The development of cognitive processes and English language abilities: The case of early English language learners in a multilingual South African setting

by
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DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

This dissertation includes three original papers submitted for publication to peer-reviewed journals. The development and writing of the three papers were the principal responsibility of myself.

Michelle Jennifer White

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ABSTRACT

The purpose of this study was to investigate the development of English language skills and the processes which underlie these skills in English Language Learners (ELLs) who are in their first year of formal schooling, Grade R. Twenty seven ELL participants were assessed longitudinally, three times over the course of their Grade R year, on an English language assessment battery, including the domains of syntax, semantics and pragmatics, along with a vocabulary test. Additionally, the processes underlying language acquisition were assessed with the use of working memory tasks, two phonological working memory tasks and two visuospatial working memory tasks.

The English language and working memory development of the 27 ELLs were compared to seven English monolingual classmates in order to determine how their trajectory and rate of development related to one another. A total of nine different first languages (L1s) were represented in the ELL group, namely (ordered from that spoken by most of the highest to the lowest number of ELLs) isiXhosa, Shona, French, Swahili, isiZulu, Sesotho, Oshiwambo, Igbo and Cameroonian Pidgin English. Moreover, most of the ELL group knew at least one language besides their L1 and English. All participants were from one low socio-economic status school, where the sole language of learning and teaching (LoLT) is English.

South Africa, with its 11 official languages and several other minority languages, is linguistically and culturally diverse, yet English continues to be the preferred LoLT (Heugh, 2000). Many South African children are thus ELLs who have little English proficiency upon entering school. The differing levels of English proficiency at school entry, together with a wide range of first languages in one classroom, pose teaching challenges. One of these challenges is that a certain level of proficiency in English is required to perform well academically in an English-medium school. It is widely accepted that academic success is highly dependent on language competence (Hoff, 2005; Owens, 2008), entailing that an understanding of the underlying processes related to language is crucial for assisting learners to perform well academically. Moreover, measures of non-linguistic processing, such as working memory, provide important information on language development in multilingual contexts (Paradis, 2010).

Results from this study showed evidence for the three distinctions within working memory stipulated by Baddeley and Hitch (1974): the phonological loop, the visuospatial sketchpad and the central executive. The phonological loop and the central executive were found to be implicated in the ELLs' English language development. It was also found that their performance on the tasks assessing these two components were predictive of outcomes on certain language domains. Furthermore, this study also found that both the ELLs and the English monolinguals showed a comparable growth trajectory to each other on the language as well as the working memory tasks. These findings contribute to the broadening of our knowledge of bilingual development, in the domains of working memory and English language learning. The South African education system is in crisis and further studies, such as this one, are needed in order to better inform practical solutions.

OPSOMMING

Die doel van hierdie studie was om die ontwikkeling van Engelse taalvaardighede en die onderliggende prosesse van taalaanleer te ondersoek in Leerders van die Engelse Taal (LETs) wat in hulle eerste jaar van formele skoolonderrig, Graad R, is. Sewe en twintig LET-deelnemers is drie maal gedurende hulle Graad R-jaar getoets met ŉ Engelse taalassesseringsbattery, wat die sintaksis-, semantiek- en pragmatiekdomeine geassesseer het, asook met ‘n woordeskattoets. Verder is die onderliggende prosesse van taalaanleer getoets met werkende geheue-take: twee fonologiese en twee visueel-ruimtelike werkende geheue-take.

Die Engelse taalontwikkeling sowel as die werkende geheue-ontwikkeling van die 27 LETs is vergelyk met dié van sewe eentalige, Engelssprekende klasmaats om te bepaal wat die verwantskap tussen die twee groepe se spoed en trajek van ontwikkeling is. Nege verskillende eerste tale is deur die LET groep gepraat, naamlik (in volgorde van die taal wat deur die meeste nad die minste LETs gepraat is) isiXhosa, Shona, Frans, Swahili, isiZulu, Sesotho, Oshiwambo, Igbo en Kameroense Pidgin-Engels. Verder het die deelnemers in die LET-groep reeds minstens een taal buiten hul eerste taal en Engels geken. Al die deelnemers was van dieselfde skool, een met ŉ lae sosio-ekonomiese status, waar die enigste taal van leer en onderrig Engels is.

Suid Afrika het 11 amptelike tale en verskeie ander minderheidstale, en is dus kultureel en talig divers; tog bly Engels die voorkeur taal van leer en onderrig (Heugh, 2000). Menige Suid Afrikaanse kinders is dus LETs en het lae Engelse taalvaardighede wanneer hulle skoolgaande ouderdom bereik. Die verskillende vlakke van Engelse taalvaardigheid met skoolaanvang, tesame met die wye verskeidenheid eerste tale in een klaskamer, lei tot onderrig-uitdagings. Een van dié uitdagings is dat ‘n sekere vlak van Engelse taalvaardigheid verlang word om akademies goed te kan presteer in ‘n Engels-medium skool. Daar word algemeen aanvaar dat akademiese sukses hoogs afhanklik is van taalvaardigheid (Hoff, 2005; Owens, 2008), wat beteken dat dit noodsaaklik is om die onderliggende prosesse van taalaanleer te verstaan as leerders ondersteun gaan word om akademies optimaal te presteer. Voorts verskaf take wat die onderliggende prosesse van taalaanleer meet, soos take van werkende geheue, belangrike inligting oor taalontwikkeling in meertalige kontekste (Paradis, 2010).

Die resultate van die huidige studie het bewyse getoon vir die drie onderskeidings binne werkende geheue, wat deur Baddeley en Hitch (1974) gehipotetiseer is: die fonologiese baan, die visueel-ruimtelike sketsblok en die sentrale uitvoerder. Die studie het ook aangetoon dat die fonologiese baan en die sentrale uitvoerder betrokke is by die Engelse taalontwikkeling van die LETs. Daar is verder bevind dat die resultate van die take wat hierdie twee komponente meet, voorspellend is van uitkomste op sekere taalgebiede. Die studie het ook bevind dat die Engels eerste taal- en LET-groepe se groei-trajek vergelykbaar met mekaar is. Hierdie bevindinge dra by tot die verbreding van ons kennis oor tweetalige ontwikkeling, beide op die gebied van werkende geheue sowel as Engelse taalaanleer. Die Suid Afrikaanse onderwyssisteem is in ‘n krisis en verdere studies soos hierdie een word benodig om praktiese oplossings vir die krisis te vind.

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“Differences are not intended to separate, to alienate. We are different precisely in order to realize our need of one another.”

- Desmond Tutu

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INTRODUCTION

1.1. General introduction

The current research is concerned with the English language development and the development of cognitive processes in young South African children who start their school career with limited proficiency in English but attend schools in which English is the sole medium of instruction. The goal of the study is to gain a better understanding of the language development process of young English language learners and the cognitive processes which underpin English language development. The cognitive processes referred to here will be addressed under the concept of working memory.

It is widely acknowledged that early intervention in an educational context is key to ensuring that any possible academic shortcomings do not worsen over time and become insurmountable in the future (Fricke, et. al., 2017; Hagen, Melby-Lervåg & Lervåg, 2017; Paradis, 2005). It is, however, difficult to ascertain the nature of the early intervention that is needed by second language learners if limited information is available on their language development, including the rate and trajectory of their language development after the onset of intensive exposure to their second language. More knowledge on this topic will allow child language practitioners and teachers to know what to expect from the second language learners who they see on a daily basis. Moreover, it will inform decisions on the possible means of support offered to these children. This study contributes to the body of scholarly work on children who are in the process of learning a second language, but more specifically on English language learners. This is done by studying the development of said learners in an English-only South African classroom over the course of their first year after entering school.

In this chapter, an introduction to the linguistic and educational situation in South Africa will be provided, followed by a discussion of the important concepts underpinning this research and, lastly, an exposition of the research questions that will be addressed in the current study.

1.2. South Africa's linguistic diversity

The end of apartheid in South Africa signalled the beginning of a new era, an era which would purportedly be free of oppression, discrimination and inequality. In 1996, these values were laid out in the new South African Constitution. One of the new additions to the Constitution was the recognition of 11 official languages – Afrikaans, English, isiNdebele, isiXhosa, isiZulu, Sepedi, Sesotho, Setswana, siSwati, Tshivenda and Xitsonga (Republic of South Africa, 1996) – whereas only Afrikaans and English were official languages before 1996. These 11 languages were afforded equal status and were thus openly (but to a limited extent) promoted.[1] There are several other languages that are also recognised by the Constitution over and above the official 11, such as South African Sign Language and the Khoisan languages (Republic of South Africa, 1996). In addition, there

[1] The constitution affords speakers of these 11 official languages several rights, for example the right to use any of the 11 languages in official governmental and judicial affairs, and also to be attended to in their official language of choice. Moreover, the right is also given which allows an individual to take their L1 as a school subject (if this language is one of the 11 official languages) up to, and including, the final year of formal schooling. In practice, however, these rights can only be exercised when it is logistically viable, in other words when infrastructure and finance allow for it (Republic of South Africa, 1996).

are a number of European languages that are spoken in some communities in South Africa, for instance German and Dutch. A number of unofficial languages can be studied as an additional language at some government schools; these include Arabic, French, German, Gujarati, Hebrew, Hindi, Italian, Latin, Modern Greek, Portuguese, Spanish, Tamil, Telugu and Urdu (Department of Basic Education, 2011). All in all, there are an estimated 42 languages in South Africa, 30 established languages and a further 12 immigrant languages (Simons & Fennig, 2018).

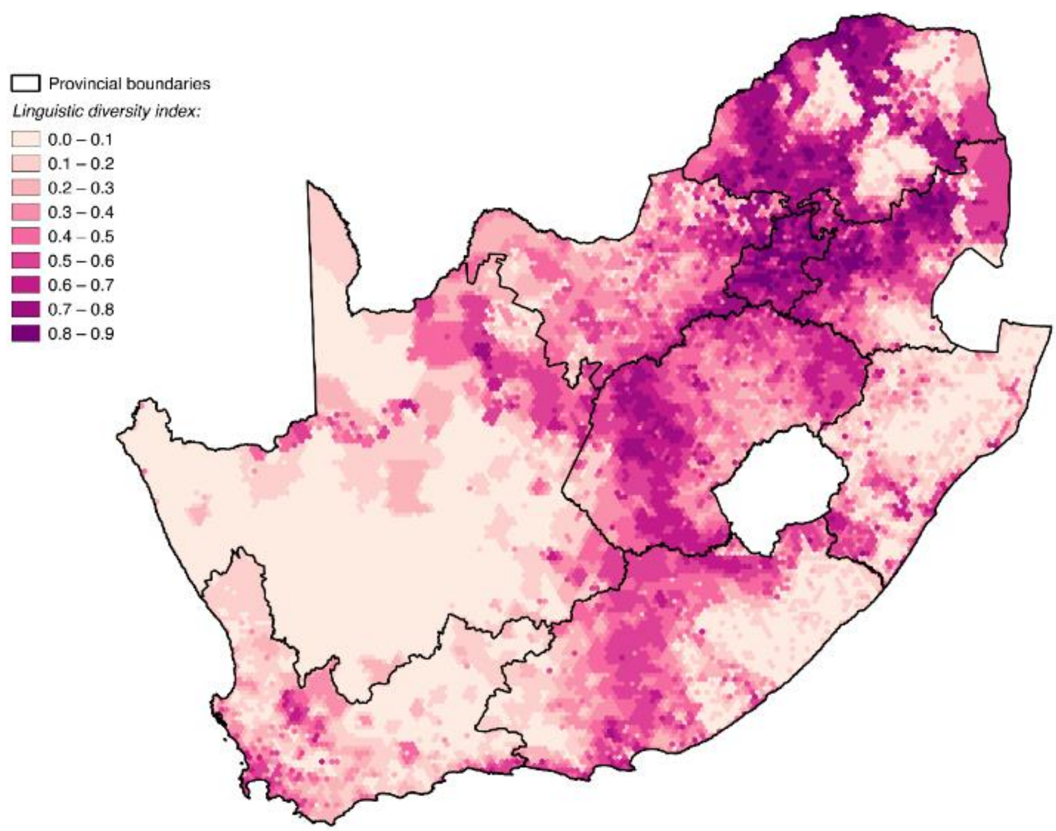
According to Statistics South Africa (2012), the most spoken first language (L1) is isiZulu, which is spoken by 24% of the population. This is followed by isiXhosa (16%), Afrikaans (14%) and English, which is the L1 of 10% of the population. The other seven official languages make up most of the difference; however, 2% of the population speak a language that is not one of the official 11. At the time of the Census 2011, 3.3% of people counted were non-South African citizens and a further 4.4% of the population were not born in South Africa. Therefore, the incidence of other African languages, and languages from other parts of the world, should also be considered as forming part of the diverse linguistic context of the country (Statistics South Africa, 2012).

The extent of linguistic diversity in any given country can be calculated using Greenberg's diversity index (Greenberg, 1956). This index is a calculation of the probability that two randomly selected strangers, who are from the same country, would have different L1s. The highest obtainable value is 1, which would indicate that no two people have the same L1 in a certain country. A value of 0 indicates that there is no diversity and that all people have the same L1. South Africa has a linguistic diversity index of 0.871, which places it as the 19th most linguistically diverse country, out of a total of

232 countries (Simons & Fennig, 2018). As is graphically illustrated in Figure 1.1, the level of linguistic diversity also varies according to which area is being taken into account within South Africa. Closer to the big cities and the borders in the north-eastern part of the country, there is greater linguistic diversity than in the rural areas (Statistics South Africa, 2012). From Figure 1.1, it can be seen that the range of diversity can be 0 in the rural areas and up to 0.9 in the major metropolitan areas.

Figure 1.1. A map of the linguistic diversity in South Africa.

Source: Frith (2017) with data from the South African Population Census (2011).

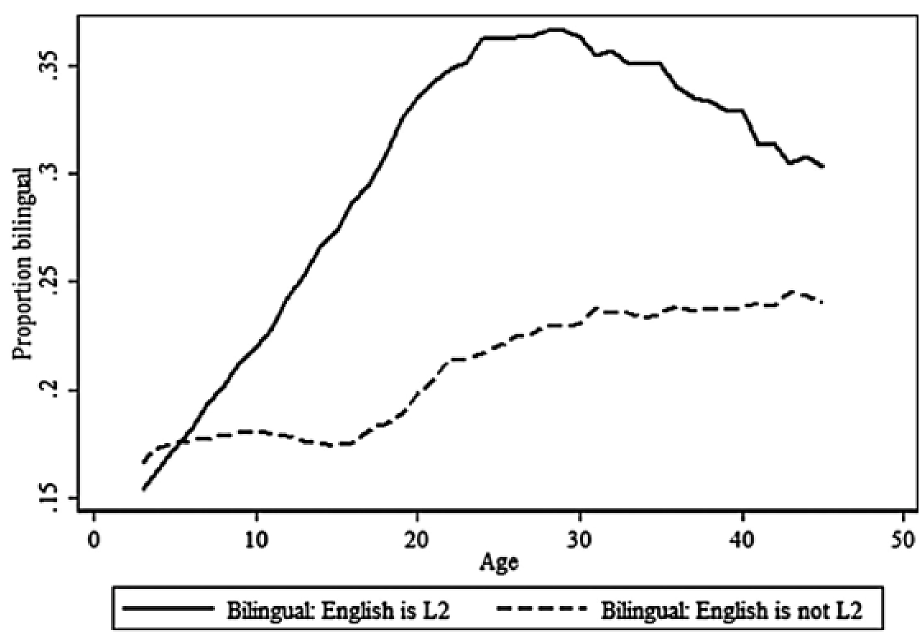


Being in the top 20 countries for linguistic diversity emphasises just how challenging the situation is that arises when selecting the language that should be used for the day-to-day running of the government. Even though the national government adheres to the 11 official languages, provincial governments declared the official languages of the province as they saw fit (Republic of South Africa, 1996). There are nine provinces in South Africa, all of which have a different language configuration. For example, the Western Cape government has designated three of the country's official languages for the purpose of government, namely Afrikaans, English and isiXhosa, which are the three most prevalent languages spoken in this province (Western Cape Government, 2017). The necessity of provincial governments determining their own language policies was borne out of the situation that not all 11 official languages are spoken throughout South Africa; instead, certain languages are concentrated in certain geographic areas. For instance, Sesotho is mostly spoken in the Gauteng province, Limpopo province, Mpumalanga province and North-West province; in contrast, however, Tshivenda has a narrower distribution and is spoken almost exclusively in the Limpopo province (Simons & Fennig, 2018). Although languages have a predominant distribution in certain areas, provincial borders as divisions for languages are not as cut and dried as it may seem in theory. This is due to the frequent migration of people within South Africa to different provinces. For example, just less than half (44%) of Gauteng's population moved to the Gauteng province from other provinces (Statistics South Africa, 2012). The logic follows that along with the movement of people comes the movement and distribution of the languages that they speak. Together with the wide variety of languages is the government's drive to promote bilingualism[2] (Republic of South Africa, 1996). A large percentage of the population (88%)

[2] The term "bilingual" is used throughout this thesis as an all-encompassing term that refers to both bilinguals as well as multilinguals, and does not make a distinction between simultaneous or sequential bilinguals.

reported being monolingual in 1996, but by 2011 bilingualism had risen markedly to almost half of the population being able to speak two or more languages (Posel & Zeller, 2016: 364). Interestingly, the pattern of bilingualism is affected by age: The prevalence of bilingualism increases steadily from childhood to 30 years of age; see Figure 1.2. Posel and Zeller (2016: 366) hypothesise that this increase in bilingualism is due to the education system which promotes bilingualism. Children are exposed to an additional language (L2) as a compulsory school subject from the age of 7, and continue to study it as a subject until the end of their school career (Department of Basic Education, 2011). Another contributing factor to the promotion of bilingualism is the joining of the labour market, which often demands the knowledge and use of a language other than one's L1 (Posel & Zeller, 2016).

Figure 1.2. Bilingualism by age in South Africa.
Source: South African Population Census (2011), in Posel and Zeller (2016)



Amongst the multitude of official and unofficial languages, English has emerged as a dominant language in the political, business and education sector, despite being spoken as an L1 by only 10% of the population (Deumert 2006; Posel & Zeller, 2016). As illustrated in Figure 1.2 above, the incidence of English as an L2 is much more common than having any other L2. English was first introduced into South Africa at the end of the 18th century when British immigrants arrived on the country's shores. In the 1820s, English became the official language of the legal court system and was subsequently given protection under the Cape constitution in 1853 (Walker, 1972). In 1910, English was declared the official language of the Union of South Africa, along with Dutch. A change came in 1948 when the National Party took control of the country and held Afrikaans in a higher regard than English (Walker, 1972). At this time, both Afrikaans and English were official languages but Afrikaans was used actively to a larger extent and was more favoured by the ruling party. This lead to Afrikaans being used as the language of the government for just less than fifty years, until such time as the resistance movements against apartheid started liberation talks. In 1992, talks and negotiations between the African National Congress and the ruling National Party were all conducted in English (Khokhlova, 2015). Since that time, the conducting of government affairs has been dominated by the use of English (Khokhlova, 2015).

The English that is most frequently spoken in South Africa, so-called South African English, commonly varies across four different registers, which are reminiscent of the apartheid racial groupings: Black South African English, Coloured South African English, South African Indian English, and White South African English (Laas, 2002; see also Mesthrie, 2017). Race is inextricably entangled in language, which is an offshoot from the separation and isolation of races during apartheid, causing language and its use to be affected (Khokhlova, 2011). Each of the four different South African English registers are distinct from one another; each register has its own characteristic way of pronouncing words, some grammatical structures differ across registers, and lexical items vary greatly across the four registers (Khokhlova, 2011). This is not to say that these different registers are so clear cut; there is also intra-register variation which depends on factors such as social class and the region from which the speakers hail (Mesthrie & McCormick, 1994: 187).

The popularity of using English as an L2 has increased greatly from 3.3% in 1996 to 27.3% in 2011 (Posel & Zeller, 2016). The preference to use English is largely motivated by the public opinion that it is a language of prestige that will afford the speaker a higher esteem and socio-economic status (SES) (De Klerk, 2000; Probyn, 2009: 126; Rudwick, 2008: 110). The trend to use English is also apparent in education; both students and parents prefer education to be in English, at the school level (De Klerk, 2000; Heugh, 2000; Jordaan, 2011; Meirim, Jordaan, Kallenbach & Rijhumal, 2010; Probyn, 2009; Webb, 2002), as well as at the tertiary level (Bangeni & Kapp, 2007; Dalvit & De Klerk, 2005; De Kadt, 2005). At the school level, the language of learning and teaching (LoLT) can be determined by the School Governing Body, which is a committee made up of parents that represent the interests of the broader school community, but particularly the interests of the parents. It is becoming increasingly common for the majority of parents to opt for English as the LoLT, regardless of their own, and their child's, L1 (NEEDU 2013: 33). This is seen in tertiary education as well, as students prefer English to be the primary LoLT because it is believed that it will afford them access to opportunities worldwide, and allow easier access to quality resources (Bangeni & Kapp, 2007; Dalvit & De Klerk, 2005; De Kadt, 2005). Although the rise in the use of English is often said to threaten the continued existence of other languages (De Klerk, 2000; De Kadt, 2002; Kamwangamalu, 2003), it is seemingly the case that bilingualism is on the rise, based on the aforementioned statistics. English is being used alongside the L1 and is most popularly used in the specific contexts mentioned above (Deumert, 2010). The advancement of African languages since 1996 is a key component in contributing to bilingualism and the maintenance of the L1, despite the popularity of English (Gough, 1996).

1.3. Education in South Africa

The South African education system spans from grade R, where the ‘R’ stands for ‘reception year’, until grade 12. The grades are divided into four phases, namely the foundation phase, the intermediate phase, the senior phase, and the further education and training phase. The foundation phase consists of the four school years from grade R to grade 3. In order to enter grade R, children should be five years old and be turning six years old during the school year. The focus in this phase is on mathematics, life skills and languages (home language and first additional language). This is when the basic reading, writing and spelling skills are taught. Importantly, during this phase, an additional language is introduced and starts to be taught in grade 1. The following phase, the intermediate phase, has a duration of three years and encompasses grades 4, 5 and 6. During this time, the language skills that were taught in the previous phase are of the utmost importance because content subjects are introduced, which requires the learner[3] to have the adequate skills to read and comprehend subjects like natural sciences and social sciences. The senior phase includes grade 7 to grade 9, which also lasts three years. This is the last phase of

[3] “Learner” is a term which is commonly used in South Africa to refer to children who are attending school. This term will be used throughout this dissertation as such.

compulsory schooling, and at the end of grade 9, there is a national standardised examination that furnishes the learner with a certificate entitling him/her to leave school if s/he passes the examination. Grade 10 to grade 12 are the final years of basic education. At the end of grade 12, a national standardised examination is written that not only determines whether the learner passes or fails, but also determines the learner's suitability for attending a tertiary education institution.

Based on its educational outcomes, South Africa is considered to have the worst schooling system in comparison to other middle-income countries, even performing worse than many low-income African countries (Spaull, 2013: 10). The education crisis in South Africa is continuing to worsen. In 2012, the reading fluency of the top three learners in each of 215 grade 2 classes was measured, and it was found that 72% of this group of 645 top learners were reading below the 'average' benchmark for their grade, and that 22% performed at or below the 'poor' benchmark (NEEDU, 2013). Two years later, in 2014, the results of the Annual National Assessment showed that, among the assessed grade 3 learners, only 66% had reached an acceptable level of reading in their home language (Department of Basic Education, 2014). Also reported by the same assessment was the average percentage achieved by grade 1 learners countrywide in their home language, a mere 63.2%.The prePIRLS international assessment in 2011, which tests children in their L1, revealed that there were great differences between the performance of South African children of different language groups: Half of all children whose L1 was Sepedi, Xitsonga or Tshivenda were unable to read at the end of their grade 4 year, whereas only 10% of children whose L1 was English or Afrikaans were unable to read (Howie & van Staden, 2012). In 2016, South Africa was ranked as the worst performing country and placed 50th out of 50 countries in the Progress in International Reading Literacy Study (PIRLS) (Howie, Combrinck, Roux, Tshele, Mokoena & McLeod Palane, 2017; Mullis, Martin, Foy & Hooper, 2017). The PIRLS assessment, which is available in all 11 official languages and tests a child in his/her L1 (or in his/her LOLT, should the LOLT not be the L1), focuses on reading comprehension processes, such as retrieving information that was directly stated, integrating ideas and information, and evaluating content (Howie et al., 2017). The PIRLS assessment also yielded the result that 78% of South African grade 4 children cannot read for meaning in any of the tested languages. This result indicates a particularly problematic situation because, as stated previously, grade 4 is the beginning of the intermediate phase, which is when reading for meaning is crucial for understanding and learning the newly added content subjects. Thus, 78% of the tested grade 4 children had not adequately acquired the skill of reading and therefore will not able to use it as a tool for academic achievement.

Conditions of poverty, ill health, poor teaching quality and mismanagement of schools all cause these problems in education to be intensified (Fleisch, 2008; Klop & Tuomi, 2007; Spaull, 2013). However, Schleicher (2009: 253) states that the poverty in South Africa cannot account for its learners' poor academic performance because, even in comparison to poorer countries, such as Tanzania, Kenya and Swaziland, South Africa delivers the worst performance. The author concludes that the disparity in socio-economic status within South Africa is instead the greater cause, as will be discussed below.

Notably, the socio-economic disparities that are evident in the schooling system are a contributor to the overall education crisis. There is a majority of schools (75%) that perform very poorly and a 25% minority that perform much better in comparison; however, this minority 25% still perform below average by international standards, in spite of being the wealthier schools (Fleisch, 2008; Spaull, 2013; Van der Berg, 2007). The difference is so vast that there can be two to four grade levels between these two groupings (Spaull, 2013: 57). In response to this problem of inequality and poverty in the schools, a policy change was made by the National Department of Basic Education in 2006, which is called the National Norms and Standards for School Funding (NNSSF) (Chudgar & Kanjee, 2009). This serves to classify government-run schools into different wealth quintiles, which guides the governmental funding allocations for each school. schools are classified as the poorest schools whereas quintile 5 schools are classified as the most affluent. The quintile level is determined by the poverty level of the community around the school, which includes the average income of the surrounding households and the general level of education of the community. This information is usually determined by census data. The national government gives a set amount of money to each school per learner, based on its quintile level. Those schools which are classified as having more money are allocated less government funding than those schools considered to be poorer. The amount of money that is given to the school per child per year is calculated annually. In 2014, quintile 1 to quintile 3 schools were each given 27.2% of the funds made available by the government, whereas quintile 4 was allocated 13.8%, and quintile 5 was allocated 4.6% of the funds (Veriava, Thom & Fish, 2017).

The parents of children attending more affluent schools pay school fees, whereas schools classified as quintile 1, quintile 2 or quintile 3 do not charge school fees (Dieltiens & Motala, 2014; Naong, 2013). It should be taken into account that no-fee schools do not realistically entail that the parents have no educational expenditure for their children; a large portion of an average family's household expenditure goes towards transport for the child to the school, the purchasing of school uniforms and the provision of the necessary stationery (Roux, 2003; Veriava, 2005).

In some cases, the opposite of what was intended to happen has happened; instead of the NNSSF minimising inequality, the distance between the needy and the affluent has remained the same or has even become greater in some instances. The middle-class schools have ended up making more money out of the NNSSF policy by adding to the government contribution with fund-raising initiatives, income from school fees and sponsorship from private bodies (Chisholm, 2004). Poorer schools do not benefit in the same way because their income from school fees, if any, is negligible, and their parent body is not wealthy enough to be able to participate in fund-raising initiatives. Furthermore, schools deemed as no-fee (quintile 1-3) are prohibited from raising money by school fees or fund-raisers; the money from the government is all that is allowed and the government dictates how the allocated funds should be used. This restricts schools from hiring more teachers, who may be more qualified, and limits the schools' ability to improve their facilities. In these cases, the gap between the rich and the poor schools grows wider (Mestry & Ndhlovu, 2014).

There are several additional shortcomings to the quintile system of classification. Chudgar and Kanjee (2009) concluded that quintiles are not effective in accurately ranking schools. They found that quintile 1 and quintile 5 schools were categorised accurately; however, schools in quintiles 2 to 4 were estimated to be less impoverished than they actually were, with some quintile 1 schools actually better off than those in higher quintiles. Hall and Giese (2008) identify some explanations for this outcome, amongst others, that schools are being misidentified by the physical neighbourhood that they are located in. If a boundary line is drawn which puts the school in the same area as high SES households, then the school is assumed to be affluent. This does not make allowances for the broader picture and it might fail to take into account the low SES neighbourhood just beside the boundary line. If the low SES neighbourhood is the main feeder area into the school, and children from low SES households make up the greatest part of the learner body, then schools should be assigned to a lower quintile. In addition, another possibility is that the school may be situated in a mixed neighbourhood, with some parts that are particularly affluent, such as a school attended by the children of low-income farm labourers that is situated in an area where prime agricultural land is owned by the wealthy whose children attend prestigious schools in nearby towns. The manner in which the area is demarcated may include the high SES neighbourhood, which will artificially raise the income level in comparison to the community from which the school's learners hail. An additional cause of misclassification results from learners not necessarily coming from neighbourhoods directly where the school is located but rather may travel from a nearby area which could have a different poverty level altogether. It is becoming increasingly popular for children from nearby low SES communities to travel to higher SES communities to attend more affluent schools, which are regarded as providing a higher quality of education (Dieltiens & Motala, 2014). Another drawcard, which is promoting this migration of learners, is that the more affluent schools are often English-medium, whereas lower SES schools typically have an African language as the LoLT up until the end of grade 3. Parents whose priority it is to have their child in an English-medium school will necessarily want to send their children to the higher quintile schools. The migration of learners also leads to schools having a learner body composed of children with differing SES levels. Low SES and high

SES children are often enrolled in, and attend, the same school. It is therefore key to acknowledge that the differing levels of SES are not only present between schools, but also within schools. A child from a low SES background may present with a linguistic and academic disadvantage as a result of their SES level, which has been found in many cases by an established body of literature (e.g., Calvo & Bialystok, 2014; Kim, Curby & Winsler, 2014). Children who are disadvantaged may need extra help with their school-work and additional support for their language development but poorer parents are typically unable to financially provide this. The divide between low and high SES is thus made wider without the necessary intervention and support for children from low SES backgrounds.

The greatest underlying problem with the quintile classification system in these aforementioned situations is that the individual learner demographics are not considered when schools are ranked, which leads to a disparity between the poverty level of the neighbourhood and the poverty level of the learners. The consequence of this is that some schools that need financial assistance from the government are not receiving it, which leads to a multitude of problems and a large disparity between rich and poor. Schools that are more affluent are able to maintain infrastructure and equipment, and hire extra teachers who are paid with private funds, whereas poorer schools are in the situation of having overcrowded classrooms, old equipment and a shortage of teachers. For instance, poorer schools have classes in excess of 40 learners to one teacher, while schools with more money have one teacher to 25 or 28 learners (Vandeyar & Jansen, 2008: 11). This is the direct effect of wealthier schools having the additional funds to hire teachers in order to improve the teacher to learner ratio. In contrast, no-fee schools are unable to fund-raise or to charge school fees, as stated above, and are thereby under the control of the government in terms of how the money allocated to the school can be spent. The government's recommended expenditure often does not include the hiring of more teachers (Mestry & Ndhlovu, 2014).

Spaull (2013) claims that another contributing factor to South Africa's education crisis is that South Africa has the greatest number of under-qualified primary school teachers, especially mathematics teachers, in Southern Africa. In 2005, 9% of all employed teachers were underqualified, in terms of an insufficient number of years of study after leaving school in grade 12 (Simkins, 2013). The author goes on to say that this is not the whole picture; a sufficient length of training to become a teacher does not necessarily mean that the teacher has an adequate understanding of the subject matter in order to teach it effectively. This was clearly illustrated when grade 6 mathematics teachers from quintile 1 to 3 schools were given five mathematical tasks that were included in the grade 6 curriculum, in other words grade 6 learners were expected to know how to solve the given mathematics problems. Of the mathematics teachers, only 67% could correctly answer three out of the five questions, whereas only 12% could answer all five questions (Simkins, 2013). Spaull (2013) found that the top 5% of grade 6 learners in the country outperformed the bottom 20% of teachers who took the same mathematics test. This begs the question of how the learners can be expected to achieve grade level equivalent academic success if their teachers are personally unable to pass the same tests that are the grade level requirements.

Despite all the abovementioned shortcomings in the education system, underdeveloped linguistic skills in the LoLT might be the primary contributing factor to the weak academic performance of South African children (Alexander, 2005; Brock-Utne & Skattum, 2009; Heugh, 2009; Klop & Tuomi, 2007). Due to the number of combinations of primary and additional languages found within the South African population, children are often taught in a language that is not their native language.

The Department of Education addressed this issue by establishing the Language in Education Policy (LiEP), which specifies the right to education in the language of one's own choosing (Department of Education, 1997). The LiEP thereby promotes instruction through the mother tongue, or in a dual medium context with English. This policy has increased mother tongue instruction in the foundation phase (grade 1 to grade 3) from 51% in 1998 to 76% in 2007 (Department of Basic Education, 2010: 18). Nonetheless, by grade 4, the beginning of the so-called intermediate phase, the vast majority of children are taught in English. This is as a result of the policy that Afrikaans and English are the only possible LoLTs from grade 4 onwards. Therefore, if the child's L1 is neither English nor Afrikaans, and they had been taught in their L1, then the beginning of grade 4 would hold a very big change for them. As of the beginning of grade 4, their LoLT changes from their L1 to English, and their L1, in turn, merely becomes one of their school subjects. The policy demands that this must happen; however, what happens in reality may differ. How this policy is put into effect depends greatly on the language knowledge of the teacher. For instance, if the teacher's command of English is lacking, then the incidence of code switching is more prevalent (Nel & Müller, 2010). Code switching in this context is said to be a hindrance to the acquisition of the formal academic language that is necessary for school, while also inhibiting the acquisition of the standard varieties of the L1 and the L2 (Holmarsdottir, 2003; Webb, Lafon & Pare, 2010). However, some authors disagree and instead state that code switching is actually a helpful tool for teaching children with limited proficiency of the LoLT (Adendorff, 1993; Adendorff, 1996; Moodley, 2003). Teachers may also adapt their English to accommodate those children who are being exposed to English for the first time, in an effort to make the subject matter more comprehensible (Nel & Müller, 2010). Notwithstanding, all assessments and study materials from the intermediate phase onwards are presented in English only.

Due to the LiEP serving only as a guideline, the schools themselves are tasked with choosing the LoLT. Oftentimes, as a result of the preference of parents and the number of languages present in one school, schools themselves will choose English to be the LoLT as the most practical solution (Posel & Zeller, 2016). The LiEP cannot generally be regarded as having been effectively implemented, and in many cases English continues to be the preferred LoLT, regardless of the learners' native language (Heugh, 2000; Jordaan, 2011; Meirim, Jordaan, Kallenbach & Rijhumal, 2010). This means that many children in South Africa are still in the process of learning English and do not have much proficiency in English at the time of entering school, where they are expected to learn only through the medium of English. Therefore, many children in the South African education system are learning the language of instruction, through the language of instruction (Cummins, 2000a).

The conclusion that one can draw from the abovementioned educational circumstances is that a child with an African language as an L1 can either go to an English-medium school, or s/he can enrol in a school where the LoLT is the same as his/her L1 up until the end of grade 3. The children who follow the situation described first, enter grade R with limited English proficiency and are immediately expected to perform academically through English. When these children reach grade 1, they will begin to learn an additional language as a subject, which could be a language of which they have no prior knowledge.

For instance, in many English-medium schools, the additional language is Afrikaans. These children have a heavy burden placed on them resulting from the need to learn their normal school subjects through their L2, English, and learn another language as a subject, which they need to pass. The child then has two lesser-known languages (one LoLT and one additional language subject) included in school, but their L1 is completely excluded from their schooling.

Another possible situation could be that a child does not go to a school with English as the LoLT but rather to a school where the child has their home language as the LoLT. In this context, s/he is more likely to be taught English in grade 1 as his/her additional language. One could say that this manner of education may place less stress on the child and could lead to better educational outcomes. However, as described above, schools with an African language as the LoLT are often financially less well-off and have comparatively fewer teachers, lower qualified teachers, classroom overcrowding and a lack of resources. Therefore, parents are more inclined to send their children to a higher SES school with English as the LoLT from grade R onwards regardless of their, or their children's, proficiency in English.

The plight of the teachers facing classrooms of learners with greatly varying levels of English proficiency should not be disregarded. From the small number of traceable studies on teachers' perceptions of ELLs, it appears that teachers find it challenging to teach ELLs (Davies & Rossouw, 2012; Du Plessis & Louw, 2008; Hooijer & Fourie, 2009; O'Connor & Geiger, 2009). Teachers are not specifically trained in how to teach ELLs, nor are they trained in child language acquisition. Therefore, they often have misperceptions of the best way to encourage a child's language development and which strategies are best for language teaching and development. The extra time that teachers need in order to support children during the school day is not practically available due to the overcrowding of classrooms and the immense workload that comes along with it (Hooijer & Fourie, 2009; O'Connor & Geiger, 2009). Furthermore, teachers are often not of the same culture as the parents of the learners, which leads to cultural divides and challenges in communication (Du Plessis & Louw, 2008). As can be seen from the obstacles that teachers are faced with, one cannot place the onus solely on the teachers to improve the educational situation in South Africa. Teachers would need support from other professionals, such as speech-language therapists, and specific training in teaching ELLs as well as navigating cultural divides, before they can be expected to efficiently teach ELLs in mixed classrooms.

1.4. Central concepts of the study

There are two central concepts that overarch this dissertation. These are English language learning and English language learners, in addition to working memory.

As discussed above, English language learning is a topic that affects many young children and their academic achievements, as well as their future opportunities. At present, there are approximately 1.5 billion English language learners in the world, which has increased greatly from 750 million in the year 2000 (Wong & Hyland, 2017). There are effectively two English language learners for every one native English speaker (Graddol, 2006). This sharp rise goes hand in hand with the increase of labour migration in recent years (United Nations Population Fund, 2017), which entails a worldwide increase in the number of children growing up with exposure to more than one language. Bilingualism has, for many decades, been an important research topic. Very early studies on bilingualism often concluded that being bilingual had negative cognitive consequences (e.g., Arsenian, 1937; Darcy, 1963; Diaz, 1983; Goodenough, 1926; Hakuta & Diaz, 1985; Jensen, 1962) and later, often methodologically more meticulous studies, reported a bilingual advantage (see, e.g., Bialystok, 1999; Bialystok & Martin, 2004; Carlson & Meltzoff, 2008; Peal & Lambert, 1962). A bilingual advantage is regarded as the positive effects of knowing more than one language, which manifests in an improved metalinguistic awareness, mental flexibility and higher scores on cognitive tasks, in comparison to monolingual peers (Bialystok & Majumder, 1998; Bialystok, Majumder & Martin, 2003; Bialystok & Craik, 2010; Ianco-Worrall, 1972; Peal & Lambert, 1962; Thomas-Sunesson, Hakuta & Bialystok, 2018). However, many recent studies have been unable to replicate these findings of bilingual advantage, as regards cognition (Anton, Duñabeitia, Estévez, Hernández, Castillo, Fuentes, Carreiras, 2014; Duñabeitia, Hernández, Antón, Macizo, Estévez, Fuentes & Carreiras, 2014; Gathercole et al., 2014). Until recently, the focus was mostly on bilingualism in so-called WEIRD contexts (Western, Educated, Industrialised, Rich, and Democratic; see Henrich, Heine & Norenzayan, 2010), but recently lesser-known language combinations in non-WEIRD contexts are being studied (see, e.g., Dekker & Young, 2005; Potgieter & Southwood, 2016; Taylor-Leech, 2013).

Though bilingualism is increasing at a high rate globally (as stated above), South Africa has always been a country where a multitude of cultures and languages are represented. The majority of the population is bilingual (Pan South Africa Language Board, 2000), with a variety of native languages and additional language combinations. As stated above, the post-apartheid government has recognised 11 official languages, making the country the most multilingual in the world according to its constitution. Such widespread and varied multilingualism comes with its own set of challenges, especially given the academic and literacy crisis in the country. Children who are ELLs are common across the world, including in South Africa, which makes it necessary to garner as much knowledge about English language learning as possible. Thus, achieving a better understanding of the development of ELLs is highly important and relevant for this study, with more specific attention being placed on understanding and assisting[4] the bilingual child. A more complete overview of English language learners is found in Section 2.1 to Section 2.3 of Chapter 2.

The second concept, working memory, is a cognitive process that is responsible for the short-term storage and use of information (Baddeley & Hitch, 1974; Just & Carpenter, 1992). The most popularly used theory to describe working memory is the multicomponent model, which consists of visuospatial working memory, controlling information storage and processing in the visual domain, and phonological working memory, which is in command of verbal storage and processing (Baddeley & Hitch, 1974; Baddeley & Logie, 1999). Working memory is implicated in most cognitive activities, including language (Miyake & Shah, 1999). For example, children who have a developmental language disorder (DLD)[5] often have disturbances in their working memory skills, which are concomitant with their language impairment (Leonard, 2014). These deficits in working memory include both the phonological and visuospatial domains (Ebert & Kohnert, 2011;

[4] Note that it is not the fact that the child speaks two or more languages that creates a need for special assistance. Whereas many bilingual children may enter school with age-appropriate language skills in their LoLT, ELLs are not fluent in English at the time of entering school. The burden of having English as their LoLT may result in a need for educational support that monolingual speakers of English may not need.

[5] Developmental language disorder will be discussed in more detail in Chapter 2, Section 2.4.

Vugs, Cuperus, Hendriks & Verhoeven, 2013). Besides evidence from DLD research, working memory is also well documented to be involved in both L1 and L2 acquisition; for instance, a larger working memory capacity often entails better listening comprehension, reading comprehension and vocabulary outcomes (Atkins & Baddeley, 1998; Daneman & Hannon, 2007; Engle, 2001). Moreover, relationships are found between language outcomes and working memory, regardless of whether the working memory tasks are presented in the individual's L1 or L2 (Osaka & Osaka, 1992). It can therefore be deduced that working memory supports all language processes. These findings have important implications for the assessment of individuals who are not proficient in their L2 yet, and where it is not possible for them to be assessed in their L1, such as where language assessment instruments are not available in the child's L1. This is often the case in South Africa, where there is a dearth of appropriate language assessment tools (see, e.g., Pascoe, Rogers & Norman, 2013; Van Dulm & Southwood, 2013). If there are working memory deficits that are found along with language deficits, there is more reason to suspect the presence of DLD and conclude that the child may be in need of intervention. Moreover, the child can be assessed in either the L1 or the L2 in order to ascertain if there are working memory deficits. This serves to create an incentive to further investigate how working memory can assist in our knowledge of L2 learning and the identification of DLD in bilingual populations, which is especially relevant for the South African situation which has been described above. Working memory will be discussed further in Section 2.4 of Chapter 2 and in Section 4.1 of Chapter 4.

1.5. Research questions

The above sections have laid out the complex South African situation and the challenges that come along with it. The diversity of the South African population and how it translates into the classroom is a multifaceted issue that teachers are first in line to deal with. Children who have limited proficiency in English enter into schools where English is the sole LoLT, and they share the class alongside children whose L1 is English. The current research is not concerned with the effect of any one specific L1 on English language learning but rather endeavours to embrace the diversity of languages and language combinations that is common across South Africa. The teachers are faced with a diverse class consisting of children who have varying levels of language proficiency and varying levels of SES. This, along with limited school resources and under-qualified teachers, showcases the many challenges that are contributing to South Africa's education crisis.

The challenges that are faced by South Africa are not unique to the country however. The increase in worldwide migration has changed the face of schools in many countries globally, with an increasing number of children having English as their L2, yet having English as the sole medium of instruction in their schools. Studying English language development and the role of working memory in childhood is an integral step to understanding ELLs' development. In order to address the problems and questions that naturally arise from language learning in a bilingual context, the current research focuses on three main research questions:

1. Are phonological and visuospatial working memory maintained by separable cognitive resources or by one common resource?

2. How does an English language learner's English proficiency and working memory develop in their first year of formal education?
3. Do phonological working memory and non-verbal complex working memory predict future English outcomes in English language learners?

1.6. Outline of the dissertation

Chapter 2 contains an overview of the literature and an in-depth discussion of the key concepts that are pertinent to this study. This chapter includes aspects of English Language Learners and bilingualism, along with what will be discussed under the umbrella term of working memory. Chapter 3 contains the overall methodology and describes, in detail, the procedures followed during data collection, the materials that were used, and the ethical considerations pertaining to the study.

Chapters 4 to 6 take the form of research articles that have been written solely by the current author. The research articles answer the abovementioned research questions. Research question 1 is addressed in Chapter 4, which takes a theoretically based approach in exploring the differences in working memory models (domain-general vs domain-specific approaches). After discussing the theory in detail, the findings of two types of working memory tasks (phonological and visuospatial) are discussed. The findings yield that the working memory structure uncovered across the year is congruent with the domain-general approach to working memory, and that this structure remains constant across the year of study. These findings add to the literature on working memory models by having studied a relatively understudied population, namely children who are from mid-low SES households, are ELLs and are in their first year of formal schooling. This journal article has been submitted for publication in a journal with a focus on cognitive psychology and cognitive mechanisms under the title "The organisation of working memory in children across their first year of formal education".

Research question 2 is laid out in Chapter 5, entitled "The development of English proficiency and working memory in 5-6 year old ELLs in their first year of formal education". This chapter also takes the form of an article and describes the rate and trajectory of development for both the language measures and the working memory measures over the course of the longitudinal study. The results show that English monolinguals and ELLs exhibit the same trajectory of development and that great positive gains on scores were made throughout the year by both groups. The implication of the findings is a clearer understanding of what typical development in English monolinguals and ELLs look like, and that the commonality between these two groups could lead to a better way of predicting whether a child needs intervention. This article has been submitted to a journal that focuses on bilingualism as well as education.

The final research question is addressed in Chapter 6, which focuses on whether working memory is a predictor of the rate of English language learning, and what the relationship between working memory and language is across the year of study. This chapter was written as a journal article entitled "Phonological working memory and non-verbal complex working memory as predictors of future English outcomes in young ELLs". The article shows that English language acquisition in ELLs is not a stand-alone process but rather that it is linked to working memory measures, which can be predictors of certain language outcomes. This result is valuable in demonstrating that working memory measures can help with making a decision about whether there is a need for intervention, especially when the ELL still has low English proficiency levels. This article has been submitted to a journal that takes a cognitive science approach to the understanding of bilingual language acquisition and the effects bilingualism has on cognition. Lastly, Chapter 7 concludes the research by drawing the results together, proposing future research directions and discussing the limitations of the current study.

THEORETICAL FRAMEWORK

2.1. Bilingualism and English Language Learners (ELLs)

Children who have knowledge of two languages are often referred to as bilinguals. This term does not give any indication of which of their languages is the dominant one, whether their primary language is used at home and/or at school, or how much exposure there is to each language on an average day. A further distinction is made between sequential and simultaneous bilinguals, where simultaneous bilinguals are described as those who learn two languages from birth (or fairly shortly thereafter), as opposed to sequential bilinguals who learn one language first and learn a second language at a later age. There is, however, no strict boundary between the classification of sequential and simultaneous bilinguals: In some cases, simultaneous bilinguals are still regarded as such if additional language learning commenced as late as at four years of age (e.g., Genesee & Nicoladis, 2009). However, other studies still use the convention set by McLaughlin in 1978, which recommended the cut-off to be at three years of age. This has great implications for the generalisability of research results because not only will the language combinations differ but also the age of first exposure and the amount of input, which are widely accepted to be predictors of language competence (Gathercole, 2018; Wood & Hoge, 2017).

Apart from the terms "sequential" and "simultaneous bilingual", children who are learning English in addition to another language are commonly referred to as an English Additional Language (EAL) learner, Dual Language Learner (DLL) or English Language Learner (ELL). These terms are broad definitions, which are largely based on the preference of the researcher, and are not fundamentally different. Primarily, all the aforementioned terms indicate that exposure to two different languages began at some point during childhood and that English is still in the process of being learned (Bialystok, 2001). There is no consensus under these terms about the age of first exposure, which could range from anytime between birth and the early school years. Some studies do not report this information and/or fail to consider them as participant inclusion/exclusion criteria (Hammer, Hoff, Uchikoshi, Gillanders, Castro & Sandilos, 2014).

The discord in the literature stresses the importance of a term to be decided upon and explained in order for a study to be sufficiently replicable. The current study will use the term "ELL". This term is preferred as it encompasses all language combinations with English and does not make claims about the sequential or simultaneous type of bilingualism. Referring to children as ELLs also makes allowances for the fact that many South African children are already bilingual before being exposed to English, as the children often speak an L1 and a community language (Broeder, Extra & Maartens, 2002). Moreover. this term also incorporates the changing language profiles of the children, as a "learner" will continue to improve his/her proficiency, which may lead to the change of their dominant language. This is especially the case where children whose L1 is not English have English as the medium of schooling, and a great change and increase in input and output of English is to be expected.

An important consideration pertaining to ELLs and the impact of their language knowledge on their academic performance is English language proficiency. How "proficiency" is defined determines from what perspective one will quantify a child's linguistic progress. Previous research has determined that typically developing children generally have an adult-like command of their native language, with most syntactic and morphological structures already being in place, by the time they start school (Tager-Flusberg, 1997: 188).[6] This acquisition happens effortlessly; for instance, during the preschool year children can learn up to 12 new words a day after only encountering the word once (Gleitman & Landau, 1994). This is, however, not the case with ELLs as they show a different pattern of English language development, often showing errors different from those made by L1 speakers of English (MacSwan, 2005: 656). Unlike L1 learners, an ELL's acquisition of English does not necessarily happen effortlessly; explicit instruction with unambiguous input helps to aid in the acquisition process (e.g., Bley-Vroman, 1989).

Cummins (1984; 2000a) defines "early language learning" by making a distinction between two skills: Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (CALP). BICS refers to the skills that are necessary to negotiate situations comprising a context-rich environment. Such a context-rich environment lends non-linguistic support to the verbal communication. BICS refers to social language such as that which is used when communicating with friends on the playground. By contrast, CALP occurs in situations where context is less evident and where higher order cognitive skills are required of the child (Baker, 2006; Cummins, 1984; 2000a). In other words, this includes language used in textbooks and classrooms, which consists of more syntactically complex utterances and more formal vocabulary, with less context to assist the child in comprehension. Cummins (2000a) expands on this by saying that the more advanced the child is in his/her education, the more demands are placed on

[6] It is acknowledged that, by this time, not all syntactic constructions and vocabulary have been acquired yet. For example, passive constructions, relative clauses and reflexives are complex constructions that are not fully acquired by this age (e.g., De Villiers, de Villiers, Roeper, Seymour, & Pearson, 2004).

his/her language knowledge. This is a result of the vocabulary and syntax becoming decreasingly like what is used in non-classroom situations.

It should be considered that BICS is not easier or less demanding than CALP but that the difference lies in the complexity of the grammatical structures and specific vocabulary that should be acquired in order to negotiate the different linguistic situations (Bailey, 2007: 9). Children who learn English as an additional language take approximately 2 years to achieve BICS; however, it has been found that it will take between 5 and 7 years to achieve CALP that will equal those of monolingual English speakers (Cummins, 1981; Macswan & Pray, 2005; Roseberry-McKibbin, 1995). In comparison, other studies have found that it can take longer than 7 years, or that ELLs will never reach L1 proficiency in certain language domains (Farnia & Geva, 2011; Roessingh & Elgie, 2009; see Saunders & O'Brien, 2006 for a review). It takes between 3 and 7 years for ELLs to perform equally with L1 English-speaking children, even in terms of productive language abilities (e.g., Oller & Eilers, 2002; Saunders & O'Brien, 2006).

Therefore, children who enter grade R with no BICS or CALP in English will be at the end of their grade 1 year by the time they have acquired the BICS that allow them to adequately interact on a social level in English. The child may only acquire the necessary CALP skills between grade 4 and grade 6, or possibly later. The implication is that the child will fall behind in school and that their academic outcomes will be hampered by not fully understanding the content of the subjects that they are being taught, merely because the English skills that are required to understand the subjects are not fully acquired yet. CALP skills are not easily acquired; therefore, assistance and explicit teaching should be available to help the ELL (Cummins, 2000a). Teachers can lend this support and help children to acquire CALP skills, which will in turn strengthen the ELL's academic performance. However, oftentimes teachers do not have the necessary training in order to support CALP development (Mroz, 2006). This is no different in South Africa, where teachers are often also L2 speakers of English and are underqualified in the subjects that they teach, thereby making it difficult for them to assist their learners (Nel & Müller, 2010). Therefore, proper teacher training and learner support is crucial for ensuring better educational outcomes.

The BICS/CALP distinction is not without its criticisms. Chief among them is that it is an overly simplistic view of language proficiency (see Cummins, 2000b). Notwithstanding, this approach does highlight the notion that fluency in a language for social purposes does not necessarily imply that academic language skills are on an equal footing and will allow them to attain literacy and access the curriculum optimally. Moreover, it also emphasises the complex interplay between language knowledge and academic demands. This should not be disregarded when conducting research with ELLs during their school career, as their English proficiency is an important predictor of future academic success (Halle, Hair, Wandener, McNamara & Chien, 2012; Prevoo, Malda, Mesman & van IJzendoorn, 2016), as discussed below.

2.2. ELLs and academic achievement

There is an existing body of literature that has found great differences between the academic achievements of ELLs and their monolingual English peers. Specifically, that monolingual English children achieve better academic outcomes than ELLs do. The same trend has been found in South African studies; for instance, children who are in an English-medium class who reported that they always speak English at home, scored almost twice as high as the children who reported never speaking English at home (Reddy, Kanjee, Diedricks & Winnaar, 2006). Jordaan's (2011) longitudinal study of South African grade 1 to grade 3 ELLs and L1 English speakers showed that the ELLs performed at a consistently lower level than their L1 English peers on measures of academic language. By the time the ELLs were in grade 3, they were performing at the same level as their L1 English peers had performed in grade 2. The academic language of the grade 3 ELLs was thus an entire year behind that of the L1s. The Western Cape Education Department found similar results in their assessment of grade 6 learners' performance on literacy tests; children who were L1 English scored 70% on average, whereas children who spoke isiXhosa as L1 scored 37% (Western Cape Education Department, 2006). Howie (2005) concludes that the English proficiency of the children with English as the LOLT is the most significant factor in determining educational outcomes in science and mathematics.

An additional consideration to be taken into account is that ELLs mostly come from low SES households. Low SES has been found to be a contributing factor to low language skills as well as low academic outcomes. For example, Hispanic children in the United States from low SES households scored in excess of half a standard deviation below the national average in mathematics and reading Not only does low SES affect academic outcomes at the beginning of the child's school career, but it can also negatively affect the long-term trajectory of academic development, even up to high school (Brooks-Gunn, Rouse & McLanahan, 2007; Morrison, Bachman & Connor, 2005; Willms, 2003). Furthermore, the National Center for Education Statistics (2004) in the United States has reported that 10% of English L1 students drop out before completing high school, which is three times lower than the dropout rate of students who speak a language other than English (Lee & Buram, 2002). at home. Low SES also affects the development of language skills in monolinguals. Children from low SES backgrounds perform worse on standardised language tests (e.g., Dollaghan, Campbell, Paradise, Feldman, Janosky, Pitcairn & Kurs-Lasky, 1999). Both productive and receptive vocabulary size has also been linked to SES, where the lower the SES, the smaller the vocabulary size (Hoff, 2003; Pan, Rowe, Singer & Snow, 2005; Reynolds, Andersen, Behrman, Singh, Stein, Benny, Crookston, Cueto, Dearden, Georgiadis, Krutikova & Fernalda, 2017; Rowe & Goldin-Meadow, 2009). Narrative skills, phonological awareness and language processing speed have also been found to be negatively affected by low SES (Vernon-Feagans, Hammer, Miccio & Manlove, 2001).

In the United States, as well as in South Africa (as can be seen from Chapter 1), it is the common finding that ELLs predominantly come from low SES households (Hoff, 2013). Low SES and the effect of being in the process of learning English as an L2 are therefore confounded in most cases. This makes it difficult to draw conclusions about the impact of low SES on academic achievement, without taking into consideration ELL status. Some researchers postulate that being an ELL might not place the child at an academic disadvantage if s/he comes from a higher SES household, and if their L1 is considered to have the same social prestige as English (Hoff, 2013). This was explored in research on Welsh-English bilingual children, where both languages are regarded as having the same level of prestige. These bilingual children did not experience the same low academic outcomes as previous research has found with bilinguals who have minority language L1s (Gathercole, 2010). The compounding factors of low SES, being an ELL and having an L1 that does not have high social prestige in the community all lead to academic outcomes that are below average. Children who fit this profile are at a higher risk for failing grades and not succeeding in their school career. Ideally, early intervention programs should be made available for children who fit this profile.

2.3. ELLs and Developmental Language Disorder

During the process of acquiring English as an additional language, children may show signs that are akin to language impairment, especially when considered in comparison to their monolingual English-speaking classmates (Windsor & Kohnert, 2004). The risk is that ELLs could be incorrectly identified as having Developmental Language Disorder (DLD). Until fairly recently, 'Specific Language Impairment' was the most commonly used term to refer to this impairment, but it has since become contentious (see Reilly, Bishop & Tomblin, 2014 and Bishop, 2017 for an overview). The word 'specific' in this context suggests that the only impairments are language-related; however, this is not the case as concomitant non-linguistic delays, which are discussed further below, have been found. Alternative terms have been proposed, including "Developmental Language Disorder" and "Language Impairment". Following Bishop (2017), "Developmental Language Disorder" is the preferred term for use in this study as it includes the possibility of concomitant non-linguistic delays, while still emphasising the main issue of language impairment.

DLD is a developmental disorder that manifests primarily as difficulties in the child's ability to acquire language, comprehend language and/or produce language. Yet, children with DLD have normal hearing, non-verbal intelligence within the normal range, no neurological disorder and no indication of autism spectrum disorder (Leonard, Weismer, Miller, Francis, Tomblin & Kail, 2007: 408). Not all children with DLD have the same language deficits – some language domains are more affected than others, and to differing extents – however, the most commonly affected domains are phonology, morphosyntax and vocabulary (Leonard, 2014; McGregor, Oleson, Bahnsen & Duff, 2013). The severity of the language deficits vary among individuals, which causes children with DLD to form a heterogeneous group. The presentation of the deficits can also change along the course of the child's life (Kohnert, Windsor & Ebert, 2009). Along with the significant impairment in the language domain, there is some evidence of non-linguistic weaknesses in motor skills, working memory, attention and inhibition (Archibald & Gathercole, 2006; Flapper & Schoemaker, 2013; Gillam, Montgomery & Gillam, 2009).

Previous research studies have reported a DLD incidence rate of approximately 7% in monolingual preschool populations (Tomblin, Records, Buckwalter, Zhang, Smith & O'Brien, 1997), and it is hypothesised that bilingual children may be affected to a similar extent (Kohnert, 2010). Bilingual children with DLD show impairment in both of their languages but the severity and characteristics thereof are dependent on the languages and their structure, as well as the developmental stage that the child is in (Ebert et al., 2014). Moreover, previous research has shown that ELLs make errors that are reminiscent of errors made by monolingual children with DLD, especially regarding the production of consonant clusters and morphosyntax (see Paradis, Genesee & Crago, 2011). For instance, the omission of English verb morphology is often seen in the utterances of ELLs but the same error pattern is observed in monolingual English-speaking children with DLD (Paradis, Rice, Crago & Marquis, 2008). ELLs also often have a small vocabulary size, which is another common identifying characteristic of DLD in monolingual children

(Bedore, Peña, Garcia & Cortez, 2005; Gross, Buac & Kaushanskaya, 2014; Kohnert, 2010). This overlap in characteristics leads to confusion in identifying and diagnosing DLD in ELLs, especially leading to an over-diagnosis of DLD in many cases as a lack of language knowledge is mistaken for a disorder in language acquisition (e.g., Bedore & Peña, 2008; Gutiérrez-Clellen, Restrepo & Simon-Cereijido, 2006; Kohnert, 2010; Paradis, Genesee & Crago, 2011).

Distinguishing between typically developing ELLs and ELLs with DLD can be a challenge for child language practitioners such as speech-language therapists. The dearth of appropriate assessment tools to identify DLD is an obstacle because standardised tests are not suitable for all children. Standardised tests are typically normed on monolingual populations, thus it follows that the norms are inappropriate for children such as ELLs who speak more than one language (e.g., Bedore & Peña, 2008; Kimble, 2013). For example, on a range of English language tests, 24% to 78% of typically developing ELLs scored below the monolingual English norms (Paradis, Schneider & Sorenson Duncan, 2013). Such results could lead to an overidentification of DLD in typically developing ELLs. Another consideration is that DLD affects all of a bilingual child's languages, thus the best way to identify DLD is to assess the child's performance in all of his/her languages (Thordardottir, 2015). However, the testing of all languages in many cases is simply not possible, due to standardised tests not being available or due to the clinician who administers the tests not having knowledge of all languages (Boerma & Blom, 2017). As mentioned in Chapter 1 Section 1.4, this has been shown to be the case in South Africa, where many languages have no tests available and speech-language therapists are forced to devise their own assessment criteria, or to use direct translations of English-language tests (van Dulm & Southwood, 2013).

In order to remedy these problems, various attempts have been made to devise assessment tools that could more accurately discern between impairment and second language learning. For instance, the use of parent questionnaires are valuable in situations where a child's language cannot be assessed directly, such as the use of the Alberta Language Development Questionnaire (ALDeQ) (Paradis, Emmerzael & Sorenson Duncan, 2010). Yet, this is deemed to be most accurate when used in conjunction with a language test battery (e.g., Paradis, Emmerzael & Sorenson Duncan, 2010). The language test battery to be used along with the ALDeQ should assess the child's L1 (Paradis, Emmerzael & Sorenson Duncan, 2010); however, this is not always possible, as has been established by the aforementioned discussion of the problems of finding suitable assessments.

Alternatively, less language-dependent measures and more memory-reliant measures are considered to render a less biased estimation of language ability, such as the use of non-word repetition, sentence repetition and other working memory measures (e.g., Henry & Botting, 2016; Kohnert, 2010). It is assumed that these measures will test language learning ability and not the child's knowledge of a certain language. In the same vein, dynamic assessment approaches have been used which focus specifically on a child's language learning capacity (Kohnert, 2010; Peña, Gillam & Bedore, 2014). These approaches involve three stages: Firstly, the child's language is tested, secondly, there is a teaching phase, and thirdly, a phase in which the child is tested on what was taught in stage two. The emphasis on a within-child comparison allows the tester to evaluate the child's capacity to learn language. DLD can also be identified by using tests that are based on norms from other bilingual children or ELLs (Bedore & Peña, 2008). For instance, ELLs with DLD perform worse on non-word repetition tasks and tasks assessing the use of tense, however, only when compared to other typically developing ELLs of the same age (e.g., Paradis et al., 2013).

The COST Action IS0804 has endeavoured to create assessment tools which are comparable cross-linguistically, such as the Language Impairment Testing in Multilingual Settings (LITMUS; Armon-Lotem, de Jong & Meir, 2015). The LITMUS is a battery of ten assessment tasks that are purposely directed at encompassing all bilingual children's languages. These tasks include, amongst others, storytelling and retelling, crosslinguistic lexical tasks (taking the form of a receptive and expressive vocabulary test), and nonword repetition tasks (see Armon-Lotem, de Jong & Meir, 2015). The LITMUS has been translated and adapted to an array of languages, including for Afrikaans by Klop, Visser and Oosthuizen (2012). The COST Action IS0804 has also devised or adapted tools that aim to collect background information about bilingual children, such as the Parents of Bilingual Children Questionnaire (PABIQ; Tuller 2015). Results from studies using the LITMUS tasks yielded good diagnostic accuracy (e.g., Boerma, Chiat, Leseman, Timmermeister, Wijnen & Blom, 2015; Chiat & Polišenská, 2016; de Almeida, Ferré, Morin, Prevost, Dos Santos, Tuller & Barthez, 2017; Marinis, Armon-Lotem & Pontikas, 2017). Yet, more research is needed with these tasks before the diagnostic accuracy can be definitive. For instance, the manner in which the clinical groups were established in these studies differed from each other, which makes the generalisation of diagnostic accuracy less reliable. Therefore, studies with large samples which include a diverse range of participants and which employ the same methodology should also be undertaken (Tuller, Hamann, Chilla, Ferré, Morin, Prevost, dos Santos, Ibrahim & Zebib, 2018).

This is clearly a complicated state of affairs that not only poses a problem for speech-language therapists but also for the teachers who need to decide which children should be referred for language screening and possible intervention, and which children merely need more exposure to the LoLT in order to develop the CALP required for academic success. The risk of failing to accurately identify the ELLs who truly have DLD will cause a delay in receiving the appropriate intervention (Paradis, 2005). Therefore, there is a need, on the one hand, for intervention to be available at as early an age as possible in order to attend to the impairment, before irreversible academic gaps are noted and, on the other hand, for an avoidance of misdiagnosing typically developing ELLs as children with DLD.

2.4. Cognitive processes underlying language acquisition

As stated in Section 1.1 of Chapter 1, the cognitive processes underlying language will be discussed under the concept of working memory. Working memory is the temporary storage and processing of information that guides cognitive activities. The processing of information in temporary storage is crucial to cognition and is implicated in performing everyday tasks (Miyake & Shah, 1999: 1). Nearly every task that is undertaken places demands on working memory, including but not limited to reading, learning, problem solving and performing calculations (Miyake & Shah, 1999). Many theories have been proposed in order to account for what working memory is and how exactly it functions. The main distinction between the theories lies in whether working memory is domain-specific or domain-general. Domain-general theories assume that there are distinct components responsible for short-term storage and selective processing (e.g., Baddeley, 2000; Baddeley & Hitch, 1974; Shah & Miyake, 1996), whereas domain-specific theories assert that working memory is unitary and part of a construct that is affected by selective attention (e.g., Cowan, 2001; Engle, 2002).

Due to working memory being implicated in language and learning, the study of working memory in the childhood years is particularly important in order to understand how it develops and how it interacts with other areas of development. Research has been conducted to this end with various child populations, for example with bilingual children (Blom, Kuntay, Messer, Verhagen & Leseman, 2014), children with Down Syndrome (e.g., Nash & Heath, 2011), intellectual disabilities (Van der Molen, Henry & Van Luit, 2014), reading delays (e.g., Jeffries & Everatt, 2004) and language impairment (e.g., Leonard et al., 2007). It is important for researchers to determine the structure and developmental course of working memory in various child populations in order to understand when intervention is necessary to prevent future academic hindrances. Performance on working memory tasks has been found to be indicative of future academic outcomes, such as reading achievement (Swanson & Beebe-Frankenberger, 2004), mathematics outcomes (Swanson & Sachse-Lee, 2001) and computational skills (Bull & Scerif, 2001; Geary, Hoard & Hamson, 1999). In all cases where working memory scores were low, outcomes on the academic domains were also low. At the beginning of a child’s school career, working memory is an even more powerful predictor of academic achievement than IQ scores (Alloway & Alloway, 2010).

According to a review of 16 studies, working memory is also correlated with proficiency outcomes in L2 acquisition (Watanabe & Bergsleithner, 2006). This correlation was positive, indicating that the better one's working memory outcomes are, the better the L2 outcomes will be. A number of authors have shown that low-proficiency bilinguals with high working memory scores performed better on L2 tasks than those with lower working memory scores (e.g., Leeser, 2007; Linck, Hoshino & Kroll, 2008). However, it seems that this apparent advantage is attenuated in L2 speakers with a higher language proficiency; Foote (2011) found that higher working memory scores did not predict better outcomes on L2 tasks if the individual had a high L2 proficiency. Phonological working memory has also been found to play a larger role in L2 vocabulary acquisition if the individual is not highly proficient in the L2 or does not have a large vocabulary in the L2 (Juffs & Harrington, 2011; Williams, 2011).

Tests of working memory usually involve tasks that tap into visuospatial, phonological and complex working memory. Visuospatial working memory is tested with tasks that tap into both visual and spatial storage, whereas phonological working memory is tested with tasks that use phonological and verbal stimuli. The complexity of these tasks affects the demands placed on working memory: Simple tasks will require less working memory resources whereas tasks that are composed of several retrievals of representations will place a higher processing load on working memory (Barrouillet & Camos, 2001). The processing load can easily be manipulated in linguistics research by, for example, varying syntactic complexity, phonemic complexity or the length of the expected response (Archibald, 2017). The context in which the task is completed also affects performance: A situation in which a child is pressed for time or is being tested in a noisy environment will place higher demands on the child's working memory.

A 2009 study by Archibald and Joanisse was the first to provide evidence of the possibility of distinct impairments in working memory and language. The authors tested 90 children on standardised tests of working memory as well as language, and found that children could be divided into three distinct groups: only language impairment, only working memory impairment, and both language and working memory impairment. Another study, that of Kapantzoglou, Restrepo, Gray, and Thompson (2015), yielded similar results: The 431 tested children were separable into three discrete groups, namely children with average development across all tests, children who showed low scores on working memory, and children who had low scores on grammaticality tasks (Kapantzoglou, Restrepo, Gray & Thompson, 2015).

A common weakness of working memory measures is that they often require a certain basic linguistic knowledge, even if the task does not set out to measure phonological working memory. For instance, some measures of complex working memory require the participant to memorise and repeat digits, letters or words. The results of working memory measures are often purported to be less sensitive to SES and cultural influences (e.g., Engel, Santos & Gathercole, 2008). However, Nadler and Archibald (2014) tested 178 Canadian children on a working memory battery that was normed on children from the United Kingdom, and found that the Canadian sample obtained higher raw scores. Working memory measures have also been found to be affected by language skills (e.g., Gangopadhyay, Davidson, Ellis & Kaushanskaya, 2015). If the participant has any problems in the language of testing, the results of the measure will be negatively affected.

This may influence the overall conclusions drawn about the nature of the child's abilities, with the risk of identifying a language impairment in the absence of one.

In the case of a known language impairment, a large number of studies of children with DLD have shown lower scores on tests of verbal working memory than their typically developing peers (e.g., Archibald & Gathercole, 2006; Briscoe & Rankin, 2007; Conti-Ramsden, 2003). Due to the existing body of literature, it is widely accepted that children with DLD have some deficits in verbal working memory. A relatively understudied area is that of the nonverbal and visuospatial working memory performance of children with DLD. Addressing this, a meta-analysis of 21 studies found that there is a visuospatial working memory deficit in children with DLD (Vugs, Cuperus, Hendriks & Verhoeven, 2013). Further adding to this, the study by Ebert, Kohnert, Pham, Disher and Payesteh (2014) investigated three different treatments for bilingual children with DLD. The authors included one treatment which focused solely on improving visuospatial working memory, which they found to positively influence language skills. Therefore, visuospatial working memory is regarded by some authors as being involved in the language of children, even though it is regarded as a nonverbal type of working memory.

Such non-verbal working memory tasks have the potential for being useful in a country such as South Africa, which has many languages and few suitable assessment tools in these languages. For a clinician that is not fluent in the child's L1, being able to assess working memory skills will be more accessible and realistic. Furthermore, not much accurate information can come from English language assessments when used with ELLs who are still in the process of learning the language. Such cases may lead to under- or over-identification of DLD. However, if these language tests are used in conjunction with working memory tasks, it will lead to a more holistic understanding of the child's abilities and may result in a more accurate perception of his/her development.

2.5. Chapter conclusion

In this chapter, the English language learning of bilingual children as well as working memory in bilingualism were discussed. As stated in Chapter 1, the current study tracked the English language learning and changes in working memory skills of young South African ELLs over the course of their grade R year. The following chapter includes a discussion of the methods by which the English language development and working memory of the participants were assessed, and well as other methodological aspects of the study.

METHODOLOGY

3.1 Ethical considerations

The child participants in the current study all attended a public (i.e. government) school in the greater Cape Town area of the Western Cape province of South Africa. As such, a first step was to approach the WCED (Western Cape Education Department) for permission to conduct research in one of its schools. Once the study was approved by the WCED and permission was granted (see Appendix A), ethical clearance was obtained from the Research Ethics Committee: Human Research (Humanities) of Stellenbosch University (see Appendix B).

Following the approval of the study, informed consent forms were sent via the school to the parents/guardians of the children who qualified to participate in the study (see Appendix C). Participating children were all under the age of 18, therefore consent had to be obtained from their parents/guardians. Due to the design of the study, parents/guardians of the children also participated in the research and were asked to give informed consent for both themselves and their child. An information sheet was sent along with the consent form which outlined the nature of the study (see Appendix D). It was emphasised that participation was voluntary, that there would be no compensation nor any risk to the participants, and that consent could be withdrawn at any time during the research. Parents/guardians were given the author's email address and telephone number and were encouraged to ask the author about anything that remained unclear.

At the time of testing, the author explained the procedure verbally to the child participants. Children responded in all cases that they were willing to participate. It was made clear that the participants did not have to take part in the tasks if they did not want to and that they could leave at any time during the testing. They were also informed that they might indicate when they were tired and needed a break, and that this would be respected. The children indicated that they understood this and short breaks were given where necessary.

3.2 School selection

A school to conduct the study at was sought that had a large grade R class and that was solely English-medium. Preferably, the school would reflect the diversity of South Africa’s population and would include children from medium to low socio-economic status families. For the purpose of this study, it was ideal to only focus on one school so that the standard of teaching and the quality of the English input, which are considered to be possible confounds, could be controlled for. Three schools in the greater suburban Cape Town area that fit these criteria were approached, and all three schools agreed in principle to act as research site for this study. One school out of the three was chosen because it had the biggest grade R class. Class size was important because it allowed for a larger sample size, especially considering that longitudinal study designs are susceptible to participant attrition, which would have a smaller impact on the data if the initial participant group were large.

The chosen school is situated in a suburban middle-class area; however, most learners came from poor and working-class areas, including informal settlements, in the vicinity. In most cases, the learners travelled to school from the poorer areas by public transport or transport organised by the school.

3.3 Participants

3.3.1 Participant selection criteria

To be included in the study, children had to be enrolled in grade R and be 5 or 6 years old. This age range was chosen in order to exclude any children who may be repeating grade R (i.e. non-newcomer grade R learners) or who entered school late. All participants had to be deemed typically developing, without any known hearing, visual, neurological or cognitive impairments. During the recruitment process, teacher reports and school records were relied upon to ascertain whether the child was typically developing or not. All parents whose children fit the aforementioned selection criteria were approached and given consent forms for participation. To this end, the author consulted with the relevant teachers to identify the children who fit the selection criteria and proceeded to give the teachers the consent forms for handing out to the suitable parents. The completed consent forms were then returned to the author via the teachers.

It should be noted that it is common for South African parents, who wish for their children to attend an English-medium school, to declare that their children are monolingual English-speaking, even when this is not the case. This results from parents being of the opinion that it will increase their child’s chances of being accepted at English-medium schools. Therefore, all grade R parents whose children fit the selection criteria were approached to participate in the study because the distinction between children who are ELLs and who are L1 English speakers could not be made at the early stage of participant recruitment.

ELL criteria

For the overall aim of the study to be reached, it was necessary that all children in this group were to be ELLs, in other words children who had an L1 other than English. Children were considered to be ELLs if they were sequential bilinguals and if their parents had any language(s) other than English as their L1. It was not the focus of this study to examine the effects of any particular language on English language learning; therefore, the decision was made to include all combinations of mother tongue languages in the sample. The age of first exposure to English had to be no earlier than in their third year of life; in other words, children who attended a bilingual or English-only day-care in the year that they turned three qualified for the study. Children who had consistent exposure to English at home for at least one year prior to the study were excluded. Hearing English from the radio or television did not qualify as consistent exposure because it has been found that these sources of input are not supportive of language development (Patterson, 2002). Answers about parents' and children's language repertoires and the onset, amount and nature of English input received were obtained from a questionnaire completed by the parents, namely the (Utrecht) Bilingual Language Exposure Calculator (BiLEC) (Unsworth, 2013), which is a parent questionnaire that which can be administered to parents of bilingual and trilingual children. Parent answers given on the BiLEC informed the author's ultimate decision about participant suitability.

English L1 criteria

It is acknowledged that recruiting a purely monolingual child in a society as culturally and linguistically diverse as South Africa is a challenge. Moreover, if children who are purely monolingual were sought out, they would be the exception and therefore not representative of the situation in the average South African classroom. Thus, children having been exposed to languages besides English and having some knowledge of these languages were considered for inclusion in the English L1 (henceforth, Eng) group. Therefore, the author needed to devise a standard for the formation of the Eng group. Firstly, it was decided that for children to be considered as an L1 speaker of English, both of their parents had to be L1 speakers of English. Secondly, the participants had to have been exposed to English in the household since birth for at least 95% of the day. This percentage was derived from answers on the aforementioned BiLEC parent questionnaire (Unsworth, 2013).

3.3.2 Socioeconomic Status (SES)

It was originally reasoned that SES could be determined by the quintile ranking of the school. As discussed in Section 1.3 of Chapter 1, South African public schools are categorised into five groups, called quintiles. Recall that quintile 1 is the "poorest" quintile, while quintile 5 is the "least poor". These poverty rankings are determined nationally by the poverty of the community around the school and infrastructural factors (WCED, 2013). However, considering the school's location where the testing took place, the quintile ranking was not an accurate reflection of the SES of the learners who attend the school. As stated in Section 3.2, the school is in a suburban middle-class area, which affords it a quintile of 4; however, most of its learners come from poor and working-class areas. A quintile of 4 entails that the school receives very little money from the government, school fees are relied upon for the bulk of the school's income, and the government does not provide lunch for the children. However, the study school is not a typical quintile 4 school – for example, the school does provide lunch for the children because the majority cannot afford to bring their own food to school. Following the above reasoning, this method of determining SES was therefore seen as inaccurate.

Moreover, to determine the SES of participants required a measurement that did not enquire directly about the family's financial situation. Direct questions about household income or financial status would be considered offensive in many of the cultures that were represented in this study. Moreover, there is a discrepancy between the author and the parents of the children in that the author is a native speaker of English, has a higher perceived educational level and is affiliated with a university. This mismatch is known to cause some discomfort in the interview setting, therefore information regarding SES, which is deemed a sensitive topic, necessarily had to be gathered in a less direct manner.

During the BiLEC parent interviews, parents were asked what their highest level of education and current occupation was. According to the BiLEC guidelines (Unsworth, 2013), the level of education for parents is classified with the International Standard Classification of Education (ISCED2011), as defined by UNESCO. If the father was not present in the child's life or was in the home less than 5 days a week, only the maternal education level was taken into consideration. If the parent was unemployed, only their highest level of education was taken into account. The SES level was measured on a scale from 1-8, where 1 is early childhood education, 2 is primary education, 3 is lower secondary education, 4 is completed secondary education, 5 is post-secondary short study, 6 is tertiary education diploma, 7 is tertiary education degree, and 8 is Master's level or higher.

3.3.3 Description of participants

A total of 36 children, all attending the same school, were recruited to take part in the study. Two of the 36 children subsequently had to be excluded due to diagnoses of a language disorder and a behavioural disorder, which were only detected during the course of the study. Therefore, a total of 34 children participated in the study. There was no participant attrition over the course of the data collection year.

Two groups were formed, namely the ELL group and the Eng group. The ELL group consisted of 27 children, where 12 were male and 15 were female. The average ages of the children at the three different points of data collection are presented in Table 3.1, along with their SES and number of older siblings.[7] The Eng group consisted of children whose dominant language since birth was English. A total of seven children, of whom three were male and four were female, were recruited to form part of this group.

Table 3.2 shows the different primary languages that are spoken by the participants in the ELL group. Only the primary languages of the children are reflected in this table, yet four participants were trilingual, and one participant had knowledge of four languages, while the other participants were bilingual with a primary language and English. Some languages represented in this sample are primarily spoken outside of Southern Africa, which indicates the heterogeneity of language backgrounds of the participants. All children were nonetheless born and raised in South Africa.

[7] Previous studies have found that older siblings contribute positively to a younger sibling's language input and can affect eventual English proficiency (Bridges & Hoff, 2014; Zukow-Goldring, 2002).

Table 3.1. Number, sex, mean age, mean SES and mean number of older siblings in the ELL and Eng groups across the year.

Group	*N*	Sex	Older siblings		SES		Age		
		(M, F)	Mean	Range	Mean	Range	Mean		Range
ELL	27	12, 15	1	0 - 3	3	2 - 4	T1	5;6	5;1-6;0
							T2	5;10	5;5-6;4
							T3	6;3	5;9-6;8
Eng	7	3, 4	1	0 - 2	3	2 - 5	T1	5;5	5;1-5;9
							T2	5;9	5;6-6;2
							T3	6;1	5;10-6;6

T1 = beginning of the school year, T2 = middle of the school year, T3 = at the end of the school year
SES: 2 = primary education, 3 = lower secondary education, 4 = completed secondary education, 5 = post-secondary short study

Table 3.2. Primary languages and the number of children speaking them in the ELL group.

Primary languages of ELLs	**Number of speakers**
isiXhosa	11
Shona	6
French	3
Swahili	2
isiZulu	1
Sesotho	1
Oshiwambo	1
Igbo	1
Cameroonian Pidgin English	1

3.4 Materials

3.4.1 The (Utrecht) Bilingual Language Exposure Calculator (Unsworth, 2013)

As stated in Section 3.3.1 above, the BiLEC is a parent questionnaire that can be administered to parents of bilingual and trilingual children. It is conducted as a face-to-face interview that has a duration of between 20 and 35 minutes. Measures that are derived from the interview are both quantitative and qualitative. Data that is gathered from the interview is input into an Excel Spreadsheet that automatically calculates the child's language exposure with built-in formulae. Refer to Appendix E for a full list of the questions (adapted from Unsworth, 2013; retrieved from Iris Digital Repository).

In order to calculate the cumulative exposure to the languages as a quantitative measure, questions were made specific and simple for the parents to answer. The quantitative measures addressed three core sections, namely current exposure, current output and cumulative length of exposure. Firstly, to address current exposure, the questionnaire enquires about when persons who live in the child's home spend time with the child, on an average weekday and an average day on the weekend, and which languages are used during this time. Parents were also asked how often the target language is spoken, and this result is quantified by the researcher as a value between 0% and 100%. These questions about a child's average day also included which languages were spoken at school and after care and which languages were spoken with the child's friends. Parents were furthermore asked about the number of hours the child spends reading, watching TV, engaging in extra-curricular activities and using a computer. A separate section addressed school holidays - what the child normally does and which languages are typically used during these times.

Secondly, the current output calculated the child's use of the target language. The input and output were therefore treated as two separate variables. This is as a result of the finding that both these variables are important when learning a language; input is important for vocabulary learning whereas output is important for building syntactic knowledge (e.g., Bohman, Bedore, Peña, Mendez-Perez & Gillam, 2010; Bedore et al., 2012). This section of the questionnaire mostly covered the same questions as the current exposure section, except that it is concerned with the child's expressive use of the languages with the people in his/her life.

Thirdly, the cumulative length of exposure was addressed with questions about the child's exposure to the languages from the first time that the child came in contact with them, until the time of data collection. The questions in this section dealt with the languages spoken in the home in the past, any previous schools or day-cares the child has attended and what languages were used there, as well as language use in holidays.

The qualitative measures included three subheadings: Nativelikeness, Variety, and Single-language conversational partners. Firstly, Nativelikeness was concerned with how well each person, who was reported as spending time with the child in the previous section, speaks the language. This was answered in terms of a 6-point Likert scale, ranging from 0 'Very bad' to 5 'Excellent, almost like a mother tongue'.[8] The various measures under the section of current exposure were included in the calculation of the average nativelikeness of exposure in each language at the current time. Also taken into consideration was the proportion of time that one person contributed to the child's overall exposure. Therefore,

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[8] The labels for the Likert scale were adapted from the original Unsworth (2013) in order for it to be simpler for the parents to answer, especially for those who were not fluent in English.

if a sibling provided the majority of the child's language input in a week, said sibling's nativelikeness would be more heavily weighted in the calculations. A comparative measure that does not take this weighting into consideration was also furnished by a built-in formula.

Secondly, Variety includes the number of different speakers who speak the language to the child. According to Place and Hoff (2011; 2016), an increase in the number of speakers using the language with the child positively increases the quality of the exposure. Two measures on the parent questionnaire considered this, namely the number of native speakers at home delivering input in the target language and the number of non-native speakers providing input at home.

The final measure of language quality was the number of single-language conversational partners. In other words, this was the number of people from whom the child received input who only interacted in one language. This was calculated by asking the parents who in the home speaks only the target language and with whom the child speaks only the target language.

Over and above the language exposure questions, the BiLEC contains questions about the personal details of the parents. This includes their full name, contact number, address and what their relationship is to the child. Also included were questions about level of education and their current occupation (as referred to above) and whether they lived in the same house as the child. Personal details were also asked about the child, such as date and place of birth and number and age of any siblings.

Due to the variety of languages that were spoken by the participants' parents, it was not possible to translate the questionnaire into all represented languages. In three cases, one of the parents felt incapable of understanding and answering the questionnaire; in these cases, the other parent acted as a translator. All interviews were conducted face to face with the parents at a time that suited them. Most interviews took place in a quiet classroom at the school but some parents opted to meet with the author at a venue nearer to their place of employment. The parents were informed that they could choose not to answer any question and that they were free to end the interview at any time. All interviews were audio recorded, with the parent's permission, using a Sony IC Voice Recorder. The recordings were played back at a later stage in order to complete the Excel Spreadsheet.

3.4.2 Phonological Working Memory tasks

Cross-linguistic non-word repetition task (CL-NWR) and the Language Specific non-word repetition task (E-NWR) (Chiat, Polišenská & Szewczyk, 2012)

The CL-NWR strives to comply with phonotactic rules that are common to a wide variety of languages. This is achieved by maintaining a simple CVCV structure for items and using a limited array of consonants /p, b, t, d, k, g, s, z, l, m, n/ and vowels /a, i, u/ in the stimuli. The longest word is five syllables and the shortest word is two syllables, with an equal number of 2, 3, 4 and 5 syllable words.

The items of the E-NWR are controlled for length, prosody and syllable structure. The items are consistent with English phonology and phonotactic rules. Those consonants and vowels that occur frequently in English are included, whereas those consonants that are considered to be acquired only later in a child's development are excluded. The latter is done in order to avoid task results becoming confounded by the normal errors made by children during the development of articulation.

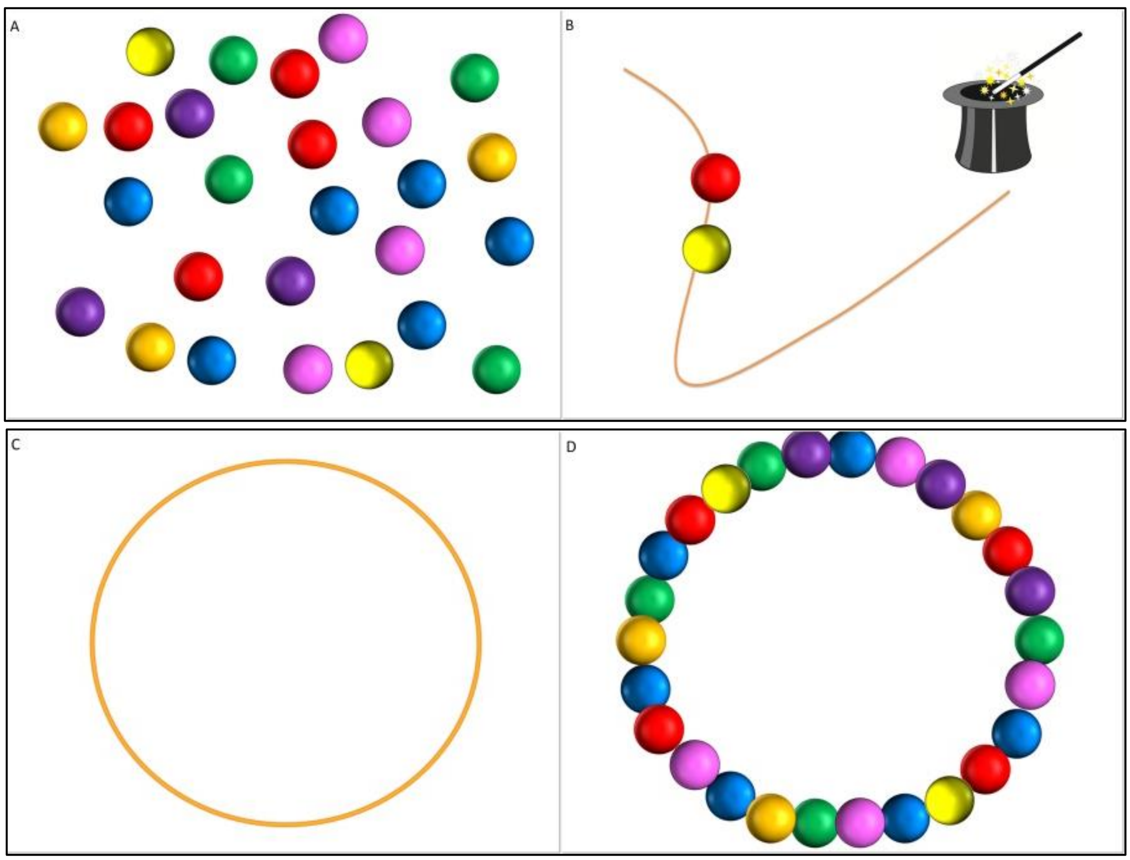
There were three existing versions of the test recordings, namely British English, Canadian English and French-Canadian. The items remain the same across languages; however, the accent of the speaker is different in each instance. For the current research, all non-words were re-recorded by the author, as the available recordings were not deemed suitable for use with children who are more accustomed to a South African accent. The recordings were made using a Zoom H2 Handy Recorder and the files were subsequently cut and amplified using Audacity recording and editing software version 2.0.6 (Audacity Team, 2014) in order to achieve the best clarity possible. Refer to Appendix F for the list of non-words that were used, which has been included with the permission of the authors (Crosslinguistic Nonword Repetition Framework: British English version; Chiat, Polišenská & Szewczyk, 2012, re-produced from Chiat, 2015: 149-150).

Both the CL-NWR and the E-NWR were presented on a laptop through a PowerPoint presentation which had the audio files embedded in the slides. The PowerPoint slides were accompanied by a short and simple story, called the "Bead Game" (Polišenská & Kapalkova, 2014), which was narrated to the participant. Some changes were made to the original story in order to simplify it further:

"Thandi made a necklace for her Mom. She used colourful beads. But the necklace broke! And the beads all fell down. We can help them. With the magic words, we can make a new necklace. When you say the magic word, you will get a bead on the necklace. Let's try it!"

The child heard the target non-word being played, after which s/he was expected to repeat the non-word. The child was rewarded with a colourful bead that appears on the screen after every repetition. Each item corresponded to a bead, and by the end of each task, all the beads together formed a necklace. Refer to Figure 3.1 for an example of the pictures which accompany the slides.

Figure 3.1. Pictures from the Bead Game, A) depicting the loose beads, B) the magic words and practice items, C) an empty necklace and D) a completed necklace (Polišenská & Kapalkova, 2014).



The test includes two practice items, which are not scored, followed by 16 items for the CL-NWR and 24 items for the E-NWR. The scoring can be done either according to the percentage of phonemes correct or as whole-item scoring. For the current study, whole-item scoring was preferred, which gave a score of either 1 for correct or 0 for incorrect repetitions. It has been found that, when compared, whole-item scoring and phoneme percentage correct yielded equal results but that whole-item scoring was faster (Roy & Chiat, 2004)[9]. All responses were scored online and also recorded on a Sony IC Voice Recorder so that the online scoring could be checked by a blind rater after data collection.

3.4.3 Visuospatial Working Memory tasks

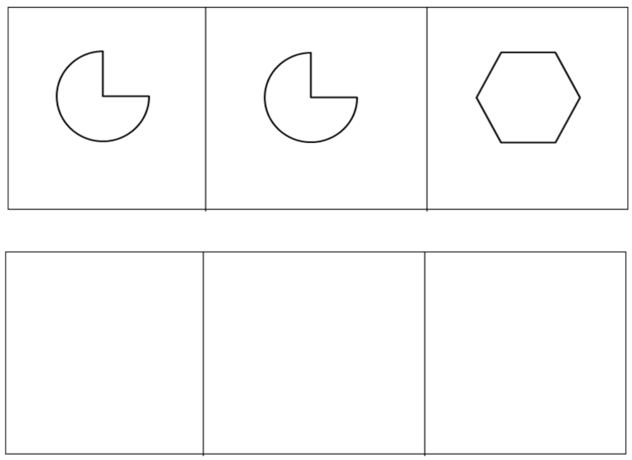
Odd-one-out (Henry, 2001)

The Odd-one-out task is a widely used visuospatial working memory task which is suitable for children aged 4 years and older (e.g., Leonard, Weismer, Miller, Francis, Tomblin & Kail, 2007; Vugs, Hendriks, Cuperus & Verhoeven, 2014; Vugs, Knoors, Cuperus, Hendriks & Verhoeven, 2015). In this task, the participant is asked to look at a grid containing three shapes, which are simple black and white line drawings; refer to Figure 3.2 for an example. Two of the shapes are alike and one shape is different, in other words the shape that is the odd-one-out. The participant should identify and point to the odd-one-out shape. The participant is then expected to remember its position and to point to it on an

[9] For example, the NRep and the Preschool Repetition Test (Seeff-Gabriel, Chiat & Roy, 2008) and the Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996) also use whole-item scoring.

empty grid that corresponds to the positions of the previously shown shapes; see the bottom grid in Figure 3.2. The paper version of this task was used.

Figure 3.2. Example of an item at Level 1 of the Odd-one-out task (Henry 2001)



The task starts with Level 1, which only requires the child to remember one odd-one-out item's position. The test gradually increases in difficulty until Level 6, where six positions need to be recalled. Each child is shown two practice items in order to become acquainted with the task, an item from Level 1 and an item from Level 2. There are three trials for every level and if the child fails to get two out of the three trials correct, the task is discontinued. The score is recorded as either correct or incorrect; if the child remembers the position(s) of the shape(s), the trial is scored as correct; otherwise the trial is scored as incorrect. The raw score is the sum of the number of trials that the child completed successfully. The Odd-one-out task (Henry, 2001) was presented to each child, without making any changes to the procedure outlined above.

Corsi blocks task (Corsi, 1972)

The *Corsi blocks* task is a nonverbal visuospatial working memory task that consists of participants watching blocks being highlighted in a specific sequence; in the paper version of the task, the blocks are tapped by the tester, and in the electronic version, the blocks light up (see below). The participants are expected to reproduce the sequence, which increases in length as the trials progress. This task has been widely used in both typical and clinical populations and has the reputation of being one of the most important nonverbal tasks in neuropsychological research (Pagulayana, Buscha, Medina, Bartok and Krikorian, 2006:1043). However, there is a lack of standardisation of the test procedure, and there are variations in most of the task's parameters, such as the task procedure, scoring and even the task apparatus (Berch, Krikorian & Huha, 1998). Fischer (2001) found that differing task variables in fact do have an effect on the performance of the participants; for example, the amount of time that the participant is exposed to the item affects his/her response accuracy. These variations in task administration do not only occur between studies but also within studies, as human error is understandable and sometimes unavoidable in timing or scoring online. Taking this into account, it was decided that for the current study the *Corsi blocks* task would be presented electronically, where the software would ensure that the variables are kept consistent across the duration of the study.

Therefore, the *Corsi blocks* task was presented electronically on a laptop through the Psychology Experiment Building Language (PEBL) software version 0.14 (Mueller, 2011). The aforementioned software allows the user to set the parameters of the experiment as desired. As a consequence of there being some variation across the literature as to the parameters of the task and the administration thereof (see Berch, Krikorian & Huha, 1998), all parameters were set according to those described in Pagulayana et al. (2006). The participant was shown nine blue blocks on a black background which were presented on a laptop screen. These blocks lit up one at a time, by turning yellow, for a duration of 1000ms. Immediately after the sequence had been revealed, the child was asked to reproduce it in the same order by pointing to the blocks. The author clicked on the blocks to which the children had pointed. When the blocks were clicked on, they lit up and made a short beeping sound. The sound and colour remained the same for both the incorrect and correct blocks that may be clicked on; in other words, the child was given no indication of whether s/he had reproduced the sequence correctly. There were three trials for every sequence length, and if the participant correctly reproduced two of the three trials, the test continued with the next series, otherwise the task ends. The block span started at two and could reach a maximum block span of nine. The participant was given two practice trials before the scoring started, at which time the tester gave guidance if there was something which remained unclear.

The PEBL Corsi Block Tapping task software (Mueller, 2011) records the participant's performance in terms of block span and total correct trials. The block span corresponds to the longest sequence that was correctly reproduced whereas the total correct trials reflects the number of trials that the participant repeated correctly.

3.4.4 Language tasks

Developmental Evaluation of Language Variation - Criterion Referenced Edition (DELV-CR) (Seymour, Roeper & De Villiers, 2003)

The task that was used to assess the English language abilities of the participants was the *DELV-CR* (Seymour, Roeper & De Villiers, 2003). Seymour et al. (2003) created the test to target structures which are said to underlie all common varieties of English and which are dialect neutral. The *DELV-CR* has been utilised successfully in a number of South African studies (e.g., Jordaan, 2011; Marshall, 2013; Meirim, Jordaan, Kallenbach & Rijhumal, 2010) and is suitable for use with native speakers of English as well as ELLs between the ages of 4 and 9 years old. Furthermore, the *DELV-CR* was designed with the intention of targeting language areas that are known to be indispensable for a child to succeed in his/her early school career (De Villiers, 2004).

The *DELV-CR* assesses both comprehension and production skills across four domains of language; namely syntax, semantics, pragmatics and phonology.[10] Firstly, the syntax domain consists of three target areas: Wh-questions, passives and articles. The overall aim of this domain is to ascertain the deeper level of syntactic knowledge without the superficial morphosyntax (de Villiers, de Villiers, Pearson, Roeper & Seymour, 2003). The Wh-question items require the child to comprehend questions that are asked about a short story. The understanding of questions is vital for a child's school success as the interactions between learner and educator are often based on question asking and

[10] The fourth category, namely phonology, requires the child to repeat a sentence, which the researcher reads out loud, while the child is looking at a corresponding picture. This task was omitted from the test battery because it was deemed unnecessary on account of the similarity between that task, the Peabody Picture Vocabulary Task (Dunn & Dunn, 2007) and the non-word repetition tasks (Chiat, Polišenská & Szewczyk 2012).

answering (Tofade, Elsner & Haines, 2013). The passive items which are tested serve to tap into the underlying knowledge that the child has of English syntax, as these constructions are more difficult to interpret than active sentences (e.g., Slobin, 1966). Furthermore, the items which test the child's knowledge of articles shed light on the child's ability to form a cohesive discourse; articles not only refer to what is inside the sentence being spoken but it can also refer to aforementioned information (Pearson & de Villiers, 2005:10).

Secondly, the pragmatics domain consists of communicative role-taking, short narratives and question-asking which are all aspects of language that are important for communication within and outside of the school context. These subtests are mainly concerned with assessing whether the child can comprehend the perspective of speakers, can link events to one another by their temporal relationship, has developed theory of mind, and whether the child is able to formulate questions based on provided information (de Villiers, de Villiers, Pearson, Roeper & Seymour, 2003). Tabors, Roach and Snow (2001) assert that these aspects found in a child's oral or spoken language will predict their ability to write narratives later in their school career. Moreover, as stated previously, the ability to ask questions is a skill that is demanded of the child throughout his/her entire school career (Tofade, Elsner & Haines, 2013). For these reasons, the question-asking subtest is included in the *DELV-CR* to discover whether the child is able to take information and transform it into a viable question.

Thirdly, the semantics domain consists of verb contrast, preposition contrast, quantifiers, and fast mapping of verbs, and thus approaches semantic knowledge without testing the size of a child's vocabulary. Instead, the focus is placed on evaluating how the lexical items are organised within the lexicon by using a high number of verb and preposition contrasts in the stimuli and thus moving away from the more commonplace practice of testing nouns. If the child's vocabulary is well organised, then retrieval of the contrasts will be quicker and more accurate (Owens, Metz & Haas, 2003). The choice was made to use verbs in particular because verbs are more culturally and dialectally neutral than nouns, and the knowledge of verbs is an integral part of language learning (Tomasello & Merriman, 1995). The prepositions task taps the child's knowledge of spatial and grammatical prepositions. The quantifier task tests the comprehension of the word 'every', which is an especially important quantifier for mathematics (Seymour et al., 2003). The final task in this domain is one that tests the child's ability to fast map verbs, in other words to derive the meaning of a novel verb from the context in which it is used. The children thus make links between the syntactic and semantic categories in order to create meaning, which is referred to as syntactic bootstrapping (Gleitman, 1990). The ability to make use of syntactic bootstrapping is highly important for a child to learn new words and derive meanings of words never heard before.

All the domains examined by the DELV-CR are scored in the same way; answers are either correct or incorrect. If the answer is incorrect, a 0 is awarded, and if it is correct, either a 1 or a 2 is awarded, depending on the guidelines in the manual. The scores from each subtest are added together to yield a score for each of the three domains. The Criterion Referenced edition is structured so that the child's score on each domain will put them into a group based on the standardisation, namely weakness, low average, average, or strength categories (Seymour, Roeper & de Villiers, 2003). Whereas the DELV was administered to each participant following the specifications in the manual, the participants were not divided into the categories weakness, low average, average, or strength for the current study because they were not compared to the standardisation sample but rather to their peers and to themselves across the year of testing.

Peabody Picture Vocabulary Test (PPVT-4) (Dunn & Dunn, 2007)

The *PPVT-4* is a receptive vocabulary test that is suitable for a vast age range; the starting age is 2 years and 6 months and goes up to 90 years and older. The test consists of colour pictures that are presented to the participant four pictures at a time. The examiner says a word aloud and the participant then points to the picture that matches the word. There are three distractor pictures and one target picture. Distractor items are only based on semantic resemblance to the target and not on phonetic resemblance, which reduces possible confounding effects. The test consists of 228 items, divided into 19 sets of 12 items. Items include nouns, verbs and adjectives in categories such as food, clothing, body parts, musical instruments, tools and emotions. The *PPVT-4* was designed to have a more equal distribution of these different categories than the earlier versions of the same test (Dunn & Dunn, 2007).

Following the specifications set out in the manual, each participant was shown the set that matches his/her age at the time of testing. If the participant made 0 or 1 errors on this set, it became the basal set, otherwise the participant was shown the preceding sets until a basal set had been established. The participant then continued with the test until eight or more mistakes were made in one set, at which time the participant had reached his/her ceiling set and the testing was discontinued. The participant's raw score was therefore the number of the item that was administered last, minus the items that were answered incorrectly.

3.5 Procedure

Consenting parents were contacted via phone call or email to make an appointment to be interviewed with the BiLEC questionnaire (Unsworth, 2013). As a result of the difficulty of finding a time which suited the parents, the parent interviews took an extended period of time to complete. Due to the strict commencement time for data collection (recall that the study was set up in a way that required the children to be tested at the very beginning of their first year of formal schooling), some children were tested before the full BiLEC was conducted with their parents. In this circumstance, parents were asked only the questions pertaining to the participant selection criteria in order to determine if their child qualified to be included in the study (see Appendix G for these questions). These parents were then later interviewed with the full BiLEC, at their convenience.

After analysing the parents' responses to the BiLEC, it became clear that the built-in formulae could not account for the amount of code-switching that was present in the parents' language use. This could neither be accounted for by quality nor quantity of input, and therefore rendered the use of the BiLEC inaccurate for the calculation of a precise amount of language exposure. Considering the self-reported and author-observed poor level of parental English (which pertained to the quality of English input that their child would receive) and their self-reported propensity for code-switching (pertaining to the quantity of input available to their child), it is unlikely that the English language input was beneficial for the children's English development (e.g., Golberg et al., 2008; Paradis, 2011; Paradis & Kirova, 2014). Due to the children's age of first exposure to English being comparable, it was therefore decided to only use age of first exposure as a measure of input.

For each child participant, three testing sessions were completed over the course of one year (T1, T2 and T3), with a 4-month window between each testing session. The order in which the children were tested was kept constant over the three data collection points in order to ensure that the time spans between the testing sessions were kept as close to four months as possible for each child. All children were tested by the author at the school during school hours. Testing was conducted individually in a quiet room, and sessions lasted between 50 and 70 minutes, including short breaks if it was observed that the child's attention was waning.

During each testing session, five tasks were administered: the Diagnostic Evaluation of Language Variation-Criterion Referenced (DELV-CR) of Seymour, Roeper and De Villiers (2003); the Peabody Picture Vocabulary Test-Fourth Edition (PPVT-4) of Dunn and Dunn (2007); the Odd-one-out (Vugs, Knoors, Cuperus, Hendriks & Verhoeven, 2015); Corsi Blocks (Corsi, 1972); and the CL-NWR and E-NWR (Chiat, Polisenska & Szewczyk, 2012). Practice items for the working memory tasks were doubled and verbal instructions were avoided as far as possible. Instead, the child was encouraged to mimic the author who demonstrated the task on the first practice items. This was done in order to avoid the possible confound of the child not understanding the verbal instructions due to the lack of knowledge of English and this lack of understanding negatively affecting their scores.

The CL-NWR, the E-NWR and the Corsi blocks (Corsi, 1972) were both presented on a laptop whereas all the other tasks were in paper format. Responses were voice recorded for the CL-NWR and the E-NWR, and items were scored online as either correct or incorrect. A total of 10% of the voice-recorded responses were taken from each testing session in order to be re-scored by an expert in the field who was blind to the original scoring, in order to ascertain the level of agreement between the ratings. The correlation between the first rater and the blind rater's scoring was very high for the E-NWR (r = .966) and high for the CL-NWR (r =.786), indicating a high agreement between ratings.

The longitudinal nature of the study necessitated the use of tests which were able to be used three times in one year without eliciting practice effects. This consideration was addressed by using tests such as the PPVT-4 (Dunn & Dunn, 2007), Odd-one-out (Vugs et al., 2015) and the Corsi Blocks (Corsi, 1972) which all increase with difficulty as the participant gets more items correct. The participant will therefore see new items when s/he completes the test at the next testing session. This was not the case for the DELV-CR (Seymour et al., 2003) or the CL-NWR and E-NWR (Chiat et al., 2012), therefore the time between testing sessions was maintained at a set duration, with four months between each testing session. This was a sufficient length of time to minimise practice effects for the latter mentioned tests.

I would add a note about learning effect and how you controlled for it HERE, Michelle.

3.6 Data analysis

Raw scores were used for all tasks instead of standard scores, because standard scores cannot be assumed to be suitable for the sample that was tested; the current sample was bilingual and mid to low SES, unlike the monolingual standardisation samples that were usually mid to high SES. The tasks mentioned in the previous section that were used for this study were all scored on different measurement scales. Therefore, in some cases, where the specific statistical method did not automatically account for it, z-score transformations were used to make the tasks more comparable. The statistical methods that were utilised were chosen according to the research question that was posed. All analyses were undertaken in R (R Core Team, 2013). Due to the unequal group sizes (ELL: n=27; Eng: n=7), both parametric and non-parametric methods were used. The statistical method used in each of the three articles, which are contained in Chapters 4 to 6, is stated below.

Article 1: The organisation of working memory in children across their first year of formal education (Chapter 4)

Firstly, the non-parametric Mann-Whitney U Test was conducted to calculate the group difference between ELL and Eng. Non-parametric analysis was preferred because it is better suited for analysing the results from groups of unequal sizes. Secondly, Pearson's correlation coefficients were calculated for all tasks in the ELL group in order to demonstrate the relations between the various working memory tasks. Lastly, exploratory factor analysis was conducted on the four working memory tasks to uncover the underlying structure of the working memory components that were measured. This was done to answer the first research question, restated here for ease of reference: Are phonological and visuospatial working memory maintained by separable cognitive resources or by one common resource?

Article 2: The development of English proficiency and working memory in 5-6 year old ELLs in their first year of formal education

Growth curve analysis was used to investigate the change in the working memory and language development in the ELL group across the three time points. Linear mixed regression models were used to estimate the growth curves. As a result of the small sample size of the Eng group, non-parametric tests had to be used to calculate the trajectory of growth. The proportional change, between T1-T2 and T2-T3, was calculated, and a Wilcoxon test was run on these results. This informed the answer to the second research question: How does an ELL's English proficiency and working memory develop in their first year of formal education?

Article 3: Phonological working memory and non-verbal complex working memory as predictors of future English outcomes in young ELLs

Bivariate correlations were calculated, which demonstrated the longitudinal relationships between the working memory measures and language measures. Subsequently, a multiple linear regression model was fit to the data and each language measure was treated separately by putting it into its own model. This allowed the author to answer the third research question: Do phonological working memory and non-verbal complex working memory predict future English outcomes in English language learners?

RESEARCH ARTICLE I

The organisation of working memory in children across their first year of formal education

4.1 Introduction

"Working memory" is defined as the ability to retain and manipulate information over short periods of time (Baddeley & Hitch, 1974; Just & Carpenter, 1992). There have been numerous studies over the past decades which have explored the notion of whether working memory is a unitary or a nonunitary phenomenon. The general consensus among researchers is that working memory cannot be defined as unitary, but rather as a single store that is made up of separable components (see Miyake & Shah, 1999 for an overview). It has been found that models claiming that there is no differentiation whatsoever within working memory, in other words that there are no domain-specific constructs, remain empirically unfounded (Miyake & Shah, 1999). This however does not rule out the existence of an overarching mechanism that may control these separable components, such as controlled attention (see Engle, Kane & Tuholski, 1999 for a review). Although consensus has not been reached about how working memory is fractionated into its subsystems, or how exactly these function in concert with each other, some agreement has been established that there is a basic distinction between verbal and visuospatial aspects of working memory.

Numerous researchers have attempted to account for working memory with differing theoretical accounts. The most notable and influential amongst these is the multicomponent model of Baddeley and Hitch (1974). Baddeley and Hitch propose a central executive, which is the mechanism responsible for attentional control, and two slave systems, namely the phonological loop and the visuospatial sketchpad. The phonological loop consists of a phonological short-term store of limited capacity and a verbal rehearsal process, whereas the visuospatial sketchpad integrates spatial and visual information into a single representation which can be stored and processed. The updated version of this model includes an episodic buffer, which serves to integrate different representations within the working memory system and between working memory and other cognitive functions (Baddeley, 2000). The presence of a centralised component, the central executive, which manages the processing of tasks, leads to this model being referred to as giving a domain-general account of working memory.

Conversely, Shah and Miyake (1996) proposed that working memory is divided into two domain-specific constructs, namely visuospatial and verbal. However, these constructs are not on the same level as the slave systems postulated by Baddeley and Hitch (1974); instead, they function at a higher level more akin to a differentiation of the central executive. Also, there is no shared component proposed; alternatively, it is postulated that each of the two constructs are capable of processing and storing information independently of one another. Therefore, this model is considered to be a domain-specific approach to working memory. Evidence is offered for their position by a study examining two complex working memory tasks, namely reading span and spatial span (Friedman & Miyake, 2000). Their study found that reading span scores predicted performance on reading comprehension but did not predict outcomes on visual tasks. The performance on spatial span tasks predicted the performance on spatial tasks but not on reading comprehension. As a result of these findings of correlational dissociations, they deemed it necessary to make a distinction between verbal and visuospatial aspects at a higher level than the phonological loop and the visuospatial sketchpad.

There is a large body of research that has attempted to uncover the structure of working memory with different populations. A study by Gathercole, Pickering, Ambridge and Wearing (2004) was conducted with 4 to 15 year old monolinguals in order to evaluate how working memory develops and changes during childhood, in terms of Baddeley and Hitch's (1974) multicomponent model. They found that the three basic components of the model, the central executive, the visuospatial sketchpad and the phonological loop, exist from the age of 6 years. Further support has been found for Baddeley and Hitch's model with studies of children between 4 and 11 years of age (Alloway, Gathercole & Pickering, 2006; Nadler & Archibald, 2014). The discovery of strong dissociations between the measures of the visuospatial sketchpad and the phonological loop advocate for the independence of the systems, which is in line with what was also found by previous studies (Jarvis & Gathercole, 2003; Pickering, Gathercole & Peaker, 1998). The strong dissociations found by Jarvis and Gathercole (2003) between verbal and nonverbal tasks advocate for a domain-specific account in older children. This is in line with what has also been found in studies with adult participants (Friedman & Miyake, 2000; Jurden, 1995; Miyake, Friedman, Rettinger, Shah & Hegarty, 2001; Shah & Miyake, 1996).

Generally, studies measure working memory capacity through complex tasks which require the short-term storage of information and the subsequent processing of such information or even additional, sometimes unrelated, information. Working memory tasks differ from short-term memory tasks in that they require processing of information. Short-term memory is considered to be a passive process and only taps the ability to briefly store information, without other information processing demands. A domain-general approach to working memory predicts that working memory tasks place an extra processing load on the central component, such as the central executive, while the storage aspect of the task is supported by the relevant specific component, such as the phonological loop or the visuospatial sketchpad. Variation in performance on working memory tasks that tap into different components and variation in performance on short-term memory and working memory tasks would be explained by the domain-general account of working memory. Alternatively, a domain-specific approach expects that both the processing and storage aspects of working memory tasks, or the storage requirements of short-term memory tasks, are linked to the specific visuospatial and verbal domains. Consequently, taking such an approach entails the expectation that performance on a visuospatial task would not predict performance on a verbal task and vice versa.

It should be noted that the terms "working memory" and "short-term memory" are at times used interchangeably in the literature, especially when referring to the classification of certain memory tasks. For example, block recall tasks, which include the Corsi blocks task, have been referred to as a test of working memory (e.g. Bull, Espy & Wiebe, 2008; Cowan, Donlan, Newton & Lloyd, 2005; Fisher, 2001, Lehmann, Quaiser-Pohl & Jansen, 2014) but also short-term memory (e.g. Alloway, Gathercole & Pickering, 2006). Likewise, non-word repetition has been referred to both as a working memory task (e.g. Gathercole, 1995; Gathercole Willis, Emslie, Baddeley, 1994; Gray, 2006; Munson, Edwards & Beckman, 2005) and as a short-term memory task (e.g. Alloway, Gathercole & Pickering, 2006; Archibald & Gathercole, 2006; Nadler & Archibald, 2014). This inconsistency could be due to short-term memory often being incorporated into the definition of working memory, where "working memory" is used as an all-encompassing term. However, it might just be a matter of the researcher's preference (see Cowan, 2008 for a discussion).

4.2 Bilingualism and working memory

The daily use of two or more languages has been demonstrated to elicit changes in performance on cognitive measures (Bialystok, 2009). It has been well established that both languages are almost always active to some extent in the mind of a bilingual individual, which necessitates the ability to monitor the target language while the other language is also activated (e.g. Blumenfeld & Marian, 2007; Dijkstra, Grainger & van Heuven, 1999; Francis, 1999; Hernandez, Bates & Avila, 1996; Kaushanskaya & Marian, 2007; Kroll, Bobb & Wodniecka, 2006; Marian, Spivey & Hirsch, 2003; Sumiya & Healy, 2004). This process is thought to bring about a cognitive change that is evident when investigating the working memory performance of bilinguals. Adesope, Lavin, Thompson and Ungerleider (2010) highlight two hypotheses about the relationship between working memory and bilingualism. Firstly, they hypothesise that managing two languages at the same time could put extra strain on working memory capacity, which would lead to a lower efficiency in information processing (Lee, Plass & Homer, 2006; Sweller & Chandler, 1994). In contrast, the second hypothesis suggests that having the ability to inhibit a language while using another language may increase the efficiency of a bilingual individual's working memory capacity (Bialystok, Craik & Luk, 2008; Fernandes, Craik, Bialystok & Kreuger, 2007; Just & Carpenter, 1992). Experimental studies regarding these two hypotheses have led to mixed results, some yielding a positive cognitive effect of bilingualism and others finding no difference (see Bialystok, 2009 for an overview).

Some studies that have compared monolingual and bilingual children's performance on measures of simple working memory have found no evidence of differences (Blom, Boerma, Bosma, Cornips & Everaert, 2017; Bonifacci, Giombini, Bellocchi & Contento, 2011; Engel de Abreu, 2011). This may be as a result of the differing tasks that were used to measure working memory. For instance, if the tasks demanded a higher amount of verbal processing, such as recalling lists of words, the bilingual participants would be at a disadvantage (Bialystok, Craik, Green & Gollan, 2009). Other factors that may have affected the outcome of studies are differences in general intelligence (Arffa, 2007; Brydges, Reid, Fox & Anderson, 2012; Craik & Bialystok, 2005) or in culture (Carlson & Choi, 2008; Carlson, 2009). Peal and Lambert (1962) published ground-breaking research that has led to new approaches in the experimental study of bilingualism. They noted that results of previous studies had been confounded by variables that were not controlled for, such as socioeconomic status (SES), language of assessment, sex and age. Once Peal and Lambert had controlled for these factors, they found a bilingual advantage on measures of verbal and nonverbal intelligence.

Studies have found bilinguals outperforming monolinguals on tasks that measure various cognitive aspects, such as attention tasks (Engel de Abreu, Cruz-Santos, Tourinho, Martin & Bialystok, 2012; Martin-Rhee & Bialystok, 2008) and on both attention and working memory tasks (Antoniou, Grohmann, Kambanaros & Katsos, 2016; Blom, Küntay, Messer, Verhagen & Leseman, 2014; Kaushanskaya, Gross & Buac, 2014). Morales, Calvo and Bialystok (2013) found that bilingual children outperformed their monolingual peers on working memory tasks across two different experiments using simple and difficult conditions. A systematic review by Adesope et al. (2010) attempted to make sense of the variability between findings; they found that bilingualism is associated with various cognitive benefits in the domains of abstract and symbolic representation, metalinguistic and metacognitive awareness, attentional control and problem solving. Adesope et al. concluded that the cognitive capacity required to effectively manage two languages enhances attentional resources and develops abstract symbolic representations, referring specifically to the awareness that words and their referents are related arbitrarily and have an abstract symbolic relationship. However, any overall conclusion about a cognitive advantage in bilingualism remains controversial because, as stated in Section 1.4 of Chapter 1, more recent studies have been unable to replicate these findings (Anton et al., 2014; Duñabeitia et al., 2014; Gathercole et al., 2014).

A disparity between findings pertaining to the performance of monolingual and bilingual children is also apparent on a popular measurement of phonological working memory, namely non-word repetition. A number of studies have found that monolinguals outperform bilinguals on non-word repetition tasks (Engel de Abreu, 2011; Engel de Abreu, Baldassi, Puglisi & Befi-Lopes, 2013; Kohnert, Windsor & Yim, 2006; Messer, Leseman, Boom & Mayo, 2010; Windsor, Kohnert, Lobitz & Pham, 2010). This has led to the conclusion that if phonological representations in the second language are not well defined at the time of testing, children may perform poorly (Gathercole, 1995). Contrastively, other studies have found no significant differences between the performance of monolingual and bilingual groups (Chiat & Polišenská, 2016; Cockcroft, 2016; Lee & Gorman, 2013; Lee, Kim & Yim, 2013; Thordardottir & Juliusdottir, 2013). These conflicting results have fuelled the debate as to whether non-word repetition tasks draw on long-term lexical knowledge or whether they are non-lexical, therefore taking the role of a non-language specific measure of phonological working memory (Archibald, 2008; Gathercole et al., 1999; Kohnert, Windsor & Yim, 2006).

The current study sets out to explore the working memory of English language learners in their first year of formal schooling. There are three aims of the study: firstly, to uncover whether ELLs have a cognitive advantage over their monolingual peers. The second aim is to provide a glimpse into the organisation of working memory components, specifically whether visuospatial working memory and verbal working memory are separable or whether they have a shared component. The final aim is to ascertain whether these two aforementioned assumptions remain constant over one year, in other words whether the findings hold true for before and after the children have undergone their first year of formal education.

4.3 Method

4.3.1 Participants

Participants were 27 English language learners (ELL) and seven monolingual English children (Eng) aged 5;5 to 6;3 who were sampled from the same multicultural, mid to low SES, suburban school. As explained in Section 3.2.2 of Chapter 3, SES was based on the primary caregiver's highest level of education, measured on a scale from 1-8: early childhood education (1), primary education (2), lower secondary education (3), completed secondary education (4), post-secondary short study (5), tertiary education diploma (6), tertiary education degree (7), and Master's level (8). Table 4.1 below shows the number, sex, average SES and average age of the children at two of the three data collection point. Note, that although there were three collection points, only the data of the first and last are considered in this chapter. The first and the last data collection points yielded the data which pertains to the research question to be answered in this chapter, as explained below.

Table 4.1. Number, average age, sex and SES in the ELL and Eng groups across the two relevant data collection points.

Group	Number	Sex (M, F)	Average SES	Average age	
ELL	27	12, 15	3	At T1[a]	5;6
				At T3[b]	6;3
Eng	7	3, 4	3	At T1	5;5
				At T3	6;1

[a] T1 = first point of data collection, at the beginning of their first year of formal schooling
[b] T3 = third and last point of data collection, at the end of their first year of formal schooling

4.3.2 Procedure and materials

For the measurement of working memory, two testing sessions were conducted, as stated above: one at the beginning of the school year (T1) and one at the end of the school year (T3). T1 and T3 were preferred as the points of testing because T1 was before the children had exposure to formal schooling and T3 was after the first year of their formal schooling. These two time points will serve to answer the second research aim of this study, namely whether a year of formal schooling affects the organisation of working memory.

Each child completed the tasks in an individual session in a quiet room in the school. The children engaged in two tasks which tap into phonological working memory (non-word repetition) and two tasks tapping into visuospatial working memory (odd-one-out and block span). Both of the visuospatial working memory tasks were administered using a span procedure, in other words starting at the simplest list level and increasing by one item when the lists were completed correctly. The procedure and all tasks were repeated at the end of the school year with the same children.

Phonological working memory

Two non-word repetition tests were used, namely the Language Specific non-word repetition (E-NWR) (Chiat, 2015), based on English phonotactics, and the Cross-linguistic non-word repetition (CL-NWR) (Chiat, 2015). Both the E-NWR and the CL-NWR were presented on a laptop through a PowerPoint presentation. The presentation is accompanied by a short story, called the Bead Game (Polišenská & Kapalkova, 2014), which is narrated to the participant before the non-words are played.

Visuospatial working memory

The Odd-One-Out task (based on Henry, 2001) as well as the Corsi blocks task (Corsi, 1972) were used. The Odd-One-Out task requires the child to choose one out of the three basic line drawings that is different from the other two and then to remember its spatial position. The child makes subsequent decisions about the next set of shapes and holds these subsequent spatial positions in mind as well. The child must then point to the position of the odd shapes on a blank grid. The Corsi blocks task was presented electronically on a laptop. The participant was shown nine blue blocks on a black background which light up one at a time in a variable sequence. The blocks remained lit for a duration of 1000ms. After the child has seen the full sequence, s/he is asked to reproduce the sequence by pointing to the blocks in the order in which they were lit up.

4.4 Results

Descriptive statistics for the raw scores of the four working memory tasks are given in Table 4.2. The means and standard deviations are reported for both the ELL and the Eng group at T1 and T3. A cursory look at the means shows improvements in performance for all the working memory tasks across the school year. Raw scores were then utilised to create plots for each task that graphically show the means at T1 and T3, with separate groups for ELL and Eng. See Figure 4.1 for the plots categorised under visuospatial working memory and phonological working memory.

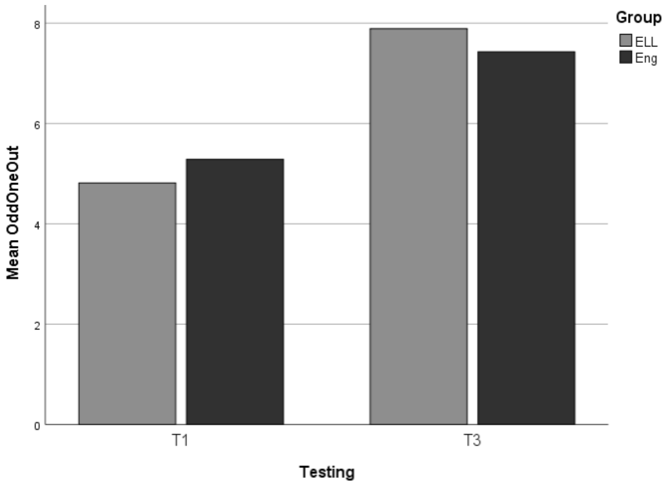
Table 4.2. Means and standard deviations in the ELL and Eng groups across T1 and T3.

	T1			
	ELL		**Eng**	
Measure	**Mean**	**SD**	**Mean**	**SD**
OddOneOut	4,81	1,075	5,29	1,604
CorsiBlocks	4,74	1,913	4,71	1,604
CLNWR	10,26	2,754	10,14	1,215
ENWR	13,7	3,911	14,86	4,298
	T3			
OddOneOut	7,89	1,281	7,43	2,225
CorsiBlocks	7,93	1,207	8	2,082
CLNWR	14,19	1,665	15	1,155
ENWR	19,63	3,804	20,14	3,805

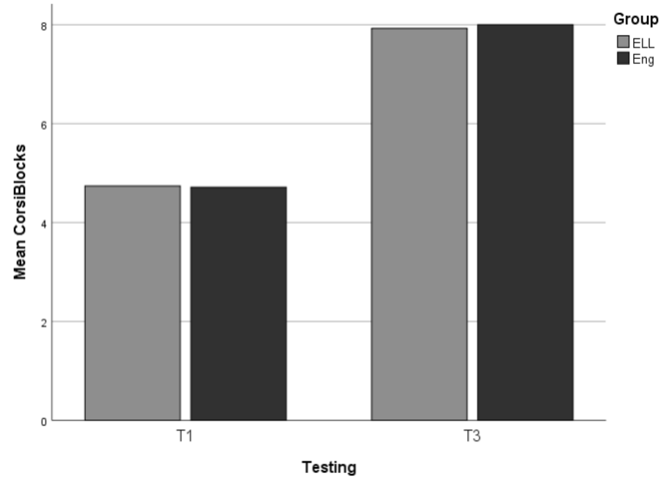
Figure 4.1. Mean raw scores for the four tasks across T1 and T3.

Visuospatial working memory

Odd-one-out

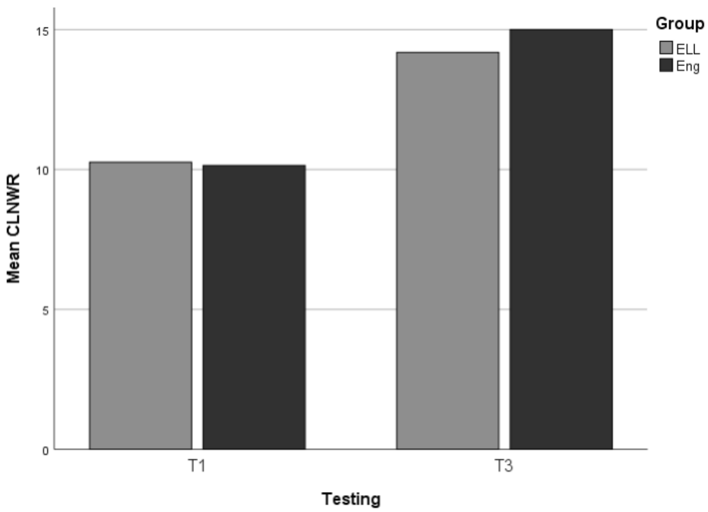


Corsi blocks

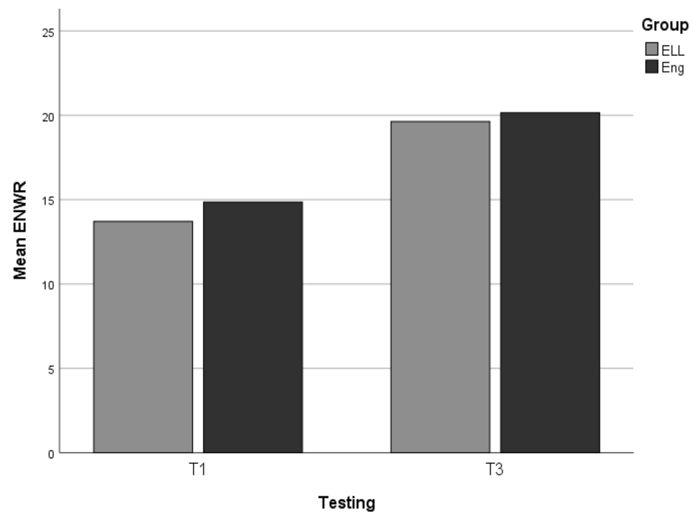


Phonological working memory

Cross-linguistic non-word repetition (CL-NWR)



Language Specific non-word repetition (E-NWR)



To determine whether there was an effect of Group (ELL versus Eng) on working memory performance, the non-parametric Mann-Whitney U Test was conducted. This test was preferred because it is more suited for analyses with unequal sample sizes (ELL: n=27, Eng: n=7). At T1, there was no significant difference for Group on any of the tasks (CL-NWR: U=94, p=0.983; E-NWR: U=92, p=0.915; Odd-one-out: U=92, p=0.913; Corsi: U=89, p=0.813), and at T3 no significant differences were found either (CL-NWR: U=94, p=0.983; E-NWR: U=89, p=0.814; Odd-one-out: U=88, p=0.777; Corsi: U=84, p=0.650).

In order to conduct the analysis across the four working memory tasks, the raw scores of each task were converted to z-scores. This was necessary because the four tasks are not standardised and their rating scales are different from one another. In order to ascertain the effect of Sex (male versus female) and SES on the visuospatial and phonological working memory tasks in the ELL group, a one-way multivariate analysis of variance (MANOVA) was conducted. The MANOVA on the two phonological working memory tasks (CL-NWR and E-NWR) revealed that there is no significant effect of Sex at T1 (F(2,24)=1.28, p=0.295, η^2_p=0.107) or at T3 (F(2,24)=1.323, p=0.285, η^2_p=0.110). At T1, no significant effect of SES was found on the phonological working memory tasks (F(2,24)=0.589, p=0.563, η^2_p=0.049), and at T3, no significance was found either (F(2,24)=0.494, p=0.616, η^2_p=0.041). Moreover, no significant effect of Sex was found for the visuospatial working memory tasks (Odd-one-out and Corsi blocks) at T1 (F(2,24)=0.505, p=0.610, η^2_p=0.042) or at T3 (F(2,24)=1.022, p=0.375, η^2_p=0.085). There was also no significant effect of SES on the visuospatial working memory tasks at T1 (F(2,24)=0.079, p=0.924, η^2_p=0.007) or at T3 (F(2,24)=0.509, p=0.608, η^2_p=0.042).

Pearson's correlation coefficients were then calculated for all tasks in the ELL group so that the relations between the various tasks could be shown. Table 4.3 demonstrates the results from the correlation analysis. There is a strong correlation between CL-NWR and E-NWR at both T1 (*r*=0.622, *p*<.001) and at T3 (*r*=0.655, *p*<.001). Interestingly, no significant correlations were found between the visuospatial working memory tasks.

Table 4.3. The correlation coefficients of the ELL group across all tasks as measured at Time 1 (T1) and Time 3 (T3)

Tasks	**Odd-one-out**	**Corsi**	**CL-NWR**	**E-NWR**
Odd-one-out (T1)	1	0.163	0.290	0.380
Odd-one-out (T3)	1	0.094	-0.134	0.323
Corsi (T1)		1	-0.155	-0.093
Corsi (T3)		1	-0.050	-0.040
CL-NWR (T1)			1	0.622***
CL-NWR (T3)			1	0.655***
E-NWR (T1)				1
E-NWR (T3)				1

*** *p* < .001

Following the aforementioned Mann-Whitney U analysis that showed no difference between groups, the two groups (ELL and Eng) were collapsed to form one group (*n*=34) for the exploratory factor analysis.[11] An important consideration of factor analysis is that

[11] Traditionally, factor analysis is run on large samples, where n>150. However, small samples have been found to yield usable results, see de Winter et al. (2009) for a discussion. Moreover, for

the latent variable(s) underlying the observed variables (the working memory assessments in this case) is the key concern. Exploratory factor analysis was conducted on the four tasks in order to uncover a possible underlying structure of the working memory components that were measured. The first step was to perform a parallel analysis in order to determine how many factors underlie the data. This analysis retained two factors[12]. Subsequently, for interpretation of the two factors, a varimax orthogonal rotation was used. Factor loadings above 0.4 were considered significant. The analysis was run on both T1 and T3 results separately because factor analysis assumes independent samples; see Table 4.4 for the factor loadings.

Table 4.4. Factor loadings based on exploratory factor analysis of four working memory tasks.

Factor Loadings			
T1	**Factor 1**	**Factor 2**	**Uniqueness**
Corsi			0.901
CL-NWR	0.584		0.652
E-NWR	0.907		0.158
Odd-One-out		0.676	0.436
T3			
Corsi			0.943
CL-NWR	0.734		0.403
E-NWR	0.993		0.003
Odd-One-out		0.997	0.003

the current analysis, findings are not intended to be generalisable and are deemed applicable to the sample concerned.

[12] Note that these factors stemmed from the exploratory factor analysis and are thus purely statistical, referring to what is underlying the variables and what differentiates them. Factor analysis makes no assumptions about what these factors are. Each factor describes an amount of the overall variance in the observed variables.

As can be seen in Table 4.4, the CL-NWR and the E-NWR loaded highly on Factor 1, whereas the Odd-One-Out task loaded highly on Factor 2. The Corsi blocks task did not load on either Factor 1 or Factor 2 but instead had a very high uniqueness rating, where the uniqueness rating refers to the variance that is unique to the observed variable.

4.5 Discussion

The performance of 5 to 6 year old English language learners (ELL) and English L1 (Eng) children was investigated on four measures of working memory. The working memory part of the study set out with three main aims: to determine whether ELLs have a cognitive advantage over the Eng group, to explore the organisation of working memory components in this sample, and lastly to uncover whether findings remain the same after the children's first year of formal education.

Before addressing these aims, analyses were conducted in order to uncover whether sex or SES played a role in the children's performance on the working memory tasks. The results from the analyses showed that there was no significant influence of SES or sex. This is in line with previous findings, such as Engel de Abreu et al.'s (2012) study, that found no effect of SES on various cognitive measures. SES and sex were thus ruled out as possible confounding factors in the results. Another explanation for the lack of a significant influence of SES is that there was limited variability in the current data.

Addressing the first aim of the working memory part of the study, i.e. to determine whether ELLs have a cognitive advantage over their monolingual peers, it was found that there was no significant difference between the ELL group and the Eng group on any of the measures. Therefore, it can be concluded that there is no marked difference in the cognitive abilities of the groups and that their language experience has not played a role in their working memory abilities. These results therefore add to the wide discrepancy in the literature on whether or not bilingualism provides a cognitive advantage. Bialystok's (2009) overview of the literature shows the disparity between previous studies that have found a bilingual advantage in some cases, and other studies which have not been able to replicate these findings. These differences in outcomes have been attributed to many causes, such as task effects, SES, sex, language of testing and general intelligence (Bialystok, Craik, Green & Gollan, 2009; Peal & Lambert, 1962). The current study attempted to account for as many of these confounds as possible. For instance, the visuospatial tasks that were used had low demands of verbal processing in order not to disadvantage bilingual participants, and the effects of SES and sex were accounted for. Taking the aforementioned considerations into account, the results that were obtained thus lead to the conclusion that, based on the cognitive abilities of the children, there is no bilingual advantage in the studied sample.

The lack of an advantage is particularly interesting in the case of the phonological working memory tasks, which are the only measures of verbal working memory. Non-word repetition tasks are designed to tap the phonological processes that underlie language and therefore strive to be language independent. Consequently, one language group would not be more advantaged than the other. This is however not shown consistently in previous findings, where in some cases monolinguals are found to outperform bilinguals, and in other cases, no difference is found between the two groups. With the intention of removing possible lexical and language effects, Chiat (2015) designed the crosslinguistic non-word repetition task, the same task that was used in the present study. Both Chiat and Polišenská

(2016), and Cockcroft (2016) conducted studies using this crosslinguistic task and found no difference between monolingual and bilingual group performance. The same results were found in the current study, which lends itself to the conclusion that the crosslinguistic non-word repetition task does tap into phonological working memory and is not influenced by prior language knowledge.

In order to address the second aim of the working memory part of the study, i.e. to find out whether visuospatial working memory and verbal working memory are separable or whether they have a shared component, correlation analysis and exploratory factor analysis were conducted. The correlation analysis found a highly significant correlation between the two measures of phonological working memory but no significant relationship between the two measures of visuospatial memory, the Odd-one-out task and the Corsi blocks. The dissociation between the performance on the phonological working memory tasks and that on the visuospatial working memory tasks is in line with the consensus of previous findings that these are two distinct processes.

The lack of a relationship between the Odd-one-out task and the Corsi blocks task is contrary to what was expected, however, as these two tasks are assumed to tap the same visuospatial domain. This result can be regarded as being in line with Baddeley and Hitch's (1974) multicomponent model of working memory, since the Odd-one-out task is at times referred to as a complex working memory task which would tap the central executive, whereas the Corsi blocks task would be relying on the visuospatial sketchpad (e.g. Alloway, 2007). Baddeley and Hitch's (1974) domain-general approach to working memory predicts that the Odd-one-out task will place an extra processing load on the central executive, while the storage aspect of the Corsi blocks task is supported by the relevant specific component, the visuospatial sketchpad. This would advocate for the notion that these two tasks are tapping two distinct cognitive processes. Further confirmation is found in the results of the exploratory factor analysis, where the Odd-one-out task loads on Factor 1 and both phonological working memory tasks load on Factor 2, but the Corsi blocks task is found to differ greatly from both Factor 1 and 2 and its variance cannot be accounted for by the factor analysis.

Taken together, these results are most congruent with Baddeley and Hitch's domain-general account of working memory (1974). The verbal and visuospatial domains are dissociated, and there is a marked separation between a complex (Odd-one-out) and a simple (Corsi blocks) visuospatial task, which provides evidence for a central executive. A domain-specific account of working memory, such as the one put forward by Shah and Miyake (1996), is not able to explain these findings. Shah and Miyake's approach assumes that visuospatial and phonological working memory are two distinct systems that do not have any higher level central component. In their approach, the results of a correlation analysis should show a strong dissociation between phonological and visuospatial working memory tasks, while the tasks that are viewed as phonological should be highly correlated with one another, and so should the visuospatial tasks. However, this is not brought to light by the current findings because Shah and Miyake's approach cannot explain the dissociation between the two visuospatial tasks, namely the Corsi blocks and the Odd-one-out. A higher level component that is tapped during the Odd-one-out task, such as the central executive, proposed by Baddeley and Hitch (1974), is the more plausible explanation for what the current study has found.

The third and final aim of the working memory part of the study was to compare results found at T1 and T3 to determine whether the findings hold true for before and after the children have undergone their first year of formal education. The analysis determined that there were no differences between T1 and T3 results on any of the analyses performed for any of the two groups. The significant results found at T1 remained significant at T3, and non-significant results remained non-significant. This is in line with the assumption that the organisation of working memory structures does not change within the first year of formal schooling, as the structure has been found to remain stable between 4 and 11 years of age (Alloway, Gathercole & Pickering, 2006; Nadler & Archibald, 2014).

The contribution of this chapter is largely theoretical in nature, with its main aim being to investigate the structure of working memory in young children. The current study contributes to the ongoing debates in working memory research by investigating a relatively understudied sample of children, who are English language learners in their first year of school, with a wide array of languages represented in the sample. Furthermore, SES was taken into account, unlike many previous working memory studies which neglected to do so (Hoff, 2003; 2006). Although the longitudinal nature of the study adds some weight to the findings, caution should be exercised when interpreting these results due to the small sample sizes. The results of the working memory part of the current study are not readily generalisable and future research with the same population and larger sample sizes will be necessary to gain further insights.

RESEARCH ARTICLE II

The development of English proficiency and working memory in 5-6 year old ELLs in their first year of formal education

5.1 Introduction

As stated in Chapter 1, South Africa is a linguistically diverse country which has 11 official languages, yet the primary language of communication in the business and public sector is English (Kamwangamalu, 2000; Wright, 2002). This is due to the public opinion that English is a language of prestige that will enable the speaker to have an improved socio-economic status (SES) (De Klerk, 2000). The popularity of English use continues to increase across the years; in 1996, 4% of South Africans used English as either a first language (L1) or an additional language; however, by 2011 this had greatly increased to 30% (Posel & Zeller, 2016). This is not to say that English is replacing African languages; instead, English is mostly used in addition to the home language and mainly in certain contexts, such as business or school (Deumert, 2010). Under these linguistic circumstances, it is understandable that parents prefer their children's education to be in English, regardless of their own L1 (De Klerk, 2000; Heugh, 2000; Jordaan, 2011; Meirim, Jordaan, Kallenbach & Rijhumal, 2010; Probyn, 2009; Webb, 2002). As a result, the children who enter English-medium schools are often English Language Learners (ELLs) who have various L1s and varying levels of English proficiency. English proficiency is considered to be the knowledge of vocabulary; of the rules governing syntax, phonology and morphology; as well as how to use this knowledge productively in a certain context, in other words knowledge of pragmatics and semantics (MacSwan & Pray, 2010).

It is well documented that there exists a gap between the academic performance of English monolingual children and ELLs in English-medium schools. For instance, weaker academic performance from the age of 4 through to 11 years was found by Strand, Malmberg and Hall (2015) in their review of ELLs' scores on national assessments in England. The same study showed that this gap between monolinguals and ELLs is only closed by the time the learners are 15 to 16 years old. Children learning English as an additional language take, on average, 5 to 7 years to achieve the academic language skills that are comparable to those of monolingual English speakers (Cummins, 1984; Roseberry-McKibbin, 1995). This places the children learning English who are attending English-medium schools at a great disadvantage because they enter school with a low English proficiency and yet have to use exclusively English for academic purposes. They are therefore required to access the curriculum in English before they have those academic language skills which are important for academic purposes.

After inspecting the academic trajectories of children learning English as a second language (L2) in schools where English was the LoLT, Halle, Hair, Wandener, McNamara and Chien (2012) concluded that proficiency in English early on in a child's school career was related to improved academic results, as compared to children whose English proficiency remained low. It is particularly noteworthy that children's cognitive and language ability in the preschool years can predict their future academic success; past research has found that ELLs' English proficiency in kindergarten predicts their academic success up to grade 8 (Halle et al., 2012; Han, 2012; Mancilla-Martínez & Lesaux, 2011). More specifically, moderate to strong associations have been found between proficiency in the language of education and mathematics, early literacy, reading, and spelling in bilingual children (Prevoo, Malda, Mesman & van IJzendoorn, 2016). It has been concluded that English proficiency could be the most important predictor of academic achievement (Strand et al., 2015). This stands to reason as proficiency in the language of education is not only a necessity for understanding the teacher but is also a forerunner to literacy (Hoff, 2013; Prevoo et al., 2016).

As a result of the influence that English proficiency has on academic achievement, the study of how ELLs' language develops is deemed to be of great importance. Researchers have focused their attention on various aspects of English in order to better understand the trajectory of language development in ELLs. For instance, Hammer, Lawrence and Miccio (2008) conducted a longitudinal study of the vocabulary and language comprehension of bilingual Spanish-English preschoolers in the USA. The authors found that the children's development was linear, in other words that scores followed a steady increase over time with no apparent accelerations or peaks. Additionally, the participants' scores were in the average range for monolingual English children after two years of consistent exposure. The finding that ELLs catch up with their monolingual English peers over time was substantiated by the study conducted by Golberg, Paradis and Crago (2008). The authors found that, for a sample of ELLs with a mean age of 5 years and 4 months, scores on a vocabulary task were within monolingual norms after 34 months of exposure to English. It has also been found that children from low-income families have expressive and receptive vocabulary scores which develop at a linear rate. These include both monolingual children (Pan, Rowe, Singer & Snow, 2005) and bilingual children (Uchikoshi, 2006).

Similarly, studies have found that the trajectory of development for syntax and morphology of L2 learners is comparable to that of monolinguals but with more inaccuracies in production (Bland-Stewart & Fitzgerald, 2001; Chilla & Bonnesen, 2011; Nicholls, Eadie & Reilly, 2011; Nicoladis & Marchak, 2011; Paradis, Nicoladis, Crago & Genesee, 2010). However, this is not to say that ELLs reach monolingual norms at the same time for all domains of English. Asynchronies have been found between how much time it will take to achieve monolingual levels in the domains of narrative skills, morphology and vocabulary (see Paradis, 2016 for a review). This highlights the importance of conducting longitudinal studies of ELLs' acquisition of English, and especially conducting separate investigations into the various linguistic domains.

Additional factors also need to be taken into consideration when addressing English proficiency and school outcomes. Children who become proficient in English faster and at an earlier age are more likely to have older siblings and are less likely to be immigrants (Halle et al., 2012). Bridges and Hoff (2014) found that older siblings are a significant source of language input and can affect the English proficiency and vocabulary development of their siblings. This has also been found in previous studies with young, typically developing bilingual children (Zukow-Goldring, 2002). The sex of the child can also play a role as it has been found that girls outperform boys in language and academic achievement (e.g., Bouchard, Trudeau, Sutton, Boudreault & Deneault, 2009; Demie, 2010). Moreover, socioeconomic status (SES) has been found to be a predictor of English skills in preschool, grade 2 and grade 5 (Oller & Eilers, 2002). In comparison to higher SES children, children from low SES backgrounds tend to have lower levels of English proficiency, and this holds for both receptive and expressive language skills (Arriaga, Fenson, Cronan & Pethick, 1998; Calvo & Bialystok, 2014; Kim, Curby & Winsler, 2014; Locke, Ginsborg & Peers; 2002; Qi, Kaiser, Milan & Hancock, 2006). According to Hoff (2013), the aspect of language that is most affected by low SES is vocabulary size. Not only is the size of vocabulary affected by SES but also the trajectory and the rate of development of vocabulary (Arriaga et al., 1998; Dollaghan et al., 1999; Rescorla & Alley, 2001). Golberg, Paradis & Crago (2008) found that children with mothers who are more highly educated were able to acquire vocabulary faster than those who had mothers with a lower level of education. This highlights the importance of considering multiple external factors when investigating children's language and the development thereof.

5.2 Working memory and academic achievement

An important factor in childhood development is the emergence of working memory skills. The development of working memory takes on a nonlinear trajectory in relation to age, as scores on working memory tasks improve greatly during the early school years, and much of the development takes place before the age of 13 (Dempster, 1981). This claim was substantiated by Siegel (1994), who found a similar nonlinear growth curve for data from a listening span task. Siegel (1994) went on to elaborate the finding of Dempster (1981) by showing that this relationship also extends to complex working memory tasks that demand additional processing requirements over and above short-term storage. The positive increase in scores on working memory tasks is assumed to be due to the working memory processes that become more efficient, rather than a qualitative change in working memory functions (Dempster, 1981, 1985, 1992; Gathercole & Baddeley, 1993). This is especially true for children older than 6 years of age, because there is some evidence that there are qualitative changes in working memory function, such as the use of different mnemonic strategies (see Fry & Hale, 2000 for a discussion). Gathercole and Baddeley (1993) proposed that attending school might promote the development of young children's working memory skills; for instance, they found that the use of active rehearsal as a memory strategy is not apparent in children who have not learnt to read yet.

Not only is language proficiency an important indicator of future academic attainment but scores obtained on working memory tasks have also been found to predict academic performance. It has been concluded that young children's working memory scores can be a more powerful predictor of their later academic success than IQ scores. For instance, a longitudinal study by Alloway and Alloway (2010) tested short-term memory, working memory and the IQ of children at 5 years old and at 11 years old. They found that working memory scores had a larger effect on academic achievement than IQ, which led the authors to the conclusion that working memory is a dissociable cognitive skill that is implicit in academic success.

There is as of yet no overall consensus about what it is specifically about working memory that causes it to be correlated so highly with academic performance. Researchers have found that academic skills are linked to various aspects of working memory, such as attentional control (e.g., Hitch, Towse & Hutton, 2001; Kane & Engle, 2003), phonological skills (e.g., Baddeley, Gathercole & Papagno, 1998) and visuospatial skills (e.g., Logie, Della Sala, Wynn & Baddeley, 2000), amongst others. Specifically, measures of working memory ability have been found to predict performance in various academic skills, such as reading (e.g., Swanson & Beebe-Frankenberger, 2004), mathematics (e.g., Swanson & Sachse-Lee, 2001) and computational skills (Bull & Scerif, 2001; Geary, Hoard & Hamson, 1999). For instance, Gathercole, Pickering, Knight and Stegmann (2004) found that children's working memory skills could predict whether they would obtain low, average or high scores on English and mathematics assessments at age 6 to 7 years, and on mathematics assessments at age 13 to 14 years.

In the case of mathematics, researchers have found that younger children use visuospatial working memory to solve mathematics problems whereas older children rely more on phonological working memory (DeSmedt et al., 2009; Krajewski & Schneider, 2009). This is to say that during young children's learning of mathematics as a new skill, visuospatial working memory is important. However, once the basic skills and components have been acquired, phonological working memory becomes more important (Laski et al., 2013; LeFevre et al., 2010; Raghubar, Barnes & Hecht, 2010). Studies have found that this heavier reliance on phonological working memory is seen especially during arithmetic problem solving when the children convert the mathematical symbols into verbal codes (Lee, Ng & Ng, 2009; Logie, Gilhooly & Wynn, 1994; Rasmussen & Bisanz, 2005).

As previously mentioned, working memory has also been found to be implicated in reading skills (see Baddeley, Gathercole & Papagno, 1998 for a review). It should be considered that the ability to read a word consists of more than one stage: The letters have to be sequentially converted into sounds and then temporarily stored until all letters in the word have been converted. The single words then need to be held in memory and subsequently combined with the following words, in order for the overall meaning of the sentence to be comprehended. During these multiple stages, working memory is implicated, especially language-specific working memory processes, which are found to predict future reading performance (Swanson, Sáez & Gerber, 2004). As part of a battery of working memory tests, the scores on backward digit recall, naming recall, non-word repetition, word list recall, and word list matching were found to be very good predictors of children's future literacy skills (Alloway et al., 2005; Engel de Abreu, Gathercole & Martin, 2011; Gathercole, Brown & Pickering, 2003; Gathercole et al., 2004).

Cognitive and academic performance have been found to be impacted by SES; moreover, SES was shown to affect language and working memory in a greater way than any of the other neurocognitive processes (Noble, Norman & Farah, 2005). Children from low SES families whose parents also have a lower level of education tend to perform worse on various cognitive tasks than their peers from higher SES families (e.g., Bradley & Corwyn, 2002; McLloyd, 1998; Sirin, 2005). This disparity between the performance of individuals from differing SES levels has been found in infants as well, where 6 to 14 month old infants from low SES families made more errors on the A-not-B Task[13] than the infants from high SES families (Lipina, Martelli, Vuelta & Colombo, 2005). SES was also a significant predictor of performance for children between the ages of 5 and 14 years who were tested on a battery of executive function tasks (Ardila, Roselli, Matute & Guajardo, 2005). Calvo and Bialystok (2014) tested children on receptive vocabulary, nonverbal intelligence, attention, and executive function. They found that middle class children scored better than working class children did on all measures, except nonverbal intelligence, which was not significantly affected.

It is clear from the literature that there are several factors influencing the development of linguistic and cognitive processes. In order to better understand what

[13] In the A-not-B Task, a toy is placed under box A, which is within the baby's reach. The baby looks for the toy under the box and retrieves it. This is repeated several times. The toy is then placed under box B. Babies under 10 months usually make the error of looking for the toy under Box A again, despite seeing the researcher placing it under Box B. Children tend to complete the task successfully by 12 months of age (e.g., Smith, Thelen, Titzer & McLin, 1999).

affects development, it is important to conduct longitudinal studies in different contexts. The current study sets out to investigate the development of South African ELLs in their first year of formal schooling. Specific focus is placed on the rate and trajectory of the development of English proficiency and working memory abilities, as both of these aspects are important predictors of future academic success. This sample of children from the unique diversity of the South African context will help to further knowledge of how language and working memory develops in lesser researched environments. In summary, the specific research question that this chapter attempts to answer is what the trajectory and rate of development of ELLs' English and working memory is during their first year of formal schooling (cf. research question 2 in Section 1.5 of Chapter 1).

5.3 Method

5.3.1 Participants

The participants were children in their first year of school, between the ages of 5;5 and 6;3. This grade group was preferred because in the first year of school the children have not learnt to read yet, which limits the possible confound of literacy in language and working memory development. The sample consisted of 27 English language learners (ELL) and seven monolingual English children (Eng) in one grade R class of a mid to low SES school which is located in a multicultural suburban area, known for the diversity of its inhabitants who come from all across Africa. All children in the ELL group's first exposure to English was in the year of their third birthday. First exposure and SES level were determined by answers on the BiLEC parent questionnaire (Unsworth, 2013). As stated before, the SES level of the participants was measured on the basis of their primary caregiver's highest level of education, measured on a scale from 1 (early childhood education) to 8 (Master's level or higher). Table 5.1 below shows the number, sex, mean SES and mean age of the children across the year.

Table 5.1. Number, sex, mean age, mean SES and mean number of older siblings in the ELL and Eng groups across the year.

Group	*n*	Sex	Older siblings		SES		Age		
		(M, F)	Mean	Range	Mean	Range		Mean	Range
ELL	27	12, 15	1	0 - 3	3	2 - 4	T1[a]	5;6	5;1-6;0
							T2[b]	5;10	5;5-6;4
							T3[c]	6;3	5;9-6;8
Eng	7	3, 4	1	0 - 2	3	2 - 5	T1	5;5	5;1-5;9
							T2	5;9	5;6-6;2
							T3	6;1	5;10-6;6

[a]T1 = beginning of the year, [b]T2 = middle of the year, [c]T3 = at the end of the year.

5.3.2 Procedure and materials

The participants were tested three times over the course of one year: at the beginning of the year (T1), in the middle of the year (T2) and at the end of the year (T3). All testing was conducted one-on-one by the author in a quiet room at the participant's school. In order to test English proficiency, the children completed a vocabulary task and a language assessment battery. For the tests of working memory, each child completed two phonological working memory tasks (non-word repetition) and two visuospatial working memory tasks (odd-one-out and block span). Both of the visuospatial working memory tasks were started by presenting the simplest list level and increasing the difficulty by one item if the lists were completed correctly. Each of the tasks was repeated across the three testing sessions following the same testing procedure. The order of the tasks was randomised at each testing session.

Vocabulary task

As explained in Section 3.4.4 of Chapter 3, the task that was utilised to measure vocabulary was the Peabody Picture Vocabulary Test (PPVT-4) (Dunn & Dunn, 2007). The PPVT-4 is a receptive vocabulary test which requires the child to listen to a word and then to point to the picture (one out of a possible four) which matches the word. If the child makes eight or more mistakes in one set, the test is stopped. The raw score for the test corresponds to the number of the item that was administered last, minus the items that were answered incorrectly.

Language battery

In order to assess the children's English proficiency, the Developmental Evaluation of Language Variation - Criterion Referenced Edition (DELV-CR) (Seymour, Roeper & De Villiers, 2003) was used. This test aims to be dialect neutral and investigates the structures that are common to most varieties of English. The child's comprehension and production skills are tested across the domains of syntax, semantics and pragmatics.

Phonological working memory

The Language Specific non-word repetition (E-NWR) (Chiat, 2015) and the Cross-linguistic non-word repetition (CL-NWR) (Chiat, 2015) were both used to assess phonological working memory. The E-NWR has items based on English phonotactics whereas the CL-NWR strives to be language independent by combining the most common phonotactics across languages. Both non-word repetition tasks were shown on a laptop presentation accompanied by a short story, known as the Bead Game (see Polišenská & Kapalkova, 2014). Whole-item scoring was used; every correctly repeated word was awarded one point and incorrect repetitions scored zero.

Visuospatial working memory

The two visuospatial working memory tasks that were used were the Odd-one-out task (based on Henry, 2001) and the Corsi blocks task (based on Corsi, 1972). In the Odd-one-out task, the participants must choose which one out of the three shapes is different and then remember its spatial position. The number of different shapes' spatial positions, that must be held in memory before pointing to their positions on a blank grid, increases by one for each list length that is passed. The task is stopped if two out of the three trials are remembered incorrectly. The Corsi blocks is a block recall task that was presented on a laptop, using the Psychology Experiment Building Language (PEBL) software version 0.14 (Mueller, 2011). The child sees nine dark blue blocks on a black background which each light up for a duration of 1000ms, in various sequences. Once the child has seen one full sequence, s/he is asked to reproduce it by pointing to the blocks in the order in which they were lit up. For both the Odd-one-out and the Corsi blocks task, the child is awarded one point for every trial that is completed correctly.

5.4 Data analysis

For all analyses, raw scores were favoured over standard scores since raw scores are more indicative of the children's real change across the year. In contrast, standard scores give information about the comparability of the children in this sample to a standard sample of their age peers. In the case of this ELL sample, it cannot be assumed that they are comparable to the children who were tested for norming. Table 5.2 displays the descriptive statistics for the raw scores for all the tasks. Note that the maximum obtainable score differs across tasks and thus only comparisons across time points and between groups are possible, and not comparisons across tasks.

Table 5.2. Means and standard deviations for the language tasks and the working memory tasks in the ELL and Eng groups across T1, T2 and T3.

Language measures	**T1**			
	ELL		**Eng**	
	Mean	**SD**	**Mean**	**SD**
Syntax	14.63	5.53	19.43	5
Semantics	17.96	5.37	23.57	5.19
Pragmatics	8.04	4.82	12.57	5.09
Vocabulary	50	15.92	68.57	8.26
	T2			
Syntax	21.04	7.07	23.29	3.35
Semantics	21.44	5.41	27.29	6.42
Pragmatics	12.3	4.66	17	4.44
Vocabulary	63.26	16.81	82	15.55
	T3			
Syntax	26.30	5.75	29	6.14
Semantics	27.19	4.49	31.43	2.82
Pragmatics	17	4.07	18.86	4.06
Vocabulary	78.33	14.98	94.86	13.38

Working memory measures	**T1**			
	ELL		**Eng**	
	Mean	**SD**	**Mean**	**SD**
Odd-one-out	4.81	1.075	5.29	1.604
Corsi blocks	4.74	1.913	4.71	1.604
CL-NWR	10.26	2.754	10.14	1.215
E-NWR	13.7	3.911	14.86	4.298
	T2			
Odd-one-out	5.41	1.72	5.43	1.81
Corsi blocks	5.96	1.22	6	1.29
CL-NWR	11.67	2.27	11.57	1.27
E-NWR	16.11	4.61	18.29	3.95
	T3			
Odd-one-out	7.89	1.281	7.43	2.225
Corsi blocks	7.93	1.207	8	2.082
CL-NWR	14.19	1.665	15	1.155
E-NWR	19.63	3.804	20.14	3.805

Due to this portion of the study focusing on developmental trajectories, growth curve analysis was used to investigate the change in the ELLs' language and working memory development across the three time points. This type of analysis has been used in various longitudinal developmental studies (e.g., Hadley & Holt, 2006; Hammer et al., 2008; Rescorla, Misrak & Singh, 2000). The ages of the children were centred around 60 months. Due to no child being younger than 60 months, the centering of the ages allows the estimate of the intercept to be more useful and interpretable. This relative age in months which was calculated was then used as the time metric to construct the growth curves. Age could be used as the time metric because the time between testing points always remained constant. Thus, the intercept of the model represents the child's score at the first testing session and the slope represents the child's rate of change across the three testing sessions.

Growth curves were estimated by the use of linear mixed regression models, which were calculated using the *lme4* package (Bates, Maechler, Bolker & Walker, 2015) in R-software (R Core Development Team, 2005). By comparing fit indices of models with linear and cubic trends, it was found that linear trends better suited the model for the data from the language tests (Syntax, Semantics, Pragmatics and Vocabulary) and three out of the four working memory tests (English non-word repetition, Cross-linguistic non-word repetition and Corsi blocks). A cubic trend best fit the model for the Odd-one-out task data. Once the most suitable baseline growth models had been established, growth predictors could be included. The independent variables that were entered as fixed effects into the model were Sex (male, female), Time (age in months centred around 60 months), Beginning age (age at first testing session), SES, and Older siblings (number of older siblings). Participant ID was added to the model as a random intercept.

Owing to the small sample size of the Eng group, growth curve analysis was deemed unsuitable, as the smallest sample size for this type of analysis that has been used effectively is n=22 (Huttenlocher, Haight, Bryk, Seltzer & Lyons, 1991). Therefore, non-parametric tests were used to calculate the trajectory of growth. The proportional change, between T1-T2 and T2-T3, was calculated for each task, and subsequently a Wilcoxon test was run in order to determine the significance of the change between the calculated values. For the same reason of sample size, the linear mixed regression model was not able to be used with the Eng group.

5.4.1 Language domain

The subtests of the DELV were analysed separately, namely Syntax, Semantics and Pragmatics. The score from the PPVT vocabulary test was also analysed in a separate model. For the Eng group, all language measures developed at a steady rate throughout the year, which is indicative of following a stable linear trajectory; see Table 5.3 for the associated p-values, where $p \leq 0.05$ is considered to be significant, and Figure 5.1 depicting the growth trajectories.

Regarding the ELL group, in the Syntax model, it was found that the linear rate of change (Time) was significant (b= 1.4, $t(54)$=13.13, p<0.001), and that the children's Beginning age also significantly affected their Syntax score (b= -1.29, $t(30)$=-3.19, p=0.003), where the younger the participants were at the beginning of testing, the lower their scores. SES, Sex, and Older siblings had no significant effect on any of the language tests, therefore these non-significant values are reported separately, in Table 5.4.[14]

For Semantics, Time was highly significant (b= 1.09, p<0.001), indicating a linear growth. Beginning age also had a highly significant effect on Semantics scores (b= -0.96, p<0.001).

[14] Note that the analyses to determine growth trajectories are fundamentally different for the ELL and Eng group. Parametric tests were used with the ELL group and significant p-values for this group would entail linear growth. Contrastively, the analysis for the Eng group is non-parametric and was carried out by, firstly, doing a subtraction sum: T1-T2 and T2-T3 to calculate the proportional change. Secondly, a Wilcoxon test was run to calculate whether or not there was a statistical difference between these two results. Opposite to the ELL group, linear growth would be indicated by a non-significant p-value (i.e. no significant change between T1-T2 and T2-T3 indicates no difference between growth rates).

Results for Pragmatics followed the same pattern as the previous tests, where Time and Beginning age were found to be significant (*b*= 1.07, *t*(13)=1.72, *p*<0.001; *b*= -0.58, *t*(35)=-2.10, p=0.04, respectively).

Table 5.3. p-values for the Eng group indicating a linear growth trajectory for all language tests.

Language outcome	***p*-value**
Syntax	0.71
Semantics	0.4063
Pragmatics	0.95
Vocabulary	0.5938

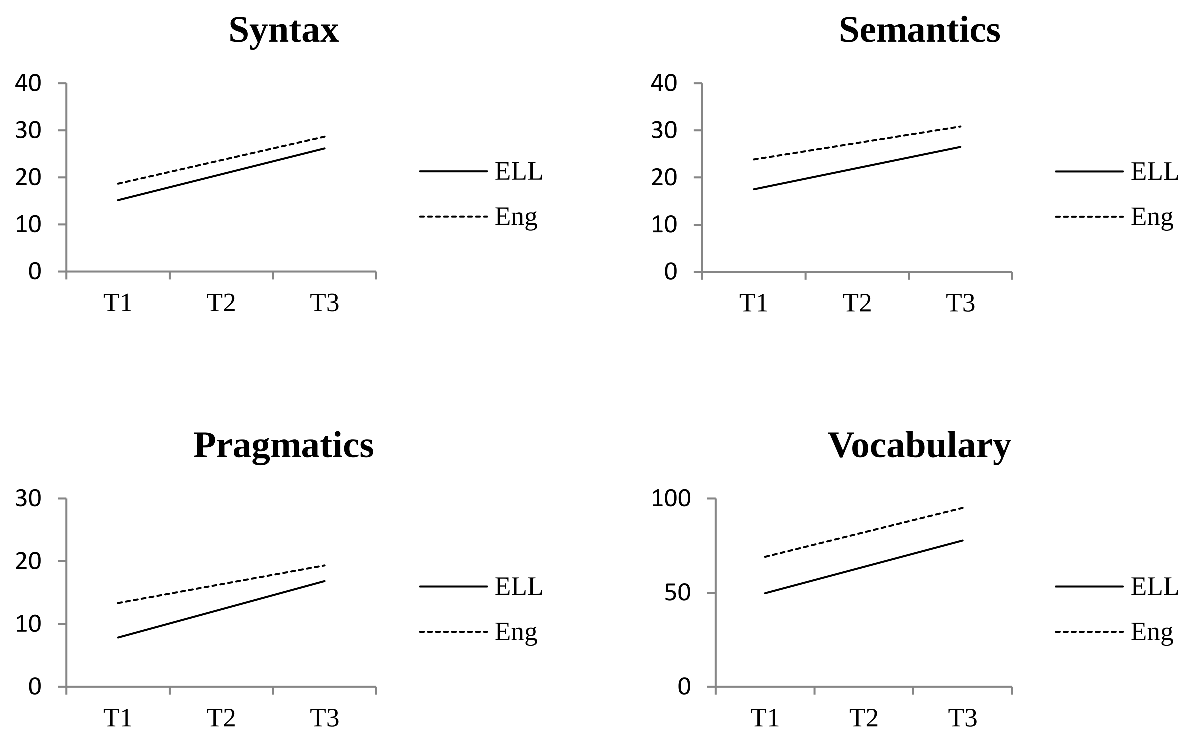
Lastly, Vocabulary, that was measured with the PPVT, yielded the same results as the previously reported linguistic domains with regards to its linear growth, indicated by a significant effect of Time (*b*= 3.35, *t*(54)=15.82, *p*<0.001). However, in this case, the children's Beginning age did not significantly influence their scores (*b*= -0.74, *t*(29)= -0.75, *p*=0.46).

Table 5.4. Outcomes for SES, Sex and Older siblings in the ELL group.

Language outcome	Predictor	*b*	*t*	*p*
Syntax	SES	0.95	-0.65	0.52
	Older siblings	-0.71	-0.67	0.51
	Sex	-0.49	-0.21	0.833
Semantics	SES	0.15	0.12	0.90
	Older siblings	0.18	0.2	0.84
	Sex	-0.23	-0.12	0.91
Pragmatics	SES	-1.88	-1.93	0.06
	Older siblings	0.82	1.14	0.26
	Sex	-0.01	-0.01	0.99

Vocabulary	SES	-4.48	-1.25	0.22
	Older siblings	-0.43	-0.16	0.87
	Sex	7.85	1.39	0.18

Figure 5.1. Growth curves for the language tasks across the year.



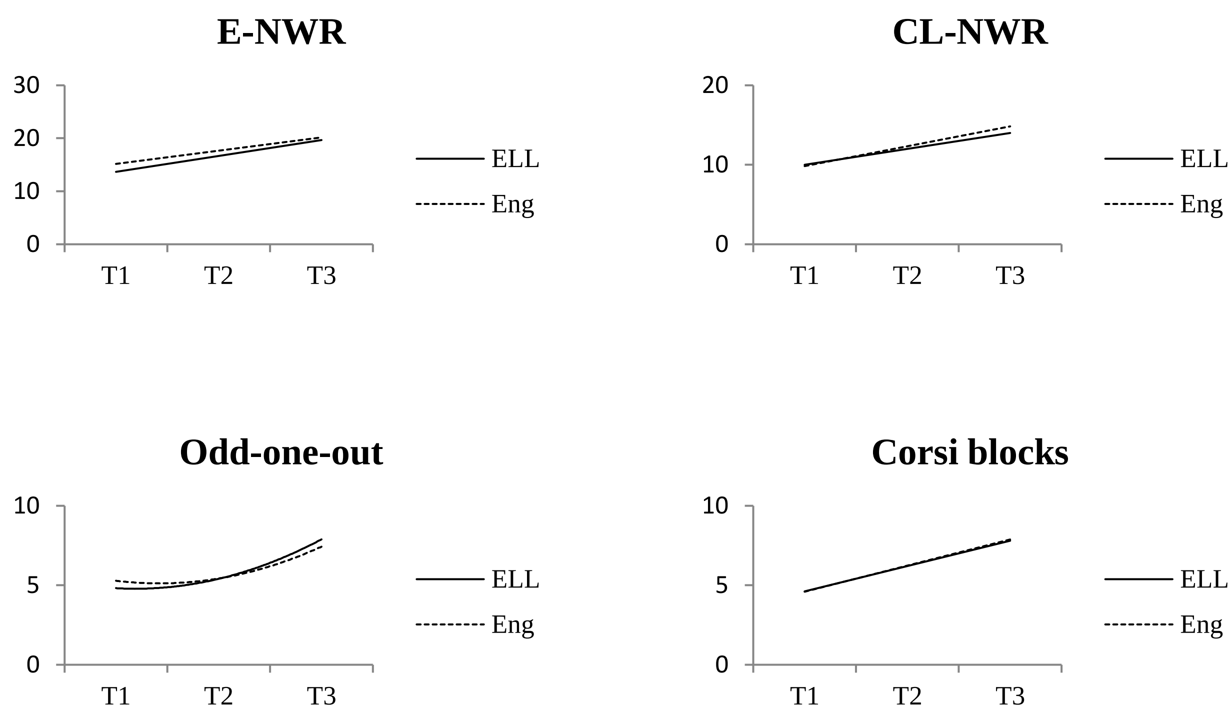
5.4.2 Working memory domain

Recall that the working memory tasks consisted of two phonological tasks (E-NWR and CL-NWR) and two visuospatial tasks (Odd-one-out and Corsi blocks). Each task was treated separately in its own model but the fixed effects remained the same for each, which included SES, Sex, Time, and Beginning age. However, Older siblings was omitted because there is no indication in the literature that having older siblings affects working memory skills. The E-NWR showed a linear growth trajectory based on the significant effect of Time in the ELL group (*b*= 0.71, *t*(54)=13.37, *p*<0.001) and the lack of significant difference in the Eng group (*p*=0.92). The Beginning age had no significant effect on E-NWR (*b*= -0.42, *t*(29)= -1.60, *p*=0.12) and neither did SES (*b*= -1.28, *t*(27)= -1.38, *p*=0.18) nor Sex (*b*= 3.10, *t*(27)= 2.05, *p*>0.05) for the ELL group. For the CL-NWR, again the growth was linear for both groups, where Time was significant for the ELLs (*b*= 0.46, *t*(54)=9.14, *p*<0.001) and the Eng group showed no significant difference between testing sessions (*p*=0.08). The Beginning age was significant, where younger ELLs scored lower than the older ELLs (*b*= -0.38, *t*(35)= -2.83, *p*=0.008). There was no significant effect of SES (*b*= -0.75, *t*(27)= -1.65, *p*=0.11) or Sex (*b*= 1.32, *t*(27)=1.79, *p*=0.08) in the ELL group.

The first visuospatial working memory task that was analysed was the Odd-one-out. The finding for the Eng group was that there was a significant difference between the rate of change between T1 and T2, and T2 and T3 (*p*=0.03), indicating an increased development rate between T2 and T3. For the ELL group, the same was seen as the growth was nonlinear and took on a quadratic trajectory, which is shown by the significant acceleration term ($Time^2$) (*b*= 0.01, *t*(62)= 2.19, *p*=0.03), suggesting that the ELLs developed at an ever increasing rate. The Beginning age of the ELLs is significant as it can be seen that younger children perform more poorly (*b*= -0.32, *t*(40)= -3.84, *p*<0.001). For the ELLs, SES and Sex are not significant predictors for performance on this task (*b*= 0.03, *t*(26)= 0.097, *p*=0.92) and (*b*= -0.45, *t*(26)= -1.03, *p*=0.31), respectively.

The second visuospatial working memory task that was analysed was the Corsi blocks. There was no significant difference between the rate of development between the testing sessions in the Eng group (p=0.58). A linear rate of growth was found in the ELL group as Time was significant (b= 0.38, $t(54)$=9.02, p<0.001). Beginning age of the children was also a highly significant predictor of performance in the ELL group (b= -0.34, $t(46)$= -4.17, p<0.001). SES and Sex were not significant (b= 0.17, $t(26)$= 0.68, p=0.5; b= -0.35, $t(27)$= -0.85, p=0.41 respectively). See Figure 2 illustrating the growth curves of the working memory tasks.

Figure 5.2. Growth curves for the working memory tasks across the year.



5.5 Discussion

The current study set out to track the trajectory and rate of development of ELLs' English and working memory during their first year of formal schooling. During this year, the children's linguistic environment changed greatly: They started to attend a school that was exclusively in English and where they were expected to communicate solely in English. Growth curve analysis was utilised in order to track how development, both cognitive and linguistic, occurred during the school year.

The domains of language that were tested were treated separately, following previous research asserting that different domains develop at different rates (Paradis, 2016). It was found that the domains of language that were evaluated, namely syntax, semantics, pragmatics and vocabulary, exhibited great positive improvements across the year for both the ELL and the Eng groups. As can be seen from the raw scores, the Eng group scored with higher accuracy consistently throughout the year. Furthermore, all language outcomes developed with a linear trajectory. This entails that development followed a path with a regular increase in scores over the year. What was found is in line with what has been found in previous research (e.g., Hammer et al., 2008), including research conducted with children from low income homes (Pan et al., 2005; Uchikoshi, 2006).

Across the DELV subtests, the older the children were at the first test session, the better their scores. Standard scores were not used in this analysis, therefore it was expected that this pattern would emerge in the raw scores. In line with what Hammer and colleagues (2008) found, the vocabulary scores were not affected by the child's age at the first test session. This could be an effect of the specific items that are included in the PPVT-4, because the pictures that are included are intended to be commonplace and easily recognisable. The children in the study had all, on average, had the same amount of educational experience. Therefore, a possible reason for this lack of effect of age could be the children having had the same amount of exposure to the English vocabulary items.

In the case of the language tests, the number of older siblings that the child has had no significant effect on their language scores. Previous research has found that the language input from older siblings can improve language scores (Bridges & Hoff, 2014). Nonetheless, this was not apparent in the current study, which might be a consequence of not taking into account the quality of the input received from the siblings. A more fine-grained analysis which takes into account the quantity and quality of the input from the older sibling may lead to more detailed and reliable conclusions.

Past studies have found that SES has a great impact on children's performance on both language and cognitive tasks (e.g., Calvo & Bialystok, 2014). However, contrary to these previous findings, SES had no effect on any of the language or cognitive outcomes in this study. This could be attributed to the participants all being from relatively low-income families, with fairly little SES variation between participants. The SES score was measured on a scale from 1 (lowest SES) to 8 (highest SES), yet the minimum score in the sample was 2 and the maximum score was only 5, with the mean lying at 3. A significant effect of SES might have been found had there been more diversity in the group and possibly with the use of a more sensitive scale which includes more than only the primary caregiver's highest level of education.

Regarding the working memory tasks, the trajectories of the two phonological working memory tasks follow a linear course, with a steady positive development across the year. There was no effect of the children's age at the beginning of the study on their performance on the E-NWR at the end of the year. Even though the children's ages differed, their amount of relative exposure is comparable, as their first exposure to English was in day-care in the year of their third birthday. It can be deduced that the children's knowledge of English phonotactics is comparable based on their past experiences. The lack of the influence of beginning age corresponds to previous studies which found that the more familiar the phonological structures of the non-word items are, the better the individual performs on the task (e.g., Gathercole, 1995; Snowling, Chiat & Hulme, 1991). This notion is substantiated by the finding that the CL-NWR is instead affected by the children's age at the first testing session. Research has shown that non-words with a high phonotactic probability are more easily remembered than non-words with lower phonotactic probability (e.g., Edwards, Beckman & Munson, 2004). Due to the CL-NWR not being based on English phonotactics and its use of items which have a low phonotactic probability, it seems to be a purer measure of phonological working memory than the E-NWR. Thus, it stands to reason that older children will perform better on the CL-NWR because their phonological working memory is more developed than that of their younger classmates.

Both visuospatial working memory tasks exhibited a positive increase in scores; however, they followed different growth trajectories: The Odd-one-out task followed a nonlinear path, taking on a quadratic form, whereas the Corsi blocks task followed a linear trajectory. The quadratic form seen in the Odd-one-out task indicates that the line changes direction at one point. That is to say that the line is curved at T2 due to a slightly slowed increase but thereafter shows an acceleration. This trajectory is therefore not a steady increase but instead is nonlinear. By contrast, the trend that the Corsi blocks task follows is steady in its positive direction and without any significant curves. The observed difference between the two trajectories is likely because of the difference in tasks due to the Odd-one-out task being a measure of complex visuospatial working memory that requires the participant to store as well as process information. This extra processing load is said to tap into the central executive (Baddeley & Hitch, 1974), whereas the Corsi blocks task is a simple visuospatial working memory task which only requires short-term storage. Siegel (1994) found a similar nonlinear trajectory when looking at the development of complex working memory tasks. The two differing developmental trajectories advocate for a difference between what the two tasks measure and that the underlying cognitive processes develop in distinct ways. The accelerating increase in scores may be an effect of school experience that would have allowed the children to employ new memory strategies in order to solve the complex Odd-one-out task. This is in line with what Gathercole and Baddeley (1993) postulated and is further substantiated by the finding that the two groups (ELL and Eng) exhibited the same growth trajectory.

The finding from the current study that the ELL and Eng groups have the same growth trajectories overall is particularly important. The two groups had the same linear trajectories for all the tasks and had the same nonlinear trajectory for the Odd-one-out task. Although the Eng group scored with a higher performance accuracy on all the language tasks, the commonality of the trajectory of growth could lead to a better way of predicting whether a child needs special intervention in order to improve his/her language skills or whether continued exposure to English will suffice. For instance, if a child exhibits a language learning trajectory which shows a deceleration in progress, there may be cause for concern, as a nonlinear trajectory, based on the results of the current study, is not an artefact of being an ELL. The importance of working memory and language skills for academic achievement is well established, and it is therefore important that children who are at risk for delays in either of these two domains should be identified and receive additional support as early as possible.

This theoretical knowledge can inspire interventions in the areas of language and working memory which will aid in future academic achievements. Relying solely on standardised language assessments to furnish an accurate estimation of an ELLs development would be a misstep, as the language of assessment will necessarily affect the child's performance if done in the L2 only and will therefore underestimate his/her abilities. This is especially relevant when there are no standardised assessment tools available in the child's L1, which is commonly the case in multilingual South Africa. Policy makers, teachers and researchers can benefit from understanding these trajectories, and the factors that may or may not influence them, in order to effectively support children in their academic career.

This study emphasised how these growth trajectories are an indication of typical development: Even if the ELL's beginning scores are low, their ability to improve steadily across the year indicates that their development is typical. Therefore, understanding what to expect from an ELLs' developmental trajectory can help to inform decisions about which cases are a cause for concern and which are simply the expected developmental pattern at a slower rate.

RESEARCH ARTICLE III

Phonological working memory and non-verbal complex working memory as predictors of future English outcomes in young ELLs

6.1 Introduction

More than half of the world's population is bilingual (Grosjean, 2010) and, globally, the majority of children are growing up in multilingual environments (Crystal, 1997). Moreover, there are considerably more second language (L2) speakers of English than there are first language (L1) speakers of this language: 743.5 versus 378.2 million, respectively (Simons & Fennig, 2018). Therefore, it is becoming increasingly common to have children in English-medium schools worldwide who are English language learners (ELL). These children are tasked with learning English relatively quickly, most commonly because it is the school's sole medium of instruction. Generally, children develop language skills at different rates and therefore do not necessarily follow one standard trajectory (Paradis, 2015). In some cases, a slow rate of language acquisition is cause for concern as it might be an indication of an underlying language learning disorder. Complicating the matter further is that not all ELLs reach native English proficiency, which impacts negatively on their performance in English-medium language-related tasks, such as reading comprehension (Kieffer, 2011; Mancilla-Martinez & Lesaux, 2010). This situation creates a great need to be able to differentiate between children with language disorder and those who are simply slower in learning their L2, because the support needed by these two types of learners differs vastly. To this end, measures that take into account not only language abilities but also more cognitive abilities have been used in an attempt to disentangle bilingualism from language disorders. Such measures include the use of non-word repetition, sentence repetition and other working memory measures (e.g., Henry & Botting, 2016; Kohnert, 2010). It is important to be able to accurately identify those ELLs who truly have a language disorder in order to avoid a delay in furnishing them with the appropriate intervention (Paradis, 2005).

Previous research has indicated that measures of non-linguistic processing may provide important information about language development in multilingual contexts (Paradis, 2010; Sandgren & Holmström, 2015), especially in the preschool years (Chiat & Roy, 2008). It is therefore of import to determine which cognitive measures underpin language processes and which of these measures can predict future language outcomes. Cognitive measures such as working memory capacity have been found to be related to language acquisition, also in studies with ELLs (e.g. Gorman, 2012; Swanson, 2014; Swanson, Orosco & Lussier, 2015). "Working memory" is defined as a limited-capacity resource which is involved with the short-term storage and use of information (Baddeley & Hitch, 1976; Engle, Tuholski, Laughlin & Conway, 1999). As stated in previous chapters, there are several models that have been proposed to describe the structure of working memory (see Miyake & Shah, 1999 for an overview). However, the multi-component model, which was developed by Baddeley and Hitch (1974) and elaborated on by Baddeley (2000), is the most suitable for describing working memory development during childhood (Alloway, Gathercole & Pickering, 2006; Bayliss, Jarrold, Baddeley, Gunn & Leigh, 2005; Henry, 2011). The multi-component model consists of a central executive, a phonological loop and a visuospatial sketchpad. The updated version of this model includes an episodic buffer that serves to integrate information from the abovementioned subcomponents (the phonological loop and the visuospatial sketchpad) and store this information temporarily (Baddeley, 2000).

The central executive component is responsible for the processing of information and serves to coordinate and control the three subsystems, namely the phonological loop, the visuospatial sketchpad and the episodic buffer. The phonological loop consists of a short-term store and a verbal rehearsal process, while the visuospatial sketchpad integrates spatial and visual information that can be used and stored. Previous studies that have investigated the development of working memory have found that these components are in place from as young as 4 years of age (e.g. Alloway et al., 2006).

Phonological working memory and its association with vocabulary learning and language acquisition make up a large body of research (e.g. Baddeley, Gathercole & Papagno, 1998; Farnia & Geva, 2011; Gathercole, 2006). Phonological working memory facilitates the long-term learning of the phonological structure of a given language (Baddeley et al., 1998) and is therefore integral to vocabulary learning in both L1 and L2 acquisition. The most commonly used task to assess phonological working memory is non-word repetition, which involves the participant hearing and repeating a novel word. Close associations between non-word repetition and vocabulary measures have been found in L1 acquisition (e.g., Engel de Abreu, Gathercole & Martin, 2011; Gathercole, 2006; Gathercole & Baddeley, 1989) as well as in L2 acquisition (e.g. Masoura & Gathercole, 2005; Service & Kohonen, 1995; Szewczyk, Marecka, Chiat & Wodniecka, 2018). Specifically, the greater the child's phonological memory span, the better the child's vocabulary scores. Outcomes from non-word repetition tasks are highly related with vocabulary measures in young children, but this relationship becomes weaker as children get older (Gathercole, 2006, p. 514): A longitudinal study of children between the ages of 4 and 8 years old showed that vocabulary and non-word repetition scores were highly correlated at the ages of 4, 5 and 6 years (r = .52–.56) but that by the age of 8 this correlation was weaker (r = .28) (Gathercole & Baddeley, 1989; Gathercole, Willis, Emslie & Baddeley, 1992). The same weakening over time is found in studies of L2 acquisition. For instance, Cheung (1996) found that the relationship between scores on English non-word repetition tasks and English vocabulary tasks was significant for Cantonese-speaking children learning English, yet only for those who had low English vocabulary scores. For the children who had high English vocabulary scores, these scores did not exhibit the same significant relationship with their non-word repetition scores. From these and other studies, it is concluded that phonological working memory is implicit, especially in new word learning (e.g. Cheung, 1996; Gathercole et al., 1992).

A possible confounding factor regarding the relationship between non-word repetition and vocabulary is the finding that the familiarity of the phonological structures of the non-word items determines performance on the task (e.g., Gathercole, 1995; Snowling, Chiat & Hulme, 1991). This has been referred to as “the wordlikeness problem”, which entails the finding that non-words which have a high phonotactic probability are easier to remember than non-words which are more irregular in their phonotactics (e.g. Edwards, Beckman & Munson, 2004). Children might therefore be using previous linguistic knowledge to aid in recall and repetition. Gathercole (1995) reported that monolingual children’s performance on wordlike non-words was correlated with their performance on vocabulary measures but that their performance on less wordlike non-words was correlated with digit span. The conclusion from this study was that vocabulary knowledge had a causal relationship with scores on the wordlike non-words but that this causal relationship did not exist with the low wordlike non-words. Baddeley (2003) posits that this may be due to the two systems that make up the phonological loop, namely the storage component, which is responsible for immediately storing phonological input, and the articulatory component, which is in charge of rehearsing the input. The storage component is said to not be influenced by previous linguistic knowledge, whereas the articulatory component is indeed dependent on previous knowledge of a given language, such as morphological rules. This follows that ELLs, who have less English exposure and a lower English proficiency, would be expected to perform poorly on the non-word repetition tasks that are closely based on English phonotactics.

Studies have also found a link between phonological working memory and L2 grammar. Authors such as Ellis and Sinclair (1996) assert that this link is found because children with more developed memory spans are more apt at creating long-term linguistic representations. Data from 11 year old French speaking children who were learning English was gathered from two non-word repetition tasks: One task was based on English phonotactics and the other was based on Arabic phonotactics, which the authors assumed was far detached from the children's prior linguistic knowledge and thus would not be affected by it (French & O'Brien, 2008). The results showed that both the Arabic and English non-word repetition tasks were significant predictors of the outcomes for the L2 grammar tasks. Similar results were found in a study by Verhagen, Messer and Leseman (2015) of bilingual 4 year old children. The authors found that the non-word repetition tasks had moderate but significant correlations with L2 grammar scores.

As opposed to the phonological loop, the central executive component is thought to play a more general role in the early acquisition of language, especially in the acquisition of language comprehension. It stands to reason that there is a relationship between this working memory component and language learning, as this component is responsible for the complex cognitive action of actively processing information while storing additional information (Baddeley, 2000). Complex working memory tasks are used to measure the central executive. The most commonly used tasks are the backward digit span and listening recall, which are classed as complex verbal working memory tasks. These are said to furnish a truthful indication of higher level cognition, which are more accurate than simple memory tasks which only require the storage of information (Daneman & Carpenter, 1980).

Processing and storage are both crucial cognitive abilities for reading and comprehending a text, where words have to be read individually and held in mind while continuing to read subsequent words. Performance on reading and language comprehension tasks is linked to scores obtained on complex memory span tasks that tap into the central executive component of working memory (e.g., Cain, Oakhill & Bryant, 2004; Swanson, 2014, 2015; Swanson & Beebe-Frankenberger, 2004). The syntactic and semantic interpretation of sentences is also affected by working memory capacity; individuals with lower working memory capacity have lower scores on tasks involving the comprehension of unfamiliar or complex syntactic structures (see Kidd, 2013 for a critical review). Complex verbal working memory has also been found to be implicated in monolingual children's receptive syntax (e.g. Ellis Weismer, Evans & Hesketh, 1999), sentence comprehension (e.g. Montgomery, 1995) and accuracy in grammaticality judgement (e.g. McDonald, 2008).

Complex verbal working memory has not only been considered in monolingual populations but also in bilingual populations. For example, Verhagen and Leseman (2016) investigated the relationship between complex verbal working memory, grammar and vocabulary in 5 year old Turkish-Dutch bilinguals as well as Dutch monolinguals. They found that complex verbal working memory was a significant predictor for both L1 and L2 morphology and syntax knowledge. Similar results have also been found in previous studies with children (e.g. Engel de Abreu & Gathercole, 2012; Masoura & Gathercole, 2005). Children between the ages of 7 and 8 years who were trilingual in Luxembourgian, German and French were tested on backward digit span and counting recall tasks by Engel de Abreu and Gathercole (2012). Their results yielded that the complex verbal working memory tasks were a predictor of syntax, reading comprehension and spelling across all three of the children's languages. Andersson (2010) investigated the role that the phonological loop and the central executive play in children's foreign language comprehension. The children's working memory abilities were tested between the ages of 9 and 10 years, and foreign language comprehension was tested one to two years later. Results showed that working memory was associated with foreign language proficiency but it was found that the phonological loop and the central executive were independent predictors for future foreign language comprehension. These results are in line with what previous studies have found in both children and adults (Geva & Ryan, 1993; Miyake & Friedman, 1998; Service, Simola, Metsänheimo & Maury, 2002).

All the aforementioned studies make use of tasks which are complex verbal working memory tasks. As their names state, all these tasks have a verbal component; the child is expected to have enough prior knowledge of the language of testing to be able to repeat what the examiner is presenting. In the case of early bilinguals, who have limited knowledge of their L2, these tasks are less suitable. A researcher cannot be sure that what is being tested is working memory abilities and that low scores on these verbal working memory tasks are not an effect of a deficit in the presumed underlying knowledge of the language of testing. A similar uncertainty about complex verbal working memory tasks has been put forward recently by a handful of authors (Gangopadhyay, Davidson, Ellis & Kaushanskaya, 2015; MacDonald, Almor, Henderson, Kempler & Andersen, 2001; MacDonald & Christiansen, 2002). A further problem is that the majority of complex verbal tasks are considered to be too complex for 5 year old children, as floor effects have been found in previous studies, which may be due to the instructions having been too difficult to grasp (Petruccelli, Bavin & Bretherton, 2012; Pickering & Gathercole, 2001).

Against this background, the current study sets out to use a complex non-verbal visuospatial working memory task, which strives to render a more accurate estimate of an ELL's central executive capacity than verbal working memory tasks do, due to the former not being dependent on language knowledge. Also, in the current study, two non-word repetition tasks are employed, one task that has a high wordlikeness with English and another task that strives to be linguistically independent. The use of two different non-word repetition tasks is to address the wordlikeness problem and to discover whether wordlikeness has an effect on the prediction of future language outcomes. The current chapter is concerned with the research question "Do phonological working memory and non-verbal complex working memory predict future English outcomes in English language learners?". In order to answer this core research question, two sub-questions were posed, A and B, which can be paraphrased as follows:

A. What is the longitudinal relationship between working memory measures and language performance in young children who are ELLs?

B. Does performance on working memory tasks predict future performance on language measures?

6.2 Method

6.2.1 Participants

Recall that children in their first year of formal schooling, aged 5 or 6 years old, were eligible for participation. Although 34 typically developing children took part in the larger study, for the purposes of this chapter, only the 27 who are ELLs (12 males and 15 females) are considered. These ELLs ranged in age from 5;6 to 6;3, and their age of first exposure to English occurred at either 2 or 3 years of age. All the ELLs were from mid to low SES households and were in the same multicultural, English-medium, suburban school in the greater Cape Town area.

6.2.2 Procedure and materials

As stated before, children were tested three times during this longitudinal study: at the beginning of the school year (T1), in the middle of the year (T2) and at the end of the year (T3). Testing was conducted individually in a quiet room at their school, and sessions lasted on average 60 minutes per child. Children were given breaks when they showed signs of fatigue and/or if they requested a break. The same tasks assessing English proficiency and working memory aptitude were presented to the child at each of his/her three testing sessions, in randomised order. For the purposes of this chapter, these tasks were the vocabulary task, the language assessment battery, the two phonological working memory tasks (non-word repetition) and the complex non-verbal visuospatial working memory task (odd-one-out). Note that the simple non-verbal visuospatial working memory task (Corsi blocks) was not considered for the purposes of this chapter. This is due to the findings from Chapter 4 which showed that the Corsi blocks taps into the visuospatial sketchpad. The visuospatial sketchpad component of working memory is not involved in language and is therefore excluded from the analysis in this chapter.

Language measures

As stated previously, the Peabody Picture Vocabulary Test (PPVT-4) (Dunn & Dunn, 2007) was used to measure receptive vocabulary, and the Developmental Evaluation of Language Variation - Criterion Referenced Edition (DELV-CR) (Seymour, Roeper & De Villiers, 2003) was used as the language assessment tool. In the DELV-CR, comprehension and production skills are assessed across the linguistic domains of syntax, semantics and pragmatics. The greatest advantage of the DELV is that it targets the linguistic structures that are most commonly found across the different varieties of English, which allows the tool to be dialect neutral (Seymour, Roeper & De Villiers, 2003). Neither the PPVT-4 nor the DELV-CR has been standardised for use and normed with English L2 South African children. For this reason, raw scores instead of standard scores are considered, in order for the child to be compared to himself/herself across three data collection points and not to the norming sample of the PPVT-4 or the DELV-CR.

Working memory measures

Recall that the two tasks used to assess phonological working memory were the Language Specific (English) non-word repetition (E-NWR) (Chiat, 2015) and the Cross-linguistic non-word repetition (CL-NWR) (Chiat, 2015) tasks. As stated before, the E-NWR uses non-words which are based on English phonotactics whereas the CL-NWR consists of items which are based on the most commonly observed phonotactics across languages. Both tasks were presented on a laptop through the Bead Game (Polišenská & Kapalkova, 2014). Scoring was based on whole item correctness where a score of one was awarded for a correct repetition and zero was given when the repetition was inaccurate. Self-corrections were allowed and a correct self-correction was awarded a score of one.

The Odd-One-Out task (based on Henry, 2001) is a nonverbal visuospatial working memory task that was used to tap into the central executive. The task began at the simplest list level and the difficulty was increased by one item if the child completed the list correctly. As explained before, the Odd-One-Out task requires the participants firstly to point to which of the three presented shapes is different, and secondly to remember the position of the different shape. If the child correctly remembers the location of the odd shape, one point is awarded.

6.3 Results

The descriptive statistics for all measures at all three testing sessions (T1, T2 and T3) are reported in Table 6.1, in the form of raw scores. A cursory look at the scores shows a marked improvement across the three testing sessions. Moreover, there were no floor or ceiling effects recorded for any of the measurements.

Table 6.1. Means and standard deviations for the tasks across T1, T2 and T3.

Working memory measures	**T1**	
	Mean	**SD**
Odd-one-out	4,81	1,075
CL-NWR	10,26	2,754
E-NWR	13,7	3,911
	T2	
Odd-one-out	5.41	1.72
CL-NWR	11.67	2.27
E-NWR	16.11	4.61
	T3	
Odd-one-out	7,89	1,281
CL-NWR	14,19	1,665
E-NWR	19,63	3,804
Language Measures	**T1**	
Syntax	14.63	5.53
Semantics	17.96	5.37
Pragmatics	8.04	4.82
PPVT	50	15.92
	T2	
Syntax	21.04	7.07
Semantics	21.44	5.41
Pragmatics	12.3	4.66
PPVT	63.26	16.81
	T3	
Syntax	26.30	5.75
Semantics	27.19	4.49
Pragmatics	17	4.07
PPVT	78.33	14.98

Bivariate correlations were calculated in order to address the research question concerning the longitudinal relationships between working memory measures and language measures. All correlations are reported in Table 6.2. As can be seen from this table, the E-NWR is significantly correlated with Syntax, Pragmatics and the PPVT vocabulary score across all three testing sessions. As for the Odd-one-out task, the only correlation that is constantly significant across the testing year is that with syntax. All correlations are positive, indicating a positive growth relationship.[15]

[15] Note that a positive correlation means that as the scores on one task increases, the scores on the other task also increases in a parallel fashion. Growth is thus seen from the direction of the correlation and can be verified by the raw scores in Table 6.1.

Table 6.2. Correlations between all working memory and language measures across T1, T2 and T3.

Tasks		Odd-one-out	CL-NWR	E-NWR	Syntax	Pragmatics	PPVT	Semantics
Visuospatial Working Memory	Odd-one-out (T1)	--	.290	.380	.486*	.350	.274	.459*
	Odd-one-out (T2)	--	.431*	.388*	.522**	.403*	.311	.340
	Odd-one-out (T3)	--	-.134	.323	.469*	.605**	.662**	.325
Phonological Working Memory	CL-NWR (T1)	.290	--	.622**	.474*	.307	.155	.162
	CL-NWR (T2)	.431*	--	.739**	.580**	.556**	.457*	.432*
	CL-NWR (T3)	-.134	--	.655**	.147	.369	.065	.412*
	E-NWR (T1)	.380	.622**	--	.671**	.505**	.414*	.258
	E-NWR (T2)	.388*	.739**	--	.481*	.432*	.555**	.347
	E-NWR (T3)	.323	.655**	--	.538**	.773**	.420*	.520**
Language tasks	Syntax (T1)	.486*	.474*	.671**	--	.584**	.609**	.500**
	Syntax (T2)	.522**	.580**	.481*	--	.723**	.712**	.752**
	Syntax (T3)	.469*	.147	.538**	--	.610**	.477*	.492**
	Pragmatics (T1)	.350	.307	.505**	.584**	--	.639**	.637**
	Pragmatics (T2)	.403*	.556**	.432*	.723**	--	.698**	.751**
	Pragmatics (T3)	.605**	.369	.773**	.610**	--	.522**	.440*
	PPVT (T1)	.274	.155	.414*	.609**	.639**	--	.565**
	PPVT (T2)	.311	.457*	.555**	.712**	.698**	--	.732**
	PPVT (T3)	.662**	.065	.420*	.477*	.522**	--	.521**
	Semantics (T1)	.459*	.162	.258	.500**	.637**	.565**	--
	Semantics (T2)	.340	.432*	.347	.752**	.751**	.732**	--
	Semantics (T3)	.325	.412*	.520**	.492**	.440*	.521**	--

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

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

A multiple linear regression model was fit using the R-software (R Core Development Team, 2005) in order to address the relevant research questions. Each language measure was treated separately and put into its own model. The predictors used in the models were E-NWR, CL-NWR and Odd-one-out, as follows the theoretical assumptions laid out in Section 6.1 of this chapter. SES and Sex were also entered into the models but were found to not be significant and also contributed to a higher Akaike's information criterion (AIC).[16] Therefore, these two predictors were left out of further analyses. On account of the high correlations between the working memory tasks, particularly between the E-NWR and the CL-NWR, which was as high as (r=0.739, p<.001), multicollinearity between predictors was checked for. It is generally accepted that if the Variance Inflation Factor (VIF) is between 2 and 3, there may be cause for concern (Field, Miles & Field, 2012, p. 276). There was evidence of collinearity between the E-NWR and the CL-NWR predictors, but not for the Odd-one-out (VIF = 2.597 for E-NWR; VIF = 2.469 for CL-NWR; VIF = 1.554 for Odd-one-out). Due to the collinearity between E-NWR and CL-NWR, only one of the non-word repetition tasks could be used in the analysis. The decision was made to retain E-NWR. The evidence of collinearity indicates that the wordlikeness problem is not evident in this dataset and therefore retaining a non-word repetition measure that is alike to English phonotactics is more in line with previous literature (e.g. Gathercole, 2006). In order to establish whether this theoretical decision affected the statistical outcomes, the AIC was calculated for the separate models with CL-NWR, E-NWR and Odd-one-out to find the model of best fit. For all language measures,

[16] Akaike's information criterion (AIC) estimates the quality of a statistical model when the models are compared to each other. The smaller the AIC value is, the higher the quality of the model (Akaike, 1981).

the E-NWR and Odd-one-out were found to be the best predictors according to the lowest AIC.

Analysis was then conducted to address research question A, which is concerned with the relationship between the working memory measures and language outcomes longitudinally. Thus, regression analysis was done using outcomes from working memory tasks at each time point as predictors in models with the language outcomes from each time point. Due to the large number of results, only the significant results will be laid out in text, but all results are presented in Table 6.3.

Firstly, outcomes at T1 were considered. E-NWR was a significant predictor of Syntax ($F(2, 24) = 12.63$, $p = 0.001$), and this model accounted for 51% of the variance, whereas for Semantics, the Odd-one-out was significant ($F(2, 24) = 3.35$, $p = 0.041$), and this model explained 22% of the variance. The E-NWR was a significant predictor of performance on the Pragmatics task ($F(2, 24) = 4.77$, $p = 0.03$) and accounted for 28% of the variance. Lastly, neither Odd-one-out nor E-NWR were significant predictors of Vocabulary.

Table 6.3. Results of regression analysis for each testing session.

	B	***SE***	***T***	***P***	***R^2***
				T1	
Syntax					.513
Odd-one-out	1.390	0.792	1.756	0.092	
E-NWR	0.803	0.218	3.689	0.001**	
Semantics					.218
Odd-one-out	2.103	0.973	2.160	0.041*	
E-NWR	0.134	0.268	0.502	0.620	
Pragmatics					.285
Odd-one-out	0.830	0.836	0.993	0.331	
E-NWR	0.535	0.23	2.329	0.029*	
Vocabulary					.187
Odd-one-out	2.022	2.943	0.687	0.499	
E-NWR	1.474	0.81	1.821	0.081	
				T2	
Syntax					.364
Odd-one-out	1.626	0.729	2.232	0.035*	
E-NWR	0.503	0.271	1.857	0.076	
Semantics					.17
Odd-one-out	0.764	0.636	1.201	0.241	
E-NWR	0.296	0.237	1.251	0.223	
Pragmatics					.252
Odd-one-out	0.753	0.52	1.448	0.161	
E-NWR	0.328	0.193	1.694	0.103	
Vocabulary					.319
Odd-one-out	1.104	1.792	0.616	0.544	
E-NWR	1.864	0.667	2.796	0.01*	
				T3	
Syntax					.387
Odd-one-out	1.482	0.758	1.955	0.062	

E-NWR	0.652	0.255	2.555	0.017*	
Semantics					.298
Odd-one-out	0.614	0.633	0.969	0.642	
E-NWR	0.547	0.213	2.564	0.017*	
Pragmatics					.739
Odd-one-out	1.261	0.35	3.607	0.001**	
E-NWR	0.689	0.118	5.855	<0.001**	
Vocabulary					.485
Odd-one-out	6.864	1.809	3.795	<0.001**	
E-NWR	0.908	0.609	1.491	0.149	

*. Significance at the 0.05 level

**. Significance at the 0.01 level

At T2, Odd-one-out was again a significant predictor of Syntax ($F(2, 24) = 6.85$, $p = 0.035$), and the model accounted for 36% of the variance, whereas, unlike at T1, there were no significant predictors for Semantics and Pragmatics. Vocabulary, however, was predicted by E-NWR ($F(2, 24) = 5.61$, $p = 0.01$), and this model described 32% of the variance.

For the third testing session, T3, E-NWR was a significant predictor for both Syntax ($F(2, 24) = 7.58$, $p = 0.017$) and Semantics ($F(2, 24) = 5.09$, $p = 0.017$). These models explained 39% of the variance and 30% of the variance, respectively.

In order to address research question B, which focuses on determining whether working memory measures at T1 and T2 can predict performance on language measures at T3, a regression analysis was run – firstly, with the T1 working memory scores and the T3 language measures, and, secondly, with the T2 working memory scores and the T3 language measures. All results of these analyses are to be found in Table 6.4, however, only significant results will be discussed in the text.

For Syntax at T3, the regression analysis showed that T1 scores on E-NWR and Odd-one-out were not significant predictors, but that E-NWR was found to be a significant predictor for Semantics ($F(2, 24) = 5.22$, $p = 0.018$), where this model accounted for 30% of the variance. Neither Odd-one-out nor E-NWR were significant predictors for Pragmatics at T3 nor for Vocabulary at T3.

Table 6.4. Results of regression analysis for predicting future language outcomes.

	B	***SE***	***t***	***P***	R^2
		T1 predict T3			
Syntax					.181
Odd-one-out	0.906	1.067	0.849	0.404	
E-NWR	0.487	0.294	1.660	0.11	
Semantics					.303
Odd-one-out	0.688	0.769	0.895	0.38	
E-NWR	0.536	0.212	2.532	0.018*	
Pragmatics					.211
Odd-one-out	0.544	0.741	0.734	0.470	
E-NWR	0.401	0.204	1.968	0.06	
Vocabulary					.164
Odd-one-out	1.791	2.809	0.638	0.53	
E-NWR	1.296	0.773	1.677	0.106	
		T2 predict T3			
Syntax					.316
Odd-one-out	1.122	0.614	1.829	0.08	
E-NWR	0.424	0.228	1.859	0.08	
Semantics					.213

Odd-one-out	-0.192	0.514	-0.373	0.713	
E-NWR	0.472	0.191	2.465	0.021*	
Pragmatics					.472
Odd-one-out	0.45	0.381	1.179	0.25	
E-NWR	0.521	0.142	3.674	0.001**	
Vocabulary					.176
Odd-one-out	1.321	1.755	0.752	0.459	
E-NWR	1.094	0.653	1.675	0.107	

*. Significance at the 0.05 level
**. Significance at the 0.01 level

Subsequent analysis was conducted in order to determine if working memory measures at T2 predict language outcomes at T3. For Syntax, neither Odd-one-out nor E-NWR were significant. In the model for Semantics, the Odd-one-out was included as well as E-NWR, where it was found that E-NWR was a significant predictor ($F(2, 24) = 3.24$, $p = 0.021$), accounting for 21% of the variance. For the Pragmatics model, only E-NWR was a significant predictor ($F(2, 24) = 10.74$, $p = 0.001$), whereas Odd-one-out was not significant, and this model explained 47% of the variance. The final language outcome that was investigated was Vocabulary; however, neither Odd-one-out nor E-NWR at T2 were significant predictors of Vocabulary at T3.

6.4 Discussion

The aim of this chapter was twofold: firstly, to uncover the relations between working memory measures and language measures in young ELLs, and, secondly, to uncover whether the working memory measures can predict future outcomes on language measures. The overall findings show clear correlations between the working memory measures and the language outcomes, which is in line with previous research with ELLs (e.g. Swanson, 2014; Swanson, Orosco & Lussier, 2015). Although some working memory measures were found to predict later language outcomes, the regression analysis shows varying results that need more fine-grained inspection and interpretation before a clearer picture of the predictions can be formed.

In order to answer research question A, correlation analysis was performed on all measures across the three testing sessions. All correlations are positive, which entails that all measures are increasing across the year in a positive relationship. Notably, the Odd-one-out is significantly correlated with syntax at every time point throughout the year. The same consistency of correlations across the testing points is seen between the E-NWR and syntax, and the E-NWR and pragmatics. However, there are apparent significant correlations between all working memory measures and all language measures in varying strengths, and in order to gain a better understanding of these observed relationships, a regression analysis was run.

The regression analysis showed that the correlations did not always translate into consistent predictions. For instance, the Odd-one-out score, measuring the central executive, only predicts semantics outcomes at T1, syntax outcomes at T2 and pragmatics outcomes at T3. This apparent inconsistency is not without explanation; the working memory strategies employed to deal with cognitive tasks vary throughout childhood. For instance, Gathercole and Baddeley (1993) found that working memory skills are promoted as a result of attending school and that children begin to use different strategies for memory tasks after entering the school system. The findings from the current study could be seen to corroborate this; the magnitude of involvement of the central executive in the language domains will vary, especially because the children included in this study are being introduced to formal schooling for the first time. Markedly, at T3 the pragmatics score was significantly predicted by both the central executive and phonological working memory, and this model accounted for 74% of the variance in the data. This result indicates that both these processes are relied upon throughout the acquisition of pragmatics but that they become more important after a year of formal schooling and English language exposure.

Furthermore, the finding that the central executive is implicated in the acquisition of syntax is in line with previous research in bilinguals (Verhagen & Leseman, 2016). The involvement of the central executive in the semantics and pragmatics tasks is also in line with what has been found previously, namely that complex working memory is implicit in the comprehension and production of complex syntactic structures (Kidd, 2013).[17] E-NWR was also found to be a significant predictor of syntax at both T1 and T3. In foreign language learning, non-word repetition, and therefore phonological working memory, has been found to play a role in grammar learning (Verhagen, Messer & Leseman, 2015), which is in line with what has been found in this study. The E-NWR task was also found to be significantly involved in the children's pragmatics at T1, vocabulary at T2 and all language measures, except for vocabulary, at T3. The significant role that phonological working memory plays in language outcomes is well-documented in previous literature, as laid out in Section 6.1 of this chapter. The lack of its involvement in the vocabulary scores is an interesting finding however, especially considering that vocabulary is one of the most

[17] The reader is reminded that the Semantics and Pragmatics domains of the DELV-CR include items with complex syntactic structures: The Semantics domain includes the fast mapping of real and novel verbs, whereas the Pragmatics domain is tested with the production of wh-questions. See Chapter 3, Section 3.4.4.

commonly observed outcomes to be associated with phonological working memory (e.g. Baddeley, Gathercole & Papagno, 1998). An explanation can be gained from past studies which have ascertained that children rely on phonological working memory less as they get older and their vocabulary grows (Gathercole, 2006). In the current study this finding is replicated; the correlation between vocabulary and E-NWR weakened from (r=.56) at T2 to (r=.42) at T3, as with the correlation between vocabulary and CL-NWR, which weakened from (r=.46) at T2 to (r=.07) at T3.

Research question B was posed to determine whether children's working memory scores at T1 and T2 could have predictive power for language scores at T3. The results showed that the T1 E-NWR scores could predict the outcomes of the semantics task at T3. The domain of semantics and its relationship to working memory is relatively under-researched, especially in terms of its development in ELLs. Considering that the semantics subtest of the DELV-CR that was used for the current study, investigates lexical retrieval, fast mapping of verbs and the comprehension of quantifiers, it follows that phonological working memory would be implicit in these specific tasks. The child would have to recognise and remember phonotactic patterns and use them productively, especially in the fast mapping task of which the items contain both inflected existing words and inflected novel words. This seemingly taps the same process which is needed for non-word repetition.

Moreover, E-NWR scores at T1 were approaching significance as a predictor of pragmatics scores at T3 however, at T2 the scores were a highly significant predictor. The DELV-CR pragmatics subtest especially focuses on the ability to ask questions and to build narratives. Both these tasks demand a significant amount of working memory due to the child hearing the relevant information and then being expected to productively use this information. The phonological working memory in this scenario would be highly taxed, especially in the case of ELLs who have to hold foreign phonological representations in mind while formulating a response in their L2 (e.g. Miyake & Friedman, 1998). These findings are therefore reasonable based on our knowledge of the tasks and the workings of phonological working memory.

One can conclude from the correlations and from the significant results of the regression analyses that both phonological working memory and the central executive are implicated in the acquisition of syntax, semantics, pragmatics and vocabulary at different points throughout the first year of formal schooling. It is therefore clear from the current longitudinal study that working memory and English language acquisition are highly related processes which interact during the language acquisition process. Due to the participating children having a limited knowledge of English at the time of the study, parsing complex syntactic structures, productively formulating syntactic structures and comprehending the language tasks are taxing for not only the central executive system, which would be responsible for comprehending the input, but also the phonological working memory system, which would be responsible for storing the decoded input (e.g. Andersson, 2010; Miyake & Friedman, 1998).

The answer to the overall research question "Do phonological working memory and non-verbal complex working memory predict future English outcomes in English language learners?" was answered by the two sub-questions. It is demonstrated that language acquisition in ELLs is not a stand-alone process and that working memory measures can be a powerful predictor of language outcomes. This can be particularly useful in furnishing educators and clinicians with important information about whether precautionary language intervention is necessary for an ELL so that, by implication, their future academic success is supported. Importantly, results from working memory measures can aid in the decision regarding the need for intervention, at a time when the ELL has still had very little exposure to English and still has low English proficiency levels. Further research with larger sample sizes and with more time between testing points will however furnish researchers with more accurate and consistent results that can better inform those who work with ELLs.

GENERAL DISCUSSION

7.1 Overview of the study

As elaborated on earlier in this dissertation, the educational situation in South Africa is faced with many hindrances and, along with the lack of sufficient funding for schools, the educational problems continue to worsen (Fleisch, 2008; Klop & Tuomi, 2007; Spaull, 2013). One such problem is that the learners are often unable to perform well when they are being taught in their L2, which is typically English. The underperformance of ELLs is greatly, but not solely, due to their limited proficiency in their LoLT (Alexander, 2005; Brock-Utne & Skattum, 2009; Heugh, 2009; Klop & Tuomi, 2007), which is exacerbated by a lack of funding for interventions and support programs to aid ELLs. Indeed, this lack of support is not limited to ELLs – in South Africa, the non-ELL population typically also has low levels of literacy (Howie, Combrinck, Roux, Tshele, Mokoena & McLeod Palane, 2017; Mullis, Martin, Foy & Hooper, 2017), indicating a lack of general educational support for even those who are taught through the medium of their L1.[18] However, this dissertation focused specifically on the ELL population. This dissertation did not set out to compare the performance of ELLs with their monolingual English peers in order to illustrate the difference in English proficiencies, rather, this study aimed to gain a fuller picture of what the developmental process looks like for each group and how this appears

[18] There are no government-funded posts for speech-language therapist in mainstream schools, and in 2011, there were only 186 SLTs employed in schools for special needs in the country as a whole (Kathard, Ramma, Pascoe, Jordaan, Moonsamy, Wium, Du Plessis, Pottas & Khan, 2011), with no known attempts to increase this number since then.

over time. Another important consideration was how working memory mechanisms develop, and how these mechanisms interact with the development of English.

Three main research questions were posed at the beginning of this dissertation. These questions were addressed by three research articles, which were included in slightly revised format in the dissertation as Chapters 4 to 6. For ease of reference, the reader is reminded of the three articles and their research questions: The first article is concerned with answering the research question “Are phonological and visuospatial working memory maintained by separable cognitive resources or by one common resource?”. The second article set out to answer the research question “How does an English language learner’s English proficiency and working memory develop in their first year of formal education?”. The final question that was posed, “Do phonological working memory and non-verbal complex working memory predict future English outcomes in English language learners?”, is answered by the third research article. The following sections will summarise the answers in response to each research question. Thereafter, the findings of this study will be drawn together into a conclusion describing the implications of the findings, the contribution of the study, and lastly the limitations of this research and possible future directions for continued research into the topic.

7.1.1 Are phonological and visuospatial working memory maintained by separable cognitive resources or by one common resource?

The performance on phonological working memory tasks and on the visuospatial working memory tasks were not correlated with each other, indicating that these two types of working memory are distinctly different processes. Moreover, the scores obtained on the two non-word repetition tasks (one resembling the phonotactics of English and the other not) were highly related to each other, and the exploratory factor analysis confirmed that both of the non-word repetition tasks loaded on the same factor. The presence of the phonological loop, originally proposed by Baddeley and Hitch (1974), was thus uncovered in the current sample. The performances on the two visuospatial tasks (one complex task and the other a simple task) were found to be unrelated; the two tasks loaded on two different factors. This illustrated the difference between complex and simple visuospatial working memory tasks, which were shown to be supported by different factors. In light of Baddeley and Hitch's (1974) multicomponent model, the current article showed that the simple visuospatial working memory task seemingly taps into the visuospatial sketchpad, whereas the complex visuospatial working memory task accesses the central executive.

7.1.2 How does an English language learner's English proficiency and working memory develop in their first year of formal education?

The growth of several domains of language were investigated, namely syntax, semantics, pragmatics and vocabulary. In order to measure working memory, the tasks which were utilised were two non-word repetition tasks, one simple visuospatial task and one complex visuospatial task. All the results from the language tasks and the working memory tasks were analysed in order to determine how English language proficiency and working memory developed during the year. Across both the ELL group and the English monolingual group, a growth pattern of linear trajectory was seen for all language domains, the two non-word repetition tasks as well as the simple visuospatial task. This indicates that development was progressing at a steady and positive rate. Contrastively, the complex visuospatial task was shown to exhibit a nonlinear growth pattern, which entailed that there was a point in time that the rate of development accelerated. This acceleration was postulated to be due to the exposure to school and the related academic tasks, which may lead to different working memory strategies (Gathercole & Baddeley, 1993).

7.1.3 Do phonological working memory and non-verbal complex working memory predict future English outcomes in English language learners?

Both phonological working memory and non-verbal complex visuospatial working memory were found to play a role in the acquisition of various linguistic domains of English. Throughout the year of testing, phonological working memory was correlated with syntax, pragmatics and vocabulary, whereas the central executive was correlated with syntax only. Regression analysis also showed that performance on the central executive tasks predicted future outcomes on syntax, and that scores on the phonological working memory tasks predicted semantics and pragmatics outcomes. We can conclude that not all language domains are affected by phonological working memory or visuospatial working memory consistently throughout the year. However, it is clear that there is a relationship between working memory and language skills.

7.2 Implications of the findings

This research is concerned with the diversity of a typical South African grade R classroom, and how the children in these classrooms develop in terms of English language skills and working memory over the course of the year. The current research study was motivated by the practical challenges which are apparent in the South African education system. There are three specific issues which inspired this study: Firstly, many South African children are being taught in English, a mostly unfamiliar language to them (Heugh, 2000; Meirim, Jordaan, Kallenbach & Rijhumal, 2010; Posel & Zeller, 2016). Secondly, ELLs often form part of a class which is made up of children with varying levels of proficiency in English, ranging from no proficiency to L1 proficiency. Moreover, the parents/caregivers of those children with non-L1 proficiency also have varying levels of proficiency in English, leading to various levels of ability to support ELLs in their English-based education. Finally, many children who experience educational setbacks are from households with lower SES (e.g., Dollaghan, Campbell, Paradise, Feldman, Janosky, Pitcairn & Kurs-Lasky, 1999; Lee & Buram, 2002). In response, this study's approach was to carefully track the linguistic and working memory development of grade R children from a single school, in order to better understand their progress. With knowledge of their progress comes an insight into what can be done in order to support and encourage positive development. This will, in turn, facilitate academic progress and promote future achievement.

Although this study is grounded in South Africa and was inspired by the linguistic diversity of this country, the results are relevant internationally. Bilingualism is increasing worldwide (Wong & Hyland, 2017), and knowledge about ELLs, and their development, is a pertinent issue. There has been a large body of prior research which has been conducted with ELLs, especially from the United States. Yet, the majority of these studies include Spanish–English language combinations only (see e.g., Barragan, Castilla-Earls, Martinez-Nieto, Restrepo & Gray, 2018; Bunta, Fabiano-Smith, Goldstein, & Ingram, 2009; Fabiano-Smith & Goldstein, 2010; Lee Swanson, Orosco & Lussier, 2015). The conclusions drawn from these studies provide valuable information about the development of ELLs. However, this needs to be pitted against more diverse samples from so-called non-WEIRD contexts in order to hone in on the differences and similarities between ELLs who have various L1s, and also ELLs who come from different contexts. Using South Africa as a base for this study lends new insights into bilingualism, amongst others due to the array of language combinations present in the country, as reflected in this dissertation.

It is well founded that early intervention is key to giving a child the best possible chance at succeeding; challenges in learning, which are apparent in the early school grades, often grow into problems which follow the child throughout their academic career (Spaull, 2013: 40). Moreover, the eventual burden of English-only instruction for ELLs has been predicted to result in negative outcomes in later years (Crawford, 2004; Guerrero, 2004; Krashen, 1996). There is a need to focus our attention on the early primary school grades in order to address these problems before they become insurmountable. Therefore, the answers that this study produced are interpreted to have practical uses for educators and practitioners.

A number of interesting findings were yielded, which stemmed from the aforementioned research questions, yet three overall findings have been deemed to be the most important and most relevant both nationally and internationally. The first hereof is that visuospatial and phonological working memory are two different and separable components of working memory, which remain the same over the course of the first year of formal schooling, despite the new influence of formal schooling. According to Baddeley and Hitch's (1974) multicomponent model, the three components, namely the the central executive, the visuospatial sketchpad and the phonological loop, exist from the age of 6 years. Further studies have found that children between 4 and 11 years of age already have the same basic structure in place (Alloway, Gathercole & Pickering, 2006; Nadler & Archibald, 2014). This was affirmed by the results of the current study with a group of 5 to 6 year old ELLs. These results were presented in Chapter 4.

The existence of the central executive in the current study supports the domain-general approach to working memory, which was discussed in detail in Chapter 4. This approach advocates for separate components (the phonological loop and the visuospatial sketchpad) being governed by one main structure, namely the central executive, which is most involved in complex working memory tasks (Baddeley & Hitch, 1974). The opportunity of isolating these underlying working memory mechanisms into designated components yields a helpful theoretical structure which can be translated practically. In other words, once the three aforementioned components have been identified, their functions can be determined and, specifically, the role that each component plays in a child's development. Therefore, each working memory component can be studied in terms of its interaction with aspects of childhood development, such as linguistic, cognitive and academic skills. A child's working memory can only be understood if the designation of its structure has first been determined. International research has been concerned with the structure of working memory in various samples of children, differing in SES and languages spoken (e.g., Alloway, Gathercole & Pickering, 2006). To the author's knowledge, the current study comprises the first of its kind conducted with South Africa based children. The results of this study confirmed that working memory is comparable across samples and countries, and the study contributes to the international body of literature by adding results from a relatively understudied sample.

The current study also did not find any major changes in the organisation or structure of working memory, even after the children's first year of formal schooling. This being said, the children in the current study had not received literacy instruction by the third and last data collection session and had only received rudimentary numeracy instruction. As Gathercole and Baddeley (1993) found, the use of active rehearsal as a memory strategy is not apparent in children who have not yet learned to read. Chapter 6 did, however, show that the way in which working memory interacts with language outcomes changes over the year, possibly indicating that the children start to use different working memory strategies when dealing with language tasks. This does not allude to a change in structure but only to a change in the children's strategies when engaging their working memory. The re-confirmation that the three component structure is established by 5 to 6 years of age, in ELLs and English monolinguals, allowed the study to further investigate how these working memory structures develop over time. This subsequently led to the question of how these separate components interact with English language acquisition.

The second overall finding of the study is that ELLs and English L1 children have the same trajectory of development on working memory tasks, and the same developmental trajectory of English acquisition. The only major differences between these two groups of children is in performance accuracy on the language assessment battery. This is apparent in the lower raw scores that were obtained by the ELLs, in comparison to their monolingual English peers. In terms of the development of working memory, the trajectory of growth is the same for the ELL and the English groups on all working memory tasks. This illustrates that progress on the tasks over the year will follow the same pattern regardless of the child's linguistic knowledge.

Both the language and the working memory results have very important consequences for the assessment of children in diverse linguistic settings who may have DLD. It has been shown that low scores on vocabulary tasks and difficulties in morphosyntax are attributes of insufficient knowledge of the target language, yet it can also be an indicator of DLD in a monolingual child (Bedore, Peña, Garcia, & Cortez, 2005; Paradis, Genesee & Crago, 2011). It has proven to be a great challenge to differentiate between a typically developing bilingual child's process of language acquisition and the occurrence of a child with disordered language acquisition, as in DLD (Gutiérrez-Clellen, Restrepo & Simon-Cereijido, 2006; Kohnert, 2010). If one could look at the working memory and linguistic development over time of a child who is at risk for DLD, the trajectory of their development may reveal insights into how typical their development is. If the trajectory is comparable to typically developing peers, then it may be likely that the child does not have DLD. This does, however, warrant further research.

Furthermore, as was seen in Chapter 6, working memory measures are implicated in language learning. It was concluded therefore that the two processes cannot be regarded as being independent. This could have an impact on identifying DLD, as also previous studies have shown that, taking into account not only language abilities, but also more cognitive abilities, can assist one in disentangling bilingualism from DLD (e.g., Henry & Botting, 2016; Kohnert, 2010). Unlike language assessments, which need to be administered by a fluent speaker and need to be culturally and linguistically appropriate for the child in order to yield reliable and valid results, working memory tests can be non-verbal if the instructions are demonstrated rather than explained verbally. Tests of working memory may thus be more easily accessible to practitioners (recall that most South African speech-language therapists are monolingual English speakers or Afrikaans-English bilinguals), more appropriate for use with ELLs, and render valid results in multilingual settings. South Africa lacks appropriate assessment tools which can discern between DLD and typically developing children (Dowling & Whitelaw, 2018; van Dulm & Southwood, 2013), and this includes ELLs. Bilingual children with DLD exhibit problems in all of their languages (e.g., Ebert, Kohnert, Pham, Disher & Payesteh, 2014), therefore in order to be absolutely sure that the child has DLD, one should be able to test all of his/her languages. However, in a country like South Africa which has 11 official languages and few assessment tools, the testing of all languages serves to be highly unfeasible in most cases (Dowling & Whitelaw, 2018; van Dulm & Southwood, 2013). There is already promising international research of the suitability of nonword repetition tasks as a tool for indicating DLD (e.g., Szewczyk, Marecka, Chiat & Wodniecka, 2018). The strength of these tasks is that they do not rely on specific language knowledge and are thereby more suitable for use in multilingual settings. Therefore, further investigation into the suitability of working memory tasks as assessment tools could yield beneficial results, especially for practitioners working in a country such as South Africa, where there is a wide range of different language combinations amongst its multilingual children.

The third and final important overall finding of the current study is that working memory skills are related to English language acquisition in ELLs. Chapter 2, Section 2.2 pointed out the importance of ELLs having adequate English proficiency in order to perform well academically (e.g., Howie, 2005; Strand, Malmberg & Hall, 2015). Teachers are often faced with classes which are made up of children who have differing levels of English proficiency. This leads to a challenging situation where the level of English that can be used by the teacher, and the level of English that can be explicitly taught, will unavoidably leave some children behind. Few children will have the necessary CALP skills to keep up with the teacher, whereas the other children will not have acquired these skills and will fall further and further behind with time. The results from Chapter 6 showed that there could be another approach, one which can support these children in the language acquisition process. It was found that working memory and language are linked; certain working memory tasks can predict outcomes on certain language domains. One can endeavour to translate this practically into ways that can support and encourage the child's language development. Such as the introduction of working memory training (see e.g. Studer-Luethi, Bauer & Perrig, 2016), which should target both phonological working memory and the central executive, may support and encourage the acquisition of the necessary CALP skills. For example, a study by Peng and Fuchs (2017) found that training verbal working memory resulted in better performance on comprehension tasks. In the situation where the resources are not available to offer additional English language support to those who need it, working memory tasks will be an easier alternative to utilise. Though working memory training has yielded varying degrees of efficacy in previous studies (see e.g., Shipstead, Hicks & Engle, 2012), more studies are warranted in order to ascertain whether it is a viable manner of supporting a child's development

Moreover, as discussed in Chapter 1, overcrowded classrooms are a reality in South African schools (Vandeyar & Jansen, 2008: 11), which generally leads to the teachers being overburdened. It would be unrealistic to expect teachers to have enough time and other resources to further tailor their teaching style to the individual needs of the large number of children in their class and to be able to offer remediation to children who have fallen behind. Therefore, working memory tasks and the training thereof can be suggested as something to be done with the child by the parents or caregivers. Even those parents or caregivers who are unable to provide high quality English input (as some whose children participated in the current study) can undertake to train working memory with their child, which could in turn help to encourage their child's development (see e.g., Holmes, Gathercole & Dunning, 2009; Peng & Fuchs, 2017; Studer-Luethi, Bauer & Perrig, 2016, for studies of working memory training).

7.3 Limitations of the study and future directions

There were several limitations that were present in the current study. The four main limitations will be discussed in this section.

The first limitation was encountered based on cultural differences between the author and the participants. The parents of the participating children were different in culture, and sometimes in nationality, from the author. This was particularly apparent in terms of customs and what is to be considered as respectful or not. During the parent interviews, the author had to be aware of these differences and try to elicit the most accurate answers while still remaining respectful. The English comprehension of the parents may also have affected their answers; their understanding of what was being asked may have been limited, even though they seemed competent to answer the questions. Accuracy of answers would have been ensured if they were offered the opportunity of having had the interview in their L1. Given the large range of L1s (nine amongst the 27 interviewed parents of ELLs) and the fact that some of them are not South African languages for which interpretation is readily available (consider, for instance, Cameroonian Pidgin English), interviewing parents in their L1 was not always practical. Though every effort was made to remain mindful of the English proficiency of the parents and to paraphrase the questions accordingly, the answers that the parents gave may have been affected by this cultural and linguistic divide. Future studies could consider using cultural and language brokers to conduct the interviews, which may allow the parents to feel more at ease.

A second limitation was the relative comparability of participants in terms of their SES. This resulted in SES being a non-significant predictor in this study's analyses, whereas some other authors have found SES to be a significant predictor in previous studies of child language acquisition. This was a characteristic of the school that was chosen, as it was chosen specifically for its low SES level. A low SES context was sought in order to shed light on a more under-researched level of SES, as most previous research has been done with participants from mid to high SES households (see e.g., Calvo & Bialystok, 2014: 4) Although SES as a predictor variable was not significant, the results from the study illustrate the situation found in low SES classrooms. In order to further address this in future and increase the generalisability of the results, it may be wise to include a mid or high SES control group which can then be compared to the low SES group. This will yield more information about how SES affects working memory and language acquisition of ELLs who are in their first year of school.

A third limitation was the sizes of both groups. The ELL target group consisted of 27 participants, whereas the English L1 group consisted of seven participants. This caused between-groups parametric statistical analysis to be made impossible, which in turn resulted in the opportunity for potentially valuable comparisons to be lost. Moreover, the generalisability of results is greatly limited by these sample sizes. The sample sizes were small for two reasons: Firstly, the author endeavoured to keep the variability in teaching quality low by only sampling from one school, and secondly, finding monolingual English children in that one school is exceedingly difficult as bilingualism is the norm in the communities whose children attend the school. Due to the decision to sample from one school only, the sample sizes were largely unalterable. Future studies could consider finding schools with comparable teaching quality in order to widen the pool of potential participants and thereby increase sample sizes.

The fourth and final limitation was the relative constraints of the working memory tasks that were utilised. In order to draw more concrete conclusions about working memory, a more comprehensive battery, comprising a larger array of both complex and simple working memory tasks, would have been preferable. This, along with the addition of executive functions, has been found by previous research to furnish great insights into children's development and future academic outcomes (see, e.g., Bull, Espy & Wiebe, 2008; Bull & Scerif, 2001; Calvo & Bialystok, 2014). The visuospatial and phonological working memory tasks that were included in the current study yielded interesting results that warrant the inclusion of additional tasks which could expand on these findings. For example, future studies could use The Automated Working Memory Assessment (AWMA; Alloway, 2007) which is a working memory test battery that includes both simple and complex working memory tasks across the verbal and visuospatial domains. It has been found to be a valid measure of working memory which is suitable for use with both clinical and non-clinical populations (Alloway & Archibald, 2008; Alloway, Gathercole, Kirkwood & Elliot, 2008; Archibald & Joanisse, 2009).

In light of the findings and the limitations of the current study, recommendations can be made for future research that will elaborate on, and contribute to, the findings of the current study. The replication of the current study with more participants would lead to better insights of which variables are most predictive of future outcomes in both language and working memory.

The longitudinal design of the current study was apt for describing the development of both language and working memory in the children's first year of formal schooling. The first year of formal schooling, grade R in South Africa, is the year before literacy instruction commences. A future study should undertake to follow the children's progress throughout their grade 1 year as well, in order to explore how working memory development is affected by literacy acquisition. The known implications of both working memory and language proficiency on academic outcomes allow a follow-up study to be viable. The same children could be tested after three or four years, which would make it possible to conclude whether the outcomes in grade R are predictive of future academic outcomes at the start of the intermediate phase, which in South Africa is when learners are expected to use their CALP to learn content subjects.

In order to fully grasp what effect working memory has on academic achievement and language outcomes, the best case would be to run a longitudinal intervention study that follows children's progress in school. Extra working memory training should be given to children who are identified as needing extra support. This will result in answering the question of whether working memory training will support South African ELLs, who have diverse language combinations and who are from mid to low SES households, with their future academic achievements and also increase their rate of English language acquisition.

Moreover, it would be beneficial to include a clinical population, more specifically, children who are suspected of having DLD. In such a diverse linguistic and cultural context like South Africa is, it is important to understand how DLD manifests in children in order to work towards more accurate diagnostic tools. Due to working memory and language having been found to be affected in children with DLD (Leonard, 2014), the inclusion of this population will further reveal where the line is between impaired and typical development.

7.4 Concluding remarks

In spite of the limitations mentioned above, this study has led to new insights, both theoretically and with practical implications. This study offers longitudinal data on language as well as working memory development of a relatively under-researched group of children. This study also contributes on an international level, as research that focuses on non-WEIRD contexts can offer new insights into our current knowledge of bilingualism.

Moreover, this study sheds light on the situation found in a typical South African classroom and the plight of the learners and teachers in this context. These ELLs come from mid to low SES households where English proficiency and knowledge is low. Meanwhile, peers in their class may have higher levels of English proficiency leading to a heterogenous learner-body in one classroom. Along with the under-resourced schools and over-burdened teachers, this kind of heterogeneity amongst the learners results in the learners not receiving the support that they need, be it academic or linguistic. English monolinguals and ELLs alike suffer from this limited support, and the offshoot of this is clearly seen in the worsening educational crisis in South Africa. This situation differs greatly from other ELL contexts, such as the USA and the United Kingdom, which deems this current study necessary in order to introduce the South African context to ELL research. Furthermore, with an extended knowledge base on ELLs and their language and working memory development, existing interventions, originating from non-WEIRD contexts, can be optimally adapted to be used with ELLs in contexts similar to those found in South Africa.

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APPENDICES

Appendix A

Western Cape Government
Education

Directorate: Research

Audrey.wyngaard@westerncape.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20160726 – 2676
ENQUIRIES: Dr A T Wyngaard

[redacted]

Dear Ms Michelle White

RESEARCH PROPOSAL: PROCESS UNDERLYING LANGUAGE DEVELOPMENT AND RATE OF ENGLISH LANGUAGE ACQUISITION, WITH SPECIFIC REFERENCE TO ELLS IN A MULTILINGUAL SOUTH AFRICAN GRADE R CLASSROOM

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **18 January 2017 till 30 September 2017**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 27 July 2016

Appendix B

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

Approval Notice

Stipulated documents/requirements

05-Dec-2016

White, Michelle MJ

Ethics Reference #: SU-HSD-003109

Title: Processes underlying language development and rate of English language acquisition, with specific reference to ELLs in a multilingual South African Grade R classroom

Dear Miss Michelle White,

Your Stipulated documents/requirements received on 01-Dec-2016, was reviewed and **accepted.**

Please note the following information about your approved research proposal:

Proposal Approval Period: 15-Nov-2016 - 14-Nov-2019

Please take note of the general Investigator Responsibilities attached to this letter.

If the research deviates significantly from the undertaking that was made in the original application for research ethics clearance to the REC and/or alters the risk/benefit profile of the study, the researcher must undertake to notify the REC of these changes.

Please remember to use your **proposal number** (**SU-HSD-003109**) on any documents or correspondence with the REC concerning your research proposal.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

We wish you the best as you conduct your research.

If you have any questions or need further help, please contact the REC office at 218089183.

Sincerely,

Clarissa Graham
REC Coordinator
Research Ethics Committee: Human Research (Humanities)

National Health Research Ethics Committee (NHREC) registration number: REC-050411-032.

The Research Ethics Committee: Humanities complies with the SA National Health Act No.61 2003 as it pertains to health research. In addition, this committee abides by the ethical norms and principles for research established by the Declaration of Helsinki (2013) and the Department of Health Guidelines for Ethical Research: Principles Structures and Processes (2nd Ed.) 2015. Annually a number of projects may be selected randomly for an external audit.

Appendix C

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
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STELLENBOSCH UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

Processes underlying language development and rate of English language acquisition, with specific reference to ELLs in a multilingual South African Grade R classroom

You and your child are asked to participate in a research study conducted by Michelle White for a Doctorate in Linguistics, from the Department of General Linguistics at Stellenbosch University. As the study forms part of a research project for degree-seeking purposes, the results will be published in the form of a dissertation and possibly later also in the form of articles in scientific journals.

Please take some time to read the information presented here, which will explain the details of this project and contact me if you require further explanation or clarification of any aspect of the study. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the Humanities Research Ethics Committee (HREC) at Stellenbosch University **and will be conducted according to accepted and applicable national and international ethical guidelines and principles.**

1. PURPOSE OF THE STUDY

The purpose of the proposed study is to investigate the development of English language skills and the development of some of the known processing skills underlying language acquisition amongst bilingual Grade R English Language Learners.

2. PROCEDURES

If you grant permission for you and your child's participation in this study, the following will occur:

(i) You complete the parent questionnare form. You are welcome to leave any question on the form unanswered.
(ii) Your child's language will be assessed with the South African English version of the *Diagnostic Evaluation of Language Variation,* the *Nonword repetition tasks* and the *Visuospatial Working Memory* tasks. The assessment session takes approximately 60 minutes and entails question asking and answering, sentence completion and picture selection on the part of your child. If some tasks were not completed in this time alternative sessions will be scheduled.
(iii) The data collected from you and your child will then form part of a data pool. Parts of the data pool may be disseminated in the form of conference presentations or scientific articles published

in journals. All references to you and your child's responses will however be anonymised carefully.

Please note that your child's responses to the tasks will be recorded with a digital voice recorder for later verification. Children and parents will be debriefed when the research is completed and parents may request feedback from the researcher on their child's language development.

3. POTENTIAL RISKS AND DISCOMFORTS

Participation in the study will not bring about risks or cause discomfort to you or your child.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

The participants will not benefit personally by taking part in the research.

5. PAYMENT FOR PARTICIPATION

No payment is being offerred to you or your child for participating in this study. Participation will also not cost you anything.

6. CONFIDENTIALITY

No names of any participants will be mentioned in the thesis or subsequent other publications; participants will be given a participant number or pseudonym that will be utilised in the thesis for ease of reference, and only the researcher and her supervisors will be able to identify the participant.

The data will be stored in a locked cabinet in the researcher's office and electronic data will be stored in a password protected folder on the researcher's computer.

7. PARTICIPATION AND WITHDRAWAL

Participants can choose whether to take part in this study or not. If your child volunteers to take part in this study, your child may withdraw at any time without consequences of any kind and without providing reasons for withdrawal. Your child may also refuse to answer any questions he does not want to answer and still remain in the study.

8. IDENTIFICATION OF INVESTIGATOR

If you or your child has any questions or concerns about the research, please feel free to contact Michelle White (researcher) Dr Frenette Southwood (supervisor)

[redacted]

Appendix D

RIGHTS OF RESEARCH PARTICIPANTS: You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.
You have right to receive a copy of the Information and Consent form.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to me ____ [*name and surname of parent of the child]* by Michelle White in English and I am in command of this language or it was satisfactorily translated to me. I was given the opportunity to ask questions and these questions were answered to my satisfaction.

____
Name of the child to participate in the study

____ ____________
Signature of parent/guardian **Date**

SIGNATURE OF INVESTIGATOR

I declare that I explained the information given in this document to ________________________________ [*name of the parent of the participant].* He/she was encouraged and given ample time to ask me any questions.

____ ____________
Signature of investigator **Date**

Appendix E

LANGUAGE BACKGROUND QUESTIONNAIRE

FOR PARENTS OF CHILD PARTICIPANTS

Date: ………………………..

Name of parent/caregiver: ………………………..

Name of child participant: ………………………………………………….................................

All information that you provide will remain confidential. Should you find any question inappropriate or too personal to answer, you are under no obligation to do so.

Your life story…

- Where did you grow up?

....

- Up until what grade did you go to school?

....

- What did you do after school?

....

- Do you work somewhere at the moment?

....

- If you are working, what do you do?

....

About your child's father/mother/primary caregiver…

- Is he/she working at the moment?

....

- Does he/she stay with you?

....

 Where did he/she grow up?

....

 Up until what grade did he/she go to school?

....

 What did he/she do after school?

....

Developmental history of child

 How old was your child when he/she first started walking?

....

 What was your child’s first word?

....

 How old was your child was when he/she spoke his/her first word?

....

 How old was your child was when he/she first started putting words together to make short sentences (e.g. more water; more milk; etc.)?

....

 Have you ever been concerned about your child’s language in the past?

....

 What do you think about his/her language now? Do you think his/her language is normal or are you concerned about it?

....

General questions about the people in your child’s life:

 Do you live in the same household as your child?

....

 How many adults live in the child's household?

....

 What language(s) does each of these adults, including you, speak?

....

 What would you say is each of these persons' first language?

....

 What language(s) do the adults use to talk to each other?

....

 What language(s) do the different adults use to speak to your child?

....

 What language(s) does your child use to speak to the different adults?

....

 What language(s) does each of your child's siblings speak?

....

 What language(s) do the siblings use to speak to each other?

....

 What language(s) do your child's best friends speak with him/her?

....

The daycares/crèches/schools that your child has attended in the past:

 How old was your child when he/she started attending a daycare/crèche/school

....

 What language(s) was/were used in the class that your child attended?

....

 What language(s) did your child's classmates speak?

....

 Before going to this daycare/crèche/school, who looked after your child?

....

 What language(s) did this person speak to your child?

....

 What language(s) did your child use when speaking to this person?

....

Questions about the languages that your child is exposed to:

 What languages does your child hear on a regular basis (i.e. daily)?

....

 In the case of each of these languages, how old was your child when he/she first heard it being spoken by others?

....

 Have the adults in your child's household always been using the same language(s) to speak to your child, from birth up until now, or did they switch from one language to another?

....

 And what about your child's mother/father/caregiver? Have they always been using the same language(s) to speak to the child from birth up until now, or did they switch from one language to another?

....

 If you own a television, what language(s) is/are used in the programs that your child is allowed to watch?

....

 What type of programs does your child mostly watch? I.e. are they mainly cartoons, educational children's programs or the same programs as the ones the adults watch?

....

 If you own a radio, what language(s) might your child hear on the channel that you most listen to?

....

□ If you or someone else reads stories to your child, what language(s) are these story books written in?

....

□ Do you ever tell your child stories? If so, in what language and how often?

....

□ What language do you think your child understands best?

....

□ What language do you think your child speaks best?

....

A description of what a typical weekday in the life of your child looks like (from Monday to Friday)…

□ What time does your child wake up in the morning?

....

□ At what time does the child go to school?

....

□ Until what time does the child stay there?

....

□ What time does your child get home again in the afternoon or evening?

....

□ What does he/she do then?

....

□ At what time does your child go to bed?

....

□ Are there certain people who come to visit your house quite often during the week or that your child often goes to visit during the week, e.g. a grandparent, aunt/uncle, neighbour, friend, etc.?

....

 If so, what language(s) does this person use to speak to (a) your child, and (b) other people in your household?

(a) ....

(b) ....

 What language(s) does your child use when speaking to this person?

....

 What language(s) do the other people in the household use when speaking to this person?

....

A typical Saturday or Sunday in the life of your child …

 At about what time does your child wake up in the morning?

....

 At what time does your child go to bed?

....

English:

 How would you describe your child's ability to *understand* English? Is it "very good", "good", "not so good", "bad"

 How would you describe your child's ability to *speak* English? Is it "very good", "good", "not so good", "bad"

Please do the same for any other language your child knows:

Language: ....

 How would you describe your child's ability to *understand* ....? Is it "very good", "good", "not so good", "bad"?

 How would you describe your child's ability to *speak* ....? Is it "very good", "good", "not so good", "bad"?

Language: ....

□ How would you describe your child's ability to *understand* ....? Is it "very good", "good", "not so good", "bad" or do you perhaps not feel competent to evaluate this?

□ How would you describe your child's ability to *speak* ....? Is it "very good", "good", "not so good", "bad"?

THANK YOU FOR YOUR TIME!

If you have any questions please do not hesitate to contact me:

[redacted]

[redacted]

Appendix F

CROSSLINGUISTIC NONWORD REPETITION TASKS

Participant ID: ______________________________

Order of presentation: ______________________________

Age: ______________________________

Gender: ______________________________

Crosslinguistic task		✓	Language-specific task		✓
1	ˈduˌlɑ		1	ˌtɒskəˈlimə	
2	ˈbɑˈmuˌdi		2	ˈlɜsnɒk	
3	ˈliˈdiˈsɑˌku		3	ˌskuməˈkaɪdə	
4	ˈmɑˈliˌtu		4	ˈfræʃək	
5	ˈziˌbu		5	ˌvɒsnəˈrɑudə	
6	ˈmuˈkiˈtɑˌlɑ		6	ˌflɑnəˈmuzə	
7	ˈsiˈpuˈmɑˈkiˌlɑ		7	rəˈnusədɑ	
8	ˈluˌmi		8	ˈzuməlɑ	
9	ˈsiˈpuˌlɑ		9	ləˈvugə	
10	ˈziˈpɑˈliˌdɑ		10	ˈmɑspəˌdɑʊ	
11	ˈmɑˈluˈziˈguˌbɑ		11	ˈrɛfəp	
12	ˈkɑˈsuˈluˌmi		12	ˈsænəri	
13	ˈluˈmiˌgɑ		13	ˌkɛfəˈmɔɪpə	
14	ˈliˈtɑˈpiˈmuˌti		14	ˈsmɪʃəˌtɑʊ	
15	ˈduˈliˈgɑˈsuˌmu		15	rɪˈvaɪk	
16	ˈnɑˌgi		16	ˈzispəˌgɔɪ	
			17	zəˈdɑgənɜ	
			18	ˈnɑskət	
			19	ˈdælən	
			20	ˈspɒdəl	
			21	pəˈzeɪnə	
			22	ˈstɒfəli	
			23	ˌpɒnəˈveɪkə	
			24	nəˈlɔʃ	

Crosslinguistic Nonword Repetition Framework: British English version (Chiat, Polišenská & Szewczyk, 2012, re-produced from Chiat, 2015: 149-150).

Appendix G

QUESTIONS FOR PARENTS/CAREGIVERS OF PROSPECTIVE CHILD PARTICIPANTS

All information that you provide will remain confidential. Should you find any question inappropriate or too personal to answer, you are under no obligation to do so.

1. PERSONAL DETAILS OF PARENT/CAREGIVER

Surname/Family name:

…………………………………………………………………………………………………

First name/Given names:

…………………………………………………………………………………………………

Your relationship to the child (e.g. mother/father/grandfather/aunt):

…………………………………………………………………………………………………

Street address at which the child lives:

…………………………………………………………………………………………………

Telephone/cell phone number:

…………………………………………………………………………………………………

E-mail address (so that I can send you feedback about your child):

…………………………………………………………………………………………………

2. PERSONAL DETAILS OF CHILD

Surname/Family name:

…………………………………………………………………………………………………

First name/Given name:

…………………………………………………………………………………………………

Is your child a boy or a girl? ☐ Boy ☐ Girl

When was your child born (exact date)?

…………………………………………………………………………………………………

Who is your child's teacher?

…………………………………………………………………………………………………

Where was your child born?

City: ……………………………… Country: ……..

If your child was not born in South Africa, when did he/she move to South Africa (date)?

………………………………………………………………………………………..

Does your child brothers and/or sisters? (Please specify)

Name and Surname	Boy or Girl	When was he/she born (exact date)
	□ Boy □ Girl	
	□ Boy □ Girl	
	□ Boy □ Girl	
	□ Boy □ Girl	
	□ Boy □ Girl	
	□ Boy □ Girl	

When was he/she/they born (exact date(s))?

…………………………………………………………………………………..........

Has the child ever had an ear infection/middle ear infection? □ Yes □ No

If yes, approximately how many times? ....

* When was the most recent infection? ……..

Are you/the child's teacher concerned about his/her intellectual development? □ Yes □ No

Does the child suffer from any of the following:

Epilepsy? □ Yes □ No

Cerebral palsy? □ Yes □ No

Any brain injury? □ Yes □ No

Any physical disability? □ Yes □ No

Any mental disability? □ Yes □ No

Any other chronic condition? □ Yes □ No

If you answered "yes" to any of the questions above, please provide detail:

....

....