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The relationship between socioeconomic status, bilingualism and working memory in school beginners

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A Research Report submitted to the School of Human and Community Development, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Education (Educational Psychology).
Johannesburg, February 2013

Declaration

I hereby declare that this research report is my own independent work, and has not been presented for any other degree at any other academic institution, or published in any form.

_____ _____

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Acknowledgements

To Hashem and those who have come before me I show my gratitude and appreciation for lighting my path.

To my parents who sacrificed sweat and tears to provide their children a quality education, I would like to say thank you for providing me with the foundations upon which I stand. I love you.

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Abstract

Children from low socioeconomic backgrounds are argued to be at a disadvantage since standardized cognitive tests tend to be biased in favour of high socioeconomic status children. Standardised tests measure the kind of crystallised knowledge that children from high socioeconomic status backgrounds are more likely to be exposed to. It is argued that assessments should truly measure the child's basic learning abilities rather than only reflecting the individual's knowledge or prior experience. Accordingly, this study explored whether measures of working memory, which are often described as being less biased than crystallised measures, are fairer for children from a low socioeconomic status. In South Africa, SES is closely related to mother tongue, since those most disadvantaged by apartheid were second language English speakers. English is not the mother tongue of the majority of South African children, yet it is the medium of education in most schools. Research suggests that bilingualism can positively influence the development of cognitive abilities, yet very little is known about the relationship between bilingualism and working memory in children. Therefore, this study explored the association between bilingualism and working memory in children from high and low socioeconomic status backgrounds. A sample of 120 students between the ages of six and eight were assessed using both crystallised and working memory measures of verbal abilities. It was found that high socioeconomic status monolingual children were greatly advantaged and outperformed the low SES children on almost all measures. The suggestion that working memory tests are unaffected by SES and that bilingualism positively influences children's working memory was not fully supported by the results of this study. However, bilingualism was seen to offer a kind of buffer against the negative influence of SES. These findings require further research, utilizing a larger sample and fewer schools, before any definitive conclusions can be drawn.

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Chapter 1 Introduction and Literature Review

Introduction.

In South Africa, the policies of apartheid created socio-economic privilege and disadvantage according to race. The country has a large low socioeconomic sector (SES) as seen by the 25.5% unemployment rate reported by Statistics South Africa (2012). It is argued that SES may influence whether parents introduce children to resources like museums, libraries or hobbies which can increase knowledge and provide varied and enriching experiences. Households in low SES areas tend to be overcrowded and children are often unsupervised as parents may work long hours (Louw, Van Ede, & Louw, 1998). Children from these backgrounds are at a disadvantage as standardized cognitive tests tend to be biased in favour of high SES children. Stored knowledge and accumulated vocabulary, which is acquired through everyday experiences and enriching activities, forms a person's crystallised knowledge. On the other hand, fluid intelligence allows people to manipulate abstract symbols and is related to abstract reasoning ability and problem solving skills. Standardised tests measure the kind of crystallised knowledge that children from high SES backgrounds are more likely to be exposed to. Children from low SES environments who are given standardized cognitive tests that are biased against them are as a result not given the same opportunity to succeed as those from a high SES environment. It is important for educators and schools to be able to accurately determine a learner's ability to perform complex tasks (Anderson, 2010). Therefore, when developing tests of cognitive ability it should be a priority to make sure that the assessments truly measure the child's basic learning abilities rather than only reflecting the individual's knowledge or prior experience. Accordingly, this study explored whether measures of working memory are related to a child's socioeconomic status. In South Africa, SES is closely related to mother tongue, since those most disadvantaged by apartheid were second language English speakers. The majority of South African children are not raised in a Western cultural environment, with only 9.6% of the population speaking English as a first language (Jordaan et al., 2012). Exposure to Western value systems and to the English language are factors that influence results in intelligence assessments. In order to understand how traditional assessments of intelligence may disadvantage many South African children it is necessary to understand the historical background to psychological assessments in South Africa. This chapter will begin with a discussion of the history of psychological assessment in South Africa.

History of psychological assessment in South Africa.

The issue of test bias is especially relevant in the South African context where results of psychological assessments were used to validate discriminatory practices during the apartheid era. Assessments that were standardized on white people only, were then unethically used to assess members of other racial groups with disregard for any potential test bias. While few tests were developed for black members of society, the tests that were developed ran along cultural or linguisitic lines (Foxcroft, 1997). The results of these tests were then used politically in order to prove and maintain the superiority of the white race over the other races living within the country (Mazabow, 2009).

With the demise of apartheid, psychological tests continued to be viewed with suspicion. Some viewed them as lacking in value and as being discriminatory and therefore called for a ban to be placed on biased tests (Foxcroft, 1997). This trend towards ensuring fair testing practices is countered by the difficulties that exist in creating and norming tests in a society with such cultural and linguistic diversity (Bedell, Van Eeden, & Van Staden, 1999). Presently, there is a shortage of new tests that have been developed for use with a variety of South African linguistic or cultural groups (Foxcroft, 2004). This has led to the application of Westernised tests on nonwestern participants and English tests on second language English (EL2) speakers, with an emphasis on "applying the norms with caution" (Foxcroft, 1997, p. 229)

It is argued that traditional cognitive assessment measures, often developed in the West, are biased when used in many South African contexts and that the focus should be shifted to process-oriented approaches (Bedell et al., 1999). Consequently, tests that involve less language or verbal skills and rely more on process or problem solving are seen as more culture-fair. Factors that lead to the aforementioned bias include test-wiseness, quality of schooling, home language and socioeconomic level (Nell, 1999). In addition the definition of intelligence upon which many of these tests were based may differ from culture to culture.

What is intelligence?

Alfred Binet defined intelligence as the ability to learn in a scholastic environment (Sternberg, 1999). The Stanford-Binet Intelligence Scales, developed by Lewis Terman, were based upon the

work of Binet and his colleague, Theodore Simon. This, however, was not the only measure of intelligence. David Wechsler created an alternative intelligence scale. He believed that intelligence was not limited to test scores, but can be seen in peoples' everyday lives. It is used when engaging with others, performing work tasks and in managing our daily activities (Sternberg, 1999). The Wechsler Intelligence Scales are presently more widely used than the Stanford-Binet Intelligence Scales. However, the psychometric measurement of intelligence is but one of a variety of approaches to the study of intelligence. Howard Gardner's theory of multiple intelligences proposes that intelligence is not a unitary construct. He distinguishes between eight separate and relatively independent intelligences, namely: linguistic intelligence, logical-mathematical intelligence, spatial intelligence, musical intelligence, bodily-kinesthetic intelligence, interpersonal intelligence, intrapersonal intelligence and naturalistic intelligence (Sternberg, 1999). These intelligences are perceived as stemming from different areas of the brain. R.J. Sternberg, on the other hand, sees intelligence as comprising of three aspects. In his triarchic theory, he postulates that intelligence relates to the internal world, to experience and to the external world (Sternberg, 1999). The external world can be described as the everyday world of places and things that we perceive and move amongst. Intelligence relates to the person's internal world through the processing of information. The theory also reflects on the nature of human experiences and how having little prior experience in completing a task requires more use of a person's intelligence. Lastly, intelligence relates to the external world in order to adapt the self to the environment, shape the environment to suit the self, or choosing appropriate new environments. Sternberg and Gardner proposed alternative approaches to intelligence. This study, however will focus on Spearman's *g* and Cattell's crystallised and fluid intelligences; which are the traditional approaches to intelligence.

Charles Spearman introduced the concept of *g*, a single general factor of intelligence, through factor- analytic studies (Sternberg, 1999). He used it to explain the common variance in all tests of mental ability (Chooi, 2012). This general factor pervades performance on all mental ability tests, while specific factors are related to specific abilities, e.g. arithmetics (Sternberg, 1999). The concept of a general factor that governs people's mental abilities has not been accepted unanimously and certain theorists have challenged this idea. Although Spearman's *g* is generally accepted as existent and measured by commonly used assessment tests like the Raven's

Progressive Matrices, Spearman and others have concluded that there are group factors of intelligence. These have been the focus of researchers who put forward the multiple factor theories of intelligence (Walsh & Betz, 1995). Louis Thurstone, for example, disagreed with the idea of a general pervading factor of intelligence. He postulated that there are seven primary mental abilities as opposed to one (Sternberg, 1999). J.P. Guilford's structure-of-intellect model included over a hundred factors which can be categorized according to three dimensions of problem solving: operations, contents and products. Multiple factor theorists saw each separate factor as having equal importance. However factor analysis of these separate factors resulted in hierarchical models being postulated (Sternberg, 1999).

The hierarchical model of human intelligence sees *g* as occupying the top stratum of the hierarchy. Group factors which are made up of broad mental abilities occupy the middle strata and the specific mental abilities make up the lower stratum (Chooi, 2012). Recently, John B. Carroll used the analysis of over four hundred data sets to create his hierarchical model according to which intelligence comprises of three strata, one of which is similar to *g*. Raymond Cattell developed a hierarchical model of intelligence in which general intelligence (*g*) is divided into two factors, namely fluid (G_f) and crystallized intelligence (G_c). These are then further divided into more specific factors (Sternberg, 1999). Carroll believes that there is a middle stratum between fluid and crystallised intelligence made up of learning and memory processes, speed and production of ideas, as well as visual and auditory perception. According to Cattell, fluid intelligence comprises cognitive-processing abilities that allow people to manipulate abstract symbols. It is related to the speed and accuracy with which people reason abstractly and is characterised by innate skills to solve novel problems. Working memory is an aspect of fluid intelligence. Crystallized intelligence, on the other hand, reflects a person's stored knowledge and accumulated vocabulary which is acquired through schooling and life experiences. Crystallised mental ability allows people to solve problems using this prior accumulated knowledge. Tests that use informational content like vocabulary, arithmetic and other already acquired knowledge and abilities measure crystallised intelligence. Fluid intelligence is measured by tests that require the testee to see relationships between shapes, numbers, etc and to solve novel problems (Walsh & Betz, 1995). It should be noted that fluid and crystallised intelligence are highly correlated with each other. Therefore, a person with high fluid intelligence can learn

more quickly and in this way can attain a higher crystallised intelligence than people with a lower fluid intelligence (Walsh & Betz, 1995).

It is important to take into account that the concept of intelligence may be understood differently from one culture to another. These differing perspectives can have a significant influence in the answering of test content (De Beer, 2000). For this reason it has been suggested that non-verbal, culture-fair assessments should be given to non-western, low SES testees. Another factor that needs to be considered is that Western assessments are based on the concept that speed of execution is an implied principle in successful completion of cognitive tasks. The African worldview does not hold this same principle, putting African participants at a disadvantage when completing timed tasks. The answer that has been suggested is to replace timed tests with power tests for members of this demographic (De Beer, 2000). A power test is aimed at measuring the testee's mastery of concepts without the added condition of time pressure.

The challenges of intelligence testing in South Africa.

Intelligence quotient (IQ) testing has great value in that it is an internationally recognized and structured method of evaluating achievement and acquired knowledge (Amod, 2013). It is also useful in the early identification of academic and learning problems, leading to the implementation of appropriate interventions. However, the 1960s brought with it questions about the definition of intelligence and the methods of assessing it. It has been argued that the Stanford-Binet Intelligence Scales, as well as those developed by Wechsler, are based on narrow and outdated perceptions of intelligence. These tests measure verbal intelligence through verbal comprehension and expression tasks and they measure non-verbal ability through tasks involving spatial understanding and figural reasoning (Naglieri, 1989). IQ scores are then seen as static and immutable, whereas these scores have been observed to change over time without purposeful intervention, especially as the result of being given fluid intelligence assessments (De Beer, 2000). This argument is given further justification when considering the cultural and racial differences that appear when these and other scales like them are presented in multicultural settings. As a result, international concern has circled around the presentation of these tests to members of cultural groups that differ from those upon whom the test was originally normed, specifically focusing on the issues of fairness and bias. Another area of concern with regards to

traditional intelligence measures is that they possess limited capability to predict whether a child will need learning interventions and whether there are underlying mental processes that provide barriers to learning (Amod, 2013). In South Africa, research has shown that those who were raised in disadvantaged educational or socio-economic environments are likely to underperform in standardized cognitive tests (De Beer, 2000). For example, Skuy, Taylor, O'Carroll, Fridjhon and Rosenthal (2000) compared the performance of black and white South African children with learning difficulties on the Kaufman Assessment Battery for Children (K-ABC) and the Wechsler Intelligence Scale-Revised (WISC-R). It was found that black South African children attained lower scores on the Wechsler Intelligence Scale for Children- Revised (WISC-R) than white South African children. The difference in these scores in the WISC-R is the result of cultural bias and not innate cognitive differences (Skuy, Taylor, O'Carroll, Fridjhon & Rosenthal, 2000). Campbell, Dollaghan, Needleman and Janosky (1997) state that "any assessment tool that taps the child's existing store of knowledge runs the risk of confusing 'difference' with 'disorder'"(p. 519). Since it may be impossible to develop tests which are completely culture-fair, assessments that reduce the level of bias should be sought and used (Campbell et al., 1997). Moreover, many disadvantaged children do not speak English as their mother-tongue and it is argued that issues presented by language differences provide barriers in the assessment process (Amod, 2013). According to Foxcroft (1997), when a test is given in a language other than the testee's home language, performance on the measure could be lowered as a result of language and not ability factors. In the South African context, it has been found that tests that rely on language tend to be less reliable than those that contain less language (Owen & Taljaard, 1996) and Nell (as cited in Foxcroft, 2004) has argued that language is the most important moderating variable in test performance especially in the multilingual South African context.

Since many commonly used assessments are insensitive to cultural, racial and linguistic diversity, a question is raised regarding whether it is still viable to use them in the South African context. Globally, cognitive assessments remain the most reliable option for understanding individual cognitive abilities and since we live in a global context it is important to develop valid and reliable measures for use within our specific society to ensure these measures have value for the various population groups they are used with (Jacklin, & Cockcroft, 2013).

One alternative is to utlilise process-dependent (fluid) rather than knowledge-dependent (crystallised) measures. Process-dependent measures, or measures of fluid intelligence, are less dependent on socio-economic background and acquired language knowledge. They are also equally unfamiliar to all participants involved (Ramachandra, Hewitt, & Brackenbury, 2011). Working memory assessments are proposed as alternative process-dependent measures of intelligence.

Research has found that general intelligence is highly related to working memory (Colom, Rubio,
Shih, & Santacreu, 2006) and that working memory is a strong predictor of g (Conway, Cowan, Bunting, Therriault, & Minkoff, 2002). However, working memory is most closely related to fluid intelligence and the next section will further explain working memory and how it is connected to fluid intelligence.

Working memory.

Working memory is a system which allows us to temporarily store and manipulate information. Baddeley (1996) describes it as the ability to store information temporarily while performing a processing task at the same time. The Baddeley and Hitch model (Baddeley, 2003) (which was later developed further by Baddeley) is an influential model of working memory and forms the theoretical framework for this study, although other viable models of working memory are also acknowledged. This view of working memory differs, for example from the original view based on the three-stores model of memory proposed by Richard Atkinson and Richard Shiffrin (1968) upon which Baddeley expanded in order to form his working memory model. According to the original model, memory is made up of a sensory store, a short term store and a long term store. From this perspective, working memory is merely another name for short term memory, which holds information for up to a minute or two (Sternberg, 1999). Other theorists such as Cowan regard working memory as part of long term memory and not as a separate system of its own (Cowan, 1995).

The Baddeley and Hitch model, as depicted in Figure 1, consists of a central executive system and two storage systems: namely the phonological loop and a visuospatial sketchpad. The

phonological loop holds verbal information while the visuospatial sketchpad manipulates visuospatial information. The final component of working memory is the episodic buffer. This is the newest component and was introduced by Baddeley in a revision of the model (2000). The episodic buffer is managed by the central executive and stores information temporarily in a multi-dimensional code that can be used by a range of systems. It therefore provides an interface between the phonological loop and the visuospatial sketchpad (Baddeley, 2000).

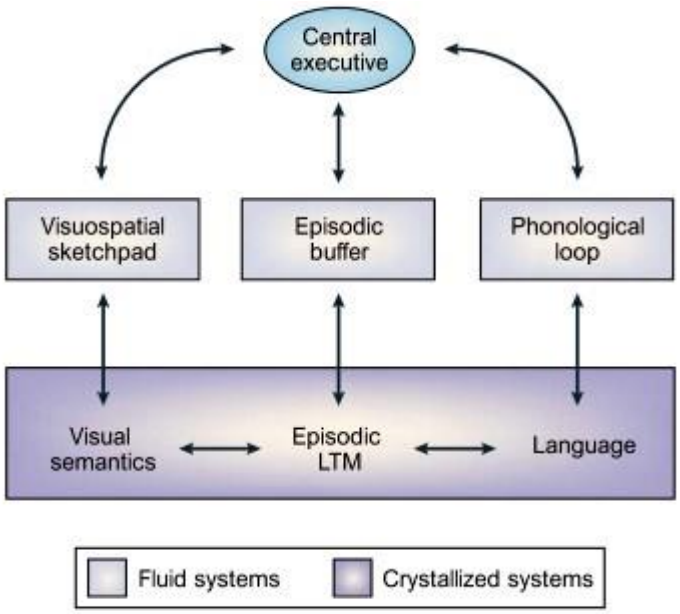

Figure 1. Baddeley and Hitch's working memory model. This figure illustrates the systems of the working memory. (Baddeley, 2003)

According to Alloway, Gathercole, Willis and Adams (2004), the episodic buffer may play an important role in learning as it inputs information into long-term memory and integrates this information into meaningful episodes. Evidence for a distinction between working memory and long term memory is found in neuropsychological research. A short term memory buffer has been provided as evidence for a dissociation between long term memory and short term memory (Sternberg, 1999). In addition PET imaging techniques have provided evidence that specific areas of the brain are highlighted when engaged in different aspects of working memory. The frontal and parietal lobes appear to be activated when the phonological loop is engaged, whereas the visuospatial sketchpad activates the occipital and right frontal lobe when in use for shorter

time periods and activates the parietal and left frontal lobes when in use for longer intervals (Sternberg, 1999).

The phonological loop is made up of the phonological store and the sub-vocal articulatory rehearsal system. Auditory memory traces are temporarily stored in the phonological store. These traces (or phonological representations) must be actively rehearsed through sub-vocal articulation or they will rapidly decay. Much of the research on the phonological loop has been based on immediate serial recall (Baddeley, 2003). In such studies, a small set of numbers, letters or unrelated words need to be remembered by participants. These are called simple span tasks as they require the participant to repeat the digits, words or other verbally presented stimuli back to the tester in the same order that they were presented to them. This is a simple working memory task because the information does not need to be manipulated before it is repeated and only uses short term memory (Pollock, 2009). It has been found that it is more difficult to correctly remember items that have similar sounds as they compete within the phonological loop. This is called the phonological similarity effect (Baddeley, 2000). The word length effect, which is the shortening of a person's immediate memory span as a word increases in length, is almost as strong as the phonological similarity effect. The word length effect disappears when sub-vocal rehearsal is suppressed (Baddeley, 2003). Articulatory suppression occurs when subjects are required to repeat an irrelevant sound or word and are therefore prevented from rehearsing the items which need to be remembered. Articulatory suppression, phonological similarity and word length are all factors that can disrupt the effective functioning of the phonological loop (Baddeley, 2003) and are given as empirical evidence for the existence of the phonological loop. The phonological loop is an important aspect of the proposed study as Baddeley (2003) proposes that it aids in the attainment of language. In a review of the literature by Baddeley, Gathercole and Papagno (1998), it was argued that the phonological loop has an important role to play in vocabulary acquisition, especially in relation to the storing of unfamiliar sounds. In addition, the capacity of a person's phonological loop is a good judge of his or her ability to learn a second language (Baddeley, 2003).

With reference to scholastic attainment, working memory skills have been linked to reading, mathematics and language comprehension (Alloway, Gathercole, Willis, & Adams, 2004). Phonological awareness (which is associated with verbal short term memory and working

memory) has been strongly linked with literacy and other language skills. Phonological awareness includes the ability to recognize that a relationship exists between sounds and letters and is the ability to encode, contact and operate the sounds of language (Alloway et al., 2004). It is therefore a prerequisite for reading. Proficiency in tasks involving phonological awareness has also been associated with vocabulary learning abilities (Alloway et al., 2004). The phonological loop plays an important role in supporting vocabulary acquisition (Engel, Santos, & Gathercole, 2008). Nonword repetition has commonly been used to measure the capacity of the phonological loop and has been found to be highly predictive of language learning difficulties. Nonword repetition entails repeating pseudowords that follow the rules of English but which do not exist in the English language. Dollaghan and Campbell (1998) used a nonword repetition task to identify children with language impairments. They found that certain levels of nonword repetition performance were highly predictive of language status, i.e. children whose language was developing normally and those whose language was not (Dollaghan & Campbell, 1998). Nonword repetition tasks were used as the items are novel and unfamiliar to everyone. The tasks are therefore considered to be independent of children's linguistic experience and socioeconomic background. The Automated Working Memory Assessment (AWMA), which was used to assess working memory in this study, includes a nonword repetition subtest.

The visuo-spatial sketchpad of Baddeley's working memory model stores and manipulates visual, spatial and possibly kinaesthetic information (Baddeley, 2000). As with the phonological loop, it consists of a storage (inner cache) and rehearsal mechanism (inner scribe) (Logie, Della Sala, Laiacona, Chalmers, & Wynn, 1996). It has a limited capacity and can hold about three or four objects at one time (Baddeley, 2003). Measures of visuo-spatial sketchpad functioning often involve the remembering or recognition of strings or patterns of movement. The ability to hold and manipulate visuospatial information is an aspect of non-verbal intelligence that predicts success in specific career paths e.g. architecture and engineering (Baddeley, 2003). As a result Baddeley states that the sketchpad may play a role in the acquisition of knowledge relating to the appearance of objects and how to use them. Logie et. al. (1996) argues that the sketchpad only stores information after it has been processed in long term memory. In this view the sketchpad begins to work after visual information has been sorted through in the long term memory. Support for this view comes from patients who show visuospatial neglect after right hemisphere damage. For example, some patients are unable to report what objects are placed in their left

visual field, but show no inability when describing a familiar remembered view (Baddeley, 2003). The sketchpad has proven difficult to research (e.g. it is difficult to study visual-spatial rehearsal).

The central executive is arguably the central constituent of the working memory (Baddeley, 2003). It allocates limited resources to allow for the performance of higher order activities such as reading and assists in the acquirement of several skills during childhood, e.g. language. The central executive is believed to directly control the activities of the phonological loop and visuospatial sketchpad. It is also used for allotting attention, planning and inhibiting irrelevant responses (Roberts & Gibson, 2002). Although Baddeley and Hitch's working memory model is chiefly founded on research with adults, as well as patients with neuropsychological impairments (Baddeley, 2000), Alloway, Gathercole, Adams, Willis, Eaglen and Lamont (2005) concluded that working memory in young children has a similar functional organization to that of adults. Baddeley is criticized for not defining the processes which underlie the central executive. He has suggested that the central executive is made up of subsystems but has also postulated that it may consist of a group of equal processes which appear as a unitary controller. In an attempt to further explain the features of the central executive he named sub-processes (such as the capacity to divide ones attention and to switch focus from one item to another) which a central executive system should have. Researchers have attempted to clarify the presented issues but a clear understanding remains elusive (Basho, 2012).

Verbal complex memory tasks are often used to assess the capacity of a person's central executive functioning. Complex span tasks e.g. digits backwards span tasks require the participant to hold the information that they have been given and to then manipulate the information before it is repeated (Pollock, 2009). For example, in digits backwards tasks, numbers are orally presented to the participant in a specific order. The person then needs to repeat the digits in the reverse order in which they were given.

Since Baddeley and Hitch's model of working memory consists of slave systems that act as short term memory stores, which hold items for a short time before they decay, the capacity of these slave systems may have a direct effect on a person's working memory capacity (Chooi, 2012). A person with a larger working memory capacity is more likely to remember more items at one time and is more able to switch attention back and forth between items while inhibiting irrelevant

information. Processing speed, which is an important aspect of this working memory model, may also have an important influence on working memory as this would affect the speed at which a person can manipulate information stored in the slave systems or how quickly the individual can direct the central executive to the task the person is engaged in.

Socioeconomic status and working memory functioning.

The primary aim of this study was to investigate whether a child's socioeconomic background is associated with their working memory functioning. Socioeconomic status (SES) is a widely studied construct which has no set definition. For the purposes of this study, a definition of SES included parental education, occupational status (Robert & Robert, 2002) and the number of electronic appliances in the home. Berk (2006) used three variables to define SES: years of parental education, social status as determined by the prestige of and skill required by one's job, and income. The demographic and socioeconomic questionnaires used in this study utilitised these variables (with the exception of income) in order to determine which demographic the students fell into. SES is an important factor as it strongly influences academic success and other life experiences e.g. high SES children experience more verbal stimulation in their homes than low SES children (Berk, 2006). The home environment of children from low SES neighbourhoods tend to have fewer material resources, like learning materials and exposure to enriching experiences (Sarsour et al., 2011). Family income is a strong indicator of educational achievement and the longer that a child is exposed to poverty, the less likely that child is to achieve in school and educational attainment (Evans & Schamberg, 2009).

It has been put forward that children from lower SES environments perform poorly in standardized language tests (Campbell et al., 1997; Engel et al., 2008). Mothers' conversations with children and the availability of reading and learning materials are two explanations that have been given for said poor performance (Berk, 2006; Robert & Robert, 2002). Mothers are often the child's primary caregiver. High SES mothers tend to converse more often with their children, read to them more and try to provide more exposure to educational opportunities (Robert & Robert, 2002). On the other hand, limited exposure to the items contained in standardized language tests often render children from low SES backgrounds less testwise than their high SES peers. This may be coupled with the fact that the latter children may not be tested in their home language.

In South Africa, SES and home language have a strong relationship because of the legacy of Apartheid. Those whose first language is English are more likely to come from a high SES environment, whereas bilingual people, whose second language is English, are more likely to come from a low SES environment (HSRC & EPC, 2005).

Socioeconomic status and child assessments.

Bradley and Corwyn (2002) propose that differences in access to material and social resources link SES to a child's well-being. More specifically high SES parents provide their children with more learning experiences (Bradley & Corwyn, 2002). While it cannot be concluded that all high SES parents spend time talking to and educating their children, Hart and Risley (1995) named economic advantages within a child's home and the frequency of language experiences as the most important factors in language acquisition in their decade long longitudinal study. They studied 42 children from the time they started to talk (around one year old) until they were three years old. These children were raised in well- functioning professional families (i.e. at least one primary caregiver employed as a professional) acquired vocabulary at a faster rate than children who come from well-functioning working-class or welfare households. This was an American study and therefore care should be made when comparing the American context to the South African one. When conducting research on the home observation for measurement of the environment (HOME) inventory, (an assessment of the stimulation and support a child receives in the home environment) Bradley and Corwyn "found that these effects applied to children from infancy through adolescence and generally hold for children from diverse ethnic backgrounds" (2002, p. 12).

Norm-referenced assessment measures rely heavily on children's previous experience and may therefore be biased against children from low SES backgrounds. Many of the most commonly used measures of intelligence and language ability depend on measuring vocabulary knowledge. Results may therefore reflect a child's lack of experience rather than a deficit in this area. Consequently, it is import to find a less biased way of assessing children, particularly at school entry. In this regard "process-dependent" measures have been used in order to carry out assessments that are relatively unaffected by history or experience (Campbell et al., 1997). The contents of these measures of fluid ability are designed to be equally familiar to all test-takers and depend more heavily on mental operations such as problem solving than acquired language

knowledge. They are therefore less biased against children from low SES environments and offer a more reliable way of determining whether poor performance reflects actual deficits rather than different environmental experiences (Campbell et al., 1997; Dollaghan & Campbell, 1998). There is also evidence that measures of simple verbal working memory that tap the phonological loop are less biased assessment tools than standardized tests of vocabulary (Dollaghan & Campbell, 1998). The main difference between working memory measures and tests of vocabulary knowledge is that the latter measures crystallized knowledge and are therefore knowledge dependent while the former measures fluid intelligence and are therefore processing dependent (Engel et al., 2008). Vocabulary tests are a commonly used measure of crystallised ability. Since working memory measures are designed to be equally unfamiliar to all test-takers and test the solving of novel problems, they are argued to tap fluid intelligence. In this way, it is believed that they do not bestow an advantage or disadvantage on individuals with differing prior knowledge and experiences. Thus, it was hypothesized that children in the current study, whether from high or low SES backgrounds, would not differ significantly in their performance on working memory measures (which tap fluid intelligence) whereas they should display significant differences in performance on vocabulary measures (which tap crystallized intelligence).

Bilingualism and its effects on intelligence.

Since SES and home language are interlinked in South African society, the role of SES on working memory functioning could not be investigated without considering the role of language. Many South African children speak an African (or other) language at home, but use English at Language of Learning and Teacher (LOLT) at school (HSRC & EPC, 2005). Being educated in a second language in childhood can positively influence the development of cognitive abilities e.g. problem solving, executive functioning and attention (Kormi-Nouri, Moniri, & Nilsson, 2003). Although current cognitive research found that bilingualism has these positive influences, researchers still know very little about the relationship between bilingualism and working memory in children (Kormi-Nouri et al., 2003). This study therefore explored the association between bilingualism and working memory in children from high and low SES backgrounds.

The common definition that a bilingual is a person who is fluent in two languages is inappropriate as many South Africans are bilingual with a dominant language and tend not to have a balanced ability in both known languages. As a result, a more pragmatic definition may

be, “someone who can function in each language according to given needs” (Bialystok, 2001, p.4). That is, the ability to be linguistically proficient enough to portray ones meaning in specific environments, according to one’s needs in each environment.

Research findings related to the advantage/disadvantage of bilingualism are inconsistent, but many studies are flawed in that they did not control for socio-economic or cultural differences between the monolinguals and bilinguals studied (Gathercole et al., 2010). In 1939, Smith concluded that bilingualism can lead to mental retardation. Although this view is regarded as unfounded today, it is generally agreed that bilingual children face more language challenges during language acquisition than monolingual children. One example is that bilingual children are more likely to display lower vocabulary scores relative to monolinguals. However, the reason for this may be that bilinguals are learning almost double the amount of words monolinguals are learning, but in the same time-frame (Snow, 1998). Peal and Lambert (1962) discovered that one of the main advantages to being bilingual was increased mental flexibility. Since then, bilinguals have been reported to show an advantage over monolinguals in areas such as metalinguistic awareness and certain cognitive abilities, especially those related to mental flexibility and control (Gathercole et al., 2010). Bialystok (2001) argues that bilinguals need to constantly control which of their languages is currently being utilised, while simultaneously suppressing the language which is not presently needed. As the central executive (which is an important constituent of the working memory) is used for allotting attention, planning and inhibiting irrelevant responses, it is involved in planning which language is needed and inhibiting the language which is not. This capacity is what gives bilinguals an advantage in metalinguistic and cognitive realms (Gathercole et al., 2010). Therefore, it is hypothesized that bilingual children may have a working memory advantage over monolingual children. In investigating this issue, it is also important to attempt to separate out the potential effects of SES. Consequently, this study investigated the relationship between bilingualism and working memory in children from high and low SES backgrounds. However, the primary question in this study was whether measures of working memory are related to a child’s socioeconomic status.

Chapter 2 Methods

Overview.

The study investigated the relationship between socioeconomic status, bilingualism and working memory in primary school children. Measures of working memory assess a person's ability to learn, rather than assessing the knowledge a person has already acquired. These measures are argued to be impervious to the effects of one's socioeconomic status. Therefore, the primary research question was: Is socioeconomic status related to working memory performance? The secondary question was: Is bilingualism related to working memory performance? In addition, two hypotheses were developed as a result of the Literature Review. Firstly, it was hypothesised that all four of the SES groups would perform equivalently on all of the working memory tests. Secondly, it was hypothesised that, the children from the high SES group would achieve better results on the measures of crystallised intelligence than the children from the low SES group as a result of the different life events and opportunities children from high and low socioeconomic statuses experience. In South Africa the majority of children speak an African language and learn in another language. Studies conducted on bilingual children indicate that learning more than one language during childhood can positively influence the development of cognitive abilities. Since the South African context involves a majority of bilingual children living in low SES environments and since children from these environments are more likely to perform poorly in standardized language tests, the secondary question was put forward.

Sample.

The sample consisted of one hundred and twenty first grade students between the ages of 6 and 8 (see Table 1). There was no significant difference between the mean ages in each group. The sample was divided into four groups and each group consisted of thirty students. Both male (N= 62) and female (N= 58) participants were included. A non-probability convenience sampling strategy was used and participants were drawn from public and private junior primary schools in the Johannesburg area. The participants were all volunteers. The participants were assigned to either a high or low socio-economic group based on their parent or guardian's responses on the socio-economic and demographic questionnaires (See Appendix E). In addition, children who attended a private school were placed into the high SES group as were children who attended

government schools that catered for children from middle class areas. Those who attended government schools that cater for children who live in a township or low SES area were generally placed into the low SES group. The groups were also divided by English language (i.e. English as home language and English as second language). More specifically, the groups were divided as follows: high SES, English as first language (EL1); high SES, English as second language (EL2); low SES, English as first language (EL1); and low SES, English as second language (EL2). The data for the high SES EL1 and low SES EL2 groups had been previously collected in 2012 following the same procedure and sampling methods described here. Consequently, this researcher collected the data for the high SES EL2 and low SES EL1 groups. The composition of the final sample of one hundred utilized in the analysis was therefore as follows:

Table 1:

Breakdown of Sample According to Demographic Factors

	High SES (N=59)		Low SES (N=61)	
	EL1 (N= 30)	EL2 (N=29)	EL1 (N=36)	EL2 (N=25)
Age Range	6-7	6-8	6-8	6-8
Mean	6. 93	6.79	6.69	6.48
Standard Deviation	0.25	0.56	0.79	0.71
Gender M:F	11:19	14:16	25:11	12:12

Note. SES= socioeconomic status; M= male; F= female; age indicated in years

Of the 120 participants in the study, 74 spoke English as a home language, 86 spoke an African language and 7 spoke French or Afrikaans. The African languages that were spoken as a home language included Zulu, Xhosa, Sepedi, Tswana, Sesotho, Swazi, Tsonga, Tshivenda and Swahili. Racially, the participants were either Caucasian or African, with 30 participants falling into the former category and 90 falling into the latter.

The high socio-economic groups were collected from private schools as well as government schools located in high SES areas. The low socio-economic groups were drawn from government schools in low socio-economic areas. All schools used English as the medium of instruction and therefore all the participants had exposure to the English language. Nevertheless, due to the fact that the majority of South African children speak an African language at home (Jordaan et al., 2012) with English as LOLT at both primary school level and above (Heugh, 2002), home language was captured in the demographic questionnaire as well as by asking each child during the assessment. Lastly, children who had been diagnosed with learning difficulties, communication disorders, cognitive disorders, speech/language disorders, motor disorders or Attention deficit/hyperactivity disorder were not included in the study (See Appendix E).

Design.

The design was non-experimental and comparative. The participants were assessed only once. Also, there was no random assignment of participants since the children were assigned to groups based on their socio-economic status. The design was ex post facto as there was no manipulation of variables involved. There was no control group, but rather a comparison between four groups, namely high SES EL1, high SES EL2, low SES EL1, low SES EL2.

Procedure.

The first step in the procedure was to obtain ethics clearance. Principals and Foundation Phase Head of Departments were contacted and meetings were set up. Specific schools were targeted in order to ensure sufficient high and low SES participants. A letter was sent to the principals requesting their participation (See Appendix A). Once principals agreed to participate their verbal consent was obtained. The next step was to send letters to all grade one parents or guardians in the participating schools (See Appendix B). Parents or guardians who agreed to allow their children to participate filled out a written consent form (Appendix C) which was put into the child's homework book so it could be collected by the class teacher. In order to determine which children fit into the required demographic, parents or guardians were sent demographic questionnaires together with the abovementioned letter and consent forms. Forms were filled out and sent to the class teacher along with the signed consent form. Sampling took place in the schools, during the time which was most convenient for the parents, teachers, principal and students. These times and days were determined by each gatekeeper. Each child

was assessed for about 60 minutes, with several breaks as they are too young to concentrate for such an extended amount of time. Each child's assent was attained before testing began (See Appendix D). Assessment took place individually in a quiet room or office, provided by the school. The room invariably included a desk, two chairs and a power source for the laptop. Assessments took the following fixed order:

1. British Picture Vocabulary Scale- II (approximately 15 minutes)
2. Raven's Colored Progressive Matrices (approximately 15 minutes)
3. Automated Working Memory Assessment (approximately 20 minutes)
4. Boston Naming Test (approximately 10 minutes)

The BPVS-II and the Raven's CPM were administered first in order to establish rapport. These assessments do not require the child to speak and therefore an anxious child was able to gain confidence by simply pointing to the correct answer. The AWMA was administered next as it is a relatively long assessment and required the child to be alert. It was deemed as essential for the child not to feel mentally exhausted before the AWMA began. The child was allowed a break between each assessment and was a bathroom break if requested.

Measures.

The study used four measures, namely: The Raven's Coloured Progressive Matrices (RCPM); the Boston Naming Test (BNT), the British Picture Vocabulary Scale (BPVS); and the Automated Working Memory Assessment (AWMA). Each is described below. The children's crystallized intelligence was assessed through the use of the Boston Naming Test and the British Picture Vocabulary Scale and fluid intelligence was assessed through the use of the AWMA. The vocabulary tests and the AWMA have not been normed or standardized on South African children. This is not perceived as a limitation in this study as the children were compared to each other and not to the test norms. Lastly, a socioeconomic questionnaire was given to the primary caregiver of each participant. This questionnaire was used to determine the child's SES, allowing the researcher to determine whether the child belongs in the high or low SES group. It should be noted however, that norms have been established for British and American populations and the appropriateness of the use of these assessment measures amongst non-western populations has not been established (Riva, Nichelli, & Devoti, 2000).

Raven's Colored Progressive Matrices (Raven, 2000). The Raven's Colored Progressive Matrices (CPM) is a test of non-verbal intellectual ability that was included to ensure that the children from the high and low socioeconomic groups were comparable in this respect. The Raven's Colored Progressive Matrices (CPM) was created to measure general intelligence (*g*) and assesses a child's capacity to think logically and solve problems (Raven, 2000). This test assesses children from the ages of 5 and 11. There are 36 items in the test and these are divided into three sets. The items progressively increase in difficulty. Each item requires the child to complete a geometric shape by selecting which of the 6 possible options is the piece that is missing from the shape. One point is scored for a correct answer and 0 points for an incorrect answer. The maximum score is 36.

The test-retest reliability of the CPM was shown to be r= 0.90 with children in America (Raven, Court & Raven, 1986) and cultural studies have shown the CPM to be both valid and culturally fair for American children (Kazem et al., 2007). The validity of the CPM has been well researched and content, construct and criterion validity have been shown (Bass, 2000). The internal consistency of the CPM amongst 371 Xhosa-speaking primary school students from Grahamstown, South Africa was r= 0.88 (Bass, 2000). In an effort to establish norms for the CPM in South Africa, Linstrom, Raven and Raven (2008) tested 2,469 children between five and twelve years of age. The data was divided according to language and three groups were formed namely, English, Afrikaans and a group of what was referred to as "other languages". It was found that the performance of English and Afrikaans speaking groups on the CPM was highly comparable to that of the groups tested in the UK. Also, the norms for the "other languages" group were higher than norms for the Xhosa-speaking students mentioned above but lower than that of the English and Afrikaans speaking groups (Linstrom, Raven, & Raven, 2008). Bass (2000) believes that the lower norms amongst the Xhosa speaking students resulted from their impoverished conditions and disadvantaged backgrounds. Despite these differences Linstrom, Raven and Raven (2008) state that the CPM works in the same way for all children and that it is therefore culture-fair.

British Picture Vocabulary Scale (Dunn, Dunn, Whetton, & Burley, 1997). British Picture Vocabulary Scale, Second Edition (BPVS II) (Dunn, Dunn, Whetton, & Burley, 1997) is commonly used to assess 3 to 15 year old children's vocabulary knowledge. A set of pictures are

shown to the child, who must then choose the correct picture that goes with the word that was spoken by the examiner (Ramachandra et al., 2011). These pictures are drawings of actions and objects which are easy for a child to recognise. In this way, the child's receptive vocabulary (the collection of words that s/he can recognize and understand) is being assessed. There are 84 items altogether. A correct response scores 1 point and an incorrect response scores a 0. Testing will stop after 8 consecutive errors and the maximum score is 84. It has been revised in 1997 with a large standardisation sample of 2571 children from the United States and Britain. The split half reliability was 0.83 and the internal consistency reliability was 0.93 (Dunn, Dunn, Whetton, & Burley, 1997).

Boston Naming Test (Kaplan, Goodglass & Weintraub, 1976). The Boston Naming Test (BNT) (Kaplan, Goodglass & Weintraub, 1976) provides the participants with line drawings of objects which must be named. The BNT differs from the BPVS in that the BPVS assesses the child's receptive vocabulary by requiring him or her to merely point to an image that is associated with the word named by the tester. In comparison the BNT requires the child to verbalise the name of the images provided and is therefore a test of expressive vocabulary. It tests a person's expressive vocabulary of school children between the ages of 5 and 13. There are 60 items in the test and these items progress in difficulty. The BNT has been used by numerous researchers and norms have been established for children and adults alike. These are generally for individuals with various disorders rather than typically developing children (Kindlon & Garrison, 1984). However Halperin, Healey, Zeitchik, Ludman, and Weinstein (1989) found that the reliability of the BNT amongst typically developing six to twelve year olds was $r= 0.54$ ($p < .001$) and concluded that the BNT was "appropriate for use" with children from this age range (p.526). The split-half reliability of the BNT amongst 371 Dutch-speaking Belgian children grades one and six was 0.88 (Storms, Saerens, & De Deyn, 2004). Amongst adults, the internal consistency of the BNT in aphasic people is $r= 0.98$ (Tallberg, 2005) and the reliability of the BNT amongst intact adults between the ages of 25 and 88 was found to be $r= 0.78$ (Tombaugh & Hubley, 1997).

Automated Working Memory Assessment (Alloway, Gathercole, & Pickering, 2006). The Automated Working Memory Assessment (AWMA) was used in order to assess the participants

working memory functioning. It is a computerized tool and is designed to allow assessors who are not experts (e.g. teachers) to screen students between the ages of 4 and 22 for major working memory problems (Alloway et al., 2006). A score of 1 is given for a correct trial. If a child answers the first four trials in the group correctly, the program automatically continues on to the next group. However, if three or more mistakes are made, the program automatically stops the test. Test reliability of the AWMA was assessed using a sample of 105 British children between 59 and 140 months (Alloway et al., 2006). It has been extensively researched and it has been shown that a child's performance on the AWMA is a strong predictor of academic attainment (Alloway et al., 2005). The AWMA was standardized using a sample of 709 students in the north-east of England. The children's ages ranged from four to eleven (Alloway, 2006). The AWMA consists of a variety of tests of which four were used in the current study, namely: The Digit Recall Test; The Non-word Recall Task; The Counting Recall Test; and The Backward Digit Recall test, described below.

Verbal short term memory. The Digit Recall test is a simple span task of visuo-spatial working memory and only requires rote rehearsal. It consists of nine blocks each of which contain six trials. A score of one is given for a correct answer and a score of 0 is given for a mistake. The maximum score is 54. It has been found to have a test-retest reliability of r= 0.89 (Alloway, 2009).

The Nonword Recall test is also a simple span task but it corresponds to verbal working memory. Forty nonwords are presented verbally to the child, who then needs to repeat the nonword correctly. A correct response acquires a score of 1 and an error acquires a score of 0. The maximum score is 40. In the event that a phoneme is mispronounced as a result of the child's accent, the misarticulation is scored as correct. The re-test reliability was reported to be r= 0.69 (Alloway, 2009).

Verbal complex span. The Counting Recall test is a complex span task which is associated with verbal working memory. It consists of seven blocks of pictures containing triangles and circles. The first block contains one picture and each block increases by one extra picture. The child should remember the number of circles in each picture. This must be done in the correct order. A correct recall acquires a score of 1 and the maximum score is 42. The child cannot

continue on to the proceeding block unless s/he correctly recalls four trials consecutively. The test-retest reliability for counting recall is r= 0.79 (Alloway et al., 2006).

The Backwards Digit Recall is a complex span task which is associated with the visuo-spatial working memory. It requires the participant to recall a chain of digits verbally conveyed by the assessor. However the digits must be recalled in the reverse order. At first the child is given two numbers, but these increase by one number in each block. This continues until the child cannot remember four trials correctly. A correct response scores 1 and an incorrect answer scores 0. The highest score is 36. For children aged four and a half and eleven and a half years, test–retest reliability is r= 0 .64 (Alloway et al., 2006).

Socio-economic status and demographic questionnaires. This measure was designed as part of the larger study to aid in approximating each participant's socioeconomic status. Important demographic information such as race, gender, age and home language were included to estimate the socioeconomic status of each child (See Appendix E). Home language information was also captured during the assessment process. The Socioeconomic Questionnaire (see Appendix E) determined the primary caregiver's occupation, marital status, level of education and area of residence. It also included a Living Standard Measure which had been previously created to determine the living standards of the 60 participants who were assessed in 2012.

Threats to validity.

It is important to note that principals, teachers and parents were often unwilling to participate in the current study. It was observed by the researcher that principals and parents who agreed to participate were often those who seemed concerned about the cognitive or learning ability of their students or children and wanted some measurement or assessment of this. For this reason it is possible that students who participated do not adequately reflect the general population, especially with reference to the high SES second language English group and the low SES first language English group.

Ethical considerations.

As the participants were young children, it was important to ensure that their rights were protected. With this in mind, ethical clearance was sought from the University Ethics Committee

(See Appendix G for ethics clearance certificate) and letters were sent to prospective parents or guardians informing them of the nature and purpose of the study and asking for their permission to allow their children to participate. Learners were too young to give consent, however they were required to give their verbal assent to participate. It should be noted that anonymity could not be guaranteed as learners were called out from class and were assessed in a face-to-face setting. However, data was anonymised by assigning each child a participant code and all the results were reported anonymously. In case feedback was required, participants' names were linked to a separate file kept only by the researcher. Every effort was made so that the child did not miss a class, e.g. assessing during aftercare. In the event that the child did miss a class, the principal and class teacher were in charge of selecting the class the child would miss according to level of importance. This was discussed with the principal and/or other gatekeeper from the outset. Participants were afforded the opportunity to withdraw from the study at any point, without prejudice. With reference to assessment findings, if it was discovered that a specific child had working memory difficulties, parents were informed and a referral to the Emthonjeni Centre (a community clinic at the University of the Witwatersrand) was made. Lastly, there were no foreseeable risks or benefits related to participation in this project.

Data analysis.

The study was comparative. There were multiple variables due to the variety of tests that were administered. Socio-economic status was divided into two levels, namely high and low. English language was divided into two levels (English as first language and English as second language). These formed the independent variables. The dependent variables were the participants' scores on each cognitive assessment. Comparisons between groups were determined by Multivariate Analysis of Co-variance (MANCOVA) or t-tests where appropriate or their non-parametric equivalents, depending on the normality of the data distribution. As data had already been collected in 2012 from two of the sample groups (namely high SES EL1 and low SES EL2), data was only collected for high SES EL2 and low SES EL1 by this researcher. Raw scores were used in all analyses.

Chapter 3

Results

In South Africa SES and home language are strongly related due in part to the legacy of Apartheid (HSRC & EPC, 2005). Therefore, children from a low socioeconomic status are likely to be second language English speakers (Jordaan et al., 2012). These children are less likely to be tested in their home language since few tests of cognitive ability exist in African languages (Foxcroft, 2004). Crystallised assessment measures have been criticized for being biased against those from a low socioeconomic status (Engel et al., 2008). Working memory measures, which tap fluid intelligence, are a possible alternative to crystallised measures as they are believed to be impervious to socioeconomic factors (Engel et al., 2008).

Consequently, this study compared children's performance on two verbal crystallised measures (namely the British Picture Vocabulary Scale and Boston Naming Test) to their performance on a verbal fluid measure (Automated Working Memory Assessment). Four groups were compared, namely high SES with English as a first language (EL1), low SES with English as a first language (EL1), high SES with English as a second language (EL2) and low SES with English as a second language (EL2). All EL2 groups were bilingual or multilingual and were being educated in English. The descriptive statistics for each of the four groups can be found in Table 2.

Table 2 shows the descriptive statistics for each of the four groups on crystallised and working memory/fluid measures. As can be seen in this table the means for the High SES EL1 group were higher than the means for all other groups, including the high SES EL2 group.

First, age (as shown in Table 1) was compared on an independent t-test to ensure that the two SES groups did not differ significantly in this regard. No significant difference was found between the high and low SES groups ($t(57) = 1.24$; $p = 0.217$). Similarly, intellectual ability (RCPM) was compared in order to determine whether the groups were equivalent in this regard. An independent t-test revealed a significant difference between the high and low SES groups, with the high SES group scoring higher ($t(118) = 5{,}00$; $p < .000002$). Consequently, it was necessary to co-vary the scores on the RCPM in future comparisons between the SES groups. A Multivariate Analysis of Co-variance (MANCOVA) was run with the RCPM as the covariate. A

MANCOVA was used as there were multiple independent (SES and language) and dependent variables (test scores on the BPVS, BNT and the four AWMA subtests, i.e. DR, BDR, NR and CR). The MANCOVA results were significant ($F(6.112) = 15.25$; $p < .000$). In order to investigate where the significant differences lay Tukey's HSD tests of planned comparison were run on each dependent variable between SES groups. The results are shown in Table 3, where it can be seen that the high SES significantly outperformed the low SES group on every dependent variable, namely on both working memory and crystallised measures.

Table 2:

Descriptive Statistics for High and Low SES and Language Groups on Each Dependent Variable

	High SES (N=59)								Low SES (N=61)							
	EL1 (N=30)				EL2 (N=29)				EL1 (N=36)				EL2 (N=25)			
	Mean	Min	Max	S.D.	Mean	Min	Max	S.D.	Mean	Min	Max	S.D.	Mean	Min	Max	S.D.
BPVS	77.80	50.00	94.00	10.64	54.93	33.00	87.00	12.26	38.89	18.00	64.00	11.50	38.96	28.00	64.00	8.50
Boston	35.57	19.00	45.00	6.84	17.62	9.00	33.00	5.99	12.11	6.00	25.00	5.11	13.16	7.00	21.00	3.064
Ravens	24.60	17.00	31.00	3.65	16.83	8.00	26.00	4.42	15.39	10.00	28.00	3.37	18.12	12.00	24.00	3.20
DR	26.07	15.0	38.00	5.45	23.69	17.00	30.00	4.30	21.00	10.00	31.00	4.41	22.00	16.00	29.00	3.65
BDR	9.77	6.00	15.00	2.42	7.83	3.00	12.00	2.17	7.13	0.00	13.00	3.12	7.24	0.00	12.00	2.59
NR	17.20	10.00	26.00	3.70	15.34	5.00	22.00	4.47	11.44	0.00	20.00	5.45	13.56	2.00	21.00	4.41
CR	13.20	7.00	21.00	3.41	11.27	7.00	17.00	3.03	10.28	6.00	17.00	3.07	11.28	4.00	21.00	3.51

Note. EL1= English first language; EL2= English second language; BPVS = British Picture Vocabulary Scale; Boston = Boston Naming Test; Ravens = Raven's Colored Progressive Matrixes; DR= Digit Recall; BDR = Backwards Digit Recall; NR = Nonword Recall; CR = Counting Recall

.

Table 3:

Tukey's Planned Comparisons between High and Low SES on Mean Dependent Variables

Dependent Variable	High SES	Low SES	Mean Square Error	df	p-value
BPVS	66.56	38.91	118.64	117	0.0001
Boston	26.75	12.54	37.24	117	0.0001
DR	24.90	21. 41	18.25	117	0.0001
BDR	8.81	7.18	6.51	117	0.0008
NR	16.29	12.31	20.80	117	0.0001
CR	12.24	10.69	9.33	117	0.006

Notes. SES= socioeconomic status; df= degrees of freedom; BPVS= British Picture Vocabulary Scale; BNT = Boston Naming Test; CPM- Raven's Coloured Progressive Matrices; DR = Digit Recall test, BDR-Backward Digit Recall test; CR= Counting Recall test; NR= Nonword Recall test.

The second element of the study concerned the relationship between language and working memory. In order to investigate this, the participants were separated into four groups according to home language and socioeconomic status. A second MANCOVA was run, this time comparing dependent variables for SES and home language groups, again with the RCPM as the covariate. The MANCOVA was significant ($F (18, 311) = 8{,}38$, $p < .000$). Tukey's HSD planned comparisons were run to compare the four groups on each dependent variable. These are shown in Table 4.

Table 4:

Tukey's planned comparisons showing significant differences between groups

Boston Naming Test	High EL1 (N=30)	High EL2 (N=29)	Low EL1 (N=36)	Low EL2 (N=25)
1		.0001****	.0001****	.0001****
2	.0001****		.0002***	.006**
3	.0001****	.0002***		.89
4	.0001****	.006**	.89	
British Picture Vocabulary Scale	High EL1	High EL2	Low EL1	Low EL2
1		.0001****	.0001****	.0001****
2	.0001****		.0001****	.0001****
3	.0001****	.0001****		.98
4	.0001****	.0001****	.98	
Digit Recall	High EL1	High EL2	Low EL1	Low EL2
1		.15	.0002***	.004**
2	.15		.07	.47
3	.0002***	.07		.85
4	.004**	.47	.85	
Nonword Recall	High EL1	High EL2	Low EL1	Low EL2
1		.04	.0001****	.02*
2	.40		.007**	.43
3	.0001****	.007**		.43
4	.02*	.43	.43	
Backwards Digit Recall	High EL1	High EL2	Low EL1	Low EL2
1		.02*	.0006***	.002*
2	.02*		.75	.79
3	.0006***	.75		.99
4	.002**	.79	.99	
Counting Recall	High EL1	High EL2	Low EL1	Low EL2
1		.08	.002**	.09
2	.08		.62	.99
3	.002**	.62		.71
4	.09	.99	.71	

Note. *p < .05; **p < .01; ***p < .001; ****p< .0001; EL1= English first language; EL2= English second language

As can be seen in Table 4, there are six variables which were divided into crystallised measures and fluid/working memory measures. The working memory measures were further divided into simple or short term memory measures (namely Nonword Recall and Digit Recall) and complex or long term memory measures (namely Backwards Digit Recall and Counting Recall). On the two crystallised measures (namely, BNT and BPVS), the high SES EL1 group performed significantly higher than all of the other groups, including the high SES second language English group. This pattern was also found on one of the working memory tests: Backwards Digit Recall. On the remaining working memory tests, the High SES EL1 and EL2 groups performed comparably. On the Counting Recall, there were no significant differences between the two high SES groups, instead the significant difference lay between the high SES first language English group and the low SES second language English groups. On Digit Recall and Nonword Recall both high SES groups performed significantly better than both low SES groups. Thus, the hypothesis that the SES groups would perform equivalently on all of the working memory tests was generally not supported. In addition, the results suggest that children from a high SES environment who speak English as a mother tongue have an advantage over other SES and language groups on both crystallised and fluid verbal measures.

Chapter 4

Discussion

For the purposes of developing effective educational techniques, it is advantageous for researchers to understand whether students' socioeconomic status influences their cognitive development and also whether there are cognitive benefits to bilingualism. The literature suggests that exposure to Western value systems and to the English language are factors that influence results in intelligence assessments (Foxcroft, 2004). A lack of cognitive assessment measures developed specifically for South African children and their unique linguistic and cultural characteristics has resulted in testing which is potentially biased against the majority of the population (Foxcroft, 2004). Therefore, South African children are assessed with Westernised tests that are based in the English language and assessors are encourage to interpret results "with caution" (Foxcroft, 1997, p. 229). Consequently, when selecting or developing tests of cognitive ability, it should be a priority to ensure that the assessments truly measure the child's basic learning abilities, rather than only reflecting the individual's knowledge or prior experience which are heavily influenced by socioeconomic status. It is therefore essential for less biased measures to be developed or adapted. Accordingly, this study explored whether measures of working memory are related to a child's socioeconomic status and home language. In order to do this 120 Grade One learners from various schools, were given crystallised and fluid verbal working memory language tests to complete. The children were placed into four groups, namely high SES EL1, high SES EL2, low SES EL1 and low SES EL2.

According to the literature, working memory measures are less influenced by socioeconomic status and language (Engel et al., 2008). It is argued that traditional cognitive assessment measures, which draw on crystallised knowledge, are often biased when used in non-Western contexts, such as South Africa. In relation to this, Sternberg (1999) posits that having little prior experience in completing a task requires greater use of a person's intelligence. Therefore, process-oriented tests that involve fewer language or verbal skills would be more culture-fair. Such tests also draw on stimuli and information that are well learned (such as letters or numbers) or are not linked to resource-based opportunities, i.e. are equally unfamiliar to all test-takers. They therefore do not confer any obvious advantages on some testees over others.

Based on the Literature Review on fluid and working memory measures, it was anticipated that there would be no differences between the students' performance on the fluid/working memory measures whereas there would be than on crystallised measures. Crystallised mental ability allows people to solve problems using their prior accumulated knowledge tests, and includes tests that use informational content like vocabulary, mathematical reasoning and other already acquired knowledge and abilities. In this study, the BNT and the BPVS were used as measures of crystallised verbal ability. It was expected that, given the different experiences and opportunities provided to the children from high and low socioeconomic statuses, the children from the high SES group would achieve better results on the measures of crystallised intelligence than the children from the low SES group.

On both these crystallised measures, the results show a consistent pattern. The high socioeconomic EL1 group had an advantage over both the low socioeconomic groups, as well as the high SES EL2 group. The initial pattern, that is the high SES group outperforming the low SES group, corresponds with the literature as it has been found that a child's socioeconomic status influences what kinds of life experiences a child is exposed to (Sarsour et al., 2011; Berk, 2006). Socioeconomic Status has also been found to be related to academic success. High SES children often reside in homes which have more learning materials and provide more opportunities for enriching experiences (Sarsour et al., 2011), while low SES children had been found to experience less verbal stimulation in their homes than high SES children (Berk, 2006). High SES mothers tend to converse more often with their children, read to them more and try to provide more exposure to educational opportunities (Robert & Robert, 2002). The longer that a child is exposed to financial disadvantage, the less likely that child is to achieve in school (Evans & Schamberg, 2009). Since norm-referenced, crystallised assessment measures rely heavily on children's previous experience and these experiences are strongly influenced by SES, it is argued that these kinds of assessments are biased against children from low SES backgrounds. The findings from this study support this. Alternatively, measures of fluid ability depend more heavily on mental operations than acquired language knowledge and are therefore believed to be less biased against children from low SES environments. Although limited exposure to the items contained in language tests often negatively influence how testwise low SES children are, bias in testing is also related to the fact that children from low SES backgrounds may not be tested in

their home language. A study by Engel, Santos and Gathercole (2008) on the relationship between working memory and socioeconomic status, found that there were no differences between SES groups on the working memory tests, while there were on the crystallised vocabulary tests. In contrast, the current study found clear differences between groups in favour of the high SES group, on all measures, including those of working memory. Engel et al. (2008) ensured that all testees were tested in their home language of Spanish. The current study differs as it has the added variable of home language; that is to say two of the four groups were not tested in their home language. In Hart and Risley's (1995) decade longitudinal research, it was discovered that economic advantages within a child's home and the frequency of language experiences are the most important factors in language acquisition. According to the outcomes of this study, children who are raised in high SES, professional families seem to develop vocabulary sooner than children who come from working-class or welfare households, despite all children residing within well-functioning families. When applying this information to the South African context, it can be seen that assessors need to be as careful as possible, not only when testing children for whom English isn't the first language, but also when testing children who are from a lower SES. In the present study, children who spoke English as a first language, but who resided in low SES households, attained significantly poorer results than high SES EL1 children on all verbal measures, both working memory and crystallised. Therefore, it is possible to venture that socioeconomic status also impacts on how advanced a child's language skills become.

In the present study, language effects were noted when comparing the two high SES groups (i.e. EL1 and EL2). Performance on the crystallised measures was significantly different between the two high SES groups with the EL1 group attaining significantly better scores than the EL2 group. Thus, it appears that home language may have an effect on children's' performance on verbal tasks despite the child's high socioeconomic status. This corresponds with the assertion made by Foxcroft (2004) that when a test is given in a language which is not the testee's home language it is difficult to ascertain whether the testee's performance is lowered as a result of language factors or whether the results are caused by lowered cognitive ability. On the other hand, language did not appear to have such a marked effect on the performance of the children from low socioeconomic environments as there was no significant difference between low SES EL1 and EL2 children on the crystallised tests. These children are the most disadvantaged when being tested on crystallised measures. They were outperformed by both high SES groups: EL1

and EL2 on both the crystallised measures (the BNT and the BPVS). In conclusion, the results on the crystallised measures suggest that children who are both from a high SES and are first language English speakers have a significant advantage on crystallised and working memory (fluid) measures.

In contrast to crystallised tests, fluid intelligence measures require the testee to see relationships between shapes, numbers, etc and to solve novel problems (Chooi, 2012). They are therefore less dependent on socio-economic background and acquired language knowledge (Campbell et al., 1997). Working memory is an aspect of fluid intelligence. As mentioned in the Literature Review, working memory measures tend to use items which are equally unfamiliar to all participants and are less tied to factual knowledge and past experiences, which influences the belief that these measures are more culture fair. Therefore, it was expected that differences would present themselves between the high and low SES groups in this study on the crystallised measures, but not on the fluid working memory tests. However, this was not the case. Instead, the results suggest that the children raised in a high SES environment and whose home language was English had an advantage over all other groups on crystallised measures, as well as on Backwards Digit Recall: which is a fluid task. In addition, the high SES EL1 group had an advantage over the low SES groups on all crystallised measures as well as working memory except Counting Recall, on which the low SES EL2 group performed comparably to the high SES groups. However, low SES EL1 was significantly poorer than both high SES groups on Counting Recall. The high SES EL2 outperformed the low SES EL1 group on Nonword Recall. Within a low socioeconomic status, SES seems to exert a greater effect than language as there were no significant differences between the two low SES language groups (EL1 and EL2) on any measures. The absence of language effects in the low SES group suggests that language creates advantage amongst high SES children only.

The Digit Recall (simple WM) and Backwards Digit Recall (complex WM) tests are measures of fluid intelligence which involve the tester reciting numbers verbally. The child is required to listen to the numbers and then repeat them in either forwards or backwards order. There are no images presented to the child and therefore the testee is more reliant on the English language to understand and respond to the questions than when engaging in the other working memory tasks, namely Counting Recall and Nonword Recall. In this study, there were no significant differences between the two high SES language groups or between the two low SES language groups on the

Digit Recall subtest. However, there was a significant difference between the high SES EL1 group and the two low SES groups on this subtest, in favour of the high SES group. The high SES EL2 group was also significantly better than both low SES groups on this subtest. Thus, having English as a home language does not seem to create an advantage when testees are required to simply passively repeat numbers in the order they were spoken to them (Digit Recall). This pattern changes however, when the testee is required to recall digits in the reverse order that it was presented. Since the Digit Recall task is a simple working memory task and the Backwards Digit Recall task is a complex working memory task, it can be said that as a task moves from simple to complex (and therefore requires more cognitive resources), so differences between groups become more evident. The results for the Backwards Digit Recall task show that high SES EL1 children outperformed all groups including the high SES EL2 children. No significant difference was found between the high SES EL2 group and the two low SES groups who appeared to perform equivalently on this subtest.

The Counting Recall (complex) and Nonword Recall (simple) tasks are measures of fluid intelligence that are less reliant on the English language than the digits tasks. It is the results on these tasks which help to answer the secondary question of this study: Is there a significant relationship between bilingualism and working memory performance? The answer is that there is a significant relationship,but the results show a selective advantage. The Nonword Recall task required the testees to listen to nonsense words spoken by an avatar on a computer and then repeat said words in the same order they were presented. No significant difference was found between the high SES groups (EL1 and EL2) and therefore it appears that this task was not affected by language when comparing this group of children. Remaining consistent with the general pattern, the high SES EL1 group outperformed the two low SES groups (EL1 and EL2), while no significant differences were found between the low SES EL1 and low SES EL2 groups. Interestingly, a significant difference was found between the high SES EL2 and low SES EL1 groups but not between the high SES EL2 and the low SES EL2 groups on Nonword Recall. This pattern suggests a possible language effect in the low SES group. Since the words on this task that the children are required to repeat are nonsense words, and are not related to knowledge of the English language, it is possible that children who have been exposed to more than one language had an advantage on this task. These children may have been better able to hold the nonsense words in their short term memory for use later. Children from a low SES environment whose mother tongue was English may have been disadvantaged by a lack of exposure to other

languages. This corresponds with Bialystok's (2001) argument that exposure to multiple languages aids children with language processing. Since nonsense words can be seen as vocabulary belonging to a new language, it can be argued that bilingual children from low SES households may have an advantaged on such tasks over their monolingual English peers.

The Counting Recall task requires the testee to make inferences with the use of images on a computer screen. Specifically, children were required to count displayed circles and to remember the number of circles that were counted on each set. Again, this task was less reliant on knowledge of the English language and in fact was not actually a verbal task. It was found that the low SES EL2 group performed comparably to the high SES EL1 group. The only significant difference that was found was between the high and low SES EL1 groups. Once again a bilingual advantage may have been in effect when comparing groups on this working memory task that is less reliant on the English language. According to results from this study is seems that on certain working memory subtests a bilingual advantage exists when children are required to hold nonverbal or non-English based information in short term memory. As discussed in the Literature Review, Bialystok (2001) maintains that bilinguals have an advantage when engaging in executive control (controlling which language to use or deciding to switch from one language or task to another) and the central executive (of working memory) is part of this control. Gathercole et al. (2010) believe that this ability provides bilinguals with an advantage when engaging in metalinguistic and cognitive tasks. The bilingual advantage may be the reason for the better performance of the EL2 groups, irrespective of SES on working memory tasks that involve minimal use of English, namely the Counting Recall and Nonword Recall tasks. Originally, the study hypothesized that there would be no difference between the SES groups on any working memory measures since the literature suggests that working memory tasks are more culture fair and equally unfamiliar to all children (Engel et al., 2008). However, the results of the present study paint a more complicated picture. It seems that low SES bilingual children perform comparably to high SES bilingual children on working memory tasks that require minimal English input (Nonword Recall and Counting Recall), while high SES EL1 children outperform low SES EL1 children on all working memory measures. This suggests a bilingual advantage, as well as an advantage of high SES amongst monolingual children. In this way it can be seen that some working memory tests are less affected by SES than bilinguals from both high and low SES perform comparably. Furthermore, when comparing language groups, within the high SES groups, no differences were found except on the Backwards Digit Recall task. When comparing

the low SES groups on this test, there were no significant differences between language groups. This shows the influence of SES as despite language differences children generally performed comparably with peers from the same SES.

With reference to the questions which this study set out to answer, a clearer understanding has been formed and answers can be gleaned. The study aimed to evaluate the relationship between socioeconomic status, bilingualism and working memory in primary school children between the ages of six and eight. The results of the study support the notion that a language bias exists when children are assessed with crystallised measures and that low SES youths are at a clear disadvantaged when being assessed with crystallised and certain fluid/working memory measures. However, when drawing on tests that use equally unfamiliar material to everyone; tests which are less reliant on the English language, low SES children who are bilingual seem to gain an advantage over their low SES monolingual peers. Nevertheless, these children are still often outperformed by the most advantaged of society's children, namely high SES EL1 youths.

Limitations of the study.

It is important to note that the results of this study may have been influenced or limited by particular factors. Despite there being no clear evidence to support this, there is the possibility that three of the schools who agreed to partake may have influenced only those parents whose children were having scholastic difficulties to participate in an effort to refer children who were seen as problematic in the classroom. This could have influenced the results. Other limitations include tester effects and school effects. Altogether there were three testers involved in the study, one who collected data in 2012 and two who collected data in 2013. Despite the fact that all testers were trained to work with the assessments concerned, it is possible that tester effects could have influenced assessment results. In addition, it would have been more desirable for all of the children who participated in the study to have come from the same school. Altogether, eight schools participated in the study, two were private schools, while the remainder were government schools. Of the eight schools, three provided education to children from the surrounding low SES community and three others were government schools that provided education to predominantly middle class children. In general, schools differ in terms of their curricula, teacher dedication and test content. In this way, some schools may have more in their curricula that helps their students when engaging with crystallised as well as with fluid problem solving measures. Other schools may have more dedicated teachers who put effort into educating

learners thus encouraging learning and classroom participation. Subjectively, it was noted that, even within SES groups the ethos of the schools and classrooms differed considerably. A final limitation is that the testee was required to listen to the voice of an avatar who speaks with an English accent for the AWMA. It is possible that testees who are less exposed to the English accent found it more difficult to understand the avatar than those who had been previous exposed to the accent.

Suggestions for future research.

Future research in this field is important within the South African context given the numbers of disadvantaged children in the country. Results from this, and future studies, can aid in the development of educational and assessment programmes which are more culture fair as well as more advantageous for low SES children who do not have English as their home language. Even though bilingualism did not appear to provide an advantage for the high SES group, it would be useful to further research ways in which bilingualism may confer cognitive and educational advantages. The curricula of schools which service low SES areas could be adapted accordingly. In order to collected further evidence for these findings future researchers could study South African children who speak languages other than African languages, for example Gujurati, Hindi, Afrikaans, Greek and Hebrew.

In the study by Engel and colleagues (2008), the assessment measures were translated from English into the testees' home language of Spanish. In this way they were able to remove the issue of language bias. In the South African context there are very few tests available in African languages and the predominantly used language for assessments is English. Although it is ideal to complete assessments in the participant's home language, translation is further complicated by the country's eleven official languages.

Finally, it would be beneficial to repeat this study with a larger and a more homogenous study where the children from the high SES group are educated at one school and the students from the low SES groups attend a second school.

Conclusion.

The study set out to explore how socioeconomic status and bilingualism influence performance on crystallised and working memory measures. The question was found to be more complex than it was originally thought. The evidence for socioeconomic status effects in crystallised measures is well documented (Engel et al., 2008) and further supported by this study. It seems that high SES EL1 children are greatly advantaged and outperformed low SES children on almost all measures. On the other hand, the position of some that all working memory tests are unaffected by SES (Engel et al., 2008) as well as the position that bilingualism positively influences children (Bialystok, 2001) were not fully supported by the results of this study. The bilingual advantage seemed to be operational within low SES children when engaging in working memory measures. However, no bilingual advantage was found in the high SES group. In addition, only some working memory tests were found to be affected by SES while others were not. Ultimately it can be said that children from low SES South African homes while being negatively influenced by their economic environments have an advantage if they are able to speak more than one language at home and school. In this way bilingualism may offer a buffer to the negative influence of SES in working memory tests that are less dependent on language. The findings of this study have implications for the education and assessment of children from high and low SES households, as well as children from monolingual versus bilingual households, especially those bilingual children that reside within low SES environments. However, these findings require further research, utilizing larger sample groups and fewer schools, before any definitive conclusions can be made.

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Appendix A

Psychology

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Working memory: Is it associated with socioeconomic status and bilingualism?

Dear Principal

My name is Lauren Bloch and I am a student completing a Masters degree in Educational Psychology at the University of the Witwatersrand. I am conducting a study with the aim of exploring working memory across different groups of children.

Traditional intelligence tests are known to be biased and there is a need to develop tests that are fairer to all groups. Working Memory measures are believed to be less biased because they rely on the ability to process information. In my study I would like to gain more information about the different patterns of performance on these tests so that we can help improve the way our children are tested in South Africa.

I would like to invite all the grade one children aged between 6 and 8 years of age to participate in this study. In order to participate in this study, each child will be required to complete cognitive assessments and working memory assessments. The entire process (including break times) should not take longer than 60-90 minutes. Assessment will take place at a time agreed upon by the parents and the school that will not disrupt the school process.

If you are willing to allow me to conduct my study at your school, I would appreciate it if you could distribute the information letters, which I will provide, to the parents as their consent is imperative. Parents will be required to complete a demographic questionnaire and a socioeconomic index questionnaire. The demographic questionnaire will contain information such as the age and gender of the child as well as whether the child has any disabilities or disorders. Due to the purposes of this study I we are looking for children who do not have any learning, cognitive or communication difficulties. If a

student participates in the assessments and it is found that he or she has any of the aforementioned difficulties, parents will be contacted and provided with referrals.

The socioeconomic status questionnaire will ask questions such as the area of residence, the occupational, educational and marital status of each caregiver as well as questions pertaining to the family's standard of living. These questionnaires can be completed and returned in a sealed envelope that will be provided. In order to ensure the integrity of the data collected I will require a quiet classroom or office with a desk, two chairs and a power source.

Please note that individual assessment results will not be provided to the schools. Nevertheless, if you feel that your school would benefit from feedback, I will do my best to provide you with useful information that can be used in the enhancement of your school programmes.

Participation is entirely voluntary thus refusal to participate and the child's withdrawal from the study at any time will be without any consequences. There are no foreseeable benefits or harms in participating in this study. The confidentiality of each child is guaranteed and all results will be published in terms of group trends only. Therefore no findings that could identify any individual participant will be published. The raw data will be accessed only by me and will be kept in a safe place.

I will contact you soon to establish your decision. Please feel free to contact me with any questions or queries.

Yours Sincerely,

Lauren Bloch

Researcher	Supervisor
Lauren Bloch	Prof. Kate Cockcroft 083
324 7656	011 717 4511
laurenbloch@gmail.com	kate.cockcroft@wits.ac.za

Appendix B

Psychology

School of Human & Community Development

Private Bag 3, Wits 2050, South Africa. Telephone: +27 11-717-4500/2/3/4. Fax: +27-11-717-4559

Working memory: Is it associated with socioeconomic status and bilingualism?

Dear Parents

My name is Lauren Bloch and I am a student completing a Masters degree in Educational Psychology at the University of the Witwatersrand. I am conducting a study with the aim of exploring working memory across different groups of children.

Traditional intelligence tests are known to be biased and there is a need to develop tests that are fairer to all groups. Working Memory measures are believed to be less biased because they rely on the ability to process information. In my study I would like to gain more information about the different patterns of performance on these tests so that we can help improve the way our children are tested.

I would like to invite your child to participate in this study. Each child will be required to complete cognitive assessments and working memory assessments. The entire process should not take longer than 60-90 minutes and the child will be allowed breaks between assessments. I have spoken to your child's principal and every effort will be made to ensure your child does not miss an important class. Assessment will take place at a time agreed upon by both you and the school. Wherever possible, efforts will be made to suit the needs of both you and your child. Therefore if you have any concerns or requests, please don't hesitate to contact me. Please note that should you agree for your child to participate you will be required to complete the demographic questionnaire. These will not take more than a few short minutes to fill out. They will be sent to you, should you consent to your child's involvement. The information required on this questionnaire is merely to help me create equal sample groups.

Participation is entirely voluntary thus refusal to participate or the child's withdrawal from the study at any time will have no consequences whatsoever. There are no foreseeable benefits or harms in participating in this study. The confidentiality of each child is guaranteed and all results will be published

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anonymously in terms of group trends only. Therefore no findings that could identify any individual participant will be published. The raw data will be accessed by me only, and kept in a secure place.

Due to the purposes of this study I would like to add that we are looking for children who do not have any learning, cognitive or communication difficulties e.g. amnesia, dyslexia, or aphasia. If your child participates in the assessments and it is found that he or she has any of the aforementioned difficulties, you will be contacted and informed about what has been discovered and you will be provided with referrals.

Please find a consent form attached. If you agree to allow your child to participate please complete the form and return it your child's class teacher as soon as possible.

If you have any questions or would like to discuss anything please feel free to contact me.

Student	Supervisor
Lauren Bloch	Prof. Kate Cockcroft
083 324 7656	011 717 4511
laurenbloch@gmail.com	kate.cockcroft@wits.ac.za

Appendix C





Psychology

School of Human & Community Development

Private Bag 3, Wits 2050, South Africa. Telephone: +27 11-717-4500/2/3/4. Fax: +27-11-717-4559

Working memory: Is it associated with socioeconomic status and bilingualism?

Consent form

I _____ agree to allow my child_____ to participate in this study carried out by Lauren Bloch under the supervision of Prof. Kate Cockcroft.

I understand that my child is allowed to withdraw at any time without any consequences and that this study will neither benefit nor harm my child in any foreseeable way. Further I understand that my child's results will be entirely confidential and that this study is in no way related to the school or schoolwork of any kind.

_____
Name

Tel No _____

Cell No _____

Email_____

_____
Signature

_____
Date

Kindly return to your child's class teacher by _____/ /2013_____

Appendix D

Psychology

School of Human & Community Development

Private Bag 3, Wits 2050, South Africa. Telephone: +27 11-717-4500/2/3/4. Fax: +27-11-717-4559

Working memory: Is it associated with socioeconomic status and bilingualism?

Assent form

Date: ……

Hello

I would like to do some tasks with you to see how good your memory is. It has nothing to do with your school work. It is only to help me with my university work. You can ask me about anything you don't understand and we can take a break if you're tired. If you don't want to continue we can stop whenever you want. Only I will know how well you did. Your teachers and friends will not be told anything about your tasks.

I _____agree to participate.

Name of child

_____ _____

Lauren Bloch Child's name

Appendix E

Demographic Questionnaire

Name:

Surname:

Age of Child/Ward:

Sex:

Home Language:

Has your child been diagnosed with any disorders?

Please tick where applicable

ADHD/ADHD	
Learning difficulties	
Communication disorders	
Cognitive disorders	
Speech/language disorders	
Motor disorders	
Other (please specify):	

Appendix F

Socioeconomic Index

Private: For analytical purposes only

1. Educational status of main/primary caregiver

Please tick where applicable

Level of Education		**Details**
No schooling		
Less than primary school completed		
Primary school completed		
Secondary school not completed		
Secondary school completed		
Tertiary education completed		
Other		

2. Occupational status of main/Primary caregiver

Please state your occupation.

_____

3. Marital status of main/primary caregiver

Please tick where applicable

Married	
Living together as husband and wife	
Widow/widower	
Divorced/separated	
Never married	

4. Number of parents in the household

Please tick where applicable

0	
1	
2	

5. Area of residence

_____

6. Living Standards Measure

Please circle the correct answer

Question	Answer	
1. I have the following in my household:		
TV set	TRUE	FALSE
VCR	TRUE	FALSE
DVD player	TRUE	FALSE
M-Net/DStv subscription	TRUE	FALSE
Hi-fi/music centre	TRUE	FALSE
Computer / Laptop	TRUE	FALSE
Vacuum cleaner/floor polisher	TRUE	FALSE
Dishwashing machine	TRUE	FALSE
Washing machine	TRUE	FALSE
Tumble dryer	TRUE	FALSE
Home telephone (excluding a cell)	TRUE	FALSE
Deep freezer	TRUE	FALSE
Fridge/freezer (combination)	TRUE	FALSE
Electric stove	TRUE	FALSE
Microwave oven	TRUE	FALSE
Built-in kitchen sink	TRUE	FALSE
Home security service	TRUE	FALSE
3 or more cell phones in household	TRUE	FALSE
2 cell phones in household	TRUE	FALSE
Home theatre system	TRUE	FALSE
2. I have the following amenities in my home or on the plot:		
Tap water in house/on plot	TRUE	FALSE
Hot running water from a geyser	TRUE	FALSE
Flush toilet in/outside house	TRUE	FALSE
3. There is a motor vehicle in our household	TRUE	FALSE
4. I am a metropolitan (city?) dweller	TRUE	FALSE
5. I live in a house, cluster or town house	TRUE	FALSE
6. There are no radios, or only one radio (excluding car radios) in my household	TRUE	FALSE
7. There is no domestic workers or household helpers in household (both live-in & part time)	TRUE	FALSE

Appendix G

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (SCHOOL OF HUMAN & COMMUNITY DEVELOPMENT

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: MEDP/13/008 IH**
PROJECT TITLE:	The relationship between socioeconomic status, bilingualism, and working memory in school beginners
INVESTIGATORS **DEPARTMENT**	Bloch Lauren Psychology
DATE CONSIDERED	01/03/13
DECISION OF COMMITTEE*	Approved

This ethical clearance is valid for 2 years and may be renewed upon application

DATE: 10 February 2014

CHAIRPERSON
(Professor M. Nduna)

cc Supervisor: Prof. K Cockcroft
Psychology

DECLARATION OF INVESTIGATOR (S)

To be completed in duplicate and **one copy** returned to the Secretary, Room 100015, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure, as approved, I/we undertake to submit a revised protocol to the Committee.

This ethical clearance will expire on 31 December 2015

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES