

Table 6.15. T-Test: Relationship between LoLT and EGRA Combined Scores3

	LoLT	N	Mean	Std. Deviation	Std. Error Mean
EGRA Totals combined	**English LoLT**	60	165.4167	87.34954	11.27678
	isiZulu LoLT	51	225.0196*	73.64659	10.31258

Table 6.16. T-Test: Relationship between LoLT and Home Language Matching using EGRA Combined Scores

	HL Match LoLT	N	Mean	Std. Dev	Std. Error Mean
EGRA Totals combined	**Yes**	41	227.9268*	73.45182	11.47125
	No	70	172.2286	87.08420	10.40855

Table 6.17. T-Test: Relationship between LoLT and EGRA Separate Language Scores

	LoLT	N	Mean	Std. Dev	Std. Error Mean
English EGRA Total	**English LoLT**	60	123.5167	60.57339	7.81999
	isiZulu LoLT	51	136.3529	50.65247	7.09276
	LoLT	**N**	**Mean**	**Std. Dev**	**Std. Error Mean**
isiZulu EGRA Total	**English LoLT**	60	41.9000	33.68936	4.34928
	isiZulu LoLT	51	88.6667*	27.68658	3.87690

6.4.2. LoLT and SR Language Scores

T-Test analyses were run to investigate the possible impact of LoLT (isiZulu and English) on the SR literacy assessment. In the first analysis both English and isiZulu total scores were combined, and it was found that there is no significant difference between English and isiZulu LoLTs on SR scores, which show similar mean scores. When considering the SR scores separately (Table 6.18), it was found that learners taught in isiZulu scored significantly (P= 0.14) higher in the isiZulu SR scores compared to English LoLT. There was however no significant difference when looking at the English SR scores. There were also no significant differences found when HL matched LoLT on combined SR scores.

Table 6.18. T-Test: Relationship between LoLT and SR Separate Language Scores

	LoLT	N	Mean	Std. Deviation	Std. Error Mean
English SR total	**English LoLT**	60	9.10	5.550	0.717
	isiZulu LoLT	51	7.20	5.072	0.710
	LoLT	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Zulu SR total	**English LoLT**	60	9.53	4.674	0.603
	isiZulu LoLT	51	11.57*	3.759	0.526

6.4.3. LoLT and Proficiency Categories

Chi-Squared tests were run to see if LoLT was independent of language proficiency using EGRA and SR proficiency categories, and the below tables suggest proficiency is dependent on LoLT. EGRA proficiency categories (p= 0.000) and SR Proficiency categories (p= 0.003).

Although it is important to note that proficiency is dependent on LoLT the numbers within each category should be interpreted with caution based on the distribution and small sample within each. Further research is necessary to fully unpack and understand how they relate to each other, especially considering previous analyses indicating that having isiZulu as a LoLT increases the scores in EGRA combined totals and isiZulu SR scores.

Table 6.19. Chi-squared Cross Tabulations: Relationship between LoLT and EGRA Proficiency Categories

			EGRA Proficiency Categories				Total
			Proficient in both English and isiZulu	Proficient in English and not in isiZulu	Proficient in isiZulu and not in English	Not proficient in either language	
LoLT	English LoLT	Count	23	19	1	17	60
		Expected Count	15.1	11.4	7.0	26.5	60.0
		% within EGRA_Prof	82.1%	90.5%	7.7%	34.7%	54.1%
	isiZulu LoLT	Count	5	2	12	32	51
		Expected Count	12.9	9.6	6.0	22.5	51.0
		% within EGRA_Prof	17.9%	9.5%	92.3%	65.3%	45.9%
Total		Count	28	21	13	49	111
		Expected Count	28.0	21.0	13.0	49.0	111.0
		% within EGRA_Prof	100.0%	100.0%	100.0%	100.0%	100.0%

Table 6.20. Chi-squared Cross Tabulations: Relationship between LoLT and SR Proficiency Categories

			SR Proficiency Categories				Total
			Proficient in both English and isiZulu	Proficient in English and not in isiZulu	Proficient in isiZulu and not in English	Not proficient in either language	
LoLT	English LoLT	Count	22	12	2	24	60
		Expected Count	18.9	9.2	8.6	23.2	60.0
		% within SR Prof	62.9%	70.6%	12.5%	55.8%	54.1%
	isiZulu LoLT	Count	13	5	14	19	51
		Expected Count	16.1	7.8	7.4	19.8	51.0
		% within SR Prof	37.1%	29.4%	87.5%	44.2%	45.9%
Total		Count	35	17	16	43	111
		Expected Count	35.0	17.0	16.0	43.0	111.0
		% within SR Prof	100.0%	100.0%	100.0%	100.0%	100.0%

6.4.4. LoLT Impact on Cognitive Processing in NEPSY and AWMWA Assessments

Basic MANOVA were run to determine whether LoLT could predict scores within the NEPSY and AWMA. These results showed that there was no significant difference between the LoLT groups (isiZulu and English). Even when learners' HL matched their LoLT, there was still no significant difference between the groups on either NEPSY or AWMA subscales.

6.5. SUMMARY

The results are discussed in depth in the following chapter, however, some important trends have emerged. Language and literacy scores across the sample are low, which is common given the context. Language proficiency does impact cognitive processing, but does not show balanced bilingual advantage. LoLT has once again proven to be an important factor to consider, where HL as LoLT has significant effect on literacy scores.

CHAPTER 7

DISCUSSION AND CONCLUSION

South Africa is a developing country, with many social inequalities. Much of the research presented in the literature sections are from more developed counties with a higher SES status and greater access to resources. This section discusses the findings of the current research, within South Africa's complex and unique environment. Given the unique context, it is unsurprising that there are disparities between the current results and previous research.

7.1. SAMPLE AND SCHOOLS

The sampled schools and learners are both considered representative of quintile 3 schools and their feeder community. Although some schools had self-reported differences regarding access to resources, these mostly related to basic facilities such as access to basic sanitation, classrooms in good working order, and even staff rooms. There were no substantial differences between the schools that would exclude them from comparative discussions. They remain DBE-ranked quintile 3 schools, characterized as low SES, with concerns of daily nutrition, social inequalities, basic sanitation, limited school facilities and culturally diverse learners (Balfour, 1999; Evans & Cleghorn, 2012; Taylor, 2012). The teachers also showed similarities to previous research, with a disparity between the teachers HL and the LoLT they taught in (Evans & Cleghorn, 2012). None of the teachers reported having English as their HL and only a few reported isiZulu as their native language. As with the PIRLS (2016) report, there was a large teacher:learner ratio which suggests over-crowded classrooms typically seen in lower SES schools (Howie et al., 2017). Quality of education is beyond the scope of this study and other than reporting the SES characteristics, these were not fully investigated at a school level. There is, however, substantial research showing how these factors impact learners

and their educational outcomes (Balfour, 1999; EGRS, 2017; Luk & Bialystok, 2013; Reddy et al., 2016; Taylor & Coetzee, 2013).

The selected sample's demographics and home environments are in line with what is expected and previously reported (Brock-Utne, 2010; Reddy et al., 2016; Taylor, 2012), for low-income communities, including low maternal education, absent fathers, and minimal access to basic resources. 80% of the learners have isiZulu as their home language but are exposed to and speak other African languages, making them multilingual. Overall, maternal parents reported not speaking English often at home, having low confidence in their own English language abilities and believed that their children had similarly low English proficiency. As learners are either taught in isiZulu or English, it is important to note that the remainder (20%) of the sample are taught in a foreign language.

7.2. PROFICIENCY CATEGORIES

Much research around language proficiency and bilingualism focuses on the initial work of Bialystok and her colleagues. Many of these early studies focused on the comparison between monolinguals and bilinguals, to determine the impact on cognitive processing. However, more recent published research has acknowledged the complexity of bilingualism and relies rather on the discussions of varying levels of bilingualism. Due to the diverse population, LiEP complexities and social economic inequalities, South Africa has many learners with varying levels of language proficiency across all languages. As the education system focuses on the theories of additive bilingualism and uses HL and FAL as LoLT, the study categorizes the learners into different types of bilinguals to test how the theories of language proficiency impact cognitive functioning.

The development of proficiency categories was done in accordance with the threshold theory, with the benchmark of two thresholds - low and high. This allowed the researcher to place learners into four different categories based on their language, using two different language assessments:

a. Proficient in both English and isiZulu (Balanced bilingual, above the highest threshold).
b. Proficient in English and not isiZulu (Less balanced bilingual, between the two thresholds).
c. Proficient in isiZulu and not English (Less balanced bilingual, between the two thresholds).
d. Proficient in neither language (Limited bilingual, below the lowest threshold).

Based on Cummins' BICS and CALP differentiation, which is more a distinction between constructs rather than a theory, it was useful to distinguish between different language proficiencies and the use of literacy assessments, in both isiZulu and English. Sentence Repetition (SR) was used as measure of communicative language capabilities, but not particularly as a measure of academic language ability. As a verbal recall assessment, SR would be considered more along the lines of BICS, which is considered relatively cognitive undemanding. The Early Grade Reading Assessment (EGRA) on the other hand, was developed by the World Bank and USAID and is currently used within the Department of Basic Education (DBE) in South Africa as a measure of Setswana literacy skills in their ongoing EGRS research (2017). The isiZulu version was implemented within this research as a measure of both English and isiZulu literacy skills, and as a measure of academic language ability.

As there are no standardized scores for these measures and no defined threshold for proficiency, mean scores were used to determine thresholds of proficiency and allocated

learners into the different categories based on levels of proficiency in each language. The proficiency categories developed for both the SR and EGRA scores show that most of the learners are within the "not proficient in either language" category, falling below the lower mean threshold, and considered limited bilinguals. For the SR proficiency categories, approximately 39% of the sample were considered limited bilinguals. For the more cognitively demanding academic proficiency assessment EGRA, 44% of the sample were considered limited bilinguals, and only 25% of the learners were considered balanced bilinguals. This result is similar to other research within the SA context, and a typical outcome, and it is argued to impact the learners' ability to learn (DBE, 2014; Howie et al., 2008; Howie et al., 2017; Prinsloo et al., 2018). In the PIRLS 2016 report, most learners showed poor literacy abilities and proficiency, and could therefore not read for meaning, nor engage with educational material (Howie et al., 2017). Brock-Utne (2010) and the ANA (DBE, 2014) results have showed the same language disparities and achievement impact. As the scores are representative of low language proficiency and literacy abilities of SA learners, any learners above the mean threshold may not be considered as fully proficient and interpretation of the results are done with caution.

7.3. LANGUAGE PROFICIENCY AND COGNTIVE PROCESSING

Initial findings from earlier research focusing on language proficiency and bilingualism indicated that bilingual learners show cognitive advantages and outperform monolinguals. As mentioned, more recent studies focus on the comparison between bilinguals and their varying levels of language proficiency. With the approach to balanced bilingualism as being the ideal, research conclusions remained the same - bilinguals that were proficient in both languages outperformed not only their monolingual but also bilingual counterparts (Bialystok, 2017; Bialystok & Barac, 2012; Kroll & Bialystok, 2013; Luk & Bialystok, 2013). Findings

indicating increased language proficiency in both languages results in positive cognitive effects are also in line with Cummins' Interdependence and Threshold theories. These theories argue that as the learners becomes more proficient and fluent in both languages, the more automated the cognitive processing becomes, reducing demand on cognitive resources and having a positive effect (Baker, 2001; Cummins 2008; Cummins 2009; Cummins & Yee-Fun, 2007; Fanson, 2009).

Cognitive functioning in this study was defined as Executive Functioning (EF) and Working Memory (WM). Using Miyake et al. (2000), Unity and Diversity View, for EF and Baddeley's, multi-componential model of WM (Baddely, 2003; De Sousa, 2016). Previous research that concentrated on executive functioning used assessments such as the Stroop, the Flanker, and the Simon tasks (Luk & Bialystok, 2013; Kroll & Bialystok, 2013), where the current study took a different approach and made use of the NEPSY. Cockcroft, et al, (2019) argue that little attention has been paid to investigating the influence bilingualism has on working memory, given it is a necessary and significant contributor to academic achievement. Therefore, the current study explores WM with the use of the AWMA, as an additional cognitive function. Both the NEPSY and the AWMA have previously been used in the South African context and according to Garratt and Kelly (2008), they are not considered culturally biased. Additionally, both assessments have subtests which separate the different components of EF and WM, just as previous studies have done. Using a different EF assessment and the exploration of WM contributes to the uniqueness of the study.

The current study explored these results within a lower SES context, to determine whether the theories were relevant, and the previous result generalizable across varying contexts. Given the literature, this study expected language proficiency to impact cognitive

processing, and the learners categorised as balanced bilinguals or proficient in both isiZulu and English to show cognitive advantages. The sections to follow discuss the findings using the language proficiency categories from the SR and EGRA assessment to determine the impact on cognitive processing of WM and EF separately.

7.3.1. Executive Functioning (EF)

The current study used Miyake et al. (2000), Unity and Diversity view to frame EF. This framework divides EF into sub-components, inhibition, shifting and Working memory, like that of the NEPSY assessment.

7.3.1.1. The Relationship between Communicative Proficiency (using SR) and Executive Functioning

The results show that only when controlling for SES as a covariate (and mothers' education in a second model) does language proficiency significantly impact executive functioning. However, SR proficiency categories only significantly affect the Clocks subscale of the NEPSY, suggesting that SR proficiency influences learners' planning and organizational skills. The results however are not in line with Bialystok's findings, as learners who are proficient in both languages did not show a cognitive advantage over other categories of learners. On the contrary, they scored the worst across all proficiency categories and were only comparable to learners who are proficient in English and not isiZulu. Although not significant, it is also important to note that the category proficient in both languages scored the worst on the inhibition subscale, which is one of the skills argued to be the "most advanced" in balanced bilinguals.

7.3.1.2. The Relationship between Academic Language Proficiency (using EGRA) and Executive Functioning

The results show that only when controlling for age as a covariate, does language proficiency significantly impact executive functioning. EGRA proficiency categories only show a significant impact on Clocks and Inhibition subscale scores. Furthermore, being proficient in both languages did not reveal higher cognitive functioning scores, with limited bilinguals (not proficient in either language) demonstrating higher scores. The finding that limited bilinguals demonstrated better inhibition scores may indicate that there is a lack of competition between languages and therefore no need for increased inhibition skills. Once again, being proficient in English and not isiZulu showed a significant impact on the Clock subscale.

7.3.1.3. Executive Functioning Discussion

The findings for the influence of language proficiency on EF processing does not match findings from Bialystok and her colleagues (Bialystok, 2017; Bialystok & Barac, 2012; Kroll & Bialystok, 2013; Luk & Bialystok, 2013), as there are no cognitive advances for learners who are proficient in both languages (as defined by mean score categorisation), with strong statistical powers being reported in both analyses. The results begin to dismantle the ideals of language interdependence and transferability of skills, as well as the reported positive or negative cognitive influence argued in the threshold theory. The results do however conform to more recent studies by Paap et al. (2014, 2015), which indicate that there are no bilingual advantages across numerous EF assessments, now also demonstrated using the NEPSY assessment. They further argue that factors such as context, SES and larger sample sizes seem to have a greater influence over cognitive abilities, which has been demonstrated in the results of this study. More recent meta-analyses by Donnelley et al. (2019), Lehtonen et al. (2018) and

Paap (2019) suggest bilingual advantages in EF are generally overstated by studies with small sample sizes and there is in fact no bilingual advantage in EF scores. Furthermore, Rey-Mermet et al. (2019) has recently called into question the existence of EF as a cognitive construct. On the other hand, Garrat and Kelly's (2008) study which used the NEPSY on a sample of low-income learners, found similar language and EF results to this current research. They reported a similar pattern to the current study's results, showing poor language abilities resulted in cognitive strengths and suggested that these bilinguals relied more on visual information and showed increased confidence when using non-verbal assessments.

Important to note however, is that the category of learners who were proficient in English and not isiZulu continuously showed an influence on Clocks as a subscale, which suggests that the NEPSY may lend itself more to English proficiency, or that Clocks as a subscale is more culturally biased than anticipated.

7.3.2. Working Memory

As with executive functioning, working memory is considered an integral part of cognitive processing, and a strong predictor of academic achievement (and assists with the acquisition of new languages) (Cockcroft et al., 2019). The bilingual advantages discussed by bilingual researchers are thought to extend past general EF and into WM, which is considered an overlap of inhibitory control and closely related to attentional control/selective attention (Kroll & Bialystok, 2013). Therefore, the same argument applies to WM: increased bilingual proficiency results in advanced WM abilities. These results have been found in South Africa, with young proficient bilingual/multilingual adults, showing advantages across WM components, compared to monolinguals (Cockcroft et al., 2019) and in similarly low SES communities (Bosman & Janssen, 2017). The discussion below compares the WM findings

using the AWMA (which is framed by Baddeley's multi-componential model of WM) (Baddely, 2003; De Sousa, 2016)., across the varying levels of bilingual categories. As the study wanted to reduce language bias in the cognitive testing, most of the AWMA subtests used focussed on visuospatial processing, which assesses non-verbal cognitive processing and is a modality sensitive domain (Baddeley, 2000, 2003). For this reason, sample exclusion factors included both visual and hearing deficits.

7.3.2.1. The Relationship between Communicative Proficiency (using SR) and Working Memory

Analysis of SR proficiency categories and the AWMA showed that language proficiency did significantly impact working memory when controlling for age and SES. However, the only significant results were seen on the digit recall subscale. As with the NEPSY results, being proficient in both languages did not indicate advanced WM scores, instead being proficient in neither language and proficiency in English and not isiZulu showed similarly high significant scores, suggesting that these two categories of learners have increased short term memory storage and processing functions compared to balanced bilinguals.

7.3.2.2. The Relationship between Academic Language Proficiency (using EGRA) and Working Memory

This analysis showed that when not controlling for any covariates, proficiency does affect working memory. The research does not consider this sufficient or generalizable. Although just missing out on statistically significant results, digit recall showed similarities to those above, in that being proficient in both languages did not indicate WM advancements over being proficient in neither language, and proficient in English and not isiZulu, which showed similarly high significant scores.

7.3.2.3. Working Memory Discussion

Since WM is considered part of or an extension of EF, is was assumed that increased language proficiency would result in WM advancements compared to other bilingual categories. This was not the case, with results either showing no statistical effect in the case of EGRA proficiency or no WM advantage in SR proficiency. These are at odds with Cockcroft et al. (2019) results, who examined proficient multilinguals and found WM advantages compared to monolinguals. This study was also conducted in South Africa, seemingly controlling for SES, but used an older age group, smaller sample and self-reported proficiency abilities. They reported that WM advantages were across all components and more prominent in visuospatial processing. Although it was not a significantly strong finding, their results showed evidence of increased scores for digit recall (Cockcroft et al., 2019). Even though their findings are believed to add to the body of evidence showing bilingual cognitive advancements, without further investigation we are unable to determine if the increase is due to EF as a general function, or WM as a separate component. Furthermore, as WM ability increases with age and formal education (Garrat & Kelly, 2008), this may be one of the contributing factors to the cognitive advancement results in comparison to the current research, which focuses on early bilinguals in the foundation phase. The current results also deviated from those of Bosman and Janssen (2017), which reported that proficient Turkish-Dutch bilingual children showed increased WM performance using the AWMA on digit recall, compared to Dutch monolingual children. However, Gathercole et al. (2010), reported no relationship between language abilities and WM functioning and Engel de Abreu's (2011) study was unable to demonstrate any bilingual working memory advantage. Almost all reports indicating bilingual advantage in WM, have been in studies with samples of learners in middle to upper SES groups. Studies have reported a difference of one standard deviation in WM ability between HL learners or

those from higher SES groups, compared to developing countries and contexts such as South Africa, without even taking language proficiency into account (Bosman & Janssen, 2017). Therefore, with continued discrepancies, it is important to replicate these studies with younger/early bilinguals in developing countries with lower SES, to determine what the actual contributions are and how they compare to the current research.

Finally, the relationship reported between SR and WM is to be expected, as although SR is used in the study to measure language ability, it is also a measure of WM. Vance (2008) suggests that SR is a measure of short-term memory and assesses the episodic buffer function. SR integrates the language system and the WM function, indicating that working memory abilities are strongly related to language processing (Jordaan, 2011; Vance 2008). Correlation analyses within this study showed a relatively strong, positive relationship between SR and WM. More so for English than isiZulu SR, further suggesting a language bias.

7.4. CONTEXTUAL FACTORS

7.4.1. Influence of Learner Contextual Factors on the Relationship between Bi/Multilingualism and Cognitive Functioning

A homogenous sample of schools and learners were selected from a quintile 3, low earning community. The majority of bilingual research has been conducted within developed, high SES countries and samples. South Africa is a developing country with a majority of its population residing in low income communities and attending under-resourced schools, therefore it is important to establish how a population such as this differs from previous research samples.

When conducting analyses between language proficiency and cognitive processing, controlling for covariates such as age, SES and maternal education (which is correlated with SES) increased the statistical power of the analyses and accounted for more of the MANCOVA models. Researchers such as Paap et al. (2014), Cockcroft et al. (2019) and Vivas et al. (2017), have all reported the importance of controlling for SES and indicated its effect. Both Paap et al. (2014) and Vivas et al. (2017) have shown, as has this research, that bilingual learners in lower SES situations have not shown cognitive advantage. Although further in-depth research is required, some arguments suggest that the influence of SES on cognitive development is far greater than bilingualism for reasons such as nutrition, health and access to resources (Balfour, 1999; Evans & Cleghorn, 2012; Taylor, 2012). Bosman and Janssen (2017) even reported that learners in low income families begin their education journey with a delay in both language and cognitive development and this often results in learners repeating grades more than once.

7.4.2. Influence of LoLT as a School Contextual Factor on Language Proficiency and Literacy Outcomes

As focus within the study was at a learner level, and only a small number of schools were sampled, it is not statistically viable to look at the specific contextual factors that impact cognitive functioning at a school level. Furthermore, with language proficiency (balanced bilingualism) not impacting cognitive abilities as theory suggests, it once again becomes relevant/important to revert to the significant debate around Language of Learning and Teaching (LoLT) and its impact on literacy scores. As schools were selected based on their LoLT (isiZulu or English) this was considered a school contextual factor.

Previous research has highlighted the impact of the diversity within South Africa and the practical implications of having 11 official languages (Evans & Cleghorn, 2012). The

implementation of the LiEP has had significant criticism, even though the ideals of additive bilingualism and increasing English proficiency while being taught in a HL is commendable. The LiEP argues that being taught and communicating in one's HL will strengthen English language ability and proficiency, for an easier transition to English as LoLT in grade 4 (DoE, 1997). It is also argued that increasing learners' access to information in their HL will assist in the transferability of that information to the L2, with the increased proficiency and literacy skills in English (Evans & Cleghorn, 2012; Taylor & von Fintel, 2016). This argument suggests there is an expectation of the learner's HL to serve as the foundation of learning and is necessary for English literacy development and the learner's ability to proceed through the education system (Prinsloo et al., 2018).

LoLT has now become one of the most defining components influencing academic achievement in South Africa, where researchers continue to argue that further investigation into the practicality of the LiEP needs to be done, to ensure the system is able to cultivate bilingual learners that are literate and proficient in both HL and English, which allows entrance and success through secondary education (Evans & Cleghorn, 2012; Prinsloo et al., 2018). Studies have shown that the straight to English approach or the transition to English as LoLT is occurring prematurely resulting in learners with poor literacy abilities, low academic proficiency and reduced development of HL as the foundational language (EGRS, 2017; Prinsloo et al., 2018; Taylor & von Fintel, 2016). Consequently, there is an unrealistic expectation from the system on learners with poor literacy abilities, to grasp the curriculum, read for understanding, and transition effortlessly through increasingly demanding grades (Evans & Cleghorn, 2012). As the current research focused on grade 3 learners and their proficiency ability based on their LoLT, the research hopes to add to the body of knowledge

and clarify some discrepancies on whether they are sufficiently prepared for the transition into grade 4.

The initial focus was on the impact of the mismatch between the LoLT and HL, as well as its implications for academic proficiency levels. The LiEP has been implemented based on the belief that by the age of five years old, learners have a sufficient grasp of their HL to allow for entrance into the education system, and ensure adequate communication and learning within the classroom (Cummins, 2009; Prinsloo et al., 2018; Sibanda, 2017). The HL is then used as a scaffold to build knowledge and the further development of literacy skills, not only in their HL, but in English too (van Staden & Howie, 2012). However, in section 6.1, mean scores show that learners at grade 3 level have an average of 43% for isiZulu and 34% for English, in what is considered basic communication skills. Even at this level learners' proficiency is too low to be used as a scaffold for academic use, even without the confounding contributions of being taught in a different language.

As discussed in chapter 2, there remains a mismatch between LoLT and HL, with learners either having a different HL to the LoLT offered in schools or parents have opted for the straight-to-English approach – each of which has their own negative implications for language and literacy abilities, impacting academic achievement. The current research reiterates many of the concerns highlighted in previous research and results show the impact of not being taught in one's HL. Although a sample was specifically selected to ensure that the majority of learners had isiZulu as their HL, 20% of the learners still reported a different African language as their HL. Furthermore, the majority of the learners (N=60) had opted for a straight-to-English LoLT approach, even though none of them reported English as their HL. Additionally, this decision was made even though the maternal parents reported that they

believed their children were confident and capable in speaking, reading and writing in their HL, but their child's English abilities were not as strong, and varied between 'only a little' and 'well enough'. This raises questions as to why they would opt for English as LoLT when it is not their HL and when they do not believe they have the language capacity to cope with the necessary academic language and literacy skills. This once again relates back to the history of the country, and the belief that English is the language of power and economic success. This is why parents are desperate to have their children succeed and have English skills (Balfour, 1999; Evans & Cleghorn, 2012; Taylor & von Fintel, 2016).

Previous reports show that this mismatch between LoLT, HL and English have negatively impacted language proficiency in both English and a learner's HL, especially in academic language proficiency (Baker, 2001; Cummins & Yee-Fun, 2007). The results of this study showed that this is plausible, as not only were there low mean scores across schools (in both languages, but the majority (44%) of the learners fell within the not proficient in both languages category and only 25% of learners were considered proficient in both languages (using EGRA academic proficiency categories). Therefore, the majority of learners in this sample are being taught in languages they are not proficient in, and 54% of the sample are taught in a language that is not their HL. These results are in line with studies such as PIRLS (2011 and 2015) which reported that the majority (71%- 80%) of their representative sample fell below the lowest international benchmark and are considered unable to sufficiently engage with the academic curriculum (Howie et al., 2016). Researchers have argued that not only does the mismatch between LoLT and HL have an impact on language proficiency, but also results in the underdevelopment of the HL as a foundational language and inevitably literacy skills across both languages, finally impacting academic achievement (EGRS, 2017; Prinsloo et al., 2018). The results of this study show similar effects, with only 37% of the sample being

considered academically proficient in isiZulu across all EGRA proficiency categories, leaving the remainder with underdeveloped HL proficiency.

7.4.2.1. Impact of LoLT on Literacy Scores.

Section 7.3 shows that although there is a relationship between language proficiency and cognitive processing, this study did not provide sufficient evidence that increased language proficiency results in cognitive advantages, as suggested by Bialystok (Bialystok, 2017; Bialystok & Barac, 2012; Kroll & Bialystok, 2013). Nor does it support Cummins' (Baker, 2001; Cummins, 2008, 2009; Cummins & Yee-Fun, 2007; Fanson, 2009) argument that as learners who become more proficient in both languages are more likely to have seamless access to academic knowledge in both languages, automating processing and showing a positive cognitive effect. Therefore, the study expanded its analysis to examine LoLT's influence on literacy scores instead, as a basis for academic achievement, and if there was in fact a significant relationship using the EGRA assessment.

For the analysis, English or isiZulu LoLT was assigned to each learner, based on what was offered at their allocated school. Correlations indicated a strong positive relationship between LoLT (as HL) and EGRA literacy scores. T-Test analyses also showed that LoLT does significantly impact literacy scores, with learners being taught in their HL having higher combined EGRA scores, compared to those taught in English. When looking at the English and isiZulu assessments separately, learners taught in isiZulu showed a 47 points difference in the isiZulu EGRA scores, compared to those taught in English. Interventions like the EGRS (2017) have highlighted the importance of improving HL literacy skills, reporting that the increase in HL (Setswana) abilities improved English literacy skills. August, Calderon, Carlo & Nutall (2006) also reported that there is an increased need to improve reading and literacy

abilities in a learner's HL as it is the scaffolding to English proficiency, which Geva (2006) and August and Shanahan (2006) believe is a strong predictor of literacy abilities at the foundation phase of education.

When running the same analyses on SR language scores, LoLT did not show a significant result on the combined scores, however, being taught in isiZulu showed higher isiZulu SR scores when examining the language assessments individually. A final test was run to determine whether there was a relationship between LoLT and a learner's cognitive scores on the NEPSY and AWMA, and it showed that there was in fact no relationship. Language of Learning and Teaching (LoLT) could not predict cognitive functioning scores, only its impact on literacy scores, which consequently influences academic language proficiency.

7.4.2.2. LoLT Recommendations

The data suggests that these grade 3 learners have poor language proficiency in both their HL (isiZulu) and English, which is being used as a scaffold for academic and language development. This results in the over reliance of an underdeveloped HL, which further leads to poor isiZulu and English literacy abilities. The study has shown that being taught in a learner's HL significantly improves HL proficiency and literacy skills, which is vital for L2/English language development and academic achievement. Therefore, the following recommendations should be taken into consideration.

Based on the proficiency levels of the grade 3 learners, a transition to English as LoLT in grade 4 may be premature, and the education system should consider extending the duration of HL as LoLT for more than the allocated three years (Cummins, 2009; Prinsloo et al., 2018; Sibanda, 2017). It takes a minimum of five years to achieve academic proficiency and literacy

skills for HL learners within a good education system (Cummins, 2009; Prinsloo et al., 2018; Sibanda, 2017). It could therefore be argued that in poorer schools with a questionable quality of HL education, it could take even longer for the development of literacy skills, not only in a learner's HL but in English as an L2. Brock-Utne (2010), EGRS (2017) and Prinsloo et al. (2018) have all shown that increased number of years of HL education increases academic performance. PISA (2006) and UNESCO (Ouane & Glanz, 2010) studies show that learners taught in their HL have significantly better understanding of foundational concepts and achieve better results across all academic subjects, including English. Prinsloo et al. (2018) not only believes that English literacy skills would improve if learners were taught in their HL for an extended period, but argues that if English was spoken more often in the household, it would offer additional support to the education system and increase language ability.

If learners continue to be forced to process information in an underdeveloped language, the quality and the quantity of the information gained will be poor. Academic performance will decline and both languages will remain insufficiently developed, leaving learners unable to cope with advancing curricula and academic demands (Baker, 2001, Cummins & Yee-Fun, 2007). This is influenced by context, where access to quality, formal bilingual education and increased exposure to languages strengthens knowledge, proficiency and processing (Luk & Bialystok, 2013). Therefore, the government needs to advocate not only for the increased number of years of HL/ African language exposure, but improved quality of HL education. Taylor & Coetzee (2013) agree that LoLT is in fact critical, but argue that socioeconomic factors throughout the education system serves as severe constraints to improving the quality of HL education. Therefore, the government faces the conundrum of knowing the importance HL education and its ability to use the minimal resources available to translate that into a functioning system (Balfour, 1999). In order to achieve a functioning additive bilingual system,

in which the learners are able to become literate and proficient in both their HL and English, the quality of HL education needs serious consideration.

As above, not only is HL education associated with poor quality of education, but English is still considered the language of prosperity. Parents are therefore rejecting evidence and opting for a straight-to-English approach as early as grade R, with the hope that it will increase English language proficiency (Evans & Cleghorn, 2012; Prinsloo et al., 2018; Taylor & von Fintel, 2016). Thus, in order for HL education to succeed, it requires more than just a mention in the constitution, but rather constant investment and endorsement by government and other policy makers (Balfour, 1999). There does not have to be a segregationist idea between the different languages, but more the idea of increased capabilities and the importance of HL proficiency, which will allow the acquisition and development of English, through HL instruction (Balfour, 1999). The government needs to work on the bias against being taught in an African language, and encourage learners (and parents) to change their mind-set for the wellbeing of the learner and their academic success (Prinsloo et al., 2018).

7.5. INTERDEPENDENCE HYPOTHESIS AND THRESHOLD THEORY IN A SOUTH AFRICAN CONTEXT

This study utilized the work of Cummins as a theoretical framework and focused on his BICS/CALP, Interdependence Hypothesis and Threshold theories. This section briefly discusses the theories and whether they are a beneficial tool for South African researchers, policy makers and its education system.

7.5.1. Interdependence Theory

The interdependence theory focuses on academic proficiency in both L1 and L2 and argues that the development of the L2 language proficiency relies heavily on L1's language abilities. Therefore, a learner's HL proficiency and language ability is used as a scaffold to strengthen the literacy skills in L2 (English) (Baker, 2001; Cummins, 2008; Cummins & Yee-Fun, 2007). Using the analogy of an iceberg, Cummins argues that academic language proficiency occurs below the surface and with the increased academic language proficiency in L1, the learner is able to access higher order thinking abilities. As L2 academic proficiency increases (with the assistance of L1 abilities) they reach a "necessary" threshold, or what Cummins calls the Common Underlying Proficiency (CUP) level (Baker, 2001; Cummins 2008). He believes that only when learners have successfully achieved this common proficiency, will there be transferability of literacy and cognitive skills, which allows for the sharing of conceptual knowledge of complex academic constructs (Cummins, 2009). Therefore, only when learners are proficient in both languages (in this case HL and English), will they show increased higher order functioning and access to skills through both languages, and be able to succeed within the education system (Cummins, 1992; Fanson, 2009). This theory also argues that because all languages are fed through the same cognitive system, information and skills can be developed and accessed through additional languages as long as they reach a proficiency threshold (Baker, 1993, 2001).

7.5.2. Threshold Theory

The Threshold theory links to the theoretical argument of the Interdependence Hypothesis and states that learners have to reach specific thresholds in order to be considered proficient in that language. With the use of a low and high threshold limits (Cummins, 2001; Coetzee- Van Rooy, 2010), learners are categorized as:

a) *Limited bilinguals*, in which both language proficiencies fall below the low threshold. Learners are considered not proficient in either language and their academic proficiency in both languages is insufficiently developed, resulting in negative cognitive effects.

b) Between the two thresholds, learners are believed to be academically proficient in at least one of their languages and in theory would show neither a positive nor negative cognitive effect.

c) *Balanced bilingual*, in which both language proficiencies are above the highest threshold. Learners are considered proficient in both languages and show a common academic proficiency in both languages (as described in the interdependence hypothesis), resulting in positive cognitive effects. Cummins would argue that at this point, languages feed through the same cognitive operating system and information and abilities are transferable between both languages (Baker, 2001; Cummins, 2001; Coetzee- Van Rooy, 2010).

7.5.3. Theoretical Interpretation

Along with Bialystok (Bialystok, 2017; Bialystok & Barac, 2012; Kroll & Bialystok, 2013), Cummins believes that balanced bilinguals will show cognitive advantages over monolinguals or other less proficient bilinguals (Baker, 2001; Cummins, 2008, 2009; Cummins & Yee-Fun, 2007; Fanson, 2009). This study, however, does not support these findings/theoretical arguments. Although the results indicated a significant relationship between language processing and cognitive functioning, particularly in EF, they did not indicate that bilingualism improves cognitive functioning or suggests any cognitive advantages. On the contrary, learners who were not proficient in either language often showed increased cognitive scores. Furthermore, learners who were proficient in English and not isiZulu showed higher observed scores compared to balanced bilinguals, where theory

indicates there should be a neutral effect (Baker, 2001; Cummins, 2001; Coetzee-Van Rooy, 2010). Therefore, learners who reach a high threshold in both languages, which should allow for transferability of skills, do not show advanced cognitive abilities in this sample.

One cannot disregard all of the theory, aspects still remain valid and useful. Cummins has always called for institutional change and emphasized the struggles of second language learners, and the unrealistic expectations placed on them within the education system to achieve, even when they are not taught in their HL (Cummins, 2008; Sibanda, 2017). Cummins uses the distinction between BICS and CALP to highlight the importance of academic language proficiency L1, which is necessary for the development of academic proficiency in L2 and consequently educational success (Brock-Utne, 2010; Evans & Cleghorn, 2012; Howie et al., 2012). These distinctions allow for the development of measurable constructs, which assist researchers when investigating the relationship between LoLT and HL, as well as investigating the impact of straight-to-English (L2) as LoLT or even the repercussions of transitioning to another language prematurely, when learners are not proficient in said language (Howie et al., 2012; Prinsloo et al., 2018). Research still agrees that learners taught in their HL have significantly better understanding of academic concepts and the ability to interpret complex constructs, as their HL is used as a foundation for English (L2) to develop, especially with the increasing demands of the curriculum (Cummins, 2008; Cummins & Yee-Fun, 2007; Heugh et al., 2007).

Given these positives, it is important to note that the current research still raises concerns about the ability to generalize Cummins' theories across all contexts, as their findings have always been from developed, higher SES contexts (Cummins, 2008). Therefore, what is considered context embedded and cognitively demanding varies across contexts and does not

take into consideration the limited access to resources and its impact on learning and academic achievement (Cummins, 2008; Sibanda, 2017). Research has also questioned whether African languages have the vocabulary to cover all academic constructs/concepts and allow for the development of academic proficiency in their HL (Sibanda, 2017), which requires further investigation and language development. Finally, it is argued that other factors within the distinctive and multifaceted context of South Africa play a larger role in language proficiency and academic achievement than simple cognitive processing, and further research is required to disentangle the effects of factors unique to South Africa, instead of generalizing from "irrelevant" international studies.

7.6. LIMITATIONS AND FUTURE CONSIDERATIONS

Within a context as unique and intricate as South Africa, any study is likely to have many methodological challenges, and this study is no different. One of the main challenges was the selection of the sample. It is acknowledged that there is much variability in the number of languages present in an urban/sun-urban school classroom, which is further complicated by the deviation in dialects of those languages. This study limited the sample to isiZulu home language speakers, as statistics have shown that they constitute the largest proportion of the language population in Gauteng. The study should therefore be replicated across other African language groups in different settings. The study limited the assessment of learners to two languages, it is recognized that the majority of learners in this context are multilingual, and although the contextual questionnaire covers exposure to all 11 languages, the "amount" of multilingualism in each learner may influence the results in a study using a bilingual approach. It is recommended that future research determine the proficiency levels of all languages of multilingual learners to determine its impact on cognitive functioning. The study also focused solely on quintile 3 schools in a sub-urban area and results are therefore not generalizable

across all of the educational contexts. The study should be replicated in lower quintile and rural schools to determine the effect SES and other contextual factors have on language proficiency and cognitive processing. It is likely the results will vary from the current study and it is important to get a holistic view of the education system within the country to make informed decisions and to determine the best interventions for each context. Furthermore, with SES highlighted as one of the biggest contributing factors to variation in results, future studies should investigate this construct in a larger more generalizable population. Although this study had a sample size of 111 learners, it is recommended that an even larger sample be selected to ensure equal distribution of learners within each proficiency category, to allow for even more accurate investigations of the relationship between varying levels of language proficiency and cognitive functioning. Given the analyses was conducted at a learner level and only a small selection of schools and teachers were sampled, this study was unable to fully determine the extent to which school and teacher contextual factors influence language proficiency and cognitive ability. This requires a larger sample of schools with the main focus on more systemic, quality of education factors.

In general, there is a lack of South African standardized language and cognitive assessments, which would allow for more accurate proficiency testing. The current study already makes advancements in that it tests language and literacy ability to determine proficiency levels, instead of simple self-report questionnaires. However, appropriately standardized assessments would increase the validity and reliability of the results. On this basis, it was more difficult to determine specific thresholds for proficiency categorization and a more standardized approach to this would be recommended for future research. As there are no standardized assessments for the South African population, the researcher is unable to rule out cultural bias, especially regarding the NEPSY and AWMA. MANCOVA and correlational

analyses further indicated that these assessments favoured learners who were more proficient in English than isiZulu and there was a stronger relationship between WM and the English SR assessment. In an attempt to reduce this bias, all instructions were translated to isiZulu and assessments were conducted using trained isiZulu speaking research assistants. Finally, although the focus for EF was on subcomponents, current research is suggesting this should be done with caution and future research should consider investigating EF as a whole.

7.7. CONCLUSION

With poor academic achievement remaining a constant concern within South Africa, as reported by studies such as PIRLS (Howie et al., 2012; Howie et al., 2017) and TIMSS (Reddy et al., 2012, Reddy et al., 2013, Reddy et al., 2017), it is important to determine the most salient contributions to these outcomes. Previous studies have attributed poor academic performance to factors such as low socio-economic status (SES), lack of community and home support, poor nutrition, ill health and diminished resources (Evans & Cleghorn, 2012; Phurutse, 2005). However, there is increasing interest regarding the impact Language of Learning and Teaching (LoLT) has on literacy skills and academic performance (Alexander, 2000; Cummins, 1979; Heugh, 2000; Ouane & Glenz, 2010), with many learners being taught in a second language they are less familiar with. South Africa has a diverse population and 11 officially recognised languages, making the practical implementation of language polices significantly more difficult (Heugh, 2000). It is argued that the South African context with its previously segregated education system, poorly implemented language and curriculum policies, unequal distribution of resources and poor quality of education not only leaves learners under-educated, but confounds the impact of the language differentiations (Heugh, 2000).

The current study sampled 111 grade 3 learners in quintile 3, sub-urban schools to investigate the relationship between language proficiency and cognitive processing, as a possible contributing factor to poor academic achievement. With the implementation of the LiEP, which focuses on the concept of additive bilingualism, learners are expected to be taught in their HL whilst developing English language abilities, for a transition to English as LoLT in grade 4. The current research focused on bilingual studies to inform its design and analysis. Researchers such as Bialystok (Bialystok, 2017; Bialystok & Barac, 2012; Kroll & Bialystok, 2013) and Cummins (Baker, 2001; Cummins, 2008, 2009; Cummins & Yee-Fun, 2007; Fanson, 2009) have argued that increased language proficiency in both HL and L2 results in bilinguals having cognitive advantages over their monolingual and less proficient bilingual counterparts. The research used the Interdependence Hypothesis and Threshold Theory as its theoretical framework. These theories hold that in order for bilingual learners to achieve increased performance and academic success, it is imperative that they become proficient in both their L1 and L2. Therefore, only when learners reach the designated threshold of language proficiency, can there be transferability of skills, knowledge and higher order cognitive abilities, resulting in increased academic performance (Baker, 2001; Cummins, 2008, 2009; Cummins & Yee-Fun, 2007; Fanson, 2009).

In order to test these theories and investigate the relationship between language proficiency and cognitive processing in grade 3 learners, both isiZulu and English sentence repetition and EGRA assessments were used. These outcomes were used to categorize learners into four different language proficiency categories, based on Cummins Threshold theory. These proficiency categories were then used to determine the impact proficiency levels had on cognitive processing, using the NEPSY for Executive Functioning and AWMA for Working Memory.

Statistical analyses showed that although there was a relationship between language proficiency and cognitive processing, it did not conform to previous bilingual cognitive outcomes or the theoretical framework. Results indicated that being proficient in both languages did not show cognitive advantages over less proficient bilingual learners, rather learners neither proficient in isiZulu or English, often demonstrated higher cognitive outcomes. Language proficiency only showed a significant influence on Clocks and Inhibition subscales of the Executive Function assessment and the digit recall subscale of AWMA (only for SR proficiency categories). The current research added to the recent body of research (Bosman & Janssen, 2017; Paap et al., 2014; Vivas et al., 2017), suggesting that factors such as SES and context influenced cognitive processing abilities more than proficiency or being a balanced bilingual. For these reasons, the research extended investigations into the influence of LoLT on literacy abilities. These showed that the mismatch between LoLT and HL reduced language proficiency and literacy scores in both isiZulu and English. More significantly, learners who were taught in their HL showed increased scores on the EGRA literacy assessment. The findings also suggest that learners are relying on underdeveloped HL proficiency as a scaffold for academic and language development, resulting in poor literacy scores and English language development. Further investigations are required to generalise this study across all SES levels and educational contexts and the government needs to focus their attention on HL education and improving its quality of education.

The research concludes that balanced bilingualism does not result in cognitive advantages in all contexts, the Interdependence Hypothesis and Threshold Theories may not be contextually appropriate and LoLT continues to play a significant role in the South African education system.

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APPENDICES

APPENDIX 1

Information Sheet and Consent Form

(School Principal)

Who I am and what am I doing

Hello! I am Shawn Rogers. I am currently conducting research in order to obtain a PhD in the field of Psychology, at the University of the Witwatersrand. The current study looks to explore the relationship between Bi/multilingualism and cognitive processing in grade 3 South Africa learners. To determine how varying levels of language proficiency affects cognitive processing, looking specifically at executive functioning and working memory.

The study will be testing approximately 250-400 grade 3 learners in schools where the LoLT is either English or isiZulu. It is hoped that the results will inform policy and improve the quality of the South African education system in the future.

Your participation

I am asking you as school principal to allow me to collect some information by means of a questionnaire from you, or any school management team member or your personal assistant to whom you may delegate specific items. Completing the whole questionnaire should not take longer than 20 minutes and include only the most important questions. The information is about conditions within the school and the availability of resources. I will need this information to contextualise the school setting of the learners and to determine how these factors may affect the results of the study. With your permission, I also hope to approach and obtain similar information from teachers and parents at the schools, to approach and obtain assent from learners to administer language and cognitive tests that will take approximately ____minutes overall, at time that is best suited for you, teachers and learners.

Please understand that **your participation is voluntary** and that you are not being forced to take part in this study. The choice of whether to participate or not, is yours alone. If you choose not to take part, you will not be affected in any way whatsoever. If you agree to participate, you may stop participating in the evaluation at any time and tell me that you don't want to continue. If you do this, there will be no penalties and nothing will happen to you.

Confidentiality

Identifying information such as coded ID numbers and lists of names will be kept in a locked cabinet or office. It will not be available to others, and will be kept confidential to the extent possible by law. The records from your participation may be reviewed by my supervisor and members of the ethics committee, making sure that research is done properly (All of these people are required to keep your identity confidential). Otherwise, records that identify you will be available only to my supervisor and me, working on the study. It is intended that results from the study be published, with your permission, in articles and other outputs from which no one will be able to connect you or your school to the answers given.

Risks/discomforts

I do not see large risks in your participation. However, you may feel embarrassed about physical conditions at your school, or fear criticism about the management practices that you follow or the knowledge or skills that you have. I undertake to handle all your and the school's information confidentially and anonymously, and for the purposes of the study only. I will not share identifiable information with anyone other than my supervisor, especially not other Department officials at the circuit, district or provincial offices. Once the study is complete and I have received my PhD degree, all further information will be destroyed.

Benefits

The main purpose of this project is to better understand the relationship between language and cognitive processing, with the hope to inform policy and improve the quality of the South African education system in the future. Final findings will be made available as soon as possible through a 1 page summary document on completion of the PhD thesis.

Should you have any questions or concerns

This research has been approved by the University of Witwatersrand Research Ethics Committee.

If you have concerns or questions about the study, you may call me, Shawn Rogers, at [redacted] or [redacted] or email at [redacted]. Or my Supervisor, Heila Jordaan at [redacted] or [redacted] or email at [redacted].

Yours thankfully,

_____

Shawn Rogers

(PhD student)

CONSENT

I hereby agree to participate in the PhD study "The relationship between bi/multilingualism and cognitive functioning in South African grade 3 learners". I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop participating at any point should I not want to continue and that this decision will not in any way affect me negatively. I understand that my participation will remain confidential.

I hereby acknowledge that teachers, parents and learners will be approached, as explained above, to participate in the study.

I understand that the information that I provide will be stored electronically and will be used for research purposes now or at a later stage.

I understand that results from the study may be published in journals and other outputs later on, as long as the responses that I gave cannot be linked to me personally or to my school

_____ _____

Signature of School Principal **Date**

_____ _____

Additional signature, if required **Date**

(School Management Team member)

_____ _____

Additional signature of Personal Assistant **Date**

(if required; or specify other designations)

APPENDIX 2

Information Sheet and Consent Form

(Parents/Caregivers of Sampled Learners)

Who am I and what do I do?

My name is Shawn Rogers and I am currently conducting research for my PhD in Psychology, at the University of the Witwatersrand. My study is called "The relationship between bi/multilingualism and cognitive functioning in South African grade 3 learners".

This study wants to assess your child's proficiency levels in their different languages, to see if there is a relationship between this and their cognitive functioning. The study will be testing about 250-400 grade 3 learners who either taught in English or isiZulu. It is hoped that the results will be very useful to try and make the schooling system better in the long run for your child and other parents' children.

You and your child's participation

I would like to invite you and your child to participate in my study. As the parent/ guardian, I am asking you whether you will allow me to collect some information from you with a questionnaire and considering giving permission for me to ask you child if they would like to help in the study. The whole questionnaire should take you no more than 30 minutes and only the most important questions are asked in the form.

I need to find out what it is like in your homes and all the languages you and your child are exposed to, so that I can understand how best to inform the schooling system in the future.

I promise that all your information is only for the use of this study and that I will not allow anyone other than my supervisor access to it.

If you fill in the form and want to stop before you have finished, you may do so. If you decide not to fill in the form you and your child will not be affected in any way.

Should you voluntarily decide to complete the form and give permission for your child to participate in the study, they will also be asked if they want to join the study. Should they decide they would like to take part, they will be asked to complete some assessments/tasks taking about ____ time. The tasks will look at your child's language skills, their memory and their problem solving and decision-making abilities. As I want to see what kind of relationship there is between their language skills and their specific cognitive abilities. These tasks will be completed during school times and will not interfere with any of their school work.

Confidentiality

All the information I get from you and your child will be locked away in my offices in Pretoria and only myself and my supervisor will be able to read it.

I will not use your names or ID numbers, or those of your children, in my work. Each form, person and learner will get special codes so that only my supervisor and I can identify the people who gave me the information.

I will put what you tell me on my computer using codes so that no one will be able to know where it comes from.

I plan to ask my supervisor to help me look at (analyse) the information. Together we also want to write reports and articles about it. We undertake that no one will be able to connect you to the answers you give when we do that.

Risks/discomforts

You may feel shy or sad about being unable to give your children more support at home or giving us more information because you cannot read and write well, or do not have much.

I undertake to handle all your information in such a way that no one will know you gave it to me (that is, confidentially and anonymously).

I will not share information that can identify you to your children's teacher, the principal, or other Department officials. Once the study is complete and I have received my PhD degree, all further information will be destroyed.

Benefits

I will make sure that you and your child's school are informed of all the results when the whole report is finished.

Should you have any questions or concerns?

This research has been approved by the University of Witwatersrand Research Ethics Committee.

If you have concerns or questions about the study, you may call me, Shawn Rogers, at [redacted] or [redacted] or email at [redacted]. Or my Supervisor, Heila Jordaan at [redacted] or [redacted] or email at [redacted].

Yours thankfully,

_____

Shawn Rogers

(PhD student)

CONSENT

I hereby agree to participate in the PhD study of "The relationship between bi/multilingualism and cognitive functioning in South African grade 3 learners". I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop participating at any point should I not want to continue and that this decision will not in any way affect me negatively. I understand that my participation will remain confidential.

I also agree that my child [name _____] can be approached and asked to participate in the study to complete some assessments, should they agree.

I understand that the information that I provide will be stored electronically and will be used for research purposes now or at a later stage.

I understand that the results from the study may be publish later in journals and other outputs as long as the responses that I gave cannot be linked to me personally, or my child.

_____ _____

Signature of parent / caregiver **Date**

APPENDIX 3

Learner Information and Assent Form

Hi, my name is Shawn Rogers and I am completing research for school. I would like your help.

You are being asked to help complete a study about how your brain works. If you would like to join, you will complete a reading task, a memory task and some problem-solving tests. This is similar to reading stories and solving puzzles. I will then use your results in my research.

Your parent (s) has agreed to allow you to participate, but if you decide not to, that is okay too. You decide whether or not you would like to be in this study or not, and no-one will be upset if you decide not to, or even if you decide to leave later on.

You may ask questions at any time, and if you have questions at a later stage you may phone me (Shawn) at [redacted] or [redacted] or my teacher (Heila) at [redacted] or [redacted]

Would you like to join the study? (Tick the box with your choice)

☐ Yes ☐ No

Signing at the bottom of this form means that you agree to participate.

Thank you very much for your time.

Shawn Rogers

Signature of child: _____

Date: _____

APPENDIX 4

Information Sheet and Consent Form

(Teacher)

Who I am and what am I doing

Hello! I am Shawn Rogers. I am currently conducting research in order to obtain a PhD in the field of Psychology, at the University of the Witwatersrand. The current study looks to explore the relationship between Bi/multilingualism and cognitive processing in grade 3 South Africa learners. To determine how varying levels of language proficiency affects cognitive processing, looking specifically at executive functioning and working memory.

The study will be testing approximately 250-400 grade 3 learners in schools where the LoLT is either English or isiZulu. It is hoped that the results will inform policy and improve the quality of the South African education system in the future.

Your participation

I am asking you to allow me to collect some information by means of a questionnaire. Completing the whole questionnaire should not take longer than 30-40 minutes and include only the most important questions. The information is about conditions within the school, your classroom, the availability of resources and some language background. I will need this information to contextualise the classroom setting of the learners and to determine how these factors may affect the results of the study. With your permission, I also hope to approach and obtain similar information parents at the schools and to approach and obtain assent from learners to administer language and cognitive tests that will take approximately ____minutes overall, at time that is best suited for you, the principal and learners.

Please understand that **your participation is voluntary** and that you are not being forced to take part in this study. The choice of whether to participate or not, is yours alone. If you choose not to take part, you will not be affected in any way whatsoever. If you agree to participate, you may stop participating in the evaluation at any time and tell me that you don't want to continue. If you do this, there will be no penalties and nothing will happen to you.

Confidentiality

Identifying information such as coded ID numbers and lists of names will be kept in a locked cabinet or office. It will not be available to others, and will be kept confidential to the extent possible by law. The records from your participation may be reviewed by my supervisor and members of the ethics committee, making sure that research is done properly (All of these people are required to keep your identity confidential). Otherwise, records that identify you will be available only to my supervisor and me, working on the study. It is intended that results from the study be published, with your permission, in articles and other outputs from which no one will be able to connect you or your school to the answers given.

Risks/discomforts

I do not see large risks in your participation. However, you may feel embarrassed about physical conditions at your school, or fear criticism about the management practices or the knowledge or skills that you have. I undertake to handle all your and the school's information confidentially and anonymously, and for the purposes of the study only. I will not share identifiable information with anyone other than my supervisor, especially not other Department officials at the circuit, district or provincial offices. Once the study is complete and I have received my PhD degree, all further information will be destroyed.

Benefits

The main purpose of this project is to better understand the relationship between language and cognitive processing, with the hope to inform policy and improve the quality of the South African education system in the future. Final findings will be made available as soon as possible through a 1 page summary document on completion of the PhD thesis.

Should you have any questions or concerns

This research has been approved by the University of Witwatersrand Research Ethics Committee.

If you have concerns or questions about the study, you may call me, Shawn Rogers, at [redacted] or [redacted] or email at [redacted]. Or my Supervisor, Heila Jordaan at [redacted] or [redacted] or email at [redacted].

Yours thankfully,

_____

Shawn Rogers

(PhD student)

CONSENT

I hereby agree to participate in the PhD study "The relationship between bi/multilingualism and cognitive functioning in South African grade 3 learners". I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop participating at any point should I not want to continue and that this decision will not in any way affect me negatively.

I understand that parents and learners will be approached, as discussed about.

I understand that my participation will remain confidential.

I understand that the information that I provide will be stored electronically and will be used for research purposes now or at a later stage.

I understand that results from the study may be published in journals and other outputs later on, as long as the responses that I gave cannot be linked to me personally or to my school

_____ _____

Signature of teacher **Date**

APPENDIX 5

Home Learner and Contextual Questionnaire

(*For office use only*) Learner code nr:

_____

1. **<u>Parent/caregiver Identifying and language background information</u>:**

(This is the person who is completing the forms information)

a) Parent/caregiver: Surname _____ and (b) First name _____

b) Male ☐ Female ☐

c) How old are you? (*Please put an "X" in the right box.*)

Below 20 years	20-30 years old	31-40 years old	41-50 years old	51-60 years old	Over 60 years

d) What is the Mother/ female guardian's highest grade (qualification) (*Please put an "X" in the right box*)

No school	Primary school	Grade 8 or 9	Grade 10 or 11	Matric / Gr 12	Diploma/degree

e) What is the Father/ Male guardian's highest grade (qualification) (*Please put an "X" in the right box*)

No school	Primary school	Grade 8 or 9	Grade 10 or 11	Matric / Gr 12	Diploma/degree

f) What is the Mother/female guardian's Home Language? (*Please put an "X" in the right box*)

Afrikaans	English	Xitsonga	isiXhosa	isiZulu	Sepedi
Sesotho	**Setswana**	**Siswati**	**Tshivenda**	**isiNdebele**	**Other(specify)**

g) How well does the Mother/female guardian speak, read and write in the Home Language? (*Please put an "X" in the right box*)

Home language	Not at all	Only a little	Well enough	Very well
Speak				
Read				
Write				

h) How well does the Mother/female guardian speak, read and write in English? (*Please put an "X" in the right box*)

English	Not at all	Only a little	Well enough	Very well

Speak				
Read				
Write				

i) How often does the Mother/female guardian speak English at home? (*Please put an "X" in the right box*)

Never	Rarely	Sometimes	A lot / often

j) What is the Father/male guardian's Home Language? (*Please put an "X" in the right box*)

Afrikaans	English	Xitsonga	isiXhosa	isiZulu	Sepedi
Sesotho	**Setswana**	**Siswati**	**Tshivenda**	**isiNdebele**	**Other(specify)**

k) How well does the Father/male guardian speak, read and write in the Home Language? (*Please put an "X" in the right box*)

Home language	Not at all	Only a little	Well enough	Very well
Speak				
Read				
Write				

l) How well does the Father/male guardian speak, read and write in English? (*Please put an "X" in the right box*)

English	Not at all	Only a little	Well enough	Very well
Speak				
Read				
Write				

m) How often does the Father/male guardian speak English at home? (*Please put an "X" in the right box*)

Never	Rarely	Sometimes	A lot / often

2. <u>Learner Identifying and language background information</u>:

(This is the person who is completing the forms information)

a) Parent/caregiver: Surname _____ and (b) First name _____

b) Boy ☐ Girl ☐

c) Date of birth of learner (*day/month/year*) _____ / _____ / _____ (e.g., <u>26</u> / <u>11</u> / <u>2004</u>)

d) What is the Learner's Home Language? (*Put an "X" in the box of the language used most*)

Afrikaans	English	Xitsonga	isiXhosa	isiZulu	Sepedi
Sesotho	**Setswana**	**Siswati**	**Tshivenda**	**isiNdebele**	**Other(specify)**

e) How well does the Learner speak, read and write in this Home Language? (*Please put an "X" in the right box*)

Home language	Not at all	Only a little	Well enough	Very well
Speak				
Read				
Write				

f) How well does the Learner speak, read and write in English? (*Please put an "X" in the right box*)

English	Not at all	Only a little	Well enough	Very well
Speak				
Read				
Write				

g) How often does the Learner speak English at home? (*Please put an "X" in the right box*)

Never	Rarely	Sometimes	A lot/often

h) How well does the learner speak, read and write in the following? (*Please put an "X" in the right box*)

		Not at all	Only a little	Well enough	Very well			Not at all	Only a little	Well enough	Very well
Afrikaans	speak					Setswana	speak				
	read						read				
	write						write				
Xitsonga	speak					Siswati	speak				
	read						read				
	write						write				
isiXhosa	speak					Thivenda	speak				
	read						read				
	write						write				
IsiZulu	speak					isiNdebele	speak				
	read						read				
	write						write				
Sepedi	speak					Other	speak				
	read					(please specify)	read				
	write						write				
Sesotho	speak					Other	speak				

	read					**(please specify)**	**read**				
	write						**write**				

i) At what age did the learner start to learn these languages? (*Please put the actual age in the right box*)

Afrikaans	**English**	**Xitsonga**	**isiXhosa**	**isiZulu**	**Sepedi**
Sesotho	**Setswana**	**Siswati**	**Tshivenda**	**isiNdebele**	**Other(specify)**

j) Has the learner experienced or had a history of any of the following? (*Please put the actual age in the right box*)

Learning deficits	**Serious head injuries**	**Neurological difficulties**	**Hearing impaired**	**Visually impaired**

3. <u>Home background information</u>:

a) Does the home have these? (*Mark each one that the home has with "X"*)

	Yes	**No**		**Yes**	**No**		**Yes**	**No**
Tap water			**Radio**			**Satellite dish**		
Electricity			**Computer**			**TV**		
Water flush toilet			**Laptop**			**CD/DVD player**		
Fridge			**Internet**			**Car**		
Telephone			**Cellphone**			**Bicycle**		
Dictionary								

b) How many books of his/her own does the learner have? *(Do not count newspapers, magazines or school books. Select only one.)*

None	**Fewer than 5**	**5-10**	**11-25**	**More than 25**

c) How many other books are there in the home? *(Do not count newspapers, magazines or school books. Select only one.)*

None	Fewer than 10	10-25	26-100	More than 100

d) How often does the learner read the following materials at home? (*Put an "X" in one box only)*

Materials:	Never/almost never	1-2 times a week	3-5 times a week	Almost daily/daily
Books				
Magazines				
Newspapers				

e) Does the learner have access to a public library? _____ (*Indicate Yes / No*)

Thank you!

APPENDIX 6

Principal and School Contextual Questionnaire

(*For office use only*) Teacher code nr:

_____

1. <u>Teacher Identifying and language background information:</u>

a) Name of School: _____

b) What quintile ranking is the school? (*Please put an "X" in the right box.*)

1	2	3	4	5

c) How many Grade learners are there in the school? ☐

d) How many Grade 3 Teachers are there in the school? ☐

e) Does your School have sufficient facilities, rate them below? *(Please complete the table below, put an "X" in the right box.)*

Facility	None/poor	Poor	Average	Good	Very good
Electricity					
Running/tap water					
Permanent buildings					
Usable classrooms					
Flushing toilets for staff					
Flushing toilets for learners					
Telephones					
Photocopier					
Fence/security					
Hall					
Staff room					
Library					
Computer facilities for staff					
Computer facilities for learners					
Storage/ safe room					
Sport Grounds					

f) Does your school have a feeding scheme? Yes ☐ No ☐

g) What is the average income level of the school's immediate area? (*Please put an "X" in the right box.*)

High	Medium	Low

APPENDIX 7

Teacher and Classroom Contextual Questionnaire

(*For office use only*) Teacher code nr:

_____

4. <u>Teacher Identifying and language background information</u>:

a) Surname _____ and (b) First name _____

a. Male ☐ Female ☐

b) How old are you? (*Please put an "X" in the right box.*)

Below 20 years	20-30 years old	31-40 years old	41-50 years old	51-60 years old	Over 60 years

c) Please indicate your highest qualification? (*Put an "X" in one box only)*

Did not complete Grade 12	Finished Grade 12	Finished post-matric certificate	Finished diploma	finished first degree	Finished honours degree or higher

d) How many years experienced do you have teaching?

Teaching overall	Teaching grade 3s	Teaching in the current medium of instruction (isiZulu)

e) What is your Home Language? (*Please put an "X" in the right box*)

Afrikaans	English	Xitsonga	isiXhosa	isiZulu	Sepedi
Sesotho	**Setswana**	**Siswati**	**Tshivenda**	**isiNdebele**	**Other(specify)**

f) How well do you speak, read and write in your Home Language? (*Please put an "X" in the right box*)

Home language	Not at all	Only a little	Well enough	Very well
Speak				
Read				
Write				

g) How well do you speak, read and write in English? (*Please put an "X" in the right box*)

English	Not at all	Only a little	Well enough	Very well
Speak				
Read				
Write				

h) How often do you speak English? (*Please put an "X" in the right box*)

Never	Rarely	Sometimes	A lot / often

i)How well do you speak, read and write in any of the following languages? (*Please put an "X" in the right box*)

		Not at all	Only a little	Well enough	Very well			Not at all	Only a little	Well enough	Very well
Afrikaans	**speak**					**Setswana**	**speak**				
	read						**read**				
	write						**write**				
Xitsonga	**speak**					**Siswati**	**speak**				
	read						**read**				
	write						**write**				
isiXhosa	**speak**					**Thivenda**	**speak**				
	read						**read**				
	write						**write**				
IsiZulu	**speak**					**isiNdebele**	**speak**				
	read						**read**				
	write						**write**				
Sepedi	**speak**					**Other**	**speak**				
	read					**(please specify)**	**read**				
	write						**write**				
Sesotho	**speak**					**Other**	**speak**				
	read					**(please specify)**	**read**				
	write						**write**				

5. <u>Classroom and resource information</u>:

a) How many learners are there in the Classroom? ☐

b) How many learners speak the medium of instruction as their home language? ☐

c) In general, how well do you think the Learners speak, read and write in isiZulu? (*Please put an "X" in the right box*)

isiZulu	Not at all	Only a little	Well enough	Very well

Speak				
Read				
Write				

d) In general, how well do you think the Learners speak, read and write in English? (*Please put an "X" in the right box*)

English	Not at all	Only a little	Well enough	Very well
Speak				
Read				
Write				

e) How many isiZulu books are there in the Classroom? *(Please put an "X" in the right box .Select only one.)*

None	Fewer than 10	10-25	26-100	More than 100

f) How many English books are there in the Classroom? *(Please put an "X" in the right box .Select only one.)*

None	Fewer than 10	10-25	26-100	More than 100

g) When you teach isiZulu, how do you use the following?

Resource	Basic for instruction	Supplement	Not used
Textbooks			
Workbooks/worksheets			
Reference material (other books, dictionary etc)			

h) When you teach English, how do you use the following?

Resource	Basic for instruction	Supplement	Not used
Textbooks			
Workbooks/worksheets			
Reference material (other books, dictionary etc)			

i)Does your classroom have sufficient facilities? *(Please complete the table below, put an "X" in the right box.)*

Facility	None/Very poor	Poor	Average	Good	Very good
Electricity					
Appropriate light/enough windows					
Permanent buildings/classrooms					
Learner desks					
Learner chairs **Overall space**					

Teacher desk					
Teacher chair					
Teaching equipment. Eg overhead projector					
Chalkboard and chalk					
Wall charts					
Language teaching material					

Thank you!

APPENDIX 8

NEPSY Subscores and SR Proficiency MANCOVA

PREDICT NEPSY WITH SR - CONTROL FOR SES

Descriptive Statistics				
	SR Prof	Mean	Std. Deviation	N
Clocks Raw	Proficient in both English and Zulu	63.30	5.769	33
	Proficient in English and not in Zulu	69.00	5.698	14
	Proficient in Zulu and not in English	65.36	4.483	14
	Not proficient in either language	66.54	5.716	35
	Total	65.61	5.828	96
Inhibition total	Proficient in both English and Zulu	61.39	42.623	33
	Proficient in English and not in Zulu	38.79	30.877	14
	Proficient in Zulu and not in English	38.07	36.172	14
	Not proficient in either language	47.63	47.353	35
	Total	49.68	42.550	96

Design Total	Proficient in both English and Zulu	13.39	5.454	33
	Proficient in English and not in Zulu	15.86	3.278	14
	Proficient in Zulu and not in English	13.00	4.403	14
	Not proficient in either language	15.29	3.824	35
	Total	14.39	4.541	96

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.927	375.835[b]	3.000	89.000	.000	.927	1127.504	1.000
	Wilks' Lambda	.073	375.835[b]	3.000	89.000	.000	.927	1127.504	1.000
	Hotelling's Trace	12.669	375.835[b]	3.000	89.000	.000	.927	1127.504	1.000
	Roy's Largest Root	12.669	375.835[b]	3.000	89.000	.000	.927	1127.504	1.000
SES_Total	Pillai's Trace	.001	.032[b]	3.000	89.000	.992	.001	.096	.055
	Wilks' Lambda	.999	.032[b]	3.000	89.000	.992	.001	.096	.055
	Hotelling's Trace	.001	.032[b]	3.000	89.000	.992	.001	.096	.055
	Roy's Largest Root	.001	.032[b]	3.000	89.000	.992	.001	.096	.055
SR_Prof	Pillai's Trace	.179	1.926	9.000	273.000	.048	.060	17.333	.833
	Wilks' Lambda	.825	1.981	9.000	216.753	.043	.062	14.354	.737
	Hotelling's Trace	.207	2.018	9.000	263.000	.038	.065	18.160	.853
	Roy's Largest Root	.180	5.453[c]	3.000	91.000	.002	.152	16.358	.929

a. Design: Intercept + SES_Total + SR_Prof

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
Clocks Raw	.476	3	92	.700
Inhibition total	1.104	3	92	.352
Design Total	1.405	3	92	.246

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Corrected Model	Clocks Raw	370.873[a]	4	92.718	2.954	.024	.115	11.818	.772
	Inhibition total	8237.370[b]	4	2059.343	1.144	.341	.048	4.577	.347
	Design Total	118.134[c]	4	29.533	1.460	.221	.060	5.841	.437
Intercept	Clocks Raw	31612.476	1	31612.476	1007.307	.000	.917	1007.307	1.000
	Inhibition total	14494.550	1	14494.550	8.054	.006	.081	8.054	.802
	Design Total	1498.010	1	1498.010	74.062	.000	.449	74.062	1.000
SES_Total	Clocks Raw	3.003	1	3.003	.096	.758	.001	.096	.061
	Inhibition total	13.716	1	13.716	.008	.931	.000	.008	.051
	Design Total	.130	1	.130	.006	.936	.000	.006	.051
SR_Prof	Clocks Raw	370.873	3	123.624	3.939	.011	.115	11.818	.816
	Inhibition total	8138.002	3	2712.667	1.507	.218	.047	4.522	.386
	Design Total	114.494	3	38.165	1.887	.137	.059	5.661	.474
Error	Clocks Raw	2855.867	91	31.383					
	Inhibition total	163763.619	91	1799.600					

	Design Total	1840.606	91	20.226					
Total	Clocks Raw	416533.000	96						
	Inhibition total	408911.000	96						
	Design Total	21825.000	96						
Corrected Total	Clocks Raw	3226.740	95						
	Inhibition total	172000.990	95						
	Design Total	1958.740	95						
a. R Squared = .115 (Adjusted R Squared = .076)									
b. R Squared = .048 (Adjusted R Squared = .006)									
c. R Squared = .060 (Adjusted R Squared = .019)									
d. Computed using alpha = .05									

Estimated Marginal Means

1. Grand Mean

Dependent Variable	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Clocks Raw	66.036[a]	.631	64.784	67.289
Inhibition total	46.500[a]	4.776	37.013	55.988
Design Total	14.381[a]	.506	13.375	15.387

a. Covariates appearing in the model are evaluated at the following values: SES_Total = 10.2292.

2. SR Prof

Estimates					
Dependent Variable	SR Prof	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Clocks Raw	Proficient in both English and Zulu	63.300[a]	.975	61.363	65.237
	Proficient in English and not in Zulu	69.021[a]	1.499	66.044	71.998
	Proficient in Zulu and not in English	65.241[a]	1.544	62.175	68.307
	Not proficient in either language	66.584[a]	.956	64.685	68.483
Inhibition total	Proficient in both English and Zulu	61.400[a]	7.385	46.731	76.070
	Proficient in English and not in Zulu	38.740[a]	11.350	16.196	61.285
	Proficient in Zulu and not in English	38.320[a]	11.688	15.102	61.537
	Not proficient in either language	47.542[a]	7.239	33.161	61.922
Design Total	Proficient in both English and Zulu	13.393[a]	.783	11.838	14.949
	Proficient in English and not in Zulu	15.862[a]	1.203	13.471	18.252
	Proficient in Zulu and not in English	12.976[a]	1.239	10.514	15.437

	Not proficient in either language	15.294[a]	.768	13.770	16.819

a. Covariates appearing in the model are evaluated at the following values: SES_Total = 10.2292.

Pairwise Comparisons

Dependent Variable	(I) SR Prof	(J) SR Prof	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
Clocks Raw	Proficient in both English and Zulu	Proficient in English and not in Zulu	-5.721*	1.789	.011	-10.545	-.897
		Proficient in Zulu and not in English	-1.941	1.824	1.000	-6.860	2.978
		Not proficient in either language	-3.283	1.367	.110	-6.969	.402
	Proficient in English and not in Zulu	Proficient in both English and Zulu	5.721*	1.789	.011	.897	10.545
		Proficient in Zulu and not in English	3.780	2.163	.504	-2.055	9.615
		Not proficient in either language	2.438	1.773	1.000	-2.343	7.219
	Proficient in Zulu and not in English	Proficient in both English and Zulu	1.941	1.824	1.000	-2.978	6.860
		Proficient in English and not in Zulu	-3.780	2.163	.504	-9.615	2.055
		Not proficient in either language	-1.343	1.843	1.000	-6.312	3.627

	Not proficient in either language	Proficient in both English and Zulu	3.283	1.367	.110	-.402	6.969
		Proficient in English and not in Zulu	-2.438	1.773	1.000	-7.219	2.343
		Proficient in Zulu and not in English	1.343	1.843	1.000	-3.627	6.312
Inhibition total	Proficient in both English and Zulu	Proficient in English and not in Zulu	22.660	13.543	.586	-13.869	59.189
		Proficient in Zulu and not in English	23.081	13.811	.589	-14.170	60.331
		Not proficient in either language	13.859	10.349	1.000	-14.053	41.770
	Proficient in English and not in Zulu	Proficient in both English and Zulu	-22.660	13.543	.586	-59.189	13.869
		Proficient in Zulu and not in English	.421	16.382	1.000	-43.765	44.607
		Not proficient in either language	-8.801	13.423	1.000	-45.006	27.404
	Proficient in Zulu and not in English	Proficient in both English and Zulu	-23.081	13.811	.589	-60.331	14.170
		Proficient in English and not in Zulu	-.421	16.382	1.000	-44.607	43.765
		Not proficient in either language	-9.222	13.953	1.000	-46.856	28.412
	Not proficient in either language	Proficient in both English and Zulu	-13.859	10.349	1.000	-41.770	14.053

		Proficient in English and not in Zulu	8.801	13.423	1.000	-27.404	45.006
		Proficient in Zulu and not in English	9.222	13.953	1.000	-28.412	46.856
Design Total	Proficient in both English and Zulu	Proficient in English and not in Zulu	-2.468	1.436	.534	-6.341	1.404
		Proficient in Zulu and not in English	.417	1.464	1.000	-3.532	4.367
		Not proficient in either language	-1.901	1.097	.519	-4.860	1.058
	Proficient in English and not in Zulu	Proficient in both English and Zulu	2.468	1.436	.534	-1.404	6.341
		Proficient in Zulu and not in English	2.886	1.737	.600	-1.799	7.570
		Not proficient in either language	.567	1.423	1.000	-3.271	4.406
	Proficient in Zulu and not in English	Proficient in both English and Zulu	-.417	1.464	1.000	-4.367	3.532
		Proficient in English and not in Zulu	-2.886	1.737	.600	-7.570	1.799
		Not proficient in either language	-2.318	1.479	.723	-6.308	1.671
	Not proficient in either language	Proficient in both English and Zulu	1.901	1.097	.519	-1.058	4.860
		Proficient in English and not in Zulu	-.567	1.423	1.000	-4.406	3.271

		Proficient in Zulu and not in English	2.318	1.479	.723	-1.671	6.308
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: Bonferroni.							

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.179	1.926	9.000	273.000	.048	.060	17.333	.833
Wilks' lambda	.825	1.981	9.000	216.753	.043	.062	14.354	.737
Hotelling's trace	.207	2.018	9.000	263.000	.038	.065	18.160	.853
Roy's largest root	.180	5.453[a]	3.000	91.000	.002	.152	16.358	.929

Each F tests the multivariate effect of SR Prof. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. The statistic is an upper bound on F that yields a lower bound on the significance level.

b. Computed using alpha = .05

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Clocks Raw	Contrast	370.873	3	123.624	3.939	.011	.115	11.818	.816
	Error	2855.867	91	31.383					
Inhibition total	Contrast	8138.002	3	2712.667	1.507	.218	.047	4.522	.386
	Error	163763.619	91	1799.600					
Design Total	Contrast	114.494	3	38.165	1.887	.137	.059	5.661	.474
	Error	1840.606	91	20.226					

The F tests the effect of SR Prof. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a. Computed using alpha = .05

APPENDIX 9

NEPSY Subscales with EGRA Proficiency MANCOVA

PREDICT NEPSY WITH EGRA - CONTROL FOR AGE

Descriptive Statistics				
	EGRA_Prof	Mean	Std. Deviation	N
Clocks Raw	Proficient in both English and Zulu	61.93	6.863	28
	Proficient in English and not in Zulu	66.71	6.034	21
	Proficient in Zulu and not in English	64.23	5.688	13
	Not proficient in either language	66.90	4.879	49
	Total	65.30	6.054	111
Inhibition total	Proficient in both English and Zulu	64.11	40.841	28
	Proficient in English and not in Zulu	59.05	50.369	21
	Proficient in Zulu and not in English	57.08	53.286	13
	Not proficient in either language	36.63	33.489	49
	Total	50.20	42.680	111
Design Total	Proficient in both English and Zulu	13.46	4.509	28
	Proficient in English and not in Zulu	15.19	4.781	21
	Proficient in Zulu and not in English	14.00	5.431	13
	Not proficient in either language	14.45	4.267	49
	Total	14.29	4.546	111

Box's Test of Equality of Covariance Matrices[a]

Box's M	21.802
F	1.130
df1	18
df2	10588.027
Sig.	.315

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.306	15.251[b]	3.000	104.000	.000	.306	45.753	1.000
	Wilks' Lambda	.694	15.251[b]	3.000	104.000	.000	.306	45.753	1.000
	Hotelling's Trace	.440	15.251[b]	3.000	104.000	.000	.306	45.753	1.000
	Roy's Largest Root	.440	15.251[b]	3.000	104.000	.000	.306	45.753	1.000
RoundedAge	Pillai's Trace	.058	2.141[b]	3.000	104.000	.099	.058	6.424	.532
	Wilks' Lambda	.942	2.141[b]	3.000	104.000	.099	.058	6.424	.532
	Hotelling's Trace	.062	2.141[b]	3.000	104.000	.099	.058	6.424	.532
	Roy's Largest Root	.062	2.141[b]	3.000	104.000	.099	.058	6.424	.532
EGRA_Prof	Pillai's Trace	.197	2.478	9.000	318.000	.010	.066	22.300	.929
	Wilks' Lambda	.810	2.541	9.000	253.259	.008	.068	18.401	.858
	Hotelling's Trace	.226	2.575	9.000	308.000	.007	.070	23.178	.939
	Roy's Largest Root	.178	6.307[c]	3.000	106.000	.001	.151	18.920	.961

a. Design: Intercept + RoundedAge + EGRA_Prof

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
Clocks Raw	.739	3	107	.531
Inhibition total	4.003	3	107	.010

Design Total	.411	3	107	.745

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Corrected Model	Clocks Raw	614.467[a]	4	153.617	4.766	.001	.152	19.063	.946
	Inhibition total	18202.397[b]	4	4550.599	2.648	.037	.091	10.591	.722
	Design Total	58.414[c]	4	14.603	.699	.594	.026	2.796	.220
Intercept	Clocks Raw	1343.053	1	1343.053	41.667	.000	.282	41.667	1.000
	Inhibition total	.584	1	.584	.000	.985	.000	.000	.050
	Design Total	35.326	1	35.326	1.691	.196	.016	1.691	.252
RoundedAge	Clocks Raw	114.219	1	114.219	3.544	.063	.032	3.544	.462
	Inhibition total	1508.699	1	1508.699	.878	.351	.008	.878	.153
	Design Total	19.964	1	19.964	.956	.331	.009	.956	.162
EGRA_Prof	Clocks Raw	549.642	3	183.214	5.684	.001	.139	17.052	.940
	Inhibition total	16146.812	3	5382.271	3.132	.029	.081	9.395	.714
	Design Total	45.547	3	15.182	.727	.538	.020	2.180	.200
Error	Clocks Raw	3416.722	106	32.233					
	Inhibition total	182173.243	106	1718.615					
	Design Total	2214.361	106	20.890					
Total	Clocks Raw	477306.000	111						
	Inhibition total	480080.000	111						
	Design Total	24934.000	111						
Corrected Total	Clocks Raw	4031.189	110						
	Inhibition total	200375.640	110						
	Design Total	2272.775	110						

a. R Squared = .152 (Adjusted R Squared = .120)

b. R Squared = .091 (Adjusted R Squared = .057)

c. R Squared = .026 (Adjusted R Squared = -.011)

d. Computed using alpha = .05

Estimated Marginal Means

1. Grand Mean

Dependent Variable	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Clocks Raw	64.846[a]	.605	63.646	66.047
Inhibition total	53.864[a]	4.421	45.099	62.630
Design Total	14.235[a]	.487	13.269	15.202

a. Covariates appearing in the model are evaluated at the following values: Rounded Age = 9.10.

2. EGRA_Prof

Estimates

Dependent Variable	EGRA_Prof	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Clocks Raw	Proficient in both English and Zulu	61.916[a]	1.073	59.788	64.043
	Proficient in English and not in Zulu	66.949[a]	1.245	64.480	69.417
	Proficient in Zulu and not in English	63.529[a]	1.618	60.321	66.737
	Not proficient in either language	66.991[a]	.813	65.380	68.602
Inhibition total	Proficient in both English and Zulu	64.060[a]	7.835	48.528	79.593
	Proficient in English and not in Zulu	59.899[a]	9.092	41.873	77.925
	Proficient in Zulu and not in English	54.527[a]	11.816	31.101	77.952
	Not proficient in either language	36.971[a]	5.933	25.208	48.734
Design Total	Proficient in both English and Zulu	13.459[a]	.864	11.746	15.171
	Proficient in English and not in Zulu	15.288[a]	1.002	13.301	17.276
	Proficient in Zulu and not in English	13.707[a]	1.303	11.124	16.289
	Not proficient in either language	14.488[a]	.654	13.191	15.785

a. Covariates appearing in the model are evaluated at the following values: Rounded Age = 9.10.

Pairwise Comparisons

Dependent Variable	(I) EGRA_Prof	(J) EGRA_Prof	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
Clocks Raw	Proficient in both English and Zulu	Proficient in English and not in Zulu	-5.033*	1.644	.017	-9.454	-.612

		Proficient in Zulu and not in English	-1.613	1.940	1.000	-6.830	3.603
		Not proficient in either language	-5.075*	1.346	.002	-8.695	-1.456
	Proficient in English and not in Zulu	Proficient in both English and Zulu	5.033*	1.644	.017	.612	9.454
		Proficient in Zulu and not in English	3.420	2.064	.604	-2.131	8.970
		Not proficient in either language	-.042	1.483	1.000	-4.029	3.944
	Proficient in Zulu and not in English	Proficient in both English and Zulu	1.613	1.940	1.000	-3.603	6.830
		Proficient in English and not in Zulu	-3.420	2.064	.604	-8.970	2.131
		Not proficient in either language	-3.462	1.821	.360	-8.358	1.434
	Not proficient in either language	Proficient in both English and Zulu	5.075*	1.346	.002	1.456	8.695
		Proficient in English and not in Zulu	.042	1.483	1.000	-3.944	4.029
		Proficient in Zulu and not in English	3.462	1.821	.360	-1.434	8.358
Inhibition total	Proficient in both English and Zulu	Proficient in English and not in Zulu	4.161	12.006	1.000	-28.118	36.441
		Proficient in Zulu and not in English	9.534	14.168	1.000	-28.558	47.626
		Not proficient in either language	27.090*	9.830	.041	.661	53.518
	Proficient in English and not in Zulu	Proficient in both English and Zulu	-4.161	12.006	1.000	-36.441	28.118
		Proficient in Zulu and not in English	5.373	15.074	1.000	-35.156	45.901
		Not proficient in either language	22.928	10.826	.219	-6.181	52.037
	Proficient in Zulu and not in English	Proficient in both English and Zulu	-9.534	14.168	1.000	-47.626	28.558
		Proficient in English and not in Zulu	-5.373	15.074	1.000	-45.901	35.156

		Not proficient in either language	17.556	13.296	1.000	-18.192	53.304
	Not proficient in either language	Proficient in both English and Zulu	-27.090*	9.830	.041	-53.518	-.661
		Proficient in English and not in Zulu	-22.928	10.826	.219	-52.037	6.181
		Proficient in Zulu and not in English	-17.556	13.296	1.000	-53.304	18.192
Design Total	Proficient in both English and Zulu	Proficient in English and not in Zulu	-1.830	1.324	1.000	-5.388	1.729
		Proficient in Zulu and not in English	-.248	1.562	1.000	-4.447	3.952
		Not proficient in either language	-1.029	1.084	1.000	-3.943	1.885
	Proficient in English and not in Zulu	Proficient in both English and Zulu	1.830	1.324	1.000	-1.729	5.388
		Proficient in Zulu and not in English	1.582	1.662	1.000	-2.887	6.050
		Not proficient in either language	.801	1.194	1.000	-2.409	4.010
	Proficient in Zulu and not in English	Proficient in both English and Zulu	.248	1.562	1.000	-3.952	4.447
		Proficient in English and not in Zulu	-1.582	1.662	1.000	-6.050	2.887
		Not proficient in either language	-.781	1.466	1.000	-4.723	3.160
	Not proficient in either language	Proficient in both English and Zulu	1.029	1.084	1.000	-1.885	3.943
		Proficient in English and not in Zulu	-.801	1.194	1.000	-4.010	2.409
		Proficient in Zulu and not in English	.781	1.466	1.000	-3.160	4.723
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: Bonferroni.							

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.197	2.478	9.000	318.000	.010	.066	22.300	.929
Wilks' lambda	.810	2.541	9.000	253.259	.008	.068	18.401	.858
Hotelling's trace	.226	2.575	9.000	308.000	.007	.070	23.178	.939
Roy's largest root	.178	6.307[a]	3.000	106.000	.001	.151	18.920	.961

Each F tests the multivariate effect of EGRA_Prof. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. The statistic is an upper bound on F that yields a lower bound on the significance level.

b. Computed using alpha = .05

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Clocks Raw	Contrast	549.642	3	183.214	5.684	.001	.139	17.052	.940
	Error	3416.722	106	32.233					
Inhibition total	Contrast	16146.812	3	5382.271	3.132	.029	.081	9.395	.714
	Error	182173.243	106	1718.615					
Design Total	Contrast	45.547	3	15.182	.727	.538	.020	2.180	.200
	Error	2214.361	106	20.890					

The F tests the effect of EGRA_Prof. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

APPENDIX 10

AWMA and SR Proficiency MANOVA

BASIC MANOVA FOR SR AND AWMA

Descriptive Statistics				
	SR Prof	Mean	Std. Deviation	N
AWMA Digit Recall	Proficient in both English and Zulu	21.26	3.320	35
	Proficient in English and not in Zulu	25.94	4.437	17
	Proficient in Zulu and not in English	23.13	3.538	16
	Not proficient in either language	25.02	4.126	43
	Total	23.70	4.229	111
AWMA Dot Matrix	Proficient in both English and Zulu	17.77	4.109	35
	Proficient in English and not in Zulu	19.00	3.674	17
	Proficient in Zulu and not in English	17.00	4.033	16
	Not proficient in either language	17.49	3.217	43
	Total	17.74	3.702	111
AWMA Spatial Recall	Proficient in both English and Zulu	13.23	6.222	35
	Proficient in English and not in Zulu	14.18	5.399	17
	Proficient in Zulu and not in English	15.25	5.196	16

	Not proficient in either language	13.93	4.008	43
	Total	13.94	5.142	111
Proc score Spatial Recall	Proficient in both English and Zulu	31.37	20.347	35
	Proficient in English and not in Zulu	35.59	19.258	17
	Proficient in Zulu and not in English	39.19	19.576	16
	Not proficient in either language	34.42	15.523	43
	Total	34.32	18.238	111

Box's Test of Equality of Covariance Matrices[a]

Box's M	65.653
F	2.002
df1	30
df2	11188.715
Sig.	.001

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.981	1333.033[b]	4.000	104.000	.000	.981	5332.133	1.000
	Wilks' Lambda	.019	1333.033[b]	4.000	104.000	.000	.981	5332.133	1.000
	Hotelling's Trace	51.271	1333.033[b]	4.000	104.000	.000	.981	5332.133	1.000
	Roy's Largest Root	51.271	1333.033[b]	4.000	104.000	.000	.981	5332.133	1.000
SR_Prof	Pillai's Trace	.250	2.412	12.000	318.000	.005	.083	28.949	.966
	Wilks' Lambda	.761	2.495	12.000	275.450	.004	.087	26.243	.944
	Hotelling's Trace	.299	2.558	12.000	308.000	.003	.091	30.699	.975

	Roy's Largest Root	.239	6.323[c]	4.000	106.000	.000	.193	25.290	.987
a. Design: Intercept + SR_Prof									
b. Exact statistic									
c. The statistic is an upper bound on F that yields a lower bound on the significance level.									
d. Computed using alpha = .05									

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AWMA Digit Recall	.742	3	107	.529
AWMA Dot Matrix	.337	3	107	.798
AWMA Spatial Recall	1.627	3	107	.187
Proc score Spatial Recall	1.282	3	107	.284

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + SR_Prof

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[e]
Corrected Model	AWMA Digit Recall	374.836[a]	3	124.945	8.396	.000	.191	25.187	.992
	AWMA Dot Matrix	38.508[b]	3	12.836	.935	.427	.026	2.805	.250
	AWMA Spatial Recall	46.126[c]	3	15.375	.575	.633	.016	1.724	.166
	Proc score Spatial Recall	711.133[d]	3	237.044	.707	.550	.019	2.121	.196
Intercept	AWMA Digit Recall	52503.199	1	52503.199	3528.012	.000	.971	3528.012	1.000
	AWMA Dot Matrix	29326.807	1	29326.807	2136.248	.000	.952	2136.248	1.000
	AWMA Spatial Recall	18491.938	1	18491.938	691.243	.000	.866	691.243	1.000
	Proc score Spatial Recall	114112.892	1	114112.892	340.311	.000	.761	340.311	1.000

SR_Prof	AWMA Digit Recall	374.836	3	124.945	8.396	.000	.191	25.187	.992
	AWMA Dot Matrix	38.508	3	12.836	.935	.427	.026	2.805	.250
	AWMA Spatial Recall	46.126	3	15.375	.575	.633	.016	1.724	.166
	Proc score Spatial Recall	711.133	3	237.044	.707	.550	.019	2.121	.196
Error	AWMA Digit Recall	1592.354	107	14.882					
	AWMA Dot Matrix	1468.916	107	13.728					
	AWMA Spatial Recall	2862.433	107	26.752					
	Proc score Spatial Recall	35879.192	107	335.320					
Total	AWMA Digit Recall	64329.000	111						
	AWMA Dot Matrix	36435.000	111						
	AWMA Spatial Recall	24469.000	111						
	Proc score Spatial Recall	167366.000	111						
Corrected Total	AWMA Digit Recall	1967.189	110						
	AWMA Dot Matrix	1507.423	110						
	AWMA Spatial Recall	2908.559	110						
	Proc score Spatial Recall	36590.324	110						

a. R Squared = .191 (Adjusted R Squared = .168)

b. R Squared = .026 (Adjusted R Squared = -.002)

c. R Squared = .016 (Adjusted R Squared = -.012)

d. R Squared = .019 (Adjusted R Squared = -.008)

e. Computed using alpha = .05

Estimated Marginal Means

1. Grand Mean

Dependent Variable	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
AWMA Digit Recall	23.837	.401	23.041	24.632
AWMA Dot Matrix	17.815	.385	17.051	18.579
AWMA Spatial Recall	14.146	.538	13.080	15.213
Proc score Spatial Recall	35.141	1.905	31.365	38.918

2. SR Prof

Estimates

Dependent Variable	SR Prof	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
AWMA Digit Recall	Proficient in both English and Zulu	21.257	.652	19.964	22.550
	Proficient in English and not in Zulu	25.941	.936	24.086	27.796
	Proficient in Zulu and not in English	23.125	.964	21.213	25.037
	Not proficient in either language	25.023	.588	23.857	26.189
AWMA Dot Matrix	Proficient in both English and Zulu	17.771	.626	16.530	19.013
	Proficient in English and not in Zulu	19.000	.899	17.219	20.781
	Proficient in Zulu and not in English	17.000	.926	15.164	18.836
	Not proficient in either language	17.488	.565	16.368	18.608
AWMA Spatial Recall	Proficient in both English and Zulu	13.229	.874	11.495	14.962

	Proficient in English and not in Zulu	14.176	1.254	11.690	16.663
	Proficient in Zulu and not in English	15.250	1.293	12.687	17.813
	Not proficient in either language	13.930	.789	12.367	15.494
Proc score Spatial Recall	Proficient in both English and Zulu	31.371	3.095	25.235	37.507
	Proficient in English and not in Zulu	35.588	4.441	26.784	44.392
	Proficient in Zulu and not in English	39.188	4.578	30.112	48.263
	Not proficient in either language	34.419	2.793	28.883	39.954

Pairwise Comparisons

Dependent Variable	(I) SR Prof	(J) SR Prof	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
AWMA Digit Recall	Proficient in both English and Zulu	Proficient in English and not in Zulu	-4.684*	1.140	.000	-7.750	-1.618
		Proficient in Zulu and not in English	-1.868	1.164	.669	-4.997	1.262
		Not proficient in either language	-3.766*	.878	.000	-6.127	-1.405
	Proficient in English and not in Zulu	Proficient in both English and Zulu	4.684*	1.140	.000	1.618	7.750
		Proficient in Zulu and not in English	2.816	1.344	.231	-.796	6.428
		Not proficient in either language	.918	1.105	1.000	-2.053	3.889
	Proficient in Zulu and not in English	Proficient in both English and Zulu	1.868	1.164	.669	-1.262	4.997
		Proficient in English and not in Zulu	-2.816	1.344	.231	-6.428	.796
		Not proficient in either language	-1.898	1.130	.575	-4.935	1.139

	Not proficient in either language	Proficient in both English and Zulu	3.766*	.878	.000	1.405	6.127
		Proficient in English and not in Zulu	-.918	1.105	1.000	-3.889	2.053
		Proficient in Zulu and not in English	1.898	1.130	.575	-1.139	4.935
AWMA Dot Matrix	Proficient in both English and Zulu	Proficient in English and not in Zulu	-1.229	1.095	1.000	-4.173	1.716
		Proficient in Zulu and not in English	.771	1.118	1.000	-2.234	3.777
		Not proficient in either language	.283	.844	1.000	-1.984	2.551
	Proficient in English and not in Zulu	Proficient in both English and Zulu	1.229	1.095	1.000	-1.716	4.173
		Proficient in Zulu and not in English	2.000	1.291	.745	-1.469	5.469
		Not proficient in either language	1.512	1.062	.944	-1.342	4.365
	Proficient in Zulu and not in English	Proficient in both English and Zulu	-.771	1.118	1.000	-3.777	2.234
		Proficient in English and not in Zulu	-2.000	1.291	.745	-5.469	1.469
		Not proficient in either language	-.488	1.085	1.000	-3.405	2.428
	Not proficient in either language	Proficient in both English and Zulu	-.283	.844	1.000	-2.551	1.984
		Proficient in English and not in Zulu	-1.512	1.062	.944	-4.365	1.342
		Proficient in Zulu and not in English	.488	1.085	1.000	-2.428	3.405
AWMA Spatial Recall	Proficient in both English and Zulu	Proficient in English and not in Zulu	-.948	1.529	1.000	-5.058	3.162
		Proficient in Zulu and not in English	-2.021	1.561	1.000	-6.217	2.174
		Not proficient in either language	-.702	1.177	1.000	-3.867	2.464

	Proficient in English and not in Zulu	Proficient in both English and Zulu	.948	1.529	1.000	-3.162	5.058
		Proficient in Zulu and not in English	-1.074	1.802	1.000	-5.916	3.769
		Not proficient in either language	.246	1.482	1.000	-3.737	4.230
	Proficient in Zulu and not in English	Proficient in both English and Zulu	2.021	1.561	1.000	-2.174	6.217
		Proficient in English and not in Zulu	1.074	1.802	1.000	-3.769	5.916
		Not proficient in either language	1.320	1.515	1.000	-2.752	5.391
	Not proficient in either language	Proficient in both English and Zulu	.702	1.177	1.000	-2.464	3.867
		Proficient in English and not in Zulu	-.246	1.482	1.000	-4.230	3.737
		Proficient in Zulu and not in English	-1.320	1.515	1.000	-5.391	2.752
Proc score Spatial Recall	Proficient in both English and Zulu	Proficient in English and not in Zulu	-4.217	5.413	1.000	-18.769	10.336
		Proficient in Zulu and not in English	-7.816	5.526	.961	-22.671	7.039
		Not proficient in either language	-3.047	4.169	1.000	-14.254	8.159
	Proficient in English and not in Zulu	Proficient in both English and Zulu	4.217	5.413	1.000	-10.336	18.769
		Proficient in Zulu and not in English	-3.599	6.378	1.000	-20.745	13.547
		Not proficient in either language	1.170	5.246	1.000	-12.933	15.272
	Proficient in Zulu and not in English	Proficient in both English and Zulu	7.816	5.526	.961	-7.039	22.671
		Proficient in English and not in Zulu	3.599	6.378	1.000	-13.547	20.745
		Not proficient in either language	4.769	5.362	1.000	-9.646	19.184
	Not proficient in either language	Proficient in both English and Zulu	3.047	4.169	1.000	-8.159	14.254

		Proficient in English and not in Zulu	-1.170	5.246	1.000	-15.272	12.933
		Proficient in Zulu and not in English	-4.769	5.362	1.000	-19.184	9.646
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: Bonferroni.							

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.250	2.412	12.000	318.000	.005	.083	28.949	.966
Wilks' lambda	.761	2.495	12.000	275.450	.004	.087	26.243	.944
Hotelling's trace	.299	2.558	12.000	308.000	.003	.091	30.699	.975
Roy's largest root	.239	6.323[a]	4.000	106.000	.000	.193	25.290	.987

Each F tests the multivariate effect of SR Prof. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. The statistic is an upper bound on F that yields a lower bound on the significance level.

b. Computed using alpha = .05

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
AWMA Digit Recall	Contrast	374.836	3	124.945	8.396	.000	.191	25.187	.992
	Error	1592.354	107	14.882					
AWMA Dot Matrix	Contrast	38.508	3	12.836	.935	.427	.026	2.805	.250
	Error	1468.916	107	13.728					
AWMA Spatial Recall	Contrast	46.126	3	15.375	.575	.633	.016	1.724	.166

	Error	2862.433	107	26.752					
Proc score Spatial Recall	Contrast	711.133	3	237.044	.707	.550	.019	2.121	.196
	Error	35879.192	107	335.320					
The F tests the effect of SR Prof. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.									
a. Computed using alpha = .05									

PREDICT AWMA WITH SR - CONTROL FOR AGE AND SES

Descriptive Statistics				
	SR Prof	Mean	Std. Deviation	N
AWMA Digit Recall	Proficient in both English and Zulu	21.12	3.352	33
	Proficient in English and not in Zulu	26.21	4.854	14
	Proficient in Zulu and not in English	23.07	3.540	14
	Not proficient in either language	24.86	4.292	35
	Total	23.51	4.367	96
AWMA Dot Matrix	Proficient in both English and Zulu	17.91	4.103	33
	Proficient in English and not in Zulu	19.43	3.546	14
	Proficient in Zulu and not in English	17.50	4.071	14
	Not proficient in either language	17.51	3.239	35

	Total	17.93	3.720	96
AWMA Spatial Recall	Proficient in both English and Zulu	13.52	6.266	33
	Proficient in English and not in Zulu	14.64	5.458	14
	Proficient in Zulu and not in English	15.71	5.045	14
	Not proficient in either language	13.77	3.774	35
	Total	14.09	5.144	96
Proc score Spatial Recall	Proficient in both English and Zulu	32.24	20.387	33
	Proficient in English and not in Zulu	37.36	19.929	14
	Proficient in Zulu and not in English	40.36	19.645	14
	Not proficient in either language	32.37	13.438	35
	Total	34.22	17.928	96

Box's Test of Equality of Covariance Matrices[a]

Box's M	64.152
F	1.922
df1	30
df2	7820.734
Sig.	.002

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.222	6.189[b]	4.000	87.000	.000	.222	24.757	.984
	Wilks' Lambda	.778	6.189[b]	4.000	87.000	.000	.222	24.757	.984
	Hotelling's Trace	.285	6.189[b]	4.000	87.000	.000	.222	24.757	.984
	Roy's Largest Root	.285	6.189[b]	4.000	87.000	.000	.222	24.757	.984
RoundedAge	Pillai's Trace	.018	.392[b]	4.000	87.000	.814	.018	1.567	.136
	Wilks' Lambda	.982	.392[b]	4.000	87.000	.814	.018	1.567	.136
	Hotelling's Trace	.018	.392[b]	4.000	87.000	.814	.018	1.567	.136
	Roy's Largest Root	.018	.392[b]	4.000	87.000	.814	.018	1.567	.136
SES_Total	Pillai's Trace	.019	.419[b]	4.000	87.000	.795	.019	1.675	.143
	Wilks' Lambda	.981	.419[b]	4.000	87.000	.795	.019	1.675	.143
	Hotelling's Trace	.019	.419[b]	4.000	87.000	.795	.019	1.675	.143
	Roy's Largest Root	.019	.419[b]	4.000	87.000	.795	.019	1.675	.143
SR_Prof	Pillai's Trace	.269	2.190	12.000	267.000	.013	.090	26.275	.944
	Wilks' Lambda	.746	2.247	12.000	230.472	.011	.093	23.622	.912
	Hotelling's Trace	.320	2.287	12.000	257.000	.009	.096	27.439	.954
	Roy's Largest Root	.247	5.492[c]	4.000	89.000	.001	.198	21.967	.970

a. Design: Intercept + RoundedAge + SES_Total + SR_Prof

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AWMA Digit Recall	1.283	3	92	.285
AWMA Dot Matrix	.265	3	92	.851

AWMA Spatial Recall	1.713	3	92	.170
Proc score Spatial Recall	2.121	3	92	.103

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[e]
Corrected Model	AWMA Digit Recall	399.500[a]	5	79.900	5.091	.000	.220	25.455	.980
	AWMA Dot Matrix	43.377[b]	5	8.675	.614	.689	.033	3.071	.215
	AWMA Spatial Recall	72.087[c]	5	14.417	.531	.752	.029	2.657	.189
	Proc score Spatial Recall	1104.972[d]	5	220.994	.676	.643	.036	3.379	.235
Intercept	AWMA Digit Recall	302.949	1	302.949	19.303	.000	.177	19.303	.991
	AWMA Dot Matrix	100.455	1	100.455	7.113	.009	.073	7.113	.751
	AWMA Spatial Recall	30.515	1	30.515	1.125	.292	.012	1.125	.183
	Proc score Spatial Recall	90.037	1	90.037	.275	.601	.003	.275	.081
RoundedAge	AWMA Digit Recall	11.588	1	11.588	.738	.392	.008	.738	.136
	AWMA Dot Matrix	3.197	1	3.197	.226	.635	.003	.226	.076
	AWMA Spatial Recall	16.175	1	16.175	.596	.442	.007	.596	.119
	Proc score Spatial Recall	191.061	1	191.061	.584	.447	.006	.584	.118
SES_Total	AWMA Digit Recall	25.199	1	25.199	1.606	.208	.018	1.606	.241
	AWMA Dot Matrix	.001	1	.001	.000	.992	.000	.000	.050
	AWMA Spatial Recall	.009	1	.009	.000	.986	.000	.000	.050
	Proc score Spatial Recall	5.737	1	5.737	.018	.895	.000	.018	.052
SR_Prof	AWMA Digit Recall	339.286	3	113.095	7.206	.000	.194	21.618	.979
	AWMA Dot Matrix	41.878	3	13.959	.988	.402	.032	2.965	.261
	AWMA Spatial Recall	50.796	3	16.932	.624	.601	.020	1.872	.176
	Proc score Spatial Recall	883.857	3	294.619	.901	.444	.029	2.703	.240
Error	AWMA Digit Recall	1412.490	90	15.694					

	AWMA Dot Matrix	1271.113	90	14.123					
	AWMA Spatial Recall	2442.069	90	27.134					
	Proc score Spatial Recall	29429.434	90	326.994					
Total	AWMA Digit Recall	54875.000	96						
	AWMA Dot Matrix	32167.000	96						
	AWMA Spatial Recall	21583.000	96						
	Proc score Spatial Recall	142943.000	96						
Corrected Total	AWMA Digit Recall	1811.990	95						
	AWMA Dot Matrix	1314.490	95						
	AWMA Spatial Recall	2514.156	95						
	Proc score Spatial Recall	30534.406	95						
a. R Squared = .220 (Adjusted R Squared = .177)									
b. R Squared = .033 (Adjusted R Squared = -.021)									
c. R Squared = .029 (Adjusted R Squared = -.025)									
d. R Squared = .036 (Adjusted R Squared = -.017)									
e. Computed using alpha = .05									

Estimated Marginal Means

1. Grand Mean

Dependent Variable	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound

AWMA Digit Recall	23.858[a]	.446	22.972	24.744
AWMA Dot Matrix	18.088[a]	.423	17.247	18.928
AWMA Spatial Recall	14.412[a]	.587	13.247	15.577
Proc score Spatial Recall	35.602[a]	2.036	31.557	39.647

a. Covariates appearing in the model are evaluated at the following values: Rounded Age = 9.10, SES_Total = 10.2292.

2. SR Prof

Estimates					
		Mean	Std. Error	95% Confidence Interval	
Dependent Variable	SR Prof			Lower Bound	Upper Bound
AWMA Digit Recall	Proficient in both English and Zulu	21.090[a]	.691	19.716	22.463
	Proficient in English and not in Zulu	26.096[a]	1.062	23.987	28.205
	Proficient in Zulu and not in English	23.471[a]	1.092	21.302	25.640
	Not proficient in either language	24.774[a]	.678	23.427	26.122
AWMA Dot Matrix	Proficient in both English and Zulu	17.930[a]	.656	16.627	19.233
	Proficient in English and not in Zulu	19.459[a]	1.007	17.458	21.459
	Proficient in Zulu and not in English	17.466[a]	1.036	15.408	19.524
	Not proficient in either language	17.496[a]	.644	16.218	18.775

AWMA Spatial Recall	Proficient in both English and Zulu	13.563[a]	.909	11.757	15.368
	Proficient in English and not in Zulu	14.708[a]	1.396	11.935	17.481
	Proficient in Zulu and not in English	15.650[a]	1.436	12.798	18.503
	Not proficient in either language	13.726[a]	.892	11.954	15.498
Proc score Spatial Recall	Proficient in both English and Zulu	32.409[a]	3.155	26.140	38.678
	Proficient in English and not in Zulu	37.557[a]	4.845	27.931	47.183
	Proficient in Zulu and not in English	40.277[a]	4.984	30.375	50.179
	Not proficient in either language	32.167[a]	3.097	26.015	38.318
a. Covariates appearing in the model are evaluated at the following values: Rounded Age = 9.10, SES_Total = 10.2292.					

Pairwise Comparisons							
Dependent Variable	(I) SR Prof	(J) SR Prof	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
AWMA Digit Recall	Proficient in both English and Zulu	Proficient in English and not in Zulu	-5.006*	1.265	.001	-8.418	-1.594
		Proficient in Zulu and not in English	-2.381	1.292	.412	-5.867	1.105
		Not proficient in either language	-3.685*	.972	.002	-6.307	-1.063
	Proficient in English and not in Zulu	Proficient in both English and Zulu	5.006*	1.265	.001	1.594	8.418
		Proficient in Zulu and not in English	2.625	1.533	.541	-1.510	6.759

		Not proficient in either language	1.321	1.259	1.000	-2.075	4.717
	Proficient in Zulu and not in English	Proficient in both English and Zulu	2.381	1.292	.412	-1.105	5.867
		Proficient in English and not in Zulu	-2.625	1.533	.541	-6.759	1.510
		Not proficient in either language	-1.304	1.303	1.000	-4.820	2.212
	Not proficient in either language	Proficient in both English and Zulu	3.685*	.972	.002	1.063	6.307
		Proficient in English and not in Zulu	-1.321	1.259	1.000	-4.717	2.075
		Proficient in Zulu and not in English	1.304	1.303	1.000	-2.212	4.820
AWMA Dot Matrix	Proficient in both English and Zulu	Proficient in English and not in Zulu	-1.529	1.200	1.000	-4.766	1.708
		Proficient in Zulu and not in English	.464	1.226	1.000	-2.843	3.771
		Not proficient in either language	.434	.922	1.000	-2.053	2.921
	Proficient in English and not in Zulu	Proficient in both English and Zulu	1.529	1.200	1.000	-1.708	4.766
		Proficient in Zulu and not in English	1.993	1.454	1.000	-1.930	5.915
		Not proficient in either language	1.963	1.194	.623	-1.259	5.184
	Proficient in Zulu and not in English	Proficient in both English and Zulu	-.464	1.226	1.000	-3.771	2.843
		Proficient in English and not in Zulu	-1.993	1.454	1.000	-5.915	1.930
		Not proficient in either language	-.030	1.236	1.000	-3.365	3.306
	Not proficient in either language	Proficient in both English and Zulu	-.434	.922	1.000	-2.921	2.053
		Proficient in English and not in Zulu	-1.963	1.194	.623	-5.184	1.259
		Proficient in Zulu and not in English	.030	1.236	1.000	-3.306	3.365

AWMA Spatial Recall	Proficient in both English and Zulu	Proficient in English and not in Zulu	-1.146	1.663	1.000	-5.633	3.341
		Proficient in Zulu and not in English	-2.088	1.699	1.000	-6.671	2.496
		Not proficient in either language	-.164	1.278	1.000	-3.611	3.284
	Proficient in English and not in Zulu	Proficient in both English and Zulu	1.146	1.663	1.000	-3.341	5.633
		Proficient in Zulu and not in English	-.942	2.015	1.000	-6.378	4.495
		Not proficient in either language	.982	1.655	1.000	-3.483	5.448
	Proficient in Zulu and not in English	Proficient in both English and Zulu	2.088	1.699	1.000	-2.496	6.671
		Proficient in English and not in Zulu	.942	2.015	1.000	-4.495	6.378
		Not proficient in either language	1.924	1.714	1.000	-2.699	6.547
	Not proficient in either language	Proficient in both English and Zulu	.164	1.278	1.000	-3.284	3.611
		Proficient in English and not in Zulu	-.982	1.655	1.000	-5.448	3.483
		Proficient in Zulu and not in English	-1.924	1.714	1.000	-6.547	2.699
Proc score Spatial Recall	Proficient in both English and Zulu	Proficient in English and not in Zulu	-5.148	5.773	1.000	-20.723	10.428
		Proficient in Zulu and not in English	-7.868	5.898	1.000	-23.780	8.044
		Not proficient in either language	.242	4.436	1.000	-11.726	12.211
	Proficient in English and not in Zulu	Proficient in both English and Zulu	5.148	5.773	1.000	-10.428	20.723
		Proficient in Zulu and not in English	-2.720	6.995	1.000	-21.592	16.152
		Not proficient in either language	5.390	5.746	1.000	-10.111	20.891
	Proficient in Zulu and not in English	Proficient in both English and Zulu	7.868	5.898	1.000	-8.044	23.780

		Proficient in English and not in Zulu	2.720	6.995	1.000	-16.152	21.592
		Not proficient in either language	8.110	5.949	1.000	-7.939	24.159
	Not proficient in either language	Proficient in both English and Zulu	-.242	4.436	1.000	-12.211	11.726
		Proficient in English and not in Zulu	-5.390	5.746	1.000	-20.891	10.111
		Proficient in Zulu and not in English	-8.110	5.949	1.000	-24.159	7.939
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: Bonferroni.							

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.269	2.190	12.000	267.000	.013	.090	26.275	.944
Wilks' lambda	.746	2.247	12.000	230.472	.011	.093	23.622	.912
Hotelling's trace	.320	2.287	12.000	257.000	.009	.096	27.439	.954
Roy's largest root	.247	5.492[a]	4.000	89.000	.001	.198	21.967	.970

Each F tests the multivariate effect of SR Prof. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. The statistic is an upper bound on F that yields a lower bound on the significance level.

b. Computed using alpha = .05

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
AWMA Digit Recall	Contrast	339.286	3	113.095	7.206	.000	.194	21.618	.979
	Error	1412.490	90	15.694					

AWMA Dot Matrix	Contrast	41.878	3	13.959	.988	.402	.032	2.965	.261
	Error	1271.113	90	14.123					
AWMA Spatial Recall	Contrast	50.796	3	16.932	.624	.601	.020	1.872	.176
	Error	2442.069	90	27.134					
Proc score Spatial Recall	Contrast	883.857	3	294.619	.901	.444	.029	2.703	.240
	Error	29429.434	90	326.994					
The F tests the effect of SR Prof. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.									
a. Computed using alpha = .05									

APPENDIX 11

AWMA and EGRA Proficiency MANOVA

BASIC MANOVA FOR EGRA AND AWMA

Box's Test of Equality of Covariance Matrices[a]

Box's M	65.280
F	1.980
df1	30
df2	8855.916
Sig.	.001

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.977	1128.621[b]	4.000	104.000	.000	.977	4514.484	1.000
	Wilks' Lambda	.023	1128.621[b]	4.000	104.000	.000	.977	4514.484	1.000
	Hotelling's Trace	43.409	1128.621[b]	4.000	104.000	.000	.977	4514.484	1.000
	Roy's Largest Root	43.409	1128.621[b]	4.000	104.000	.000	.977	4514.484	1.000
EGRA_Prof	Pillai's Trace	.180	1.694	12.000	318.000	.067	.060	20.333	.859
	Wilks' Lambda	.827	1.708	12.000	275.450	.065	.061	18.002	.800
	Hotelling's Trace	.200	1.714	12.000	308.000	.063	.063	20.569	.863
	Roy's Largest Root	.139	3.693[c]	4.000	106.000	.007	.122	14.774	.870

a. Design: Intercept + EGRA_Prof

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AWMA Digit Recall	.542	3	107	.655

AWMA Dot Matrix	.728	3	107	.538
AWMA Spatial Recall	2.407	3	107	.071
Proc score Spatial Recall	.784	3	107	.505

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[e]
Corrected Model	AWMA Digit Recall	151.378[a]	3	50.459	2.973	.035	.077	8.920	.689
	AWMA Dot Matrix	14.547[b]	3	4.849	.348	.791	.010	1.043	.116
	AWMA Spatial Recall	128.438[c]	3	42.813	1.648	.183	.044	4.943	.422
	Proc score Spatial Recall	1290.959[d]	3	430.320	1.304	.277	.035	3.913	.340
Intercept	AWMA Digit Recall	47862.205	1	47862.205	2820.368	.000	.963	2820.368	1.000
	AWMA Dot Matrix	27835.639	1	27835.639	1995.084	.000	.949	1995.084	1.000
	AWMA Spatial Recall	17509.228	1	17509.228	673.887	.000	.863	673.887	1.000
	Proc score Spatial Recall	103674.092	1	103674.092	314.259	.000	.746	314.259	1.000
EGRA_Prof	AWMA Digit Recall	151.378	3	50.459	2.973	.035	.077	8.920	.689
	AWMA Dot Matrix	14.547	3	4.849	.348	.791	.010	1.043	.116
	AWMA Spatial Recall	128.438	3	42.813	1.648	.183	.044	4.943	.422
	Proc score Spatial Recall	1290.959	3	430.320	1.304	.277	.035	3.913	.340
Error	AWMA Digit Recall	1815.811	107	16.970					
	AWMA Dot Matrix	1492.876	107	13.952					
	AWMA Spatial Recall	2780.121	107	25.982					
	Proc score Spatial Recall	35299.365	107	329.901					
Total	AWMA Digit Recall	64329.000	111						
	AWMA Dot Matrix	36435.000	111						
	AWMA Spatial Recall	24469.000	111						
	Proc score Spatial Recall	167366.000	111						
Corrected Total	AWMA Digit Recall	1967.189	110						
	AWMA Dot Matrix	1507.423	110						
	AWMA Spatial Recall	2908.559	110						
	Proc score Spatial Recall	36590.324	110						

a. R Squared = .077 (Adjusted R Squared = .051)

b. R Squared = .010 (Adjusted R Squared = -.018)

c. R Squared = .044 (Adjusted R Squared = .017)
d. R Squared = .035 (Adjusted R Squared = .008)
e. Computed using alpha = .05

PREDICT AWMA WITH EGRA - CONTROL FOR AGE

Descriptive Statistics				
	EGRA_Prof	Mean	Std. Deviation	N
AWMA Digit Recall	Proficient in both English and Zulu	22.79	3.938	28
	Proficient in English and not in Zulu	24.38	3.398	21
	Proficient in Zulu and not in English	21.23	3.898	13
	Not proficient in either language	24.59	4.527	49
	Total	23.70	4.229	111
AWMA Dot Matrix	Proficient in both English and Zulu	17.46	3.415	28
	Proficient in English and not in Zulu	18.43	4.057	21
	Proficient in Zulu and not in English	17.31	4.662	13
	Not proficient in either language	17.71	3.500	49
	Total	17.74	3.702	111
AWMA Spatial Recall	Proficient in both English and Zulu	12.68	4.714	28
	Proficient in English and not in Zulu	13.10	5.924	21
	Proficient in Zulu and not in English	16.00	7.234	13
	Not proficient in either language	14.47	4.209	49
	Total	13.94	5.142	111

Proc score Spatial Recall	Proficient in both English and Zulu	29.21	17.629	28
	Proficient in English and not in Zulu	32.76	21.675	21
	Proficient in Zulu and not in English	37.92	19.504	13
	Not proficient in either language	36.96	16.424	49
	Total	34.32	18.238	111

Box's Test of Equality of Covariance Matrices[a]

Box's M	65.280
F	1.980
df1	30
df2	8855.916
Sig.	.001

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.205	6.660[b]	4.000	103.000	.000	.205	26.639	.990
	Wilks' Lambda	.795	6.660[b]	4.000	103.000	.000	.205	26.639	.990
	Hotelling's Trace	.259	6.660[b]	4.000	103.000	.000	.205	26.639	.990
	Roy's Largest Root	.259	6.660[b]	4.000	103.000	.000	.205	26.639	.990
RoundedAge	Pillai's Trace	.004	.110[b]	4.000	103.000	.979	.004	.439	.072
	Wilks' Lambda	.996	.110[b]	4.000	103.000	.979	.004	.439	.072
	Hotelling's Trace	.004	.110[b]	4.000	103.000	.979	.004	.439	.072
	Roy's Largest Root	.004	.110[b]	4.000	103.000	.979	.004	.439	.072
EGRA_Prof	Pillai's Trace	.173	1.602	12.000	315.000	.090	.058	19.219	.834
	Wilks' Lambda	.834	1.611	12.000	272.804	.088	.059	16.975	.770
	Hotelling's Trace	.190	1.613	12.000	305.000	.087	.060	19.351	.836
	Roy's Largest Root	.129	3.394[c]	4.000	105.000	.012	.114	13.574	.836

a. Design: Intercept + RoundedAge + EGRA_Prof

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AWMA Digit Recall	.526	3	107	.665
AWMA Dot Matrix	.730	3	107	.536
AWMA Spatial Recall	2.377	3	107	.074
Proc score Spatial Recall	.772	3	107	.512

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Corrected Model	AWMA Digit Recall	152.728[a]	4	38.182	2.231	.071	.078	8.922	.637
	AWMA Dot Matrix	18.589[b]	4	4.647	.331	.857	.012	1.323	.122
	AWMA Spatial Recall	129.274[c]	4	32.319	1.233	.302	.044	4.930	.375
	Proc score Spatial Recall	1303.544[d]	4	325.886	.979	.422	.036	3.916	.301
Intercept	AWMA Digit Recall	327.293	1	327.293	19.120	.000	.153	19.120	.991
	AWMA Dot Matrix	119.002	1	119.002	8.473	.004	.074	8.473	.822
	AWMA Spatial Recall	87.042	1	87.042	3.320	.071	.030	3.320	.439
	Proc score Spatial Recall	457.288	1	457.288	1.374	.244	.013	1.374	.213
RoundedAge	AWMA Digit Recall	1.350	1	1.350	.079	.779	.001	.079	.059
	AWMA Dot Matrix	4.042	1	4.042	.288	.593	.003	.288	.083
	AWMA Spatial Recall	.837	1	.837	.032	.859	.000	.032	.054
	Proc score Spatial Recall	12.585	1	12.585	.038	.846	.000	.038	.054
EGRA_Prof	AWMA Digit Recall	137.815	3	45.938	2.684	.050	.071	8.051	.639
	AWMA Dot Matrix	16.945	3	5.648	.402	.752	.011	1.206	.128
	AWMA Spatial Recall	121.980	3	40.660	1.551	.206	.042	4.652	.399
	Proc score Spatial Recall	1269.422	3	423.141	1.271	.288	.035	3.813	.331
Error	AWMA Digit Recall	1814.461	106	17.118					
	AWMA Dot Matrix	1488.835	106	14.046					
	AWMA Spatial Recall	2779.284	106	26.220					
	Proc score Spatial Recall	35286.780	106	332.894					

Total	AWMA Digit Recall	64329.000	111						
	AWMA Dot Matrix	36435.000	111						
	AWMA Spatial Recall	24469.000	111						
	Proc score Spatial Recall	167366.000	111						
Corrected Total	AWMA Digit Recall	1967.189	110						
	AWMA Dot Matrix	1507.423	110						
	AWMA Spatial Recall	2908.559	110						
	Proc score Spatial Recall	36590.324	110						
a. R Squared = .078 (Adjusted R Squared = .043)									
b. R Squared = .012 (Adjusted R Squared = -.025)									
c. R Squared = .044 (Adjusted R Squared = .008)									
d. R Squared = .036 (Adjusted R Squared = -.001)									
e. Computed using alpha = .05									

Estimated Marginal Means

1. Grand Mean

Dependent Variable	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
AWMA Digit Recall	23.258[a]	.441	22.383	24.133
AWMA Dot Matrix	17.711[a]	.400	16.918	18.503
AWMA Spatial Recall	14.053[a]	.546	12.970	15.135
Proc score Spatial Recall	34.182[a]	1.946	30.325	38.040

a. Covariates appearing in the model are evaluated at the following values: Rounded Age = 9.10.

2. EGRA_Prof

Estimates

Dependent Variable	EGRA_Prof	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
AWMA Digit Recall	Proficient in both English and Zulu	22.787[a]	.782	21.237	24.337
	Proficient in English and not in Zulu	24.355[a]	.907	22.556	26.154

	Proficient in Zulu and not in English	21.307[a]	1.179	18.969	23.645
	Not proficient in either language	24.582[a]	.592	23.408	25.756
AWMA Dot Matrix	Proficient in both English and Zulu	17.462[a]	.708	16.058	18.866
	Proficient in English and not in Zulu	18.473[a]	.822	16.843	20.102
	Proficient in Zulu and not in English	17.176[a]	1.068	15.058	19.293
	Not proficient in either language	17.732[a]	.536	16.668	18.795
AWMA Spatial Recall	Proficient in both English and Zulu	12.677[a]	.968	10.759	14.596
	Proficient in English and not in Zulu	13.115[a]	1.123	10.889	15.342
	Proficient in Zulu and not in English	15.940[a]	1.459	13.046	18.833
	Not proficient in either language	14.477[a]	.733	13.024	15.930
Proc score Spatial Recall	Proficient in both English and Zulu	29.210[a]	3.448	22.374	36.046
	Proficient in English and not in Zulu	32.840[a]	4.002	24.906	40.773
	Proficient in Zulu and not in English	37.690[a]	5.200	27.380	48.000
	Not proficient in either language	36.990[a]	2.611	31.813	42.167
a. Covariates appearing in the model are evaluated at the following values: Rounded Age = 9.10.					

Pairwise Comparisons							
Dependent Variable	(I) EGRA_Prof	(J) EGRA_Prof	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
						Lower Bound	Upper Bound
AWMA Digit Recall	Proficient in both English and Zulu	Proficient in English and not in Zulu	-1.568	1.198	1.000	-4.790	1.653

		Proficient in Zulu and not in English	1.480	1.414	1.000	-2.322	5.282
		Not proficient in either language	-1.795	.981	.421	-4.432	.843
	Proficient in English and not in Zulu	Proficient in both English and Zulu	1.568	1.198	1.000	-1.653	4.790
		Proficient in Zulu and not in English	3.048	1.504	.271	-.996	7.093
		Not proficient in either language	-.226	1.080	1.000	-3.131	2.679
	Proficient in Zulu and not in English	Proficient in both English and Zulu	-1.480	1.414	1.000	-5.282	2.322
		Proficient in English and not in Zulu	-3.048	1.504	.271	-7.093	.996
		Not proficient in either language	-3.275	1.327	.091	-6.842	.293
	Not proficient in either language	Proficient in both English and Zulu	1.795	.981	.421	-.843	4.432
		Proficient in English and not in Zulu	.226	1.080	1.000	-2.679	3.131
		Proficient in Zulu and not in English	3.275	1.327	.091	-.293	6.842
AWMA Dot Matrix	Proficient in both English and Zulu	Proficient in English and not in Zulu	-1.011	1.085	1.000	-3.929	1.907
		Proficient in Zulu and not in English	.286	1.281	1.000	-3.157	3.730
		Not proficient in either language	-.270	.889	1.000	-2.659	2.119
	Proficient in English and not in Zulu	Proficient in both English and Zulu	1.011	1.085	1.000	-1.907	3.929
		Proficient in Zulu and not in English	1.297	1.363	1.000	-2.367	4.961
		Not proficient in either language	.741	.979	1.000	-1.891	3.372
	Proficient in Zulu and not in English	Proficient in both English and Zulu	-.286	1.281	1.000	-3.730	3.157
		Proficient in English and not in Zulu	-1.297	1.363	1.000	-4.961	2.367

		Not proficient in either language	-.556	1.202	1.000	-3.788	2.676
	Not proficient in either language	Proficient in both English and Zulu	.270	.889	1.000	-2.119	2.659
		Proficient in English and not in Zulu	-.741	.979	1.000	-3.372	1.891
		Proficient in Zulu and not in English	.556	1.202	1.000	-2.676	3.788
AWMA Spatial Recall	Proficient in both English and Zulu	Proficient in English and not in Zulu	-.438	1.483	1.000	-4.425	3.549
		Proficient in Zulu and not in English	-3.262	1.750	.390	-7.967	1.443
		Not proficient in either language	-1.800	1.214	.847	-5.064	1.464
	Proficient in English and not in Zulu	Proficient in both English and Zulu	.438	1.483	1.000	-3.549	4.425
		Proficient in Zulu and not in English	-2.825	1.862	.793	-7.831	2.181
		Not proficient in either language	-1.362	1.337	1.000	-4.957	2.233
	Proficient in Zulu and not in English	Proficient in both English and Zulu	3.262	1.750	.390	-1.443	7.967
		Proficient in English and not in Zulu	2.825	1.862	.793	-2.181	7.831
		Not proficient in either language	1.463	1.642	1.000	-2.953	5.878
	Not proficient in either language	Proficient in both English and Zulu	1.800	1.214	.847	-1.464	5.064
		Proficient in English and not in Zulu	1.362	1.337	1.000	-2.233	4.957
		Proficient in Zulu and not in English	-1.463	1.642	1.000	-5.878	2.953
Proc score Spatial Recall	Proficient in both English and Zulu	Proficient in English and not in Zulu	-3.630	5.284	1.000	-17.836	10.577
		Proficient in Zulu and not in English	-8.480	6.235	1.000	-25.245	8.285
		Not proficient in either language	-7.780	4.326	.450	-19.412	3.852

	Proficient in English and not in Zulu	Proficient in both English and Zulu	3.630	5.284	1.000	-10.577	17.836
		Proficient in Zulu and not in English	-4.850	6.634	1.000	-22.688	12.987
		Not proficient in either language	-4.150	4.765	1.000	-16.962	8.661
	Proficient in Zulu and not in English	Proficient in both English and Zulu	8.480	6.235	1.000	-8.285	25.245
		Proficient in English and not in Zulu	4.850	6.634	1.000	-12.987	22.688
		Not proficient in either language	.700	5.852	1.000	-15.033	16.433
	Not proficient in either language	Proficient in both English and Zulu	7.780	4.326	.450	-3.852	19.412
		Proficient in English and not in Zulu	4.150	4.765	1.000	-8.661	16.962
		Proficient in Zulu and not in English	-.700	5.852	1.000	-16.433	15.033
Based on estimated marginal means							
a. Adjustment for multiple comparisons: Bonferroni.							

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.173	1.602	12.000	315.000	.090	.058	19.219	.834
Wilks' lambda	.834	1.611	12.000	272.804	.088	.059	16.975	.770
Hotelling's trace	.190	1.613	12.000	305.000	.087	.060	19.351	.836
Roy's largest root	.129	3.394[a]	4.000	105.000	.012	.114	13.574	.836

Each F tests the multivariate effect of EGRA_Prof. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. The statistic is an upper bound on F that yields a lower bound on the significance level.

b. Computed using alpha = .05

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
AWMA Digit Recall	Contrast	137.815	3	45.938	2.684	.050	.071	8.051	.639

	Error	1814.461	106	17.118					
AWMA Dot Matrix	Contrast	16.945	3	5.648	.402	.752	.011	1.206	.128
	Error	1488.835	106	14.046					
AWMA Spatial Recall	Contrast	121.980	3	40.660	1.551	.206	.042	4.652	.399
	Error	2779.284	106	26.220					
Proc score Spatial Recall	Contrast	1269.422	3	423.141	1.271	.288	.035	3.813	.331
	Error	35286.780	106	332.894					
The F tests the effect of EGRA_Prof. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.									
a. Computed using alpha = .05									