THE CONTRIBUTION OF PHONOLOGICAL PROCESSING SKILLS TO EARLY LITERACY DEVELOPMENT IN NORTHERN SOTHO-ENGLISH BILINGUAL CHILDREN – A LONGITUDINAL INVESTIGATION.

by

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ABSTRACT

Phonological processing skills, including phonological awareness, phonological working memory and rapid automatised naming, are widely accepted as essential building blocks of early literacy development (Wagner and Torgesen 1987, 192). Despite this, no previous research has investigated the long-term contribution of phonological processing skills to literacy acquisition in Northern Sotho-English emergent bilingual children. Perhaps as a result of this knowledge gap, the South Africa curriculum provides no systematic guidance on how these foundational skills should be taught in Northern Sotho. There is also little understanding of how these skills might transfer between Northern Sotho and English. This longitudinal study investigated the contribution of various phonological processing abilities to literacy acquisition in Northern Sotho children and examined the cross-linguistic relationship between these skills. Using both standardised and self-made assessments, data was collected in both Northern Sotho and English from two groups of learners (134 in total) in the foundation phase. One group used Northern Sotho as Language of Learning and Teaching, while the other group used English as Language of Learning and Teaching. Data were collected at three points (beginning of Grade 2, end of Grade 2 and end of Grade 3). Statistical analysis of the data suggests that phonological awareness and rapid automatised naming are the strongest long-term predictors of literacy acquisition in Northern Sotho and in English in this population. Phonological awareness was also the strongest cross-linguistic predictor of literacy skills. Furthermore, the results provided evidence that learners were (over)using one linguistic grain size (syllables) to facilitate reading in both Northern Sotho and in English, but that phoneme awareness predicted literacy outcomes better than syllable awareness. Learners showed significant progress on most skills from the beginning of Grade 2 to the end of Grade 2. A few significant group differences were observed, but the findings did not suggest substantial mother tongue advantages in the overall development of learners' cognitive-linguistic and literacy skills. The study provides evidence of the importance of teaching phonological awareness at the phoneme level in both Northern Sotho and English. The implication is that language-specific phonological and orthographic features of Southern African Bantu languages must be considered in the South African curriculum and in African reading methodologies.

KAKARETŠO KA SESOTHO SA LEBOA

Mabokgoni a tshepedišo ya thutapopomodumo, e akaretša temošo ya thutapopomodumo, monagano wo o šomago wa thutapopomodumo le mmitšo wa ka pele wa go itiriša, di amogelwa ka bophara bjalo ka diboloko tše bohlokwa tša go aga tša tlhabollo ya go bala le go ngwala (litherasi) (Wagner le Torgesen, 1987:192). Le ge go le bjalo, ga go na thuto ya nyakišišo yeo e dirlwego ya go nyakišiša pakatelele ya kabo ya mabokgoni a tshepedišo ya thutapopomodumo mo go ithuteng ga go bala le go ngwala (itherasi) ka Sesotho sa Leboa – Seisemane mo thomegong ya barutwana ba dipolelopedi. Mohlomongwe ka lebaka la sekgoba sa tsebo se, kharikhulamo ya Afrika Borwa ga e fe tlhahlo ye e tsepamego ya ka moo mabokgoni a a motheo a swanetšwego go ka rutwa ka Sesotho sa leboa. Go na le tsebo ye nnyane ya ka moo mabokgoni a ka fetetšwago ka gona magareng ga Sesotho sa Leboa le Seisemane. Thuto ye ya go laetša botelele e nyakišišitše kabelo ye e fapafapanego ya dikgonagalo tša tshepedišo ya thutapopomodumo mo go ithuteng go bala le go ngwala ga bana ba Sesotho sa Leboa le go hlahloba tswalano ye e putlago ya popopolelo magareng ga mabokgoni a. Go šomiša bobedi diteko tša semmušo le tša maitirelo, difiwa (data) di ile tša kgoboketšwa ka Sesotho sa Leboa le ka Seisemane, go tšwa go dihlopha tše pedi tša barutwana (134 ka palo) go kgato ya motheo. Sehlopha se sengwe se ile sa šomiša Sesotho sa Leboa bjalo ka Leleme la go Ithuta le go Ruta, mola se sengwe sehlopha se ile sa šomiša Seisemane bjalo ka Leleme la go Ithuta le go Ruta. Difiwa (data) di ile tša kgoboketšwa makgethong a mararo (mathomong a Kereiti ya 2, mafelelong a Kereiti ya 2 le mafelelong a Kereiti ya 3). Phetleko ya dipalopalo ya dfiwa (data) e akanya gore temošo ya thutapopomodumo le mmitšo wa ka pele wa go itiriša ke dintlha tše tiilego tša ditšhupi tša pakatelele tša go ithuta go bala le go ngwala (litherasi) mo go Sesotho sa Leboa le Seisemane mo go batho ba. Temošo ya thutapopomodumo e laeditše gape ditšhupi tše tiilego tša pakatelele tša mabokgoni a go bala le go ngwala (litherasi). Go feta moo, dipoelo di file bohlatse bja gore barutwana ba be ba šomiša kudu saese ya go lekana le thoro ya popopolelo (dinoko) go nolofatša go bala mo go Sesotho sa Leboa le Seisemane, eupša temošo ya tlhaka e akantše dipoelo tša go bala le go ngwala (litherasi) bokaone go feta temošo ya senoko. Barutwana ba laeditše tšwelopele ye kgolo mo go mabokgoni a mantši go tloga mathomong a Kereiti ya 2 go ya mafelelong a Kereiti ya 2. Go bile le diphapano tše mmalwa go dihlopha, eupša dikhwetšo ga se tša akanya kudu mohola wa leleme la gae bjalo ka kgodišo ya barutwana ya mabokgoni a tsebo ya popopolelo le go bala le go ngwala (litherasi). Thuto e fana ka bohlatse bja bohlokwa bja go ruta temošo ya thutapopomodumo mo go maemo a tlhaka ka Sesotho sa Leboa le Seisemane. Se se eletša gore thutapopomodumo ya polelo ye e rilego le dibopego tša mongwalo wa dipolelo tša Bathobaso tša Borwa bja Afrika di swanetše go lebelela kharikhulamo ya Afrika Borwa le mekgwa ya go bala ya SeAfrika.

OPSOMMING IN AFRIKAANS

Fonologiese verwerkingsvaardighede, insluitende fonologiese bewussyn, fonologiese werkgeheue en snelle geoutomatiseerde benaming word algemeen beskou as noodsaaklike boustene in vroeë geletterdheidsontwikkeling. Ten spyte hiervan is daar tot dusvêr geen navorsing verrig om die *longitudinale* effek van fonologiese verwerkingsvaardighede op die ontwikkeling van geletterdheid in Noord-Sotho - Engels ontluikende tweetalige kinders te ondersoek nie. Moontlik as gevolg van hierdie kennisgaping is daar tans geen sistematiese riglyne in die Suid-Afrikaanse kurrikulum wat op die instruksie van hierdie fundamentele vaardighede in Noord-Sotho fokus nie. Daar is ook weining insig in hoe (indien enigsins) hierdie vaardighede van Noord-Sotho na Engels (en omgekeerd) oorgedra word. Hierdie longitudinale studie se hoofdoel is om die rol van verskeie fonologiese verwerkingsvaardighede in die verwerwing van geletterdheid in Noord-Sotho vas te stel. ’n Sekondêre doel is om die aard van die wedersydse verband tussen hierdie vaardighede in Noord-Sotho en in Engels vas te stel. Data vir hierdie studie is van twee groepe Noord-Sotho leerders (134 in totaal) in die grondslagfase gekollekteer deur middel van sowel gestandardiseerde as selfgemaakte toetse. Groep 1 se onderrigtaal was Noord-Sotho, terwyl Groep 2 se onderrigtaal Engels was. Data is op drie punte gekollekteer (aan die begin van Graad 2, aan die einde van Graad 2 en aan einde van Graad 3). Statistiese analise van die data suggereer dat fonologiese bewussyn en snelle geoutomatiseerde benaming die beste langtermyn voorspellers is van geletterdheidsverwerwing in sowel Noord-Sotho as in Engels in hierdie populasie. Fonologiese bewussyn was ook die beste kruislinguïstiese voorspeller van geletterdheidsvaardighede. Die resultate dui verder daarop dat leerders een spesifieke linguïstiese deeltjie (naamlik die lettergreep) oorgebruik om lees in sowel Noord-Sotho as Engels te fasiliteer – dit ondanks die feit dat foneembewussyn ‘n beter voorspeller van geletterdheidsuitkomste was as lettergreepbewussyn. Leerders in albei groepe het beduidende vordering getoon in meeste van die vaardighede wat getoets is, maar die oorkoepelende resultate het nie die idee van ‘n moerdertaalonderrigvoordeel ondersteun nie. Hierdie studie beklemtoon die belang van sistematiese instruksie van fonologiese bewussyn op die foneemvlak in sowel Noord-Sotho as Engels in die grondslagfase. Die implikasie is dat die taalspesifieke fonologiese en ortografiese kenmerke van Suidelike Bantoetale in ag geneem moet word in die Suid-Afrikaanse kurrikulum en in leesmetodologieë van Afrika-tale.

KEY TERMS

Phonological Processing
Literacy Development
Phonological Awareness
Phonological Working Memory
Rapid Automatised Naming
Cognitive Linguistic Skills
Northern Sotho-English bilingual children
Language of Learning and Teaching
Cross-linguistic Transfer
First and Second Language Learning

MANTŠU A MOTHEO KA SESOTHO SA LEBOA

Tshepedišo ya Thutapopomodumo
Kgodišo ya go Bala le go Ngwala (Litherasi)
Temošo ya Thutapopomodumo
Monagano wo o Šomago wa Thuapopomodumo
Mmitšo wa ka Pele wa go Itiriša
Mabokgoni a Tsebo ya Popopolelo
Bana ba Polelopedi ya Sesotho sa Leboa le Seisemane
Leleme la go Ithuta le Leleme la go Ruta
Phetetšo ya go Putla ya popopolelo
Thuto ya Leleme la Pele le la Bobedi

SLEUTELWOORDE IN AFRIKAANS

Fonologiese verwerking
Geletterdheidsontwikkeling
Fonologiese bewussyn
Fonologiese werkgeheue
Snelle geoutomatiseerde benaming
Kognitiewe-linguïstieke vaardighede
Noord-Sotho - Engels tweetalige kinders
Onderrigstaal
Kruislinguïstiese oordrag
Eerste en tweedetaal aanleer

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LIST OF ABBREVIATIONS

DBE	Department of Basic Education
DoE	Department of Education
CAPS	Curriculum Assessment Policy Statement
CTOPP	Comprehensive Test of Phonological Processing
CV	Consonant Vowel
CVC	Consonant Vowel Consonant
L1	First Language
L2	Second Language
LoLT	Language of Learning Language and Teaching
NS	Northern Sotho
OECD	Organization for Economic Co-operation and Development
PA	Phonological Awareness
PIRLS	Progress in International Literacy Reading Study
PWM	Phonological Working Memory
RAN	Rapid Automatised Naming
RDN	Rapid Digit Naming
RON	Rapid Object Naming
RLN	Rapid Letter Naming
RON	Rapid Object Naming
UNDP	United Nations Development
UNESCO	United Nations Educational Scientific and Cultural Organisations

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CHAPTER 1
INTRODUCTION

This study examined the role of phonological processing skills (i.e. phonological awareness (PA), phonological working memory (PWM) and rapid automatised naming (RAN) in the early literacy development (i.e. letter knowledge, letter reading, word recognition, fluent reading, reading comprehension, spelling and early writing) of Northern Sotho-English bilingual children. The term literacy encompasses the basic learning skills of listening, reading, spelling and writing (Naidoo, Reddy and Dorasamy 2014, 156). According to Pretorius and Mokhwesana (2009, 55), literacy forms the basis for educational success. Learners with well-developed literacy skills are more likely to excel in future academic endeavours. If a learner's early literacy skills are inadequately developed, he/she will struggle to cope with future academic demands (Zimmerman, Howie and du Toit 2009, 3). Research has indicated that most learners in South Africa struggle to acquire basic literacy and numeracy skills (Willis 2016, 1; Gardiner 2017, 25). This circumstance is not unique to South Africa – similar cases have been reported in other developing countries (Geske and Ozola 2008, 71; Nzomo, Kariuki and Guantai 2001, 75). South Africa needs to respond to what has been called a "crisis" in literacy development for at least the last decade (De Vos, Van der Merwe and Van der Mescht 2015, 1).

This study aims to make a vital contribution to our understanding of the role that various cognitive-linguistic factors play in literacy development in one of the Southern Bantu languages (Northern Sotho) used as a medium of instruction in South Africa. Although valuable research has been conducted regarding the development of phonological processing skills and the correlation between such skills and literacy skills in South Africa, existing research is still limited and is mostly cross-sectional, which signals a gap. Thus, a longitudinal approach was utilised in this study to investigate the contribution of various cognitive-linguistic skills to literacy acquisition in the foundation phase over about an 18-month period. This approach enabled the researcher to establish causal relationships that exist between different cognitive-linguistic and literacy skills. More specifically, the study followed the development of phonological processing and literacy skills in Northern Sotho-English emergent-bilingual learners from the beginning of the second grade until the end of the third grade.

1.1 Background to the study

1.1.1 The quest for literacy development in South Africa

Literacy development is high on the global development agenda because of its ability to facilitate sustainable development (The World Bank 2016, 8). Worldwide, approximately 758 million adults cannot read and write; and about 250 million children are not acquiring adequate literacy skills (United Nations Educational Scientific and Cultural Organisations (UNESCO) Institute of Statistics 2013; 2016). Low literacy rates are also an issue of concern in Africa (UNESCO Institute of Statistics 2016). Thirty-six per cent of the adults living in Africa are illiterate, a number which is outranked only by Southern Asia (which is home to almost one-half (46%) of the global illiterate population) (UNESCO Institute of Statistics 2017). International governmental and non-governmental organisations are actively engaged in literacy policy development. The right to education has been reaffirmed internationally, and several targets were set in Africa to reduce the illiteracy rate (United Nations Children Education Fund 2015). UNESCO (since the founding of the organisation in 1946) has also taken a leading role in promoting literacy development on the African continent and in compelling governments to prioritise literacy on the national, regional and international agendas (Luchembe 2016, 13).

The South Africa government acknowledges literacy development as a high priority on policy agendas. In its goal to attain a high literacy rate in the country, the government has participated in several global literacy initiatives, including the Education for All, Millennium Development Goals, Sustainable Development Goals and Bridges to the Future Initiative (Department of Basic Education (DBE) 2009, 1; DBE 2014, 7; Dikotla 2010, 1; UNDP 2011; UNESCO Institute of Statistics 2016, 1). For instance, with the adoption of the Sustainable Development Goals by the UN General Assembly in September 2015, several countries, including South Africa, pledged to achieve a new target of ensuring that youth and adults attain literacy and numeracy by 2030 (UNESCO Institute of Statistics 2016, 1). At the national level, several policy initiatives, strategies and interventions aiming to improve literacy have been put in place, such as the Curriculum Assessment Policy Statement (CAPS), the Action Plan to 2030, the National Reading Strategy, the National Reading Coalition, the Literacy and Numeracy Strategy and the implementation of the Annual National Assessments (DBE 2014, 38; DBE 2011, 4-5; Louw and Wium 2015, 16; Spaull 2013b, 7). The Action Plan to 2030 elaborates the primary educational goals of literacy development in the country. Thus, literacy development is increasingly one of the most prioritised policy initiatives of the DBE in South Africa (DBE 2015, 3).

However, despite the numerous government initiatives, literacy rates in the country remains a challenge (Zimmerman and Smit 2014, 1). Recent literacy assessments conducted in South Africa indicate that a majority of children are still not acquiring age-appropriate literacy skills (Department of Education (DoE) 2014, 33; Draper and Spaull 2015, 71; Howie et al. 2012, 48; Mullis, Martin, Kennedy and Foy 2007, 70). The Progress in International Literacy Reading Study (PIRLS 2016) report shows that South Africa's Grade 4 learners' overall literacy achievement was below the international benchmark of 500, achieving the lowest score of the 50 participating countries (Howie, Combrinck, Roux, Roux, Mokoena and Phalane 2017, 49). Generally speaking, by the fourth grade, most learners are reading and writing below the expected grade level and cannot read for meaning (Spaull 2017, 1; Spaull and Kotze 2015, 12; Van der Berg 2015, 1). Literacy problems (which start in the foundation phase) exacerbate the problem of functional illiteracy in South Africa. It is estimated that about 3 million adults in South Africa are entirely illiterate, and about 5 to 8 million people are functionally illiterate (Gustafsson, van der Berg, Shepherd and Burger 2010, 2; World Literacy Foundation 2015, 5). The statistics show that policy and intervention initiatives in the country remain insufficient as most of them are not evidence-based literacy teaching methodologies. This shortfall has often been ignored in literacy development strategies (DBE 2014; 2015). The CAPS highlights some components of literacy development (CAPS 2012, 13) but with little emphasis on the methodological aspects of teaching literacy in the African languages used for instruction. In particular, the development and explicit instruction of the cognitive-linguistic skills that are important for literacy development seems to have a low priority. This situation may be due to political influences in teaching and learning (Maile 2008, 56). Most literacy development policies are crafted from a political perspective and public opinions, with too little input from teaching and learning specialists (such as language education specialists, applied linguists, psychologists, psycholinguists and remedial teachers). As a result, South African literacy rates remain stagnant with high rates of repetition and dropouts (Pretorius and Mampuru 2007, 41).

1.1.2 Cognitive-linguistic skills and literacy development

Cognitive linguists and psycholinguists are, amongst other things, interested in how cognition influences various components of language development (Harris 1999, 3), including vocabulary, syntax, morphology and phonology (Evans and Green 2006, 28). Research has highlighted the importance of a range of cognitive-linguistic (i.e. vocabulary knowledge, phonological ability, morphological and syntactic awareness) skills in literacy development (Heckman, Stixrud and Urzua 2006, 411; Verhoeven, Reitsma and Siegel 2011, 388). Cognitive-linguistic skills are central to the theories of language teaching and learning. According to Svinicki (1991, 27) the precepts of cognitive theories provide highly practical suggestions for teachers and learners, which make teaching and learning more efficient. Teachers must, therefore, be trained and encouraged to use teaching and learning strategies that facilitate the development of learner's cognitive-linguistic skills (Fryer 2008, 56). Policies on literacy development, as well as the curriculum, must provide teachers with sufficient support to instruct cognitive-linguistic skills to learners. Some scholars believe that the South African government falls short in this area of concern (Draper and Spaull 2015, 72; Zimmerman, Howie and Smit 2011, 219). As a result, teachers' training and professional development do not adequately prepare them to teach cognitive-linguistic skills to learners in the foundation phase.

This study is central in understanding various cognitive-linguistic variables (particularly phonological processing and, to a lesser extent, vocabulary) that contribute to literacy development. Phonological processing skills are one of the critical building blocks of literacy development (Limbird 2006, 5). The DoE is aware of the significance of early development of learners' phonological processing abilities through its emphasis on phonics instruction (DoE 2008a, 12-13; DoE 2008b, 8). Early literacy instruction in the South African education system is based on a balanced literacy approach that emphasises a combination of phonics[1] and whole language instruction. In a whole language approach, children are instructed to read by recognising words as a whole instead of sounding out each word phonetically (Morin 2020). This balanced literacy instruction happens, or at least is supposed to happen, within a Communicative Langauge Teaching Approach in the South African context.[2] There is, however, little evidence that the current policies equip teachers with adequate methodologies

[1] Refer to Section 2.4 for further information on phonics instruction.

[2] Communicative Language Teaching provides learners with opportunities to interact and learn in groups via informal classroom activities. However, a potential problem in the South African context is that an overemphasis on 'conversational' language creates L2 learning contexts where learners only develop Basic Interpersonal Communication Skills (BICS), and fail to develop Cognitive Academic Language Proficiency (CALP) skills. This discussion, however, is beyond the scope of the current study.

to teach phonics. For instance, de Vos et al. (2015, 3) indicated that the CAPS document (DoE 2012) is a testimony to how little is known of linguistic aspects of learning to read in the Southern African Bantu languages. The document fails to outline an adequate sequence of phonics instruction based on the specific structures of each language due to direct translations from English reading methodologies to African languages. While direct translation may establish some form of standardisation, it runs the risk of overlooking essential language-specific aspects (Madiba 2013, 25). As recommended by Diemer (2016, 3) language-specific research in South Africa is needed to inform literacy instruction guidelines and literacy policy development. Apart from phonics, teaching methodologies in South Africa also have an emphasis on PA instruction[3]. However, the PA-based instruction is mainly syllable-oriented (De Vos et al. 2014, 16; Probert 2019, 3) at the expense of phonemes. Southern-Bantu languages like Northern Sotho tend to have a stronger consonant-vowel (CV) oriented phonological structure (Demuth 2007, 529; Endemann 1964, 6; Kgasago 2001, 13), which may explain why syllables are the major focus in early literacy instruction in these languages. In short, the development of phonological processing skills in African languages must be well-researched and understood within the multilingual South African context. This study will provide information concerning the causal relationships between phonological processing and literacy skills in the Northern Sotho language, which will enhance our understanding of how literacy ought to be instructed in Northern Sotho at various points in time. This study can also provide curriculum developers with insights for developing a curriculum with content that facilitates phonological processing and literacy development. Finally, this study could also assist in the development of standardised phonological processing and literacy measures in Northern Sotho.

1.2 Research problem

The research study examined the role of phonological processing (PA, PWM and RAN) in early literacy development (letter knowledge, letter reading, word recognition, fluent reading, reading comprehension, spelling and writing) of Northern Sotho-English bilingual children. Research has confirmed the importance of phonological processing in early literacy development across languages – i.e. these skills are important regardless of a language's phonological and orthographic structure (Gottardo and Lafrance 2005, 559; Veii and Everatt 2005, 239). However, existing research does not sufficiently address the role of a wide range of phonological processing skills in various aspects of literacy development in multilingual South Africa. Although valuable research exists regarding the role of phonological processing in African languages (Brink 2016; Diemer 2015; Makaure 2016; Soares de Soussa and Broom 2011; Soares de Soussa, Greenop and Fry 2010; Wigdorowitz 2016; Wilsenach 2013; Wilsenach 2019), most of these studies adopted cross-sectional approaches and are focused mostly on one age group. As such, there is very little understanding of the causative relationships between various aspects of phonological processing and literacy and of the bilingual development of phonological processing skills over time.

Studies in South Africa have also focused primarily on the associations between phonological

[3] Refer to Section 3.2.1.2 for further information regarding PA.

processing and word and/or fluent reading. They have often neglected other literacy components, such as spelling, writing and reading comprehension. Only a few studies have focused on other aspects parts of literacy, such as spelling (Soares de Soussa et al. 2010). Furthermore, although there is an abundant amount of research on the role of phonological processing in literacy development internationally, such research is limited in the African languages spoken in South Africa. De Vos et al. (2015, 6) argues that there is still too little focus on the cognitive functions involved in understanding the "linguistic building blocks" of literacy in South Africa.

Some cross-linguistic studies have provided support for the idea that universal principles underlie the acquisition of phonological processing skills (Durgunoglu 2002; Durgunoglu and Hancin-Bhatt 1992), but there is also evidence for language-specific differences in phonological processing development (Geva and Siegel 2000). Thus, despite the universal importance of these skills, phonological processing skills underpinning literacy do play out differently in different languages and for different orthographies (Bialystok 2002, 192). This makes it even more important to consider the phonological and orthographic differences that exist between Northern Sotho and English (Demuth 2007, 530; Milwidsky 2008, 15; Wilsenach 2013, 28). As argued by De Vos et al. (2015, 22) there is no one-size-fits-all approach to literacy development in South Africa. There is a need to acknowledge linguistic differences in bilingual literacy development. Understanding phonological processing and literacy acquisition in the Northern Sotho language is a crucial academic step in developing appropriate Northern Sotho instructional material. It is also vital towards critiquing teaching and learning strategies adopted from other languages to teach Northern Sotho in facilitating literacy development. This study aims to address this research problem by providing a more in-depth understanding of a broad range of phonological processing skills that impact literacy development in Northern Sotho-English bilingual children, using a longitudinal approach. This study enabled the researcher to describe the developmental progression of phonological processing skills over time and to establish any causal links which exist between these skills and literacy skills.

Although much is known about literacy development in the first language (L1), there is no comprehensive theory that explains how learners acquire literacy skills in an L2 or in a language other than the first language (Bialystok 2002; 2007). The present study's scope is to establish the processes involved in literacy acquisition in both Northern Sotho and English. This scope makes the research interesting, considering the phonological and orthographic structural differences that exist between English and Northern Sotho. English is a stress-timed language with an opaque orthography (Gottardo and Lafrance 2005, 56). Northern Sotho is an agglutinating, syllabic language with a transparent, disjunctive orthography (Milwidsky 2008, 15; Wilsenach 2013, 20). These distinct structural differences might entail different processing mechanisms in the two languages. Finally, one group of learners in this study received mother tongue (Northern Sotho) literacy instruction from Grade 1-3, while the other group received instruction in English from Grade 1 onwards. The researcher will thus also investigate the effect of Language of Learning and Teaching (LoLT)[4] on literacy development, as this is not well-understood in the South African context (in the sense that the theoretical advantage associated with mother-tongue instruction has not been established in previous large scale studies such as the PIRLS).

1.3 Research aims

The primary aim is to establish the causal relationships between phonological processing and various aspects of literacy (letter knowledge, letter reading, word recognition, reading fluency, reading comprehension, spelling and early writing) in Northern Sotho-English bilingual children.

Based on this primary aim, the following sub-aims are considered essential for this study:

i. To determine the associations between PA, PWM and RAN abilities.
ii. To establish whether the relationship between PA and literacy is specific to linguistic grain sizes.
iii. To assess whether Northern Sotho-English bilingual children positively transfer cognitive-linguistic skills from Northern Sotho to English and vice versa.
iv. To assess whether there are any statistically significant differences in phonological processing and literacy abilities of Northern Sotho-English bilingual children instructed in Northern Sotho and those instructed in English.
v. To establish whether Northern Sotho-English bilingual children progress faster in a language like Northern Sotho, which has a transparent orthography, than in English, which has a more opaque orthography.
vi. To establish the developmental nature of phonological and literacy abilities in Northern Sotho-English bilingual children.
vii. To establish the extent to which vocabulary knowledge predicts literacy in Northern Sotho-English bilingual children.

1.4 Research questions

The main research question for this study is:

What is the nature of the association between phonological processing and various aspects of literacy (letter knowledge, letter reading, word recognition, fluent reading, reading comprehension, early writing and spelling) in Northern Sotho-English bilingual children?

Based on this primary research question, several sub-questions were considered for this study. These include:

i. What is the relationship between PA, PWM and RAN abilities?
ii. How does linguistic grain size influence the relationship between PA and literacy abilities in Northern Sotho-English bilingual children?

[4] The Language of Learning Language of teaching is the medium of instruction or the language of instruction used in the classroom (DoE 2013c). In the South context a LoLT may be either a home language or second language (i.e. English).

iii. To what extent do Northern Sotho-English bilingual children transfer cognitive-linguistic abilities from Northern Sotho to English and vice versa?

iv. What effect does the LoLT (Northern Sotho or English) have on the development of phonological processing and literacy abilities of Northern Sotho-English bilingual children?

v. Is there a difference in the progression of literacy development between Northern Sotho-English bilingual children instructed in a transparent orthography (like Northern Sotho) and those instructed in an opaque orthography (like English)?

vi. What is the developmental pattern of phonological processing and literacy abilities in Northern Sotho-English bilingual children?

vii. To what extent does vocabulary knowledge predict literacy acquisition in Northern Sotho-English bilingual children?

1.5 Research hypotheses

The researcher tested the following hypotheses:

i. Phonological processing skills will predict literacy acquisition of Northern Sotho-English bilingual children considering its established importance in literacy acquisition (Wagner and Torgesen 1987).

ii. There is a close association between PA, PWM and RAN abilities (Wagner and Torgesen 1987).

iii. Northern Sotho-English bilingual children are expected to use different linguistic grain sizes when acquiring literacy in Northern Sotho and in English (Ziegler and Goswami 2005).

iv. Northern Sotho-English bilingual children are expected to positively transfer literacy abilities from Northern Sotho to English, and vice versa, since bilingual children typically transfer their L1 skills to their L2 in literacy development (Jimenez, Garcıa, and Pearson 1995; Hornberger and Link 2012).

v. Northern Sotho-English bilingual children instructed in Northern Sotho are more likely to have better phonological and literacy outcomes in Northern Sotho relative to English.

vi. Northern Sotho-English bilingual children will progress faster in Northern Sotho (which has a transparent orthography, than in English (which has an opaque orthography).

vii. Northern Sotho-English bilingual children are expected to progress over time in their phonological and literacy skills.

viii. Vocabulary knowledge is expected to explain some variance in Northern Sotho and English literacy skills, considering its importance as a cognitive-linguistic skill in literacy development apart from phonological processing (Haastrup and Henriksen 2000 Nelson and Stage 2007).

1.6 Phonological processing

Phonological processing is the ability to use phonological information (i.e. the sounds of one's language) in processing oral and written language (Wagner and Torgesen 1987, 192). This definition entails a 'sensitivity to' (i.e. an understanding of a language's sound structure) and the ability to use various aspects of the incoming speech stream. Every child is assumed to be born with a genetically determined inbuilt phonological system (Shaywitz 1996, 1), responsible for processing, analysing and manipulating the sound structures of words (Eide and Eide 2011, 23).

There are three subcategories of phonological processing, namely PA, PWM and RAN (Torgesen, Wagner, Rashotte, Burgess and Hecht 1997, 468). PA involves the ability to identify, recognise and manipulate the phonological units that exist in the phonological structure of a language (Koda and Zehler 2008, 42; Ziegler and Goswami 2005, 4). This skill comprises the phoneme, syllable and onset/rime awareness skills (Anthony and Francis 2005, 255). Phoneme awareness is the ability to manipulate the individual sounds in a word (Anthony, Williams, McDonald and Francis 2008, 114). For example, it entails realising that the word *cat* has three phonemes */k/, /æ/,* and */t/.* Syllable awareness entails segmenting and blending chunks within a word (Lane 2007, 2). For example, it entails segmenting the word *fantastic* into two syllabic components */fan-tas-tic/.* Onset-rime awareness is the ability to manipulate the intrasyllabic units within a word (Lane 2007, 2). The onset comprises the first consonant or consonant cluster in a word, whilst the rime is composed of the remaining vowels and consonant sounds (Anthony and Francis 2005, 256). For example, in the word *spoon, sp* is the onset; while *oon* is the rime. Children with a good understanding of PA have a strong foundation for reading, writing and spelling acquisition (Fitzpatrick 1997, 119).

PWM is the ability to store sound-based representations temporarily in short-term or working memory (Wagner et al. 1997, 469). This skill is utilised during cognitive tasks involving sound information processing (Anthony et al. 2008, 114). O' Brian, Segalowitz, Freed and Collentine (2007, 558) state that PWM is vital in that it allows the listener to identify words and syntactic structures. The relationship between this short-term storage system and literacy development in typically developing children is less well understood and has mostly been overshadowed by PA, which progresses considerably over the early and middle childhood years (Gathercole, Hitch, Service and Martin 1997, 967).

RAN involves naming familiar symbols presented visually as quickly as possible (Georgiou et al. 2013, 1), and it comprises of two subcategories: alphanumeric (digit and letter) and non-alphanumeric (object and colour) RAN (Manis, Doi and Bhadha 2000, 325). RAN is typically operationalised by tasks in which individuals have to identify letters, numbers, colours or objects presented verbally, as quickly as possible (Anthony et al. 2008, 114). Studies show that the ability to learn arbitrary sound-symbol associations is involved in both RAN and reading (Lervåg and Hulme 2009, 1040; Manis et al. 2000, 325; Ziegler, Bertrand, Tóth, Csépe, Reis, Faísca, Blomert 2010, 551).

Furthermore, there have been discussions on whether PA, PWM and RAN are indeed all phonological processing skills (Pennington and Lefly 2001; Pennington, Cardoso Martins, Green and Lefly 2001) or whether RAN represents a different underlying cognitive skill. One view subsumes RAN within the phonological processing domain, along with PA and PWM (Torgesen et al. 1997, 468; Wagner et al. 1994, 73). Researchers subscribing to this view suggested that there may be a single factor representing phonology that underlies phonological processing skills' development (Hoskyn and Swanson 2000, 102; Shankweiler et al. 1995, 149; Stanovich 1998; 18; Stanovich and Siegel 1994, 24; Stone and Brady 1995, 51). Contrary, some researchers suggested that RAN represents a different cognitive skill (Wolf et al. 2000, 387; Wolf et al. 2002, 43). Hence, it is worth exploring the relationships between various phonological processing abilities in this study. The strength of the relationship between these skills varies with languages, possibly due to the variations in the transparency of phoneme-grapheme correspondences in various languages (Babayiğit and Stainthorp 2011).

This study used Wagner and Torgesen's (1987) classification of phonological processing. The rationale being that the standardised measuring instruments used to asses this skill comprise RAN as its subcategory. However, the present study did seek to establish the relationship between phonological processing abilities to develop a better understanding of the associations between RAN and other phonological processing components.

1.6.1 Phonological processing and literacy development

Literacy development is a gradual and mainly subconscious process (Govender 2011, 25) that begins at birth (the first year) with exposure to language (Antilla 2013, 9; Mason and Allen 1986, 3; Sulzby and Teale 1991, 727) and that continues to develop throughout a learner's time at school (Govender 2011, 21). However, the term 'sub-conscious' seems like a fluid interpretation of what it means to become literate. The reason is that while some aspects of 'literacy' develop subconsciously[5], other literacy aspects have to be explicitly taught[6] The child’s environment and parental stimulation of early literacy skills before formal education are also critical elements in their overall literacy development (Awramiuk 2014, 120; Bornfreund 2012, 2; Rohde 2015, 2; Shi 2013, 30). Therefore, parents and teachers must be appropriately informed about the unique importance of literacy skills and on how to support its acquisition (McCracken and Murray 2010, 46; Rohde 2015, 2). Children's language experiences at home are critical for developing early literacy skills, and parents have to create a favourable environment for the development of the skills associated with early literacy.

Literacy is not a unitary skill (Cairney 2003, 85; White 2011, 21); instead, it is a complex ability that draws upon many cognitive-linguistic processes (Nagy and Snowling 2013, 2). Empirical evidence suggests that phonological processing skills are a crucial prerequisite in the development of letter knowledge (Anthony et al. 2006, 266; Share 2004, 213); reading (Antony and Lonigan 2004, 43; Castles and Coltheart 2004, 78); spelling (Treiman 2006, 581; Yeong et al. 2014, 1107) and early writing skills (Both-de Vries and Bus 2008, 183) from the beginning of formal schooling (Anthony et al. 2008, 115). Research evidence suggests a causal association between phonological processing skills and early literacy development (Bentin 1992, 175; Castles and Coltheart 2004, 88). Some aspects of PA, such as syllable awareness, develop before individuals learn to read and are causally related to reading acquisition

[5] This includes the ability to reason about a particular issue and to put events in a logical order.
[6] This include adopting writing conventions of languages, acquiring different genres of writing, letter knowledge, linking graphemes to phonemes, phoneme and onset-rime awareness.

(Goswami and Bryant 1990, 4). The relationship between certain aspects of phonological processing and literacy development is, in fact, reciprocal (Burgess and Lonigan 1998, 117; Wagner et al. 1997, 468; Martins and Silva 2003, 14). For instance, phoneme awareness and RAN improve as a reader becomes more skilled in reading. Thus, while some phonological processing skills are causally related to literacy development, literacy knowledge can, in turn, enhance phonological processing development.

Phonological processing skills are significant in literacy acquisition in both alphabetic (Gottardo and Lafrance 2005, 559; Soares De Soussa and Broom 2011, 15) and non-alphabetic orthographies (Chow, McBride-Chang and Burgess 2005, 87; Gottardo, Chiappe, Yan, Siegel and Gu 2006, 389). Differences in phonological structure and orthographic transparency (i.e. the degree of consistency in the spelling system of a language) influences the developmental pattern and rate of phonological processing and literacy abilities in various languages (Vandewalle, Boets, Ghesquière 2014, 1055; Wagner et al. 1997, 478). Literacy and phonological processing skills are thought to develop more slowly in less transparent languages (e.g. English) than in more transparent orthographies (Caravolas and Bruck 1993, 28; Frith et al. 1998, 31; Seymour et al. 2003, 143). A better understanding of cross-language similarities and differences is required to optimise teaching strategies in different languages (Goswami 2005, 273) and to develop language-specific assessment tools (Schaeffer, Fricke, Szczerbinski, Fox-Boyer, Stackhouse and Wells 2009, 404).

1.6.2 Phonological processing development in bilingual children

The study of phonological processing development in bilinguals is vital for our understanding of literacy development in the South African context, as all learners have to become literate in at least two languages. The Language in Education Policy in South Africa asserts that every learner has the right to acquire basic education in the language of his or her choice, where this is reasonably practicable (DoE 1997, 1), and it embraces an additive bilingual approach where the L1 is utilised as the Language of Learning Language of Teaching (LoLT) from Grade 1-3, and where learners are introduced to the additional language (English) in Grade 1 (Howie et al. 2011, 10; Msimang 2017, 207). Thus, theoretically, most schools are bilingual learning environments to some extent.

Bilingualism refers to the mastery and use of two languages (Butler and Hakuta 2006, 118). There are different classifications of bilinguals which include simultaneous and sequential bilinguals. A simultaneous bilingual is a person who acquires two languages at the same time from birth, whilst a sequential bilingual acquires a second language (L2) after an L1 has started developing (Meisel 2004, 91). Most of the Northern Sotho-English bilingual learners in this study can be categorised as sequential bilinguals. Some scholars suggested that bilingual children's phonological development follows a similar developmental trajectory to that of monolinguals (Dodd, So and Li 1996, 137; Holm and Dodd 1999, 349). However, others suggested that a bilingual child's phonological development may be subtly different from that of a monolingual child (Marecka, Wrembel, Otwinowska-Kasztelanic and Zembrzuski 2015, 4; Vihman 2002, 244).

Although bilingual children are thought to have two separate phonological systems (Beckman and Edwards 2000, 215; Genesse 1989, 161; Vihman 2002, 244), the two systems are perhaps not completely autonomous, and interactions may occur (Hazan and Boulakia 1993, 17; Paradis 1997, 331; Paradis 2001, 34). The extent of their interaction is still unclear (Paradis and Genesee 1996, 23). For instance, research on bilingual children's discriminative abilities indicates that bilinguals find it difficult to make sharp phonetic contrasts between their L1 and L2 sounds (Bosch and Sebastian-Gallés 2005, 355, Bosch, Costa and Sebastian-Gallés 2000, 183; Flege 2003, 8; Fledge et al. 2003, 469). These findings indicate that bilingual learners cannot always fully separate their L1 and L2 phonological systems, which makes it imperative to assess the progress of Northern Sotho-English bilinguals in terms of phonological and literacy acquisition in English and Northern Sotho languages. Bilingual children are assumed to transfer skills from one language to aid mastery of another language (Yang, Cooc and Sheng 2017, 1). Research studies provide evidence of cross-linguistic transfer of phonological processing (i.e. PA skills) and literacy skills from one language to another (Geva and Siegel 2000, 1; Gottardo 2002, 46; Gottardo, Siegel, Yan and Wade-Woolley 2001, 530). Hence, the transfer of cognitive-linguistic skills will also be a major focus in this study.

1.7 The theoretical and analytical framework

This study utilised the phonological processing model proposed by Wagner and Torgesen (1987) and Wagner, Torgesen, Rashotte and Pearson (2013a) as the theoretical and analytical framework of the study. The model holds the view that phonological processing encompasses three related yet distinct skills, namely PA, PWM and RAN abilities. The phonological processing model has been supported and affirmed by different studies (Burgess and Lonigan 1998, 117; Castles and Coltheart 2004, 78; Treiman 2006, 581). Although much of the work by Wagner and colleagues have addressed the associations between phonological processing and reading (Wagner and Torgesen 1987; Wagner et al. 2013), some scholars have also linked other literacy abilities (i.e. the letter knowledge, spelling and writing) with phonological processing (Both-de Vries and Bus 2008, 183; Burgess and Lonigan 1998, 117; Martins and Silva 2003, 14; Share 2004, 213; Treiman 2006, 581). Some scholars have challenged the phonological processing framework (Wolf and Bowers 1999, 415; Wolf et al. 2000, 387), whilst others suggested that literacy development entails more than developing phonological processing abilities (Kibby, Lee and Dyer 2014, 1). Many critics of the phonological processing model criticised it based on weak relations between the phonological processing variables. As recommended by Wagner et al. (2013), rather than dismissing the model prematurely, there is a need to continue examining the interrelationship between PA, PWM and RAN, and the changes in causal relations between phonological processing abilities and literacy.

Theories of how children develop literacy in two languages, namely, the linguistic interdependence hypothesis (Cummins 2005), the linguistic threshold hypothesis (Bernhardt and Kamil 1995), the central processing hypothesis (Geva and Siegel 2000), the script dependent hypothesis (Geva and Wade-Woolley 1998)[7] and the psycholinguistic grain size

[7] Further information regarding the linguistic interdependence hypothesis, the linguistic threshold hypothesis, the central processing hypothesis, the script dependent hypothesis is given in Section 3.5.1.

theory (Ziegler and Goswami 2005)[8], were used as part of the theoretical framework, to complement the phonological processing model. These theories will be discussed in detail in Chapter 3.

1.8 Research methodology

A quantitative, quasi-experimental and longitudinal design was used to investigate the importance of phonological processing abilities in the literacy acquisition of Northern Sotho-English bilingual learners. The researcher used a convenience sample of 134 participants from two primary schools in Gauteng Province. The participants had an age range of 7-8 years. In the South African education system, children start school at the age of 6 and have a choice of attending Pre-Grade R and Grade R (reception year) programs before that. The South African pre-school system comprises of two main programs: Pre-Grade R (intended for children between an age range of 0-4) and Grade R (a program which is appropriate for children with an age range of 5-6 years) (Expatica 2021). The sample was selected based on the population being L1 Northern Sotho speakers. The participants were in Grade 2 at the onset of the study and were distributed equally into two groups depending on their LoLT (i.e. Northern Sotho LoLT and English LoLT groups). While learners in both LoLT groups were exposed to the Northern Sotho mother language (i.e. at home and school), they may hardly ever have had interaction with English outside the school context. However, they are likely to see English writing on billboards, packets of food and advertisements on buses etc. The researcher assessed the effect of the LoLT by comparing the performance of two groups of Northern Sotho-English bilingual learners on phonological processing and literacy tasks. Standardised, as well as custom made tests, were used to collect data. A range of statistical procedures were used to analyse the data and to draw conclusions from the data (Gall, Gall and Borg 2003, 295). The researcher used the Statistical Package for Social Science (SPSS) in analysing data.

The longitudinal approach enables the researcher to establish the causal relationship between phonological processing and literacy abilities. The rationale was to provide support for the phonological processing model. To cater for attrition, the researcher sampled a larger than needed number of participants (80 participants per school), to increase the chance of having a suitable sample size by the end of the study (this was deemed to be about 60). Naturally, an even larger sample would have been preferable, but given the extensive nature of the assessments, which had to take place in both Northern Sotho and in English, it was not possible to include more participants. The researcher used the Comprehensive Test of Phonological Processing (CTOPP) to collect English data on phonological processing development because these tests were developed by Wagner et al. (2013a), whose model formed the basis of the study. The Diagnostic Test of Word Reading processes was used to collect some of the English literacy data. Since there are no standardised Northern Sotho tests to assess phonological processing or literacy, the researcher designed most of these assessments (a few could be adapted from previous research studies). The researcher followed appropriate procedures of ensuring that these tests were age-appropriate. The reliability and validity of these tests were tested rigorously during a pilot study.

[8] Refer to Section 2.5.2 for further information on the psycholinguistic grain size theory.

1.9 The scope and limitations of the study

It is essential to highlight that, although the sample is representative of the Northern Sotho-English bilingual foundation phase learners in Gauteng Province, the findings may not be generalised to the entire Gauteng learner population or the South Africa population at large because of the small sample size. The study is also limited to quantitative data collection. Without qualitative data collection (i.e. teacher or parent interview and classroom observations), it is impossible to form a complete picture of the socio-economic and educational factors that might explain children's performance on phonological processing and various literacy abilities.

1.10 Synopsis of the thesis

Chapter one comprises the research background, problem, questions, aims, hypotheses and theoretical framework for the study. **Chapter two** is the initial literature review, focusing on literacy acquisition and the theories of literacy development. **Chapter three** is the second literature review focusing on phonological processing theories and their application to literacy development. The chapter also focuses on aspects of bilingual literacy development. **Chapter four** contains information about the research design, sample and sampling procedure, research methodology, ethical considerations, data collection and analysis procedures. **Chapter five** provides data on the differences between the two LoLT groups, on cross-linguistic relationships as they manifested in the two groups and on the cross-sectional relationships between phonological processing and literacy skills at measuring points one and two. **Chapter six** presents data on the developmental paths of phonological processing skills and the longitudinal relationships between phonological processing and literacy skills. The chapter also focuses on the longitudinal associations between receptive vocabulary and literacy abilities. **Chapter seven** focuses on the discussion of findings, the summary of key findings, limitations of the study, recommendations for future research, practical implications of the study and the conclusion.

1. 11 Conclusion

This introduction highlighted the importance of developing a variety of cognitive-linguistic abilities that children need to develop literacy skills. Particularly, the idea that phonological processing skills should hypothetically play a key role in the longitudinal development of Northern Sotho literacy skills was introduced. The research background, the research problem, aims, questions, relevant models and theories, methodology and scope of the study were discussed. The present study seeks to determine whether there is a causal association between phonological processing abilities and literacy abilities in Northern Sotho-English bilingual learners. The study also seeks to ascertain whether Northern Sotho-English bilingual learners utilise phonological processing skills acquired in their L1 to learn how to read in L2. Finally, the study will investigate whether the development of phonological processing skills and literacy skills in this population is influenced by the LoLT. The phonological processing model by Wagner et al. (1987; 1994) will be used to guide the study. Critics of the model do not provide adequate information to refute the model; hence the present study can make an essential contribution in testing the model. The use of a longitudinal approach was justified based on the need to establish a causal relationship between phonological processing and literacy abilities, which a cross-sectional approach cannot achieve. The sampling procedure was briefly outlined, and a justification was given as to why the researcher targeted a specific population, within a larger population of South Africa. The discussion highlighted the importance of conducting the study in South Africa. Since South Africa is a multilingual community, small-scale studies across all languages spoken in the country should be useful in informing policymakers on how best they can regulate education and promote literacy development. The nature of literacy development, the phonological processing model and other theories of bilingual literacy development will be further deliberated in chapters two and three, to ascertain their implications in literacy development.

CHAPTER 2
LITERACY DEVELOPMENT

This chapter explicates the concept of literacy and also deliberates on the process of literacy development. Key components of literacy, which include letter knowledge, letter reading, word recognition, reading fluency, reading comprehension, early writing and spelling skills, are discussed in this chapter. Different theoretical perspectives that underpin literacy development are central to this discussion. This chapter also discusses various instructional strategies that can be used to facilitate literacy development and literacy acquisition varies in languages with different orthographies.

2.1 The concept of literacy

The concept of literacy is complex and dynamic (Keefe and Copeland 2012, 92; Park 2016, 2) and has been interpreted and defined in various ways (UNESCO 2005, 158; UNESCO 2006, 147). There is actually no universally accepted definition of literacy (Addo-Adeku 1992, 168; Naidoo et al. 2014, 156). Traditionally, literacy was defined as a person's ability to read and write with comprehension a simple short statement (UNESCO 2006, 149; UNESCO 2008, 18). This definition denotes a singular, autonomous notion of literacy (Kahn and Kellner 2005, 238), in which literacy is viewed as just a set of tangible and discrete cognitive skills (UNESCO 2006, 149). However, it has become clear that literacy goes beyond reading and writing (Naidoo et al. 2014, 156) and thus, the concept of literacy continues to evolve (Uys and Pretorius 2015, 3).

Modern definitions have since moved from the autonomous to an ideological perspective of literacy (Perry 2012, 51; Street 2003, 77), which places literacy within the social, political and economic contexts of a particular environment (Park 2016, 2). For instance, the international policy community, led by UNESCO, has expanded from interpretations of literacy as basic cognitive skills to an understanding of literacy being functional. Within this framework of functionality, literacy is viewed as the ability to use basic cognitive skills in a way that positively impacts social awareness, personal and social change as well as socio-economic change (UNESCO 2006, 154; UNESCO 2008, 18). The acquisition of literacy skills is not an end in itself, but the acquired skills should be put to meaningful use in society. Adequate development of literacy skills is key to ensuring that these goals are realised.

The notion of literacy is also influenced by cultural values, personal experiences, national contexts, academic research and institutional agendas (UNESCO 2006, 147). For instance, in South Africa, the DBE (2017, 1) defines literacy as the ability to read for knowledge, write logically, communicate verbally and think critically about printed material. Literacy, in this case, goes beyond basic skills and also involves aspects of communicative ability, critical thinking and active interaction with print. The Department of Education and Skills of the Republic of Ireland (2011, 8) defines literacy as the capacity to read, understand and appreciate various forms (i.e. broadcast and digital media, printed text and spoken language) of communication. This definition acknowledges that literacy is not only rooted in printed texts but also incorporate other aspects of communication, such as digital media (Shi 2013, 29). The

Program for International Student Assessment (PISA) defines literacy as the individual's capacity to understand the written texts, to acquire knowledge and to participate effectively in society (Organisation for Economic Co-operation and Development 2006, 46). This definition is more interactive, acknowledging the role brought by the reader to the written texts (Keefe and Copland 2011, 93) and is grounded on the belief that literacy facilitates the fulfilment of the readers' aspirations (OECD 2006 46).

Definitions of literacy have been further expanded in many curriculum documents to encompass aspects such as spelling, speaking, listening (Cambridge Assessment 2013, 8; DoE 2008, 4) as well as numeracy skills (UNESCO 2006, 149). In this study, literacy is conceptualised from a broad skill perspective, taking into account basic abilities such as word recognition, letter knowledge, reading fluency, reading comprehension, writing and spelling abilities.

2.2 Literacy development

2.2.1 Early literacy development

Literacy development is assumed to be an ongoing and gradual process (Burns, Griffin and Snow 1999, 38) that begins once a child is exposed to language (Antilla 2013, 9; Mason and Allen 1986, 3; Sulzby and Teale 1991, 727) and which continues to develop throughout a learner's time in school (Govender 2011, 25). Early experiences (i.e. knowledge of sound pattern and rhythm, verbal and non-verbal communication awareness, awareness of symbols (Bornfreund 2012, 2), as well as the child's environment and parental meaningful interactive practices and literacy behaviours (i.e. parental leisure reading and literacy beliefs, shared storybook reading) are key components to a child's early literacy development prior to direct formal literacy instruction (Aram 2006, 490; Awramiuk 2014, 120; Govender 2011, 2; National Early Literacy Panel 2009, 51; Rohde 2015, 2; Shi 2013, 30; Thengal 2013, 127).

2.2.2 The role of parents and the environment

Meaningful parental involvement is considered key in the early literacy development of a child (Sulzby and Teale 1991, 729). Parents are encouraged to engage in meaningful activities (i.e. shared book reading) for children to recognise the pleasure and purpose of reading (Whitehurst and Lonigan 1998, 849). This paves the way for children's independence in literacy growth (Moran and Senseny 2016, 4). A literacy-rich home environment with many books, newspapers and magazines has been emphasised as an important aspect of a child’s literacy development (Whitehurst and Lonigan 1998, 849). Exposure to a wide range of printed materials and encouragement from parents is preferable for children's literacy development. Uys and Pretorius (2015, 9) and Morrisroe (2014, 25) argue that children growing up with parents with good literacy skills are more likely to excel in literacy acquisition. On the other hand, children are likely to perform poorly if there is little parental involvement (Thengal 2013, 127).

Therefore, parents must be appropriately informed and equipped with skills and strategies on how to foster literacy acquisition (McCracken and Murray 2010, 46), and parental involvement programs are key to ensure that parents understand their role as first teachers (National Early Literacy Panel 2008, 173). Societal expectations and cultural values concerning literacy also provide a basis for children's interest and literacy success (Gunn et al. 2004, 15; Mason and Allen 1986, 3; von Tetzchner et al. 2005, 82). Rohde (2015, 6) goes further to emphasise the important role that the larger community should play (e.g. by organising storybook reading or reading clubs at community libraries) to foster emergent literacy development. Communities that do not prioritise literacy development are less likely to provide adequate opportunities for children's literacy growth.

2.2.3 The development of pre-literacy skills

In the initial phases of literacy acquisition, children develop pre-literacy (or emergent literacy skills), such as PA, knowledge of print conventions and concepts, alphabetic knowledge, name writing, oral language and communication skills (Anthony et al. 2009, 346; Clay 2001, 95; Lonigan et al. 1990, 155; Sulzby and Teale 1991, 729), rather than conventional literacy skills, such as word recognition, fluent reading, reading comprehension, writing and spelling (Govender 2011, 24; National Early Literacy Panel 2009, 4). Emergent literacy skills are assumed to develop from birth to the age of five (Lonigan 2006, 91), and they predict success in a child's later conventional literacy skills (National Institute of Literacy 2008, 16; Sulzby and Teale 1991, 728; Whitehurst and Lonigan 1998, 849).

Emergent literary theorists suggest that pre-literacy skills develop spontaneously when children receive appropriate environmental stimulation (Lonigan 2006, 92). Formal teaching is not a requirement for emergent literacy skills to develop (Teale and Sulzby 1986, 1), but early emergent literacy may be enriched by exposure to language and direct instruction in early childhood (Moran and Senseny 2016, 6). Through interaction with print, children develop an awareness of its conventions and functions, which stimulates literacy development (Connor et al. 2006, 655; Dickinson and Sprague 2001, 1; National Council for Curriculum and Assessment 2009, 54). Emergent theorists ascribe to the child the role of a constructor, and the child's active involvement with literacy constructs is emphasised during emergent literacy development (Mason and Stewart 1990, 155; Sulzby and Teale 1991, 729). Children construct their own understanding as a result of different learning opportunities. This is supported by Piaget’s cognitive theory, which assumes that children learn best naturally (i.e. through experiences and environmental interactions) when playing or engaging in ordinary activities (Piaget 1983, 1). This position downplays the importance of formal teaching in the earliest years when natural experiences form the basis of all learning (Fleming 2004, 5).

Emergent literacy skills are assumed to develop on a continuum (Teale and Sulzby 1991, 730; Whitehurst and Lonigan 1998, 850). Even so, each component is assumed to have its own developmental trajectory (McGee and Richgels 2003). For instance, research reveals that oral language and PA skills develop in a consistent pattern and predictable sequence (Goswami 2006, 4; von Tetzchner et al. 2005, 82; Ziegler and Goswami 2005, 4). Emergent literacy development involves a series of experiences that build knowledge and skills related to the literacy process (Rohde 2015, 3). Recognising the stages of development within each component is essential in providing scaffolded support and appropriate learning opportunities (Rohde 2015, 3). Emergent literacy theorists assume that although children go through the same predictable growth stages, they do so at their own rates (Moran and Senseny 2016, 2). For this reason, early literacy instructional practices should be grounded in the assumption that young children's early literacy development will be varied (Paris 2011, 228). Clay (2001, 91) emphasised the importance of educators recognising individual differences and meeting each child at his or her developmental level. Teachers also need to take into account the intellectual and cognitive levels of children to ensure effective literacy development (Bukatku and Daehler 1995, 34; Fleming 2004, 26; Kendra 2016, 1; Lefa 2014, 7). For instance, many scholars argue that children are usually cognitively ready to be introduced to more formal literacy skills around the fourth or fifth year and that the process should not be rushed prior to this age (Invernizzi, Landrum, Teichman and Townsend 2010, 437; Moran and Senseny 2016, 6).

Some have, however, claimed that the naturalistic view of emergent literacy, in which the teaching approach has to wait for children to develop, causes some delay (Rohde 2015, 2), which may result in literacy failures (Shea 2011, 34). Children who start elementary school with well-developed preliterate skills have a greater chance of success in literacy development. The literacy problems that children experience later are associated with the pre-literacy skills they bring from preschool (Claessens, Duncan and Engel 2008, 415; de Witt 2009, 619; Lonigan et al. 2009, 346). The emergent literacy behaviours of children gradually develop and become conventional over time (Neuman, Copple and Bredekamp 2000, 123). The classroom should provide quality educational experiences and interactions to support and strengthen literacy development (Antilla 2013, 24). Therefore, it is of utmost importance for educators to create an atmosphere which encourages learners' early literacy success. As stated before, early literacy development is crucial for learners' educational success (Moran and Senseny 2016, 11; Pretorius and Mokhwesana 2009, 55) and has long term implications for a country's social and economic development (Snow, Burns and Griffin 1999, 33).

The next section will focus on the development of different components of formal literacy, which include letter knowledge, letter reading, word reading, fluent reading, reading comprehension, spelling and writing.

2. 3 The development of formal literacy skills

2.3.1 The development of letter knowledge skills

Letter knowledge is the ability to recognise and pronounce letters by their sounds and names, as well as to write letters to dictation (Málková and Caravolas 2016, 33). It encompasses the knowledge of both letter-names and letter-sounds. Letter knowledge may be acquired incidentally or through formal instruction (Gunn, Simmons and Kameenui 2004, 12). Children can acquire print-related concepts prior to formal school through incidental learning (Hiebert and Papierz 1990, 317), and this knowledge can then later be reinforced through formal educational practices. Letter knowledge is developed and reinforced through systematic phonics instruction, which stresses on the acquisition of letter names and letter sound as well as how to make explicit letter-sound correspondences (Ehri 1991, 384). Further information regarding phonics instruction is given in Section 2.4.

Findings reveal that letter-name and sound knowledge intercorrelate (Richgels 1986, 41; Worden and Boettcher 1990, 277), but letter-name knowledge precedes letter-sound knowledge (de Abreu and Cardoso-Martins 1998, 85; Treiman et al. 1998, 1524). Letter-name knowledge involves the acquisition of several letter identities, which include its name, sound and graphic shapes (i.e. uppercase and lowercase forms) (Foulin 2005, 129; Jones and Reutzel 2012, 448; Worden and Boettcher 1990, 278). Children typically acquire knowledge of lowercase letters prior to the knowledge of uppercase letters (de Abreu and Cardoso-Martins 1998, 85; Tincoff et al. 1998, 1524). Knowledge of letter names makes them familiar, allowing efficient and rapid processing (Walsh, Price and Gillingham 1988, 108) and easy access to the letter-sounds (Evans et al. 2006, 959). Available evidence suggests that children access the associated letter-sounds easily when they already know the letter-names (Treiman et al. 1998, 1524). In other words, knowledge of letter-names reinforces letter-sound learning (Evans et al. 2006, 959).

Research also shows that letter knowledge is a critical foundational skill in early literacy acquisition (Hiebert Cioffi and Antonak 1984, 115; Lomax and McGee 1987, 223; McClelland and Rumelhart 1981, 375; Treiman et al. 1998, 1524). Letter knowledge is necessary for mastering the alphabetic principle[9] (i.e. forming connections between the letters and sounds) (Ehri 1991, 384; Foulin 2005, 129; Stuart and Coltheart 1988, 139). Mastering the alphabetic principle is a key step in reading, writing and spelling acquisition (Bruck, Genesee and Caravolas 1997, 145; Caravolas et al. 2001, 751; Ehri 1997, 237; Muter, Hulme, Snowling and Taylor 1998, 24; Phillips, Clancy-Menchetti and Lonigan, 2008, 12). Thus, establishing the explicit links between letters and sounds is essential when teaching (Foorman, Francis, Novy and Liberman 1991, 456) as it facilitates functional alphabetic skills (Stackhouse et al. 2002, 39).

Letter knowledge is also critical for the establishment of phonological processing skills. Existing evidence suggests that letter knowledge significantly predicts phonological processing development (Burgess and Lonigan 1998, 117; Lukatela, Carello, Shankweiler and Liberman 1995, 463; Pennington and Lefly 2001, 816; Wagner et al. 1994, 84), but it is also the case that phonological processing abilities predict letter knowledge development (Lonigan et al. 2009, 345; Neuhaus 2002, 6; Pennington and Lefly 2001, 817). For instance, knowledge of letters depends on the ability to manipulate the sound units of a language (i.e. PA). It seems then that on the one hand, letter knowledge depends on the development of the underlying phonological structures since children's sensitivity to a language's sound structure might facilitate the easy establishment of letter-sound associations (Diuk and Ferroni 2011, 574; Lonigan et al. 2009, 349; Share 1995, 151). On the other hand, as letter knowledge develops, so does phonological processing skill. Thus, the relationship between phonological processing abilities and letter knowledge is most likely reciprocal.

2.3.2 Reading literacy development

Reading is considered a complex process involving the acquisition of various perceptual, cognitive and linguistic abilities (Catts and Kamhi 1987, 67) and successful reading depends

[9] Alphabet knowledge is the ability to recognise letters as distinct symbols with specific names and sounds associated with them (National Early Literacy Panel 2009, 18).

on adequate integration of these different skills (Liberman and Shankweiler 1987, 205). Reading is a set of skills that allows an individual to derive linguistic meaning from orthographic forms of speech (Whitehurst and Lonigan, 1998, 848) and is conventionally categorised into two levels: lower-level and higher-level processes (Pijper 2003, 7). Lower-level processes involve basic linguistic skills (i.e. letter identification, word recognition etc.) whilst higher-level process encompasses cognitive and metacognitive skills such as information integration within a text, utilisation of background information when constructing meaning, monitoring comprehension, making inferences and strategic processing (Yamashita 2013, 52). Lower-level processes inform and support the development of higher-level processes (Seidenberg and McClelland 1989, 255); therefore, if the former is slow and cannot provide quality information to the latter, then the development of higher-level processes may be compromised (Yamashita 2013, 52). The following sections will focus on three components of reading development, which include word recognition (also referred to as word reading), fluent reading and reading comprehension.

2.3.2.1 Word recognition

Word recognition is defined as the ability to identify a written word (i.e. its pronunciation and meaning) that is encountered in print (Kurvers 2007, 23). Three models have been put forward to explain word reading development, namely the single-route model, the dual-route model and the connectionist model. These models provide the basis for understanding the development of word recognition skills and are central to this discussion.

a. Single route model

Proponents of the single-route model (Frost 2006; Ziegler and Goswami 2006, 429) suggest that word reading is achieved through a single mechanism in which an orthographic input is first mapped onto a phonological code through which the lexicon is accessed (Gillon 2004, 23; Miller et al. 2012, 409). In other words, word reading involves a single phonological procedure of associating letters to their corresponding sounds. Knowledge of sub-skills like letter knowledge, PA (i.e. phoneme segmentation and blending) and the ability to match incoming speech sound information with phonological representations in long-term memory is needed in order to access words through the phonological route (Sutherland 2006, 33). This phonological activation procedure provides a mechanism for acquiring the knowledge of written words, for regular words (i.e. which follows the phoneme-grapheme mapping rules) and irregular words (Ehri 1998, 3; Perfetti 1992, 107; Share 1995, 152). Phonological activation is assumed to be mandatory for both the beginning reader and skilled reader (Ziegler and Goswami 2005, 4).

According to the single route model, a beginning reader has to acquire a multifaceted set of phoneme-grapheme correspondence rules, which associate a grapheme with its specific phoneme unit (Ziegler and Goswami 2005, 4). These associations facilitate the letter-sound mapping process. The graphemic units that are converted into phonemic units, however, may vary depending on the orthographic depth of the language (Miller et al. 2012, 410). In a transparent/shallow orthography, these units are small (i.e. single graphemes directly map into phonemes), whilst in an opaque/deep orthography, larger units (i.e. rimes, syllables) may be involved as a result of inconsistencies in grapheme-to-phoneme correspondences or phonological under-specification (Frost 2006, 439; Katz and Frost 1992, 150; Miller et al. 2012, 410). Thus, readers reading in a shallow orthography are thought to have advantages over readers in a deep orthography (Katz and Frost 1992, 6; Lukatela et al. 1995, 463; Seymour et al. 2003, 144). Cross-linguistic studies reveal that the activation of phonological information is more automatic in transparent than in deep orthographies (Goswami, Ziegler, Dalton and Schneider 2001, 648), implying that the involvement of the phonological procedure in reading acquisition is mandatory in transparent orthographies (Sprenger-Charolles, Siegel, Bechennec and Serniclaes 2003, 197). However, although the distinction between shallow and deep orthographies is mentioned, languages are assumed to exist on a continuum (Schmalz, Marinus, Coltheart and Castles 2015). This implies that languages can be categorised along a single scale without any clearly definable boundaries.

b. Dual-route model

The dual-route model proposes that word reading proceeds along two different routes: the lexical/direct orthographic route and a non-lexical route (Coltheart 1980, 197; Coltheart et al. 1993, 589; Coltheart et al. 2001, 108; Share 2004, 267). These routes are assumed to operate independently from each other (Besner 1999, 413; Coltheart and Rastle 1994). The lexical route encompasses direct mapping from the orthography to the mental lexicon (Jackson and Coltheart 2001, 32), and phonological codes are only activated once the correct lexical entry has been accessed (Coltheart et al. 2001, 108). In other words, reading through the lexical route involves accessing a word with specific information (i.e. the spelling and pronunciation) directly from the mental lexicon (Coltheart 2005, 9). This process is thought to arise from activation within the inferior basal region, left occipitotemporal region, inferior frontal gyrus and the posterior temporal gyrus (Jobard, Crivello and Tzourio-Mazoyer 2003, 693). The lexical route is consistent with studies indicating that skilled readers extract word meanings through direct mapping of orthographic representations onto semantic information, without making phonological references (Besner 1987). The lexical route accounts for the pronunciation of irregular words (Jackson and Coltheart 2001, 33) but cannot be used accurately for non-words (Coltheart 2005, 12). For instance, a non-word such as */sare/* activates visually similar words (i.e. *care, sore,* or *sane),* but such activation does not provide an accurate pronunciation for a non-word (Coltheart 2005, 12).

On the other hand, the indirect/non-lexical route assumes that reading involves the conversion of written symbols into speech sounds to access the meaning associated with words (Doctor and Coltheart 1980, 195; Gough 1970, 136). Readers do not access the lexicon (Coltheart 2005, 9), but use grapheme to phoneme mapping rules to generate phonological codes (Coltheart et al. 1993, 589). This conversion process relies on the superior temporal region, supramarginal gyrus and inferior frontal gyrus (Jobard et al. 2003, 693). The non-lexical route accounts for the correct pronunciation of regular words, new words and non-words (Coltheart 2005, 9).

Proponents subscribing to the dual-route model assume that the direct (orthographic) route is more efficient and is the major route for skilled readers (Coltheart 1980, 197), while the indirect (phonological) route is used by beginning readers or by skilled readers when encountering a new word (Doctor and Coltheart 1980, 195). Research evidence suggests that beginning readers rely on the phonological route when reading aloud (Backman et al. 1984, 114; Sprenger-Charolles et al. 1998a, 3; Waters et al. 1984, 293; Wimmer and Hummer 1990, 349) and for tasks which require silent reading (Doctor and Coltheart 1980, 195). Skilled readers do not necessarily generate pre-lexical phonological codes during reading comprehension but would bypass the phonological route as direct access becomes available (Coltheart 1980, 127). Word identification via the phonological route takes more time than through the direct orthographic lexical route (Frost 1998, 71).

Developmental models based on the dual-route account assume that readers acquire the two procedures successively, starting with a dependence on the phonological procedure before shifting to orthographic usage (Frith 1986, 69; Morton 1989, 43). Studies indicate that the replacement of the phonological procedure by the orthographic procedure occurs gradually (Backman et al. 1984, 114; Coltheart, Laxon, Rickard and Elton 1988, 387; Dalton and Schneider 2001, 648; Goswami, Ziegler, Sprenger-Charolles et al. 1998b, 134), but little is known about the nature of the mechanisms which allows this shift to occur (Sprenger-Charolles et al. 2003, 195).

c. Connectionist models of reading

The proponents of the connectionist models of reading propose that reading involves a single mechanism based on a network of weighted distributed connections between orthographic and phonological units (Harm and Seidenberg 1999, 491; Plaut et al. 1996, 103). The phonological and orthographic units work in parallel to facilitate word recognition. This single procedure facilitates the reading of all words (regular, irregular words) as well as non-words (Seidenberg and McClelland 1989, 524). Phonological and orthographic procedures are assumed to be reciprocally related, rather than autonomous components of word recognition (Harm and Seidenberg 1999, 492), unlike in the dual-route models.

2.3.2.2 Implication of the reading models

The word reading models described above conceptualise reading as a cognitive skill that is dependent on different processing skills such as phonological and orthographic processing, amongst others. The main distinctions between the various theories are in their perception of lexical recognition as a distinct process from non-lexical recognition, which is mediated by a rule-governed conversion system or an analogy process (Cockcroft 1998, 16). The centrality of phonological processing (which is the key focus in this study) in literacy acquisition is affirmed by all contemporary models of word reading.

2.3.2.3 Development of word recognition skills

The first steps in reading require the acquisition of the letter-sound mapping rules (Ziegler and Goswami 2006, 429; Beck and Juel 1992, 4). This process is known as phonological decoding or phonological recoding (Share 1995, 151; Ehri 2005, 168; Ziegler, Perry and Zorzi 2014, 1), and it is the primary means for attaining proficiency in word recognition in alphabetic writing systems (Ziegler and Goswami 2005, 3). Phonological decoding is described as a self-teaching device, which allows an individual to access many words present in the mental lexicon prior to reading and to successfully recoding new words (Share 1995, 151; Ziegler et al. 2014, 1).

Phonological representations of available spoken words facilitate this internally generated teaching signal (Liberman, Shankwailer and Liberman 1990, 2; Perfetti 1992, 108). Some scholars have stressed the importance of systematic, direct and explicit instruction in phonological decoding at the start of reading development to facilitate the development of the alphabetic code (Turner and Hoover 1993, 166; Ziegler et al. 2014, 20).

Although phonological decoding is very reliable for processing the majority of (regular) words, some irregular words[10] do not follow the decoding rules of a language (e.g. in English *could*, *friend*, *already*) and need to be automatically identified (Ehri 1991, 384; Ehri 2011, 149). It is recommended to delay the introduction of irregular words until young readers can reliably decode words at a rate of one letter-sound per second to ensure the effectiveness of and reliance on the decoding strategy (Bay Area Reading Task Force 1997, 2). It should be noted that although traditionally it was thought that irregular words cannot be decoded, this position is somewhat outdated. Movement in the field suggests that these words are decodable (Florida Center for Reading Research 2017, 1), if learners are introduced to an appropriate set of decoding rules. Phonological decoding also involves an advanced analysis of words. Advanced word analysis requires an awareness of letter-sound correspondences, phonological processing skills (Ehri 1991, 385), the ability to identify word patterns and their derivative, knowledge of prefixes, suffixes and roots, and how to use them to 'chunk' word parts within a larger word to gain access to meaning (Texas Center for Reading and Language Arts 1998, 1).

The phonological decoding process is based on an appreciation of the alphabetic principle (Adams 1990; 1997, 237; Byrne 1998, 2), which is a cognitive procedure that associates graphemes with their corresponding phonemes (Miller, Kargin and Guldenoglu 2012, 409). When confronted with an unfamiliar word, beginning readers convert the grapheme into its phonological representation, to access word meaning from the mental lexicon (Liberman and Shankweiler 1991, 3; Perfetti 1997, 22; Turner And Hoover 1993, 161). To illustrate the alphabetic principle practically: it involves realising that the word *mat* is spelt with three letters, *m*, *a*, and *t*, each representing a phoneme /m/, /æ/, and /t/ respectively (Miller et al. 2012, 409). This knowledge is crucial for reading, spelling and writing acquisition in alphabetic orthographies[11] (Scarborough 1998, 75; Schatschneider et al. 2004, 265; Torppa et al. 2006, 1128). The efficiency and automaticity in mapping print to sound is essential for successful literacy development (Goswami 2005, 273; Ziegler and Goswami 2005, 3).

The alphabetic-principle-based conversion procedure is likely to function well in a shallow, consistent orthography (Katz and Frost 1992, 150), while reliance on the same procedure in deep, inconsistent orthography may prove far less effective (Miller et al. 2012, 409) and may

[10] Irregular words refer to words that cannot be decoded because either (a) the sounds of the letters are unique to that word or a few words, (b) /words whose sounds do not result in the correct pronunciation of the word (none, either) or (c) the learner has not yet acquired the letter-sound associations in the word (Carnine, Silbert and Kame'enui 1997, 1).

[11] Alphabetic orthographies use limited sets of graphic symbols called graphemes (e.g. single letters or letter combinations, vowel diacritics) for the representation of sub-lexical meaningless speech units – the phonemes of words (Miller et al 2012, 409).

result in phonological deviations (Spencer and Hanley 2003, 25). For instance, the grapheme *'a'* in the English language has various pronunciations, as in words *cat, case, call and car*. Applying the alphabetic principle, where the same pronunciation is applied to all words, may lead to a distortion of the assembled phonology in words like these (Goswami 2005, 274; Miller et al. 2012, 410).

Over time, due to increased reading experience, a transition occurs in which readers shift from a reliance on phonological decoding. Thus, beginning readers rely more on phonological decoding, but for skilled readers, the processing is more automatic. When this happens, word identification becomes a more automated holistic process (Blythe Pagán and Dodd 2015, 1244; Sprenger-Challos et al. 2003, 212). Ehri (2005, 151) defines automaticity as the ability to recognise the pronunciations and meanings of written words effortlessly. This process involves (a) recognising words without mediation or phonetic analysis, (b) reading words directly from memory (Ehri 2005, 169) and (c) reading with speed, effortlessness and autonomously, without conscious awareness and with little cognitive effort (Logan 1997, 124; Kuhn and Stahl 2000, 6). The stage at which automatic word recognition occurs is known as the orthographic stage (Ehri 2005, 151). At this stage, children group letter patterns in words into larger orthographic chunks (Adams 1990), which may include spellings of common rimes, morphemes, or syllables (e.g. *-ight, -ing, -er,* etc.). Such chunks are treated as orthographic units (Ehri 2005, 175). Knowledge of letter chunks is important for reading multisyllabic words because fewer links are needed to access the word (Henry 2003, 56). For example, the word *interesting* is learnt easier if the word is divided into four syllabic units /*in-ter-est- ing*/ than if the word is analysed as ten grapho-phonemic units (Ehri 2011, 150). As children's ability to identify similar patterns in words and to retain more sight words increases, their knowledge of individual word specific forms also improves (Hagiliassis, Pratt and Johnston 2006, 235).

The transition to automatic word reading marks a shift from reliance on the phonological procedure to orthographic reliance (Sprenger-Challos et al. 2003, 212). Most models suggest a transition from phonological processing to orthographic processing in literacy development (Coltheart et al. 1988, 387; Ehri 2005, 151; Sprenger-Charolles et al. 1998b, 134). Recent research by Kilpatrick (2015; 2019) advocates for the development of "orthographic mapping" in the beginning and struggling readers to facilitate the acquisition of adequate word recognition skills. Kilpatrick (2015) suggest different techniques that promote mapping, which include: (i) providing direct instruction on phonological/phonemic awareness, (ii) directly targeting the development of sound-symbol skills and (iii) word study techniques (i.e. through introducing oral words first, teaching learners to map rime units, use of look-alike words etc.). Some studies have, however, shown that phonological dependence does not appear to decline even when indicators of orthographic reliance appear (Sprenger-Charolles et al. 1998a, 3; Sprenger-Charolles 1998b, 134), suggesting a lack of a clear developmental shift from one procedure to the other (Sprenger-Charolles et al. 2003, 212). It would seem then that both phonological and orthographic processing facilitate automaticity in printed word recognition (Coltheart et al. 2001, 205). Problems in word recognition is thus a failure to utilise the phonological and orthographic information that determines a word's identity (Perfeti 2001, 12801).

2.3.2.4 Reading fluency

Reading fluency is a rather neglected component of reading, in the sense that researchers traditionally assumed that reading fluency was the immediate result of word reading proficiency (Kuhn, Schwanenflugel and Meisinger 2010, 230). This led to directed efforts to ensure the development of word recognition in young readers (National Reading Panel 2000, 193). During the past three decades, however, research and theory have reconceptualised reading fluency, which led to an emphasis on reading fluency instruction within the curriculum (Kuhn et al. 2010, 230; Pikulski and Chard 2005, 510).

Reading fluency is the capacity to read a text quickly and precisely while using the proper expressions (Allington 1983, 556). Fluent readers are able to recognise letters and words automatically and to maintain a flow that allows them to make connections and inferences that make the text understandable while reading (National Reading Panel 2000, 194; Warrington 2006, 52). There is a growing consensus that accuracy, automaticity and prosody (i.e. variations in pitch, stress patterns and duration) contribute to reading fluency (Pikulski and Chard 2005, 511; Warrington 2006, 52). Phonological knowledge is key for the development of reading fluency in both beginner and skilled readers (Elhassan, Crewther and Bavin 2017; Heikkilä 2015). Thus, the importance of phonological processing does not cease to exist in more fluent readers. Inaccurate word recognition and difficulties in phonological processing are major setbacks in the acquisition of reading fluency (Ehri, Nunes, Stahl and Willows 2001, 393). Children need well-developed and automatic word decoding skills (which are based on phonological processing skills) to excel in reading fluency.

Ehri's stage theory predicts that the careful processing of print in the full alphabetic stage (i.e. when readers make complete grapheme-phoneme connections) sets the stage for fluent reading (Ehri 1998, 11). According to Chall's reading development model, the fluency stage is assumed to occur between 7-8 years of age (Chall 1996, 18). Fluency in reading is considered a precondition for the effective construction of meaning from text (Allington 1983), and a lack of reading fluency causes difficulties in reading comprehension (Stanovich 1991, 70). Lack of fluent reading is a problem for poor readers because they tend to read in a laboured and disconnected way, which makes comprehension difficult or impossible (Hudson, Lane and Pullen 2009, 2). Stanovich (1986, 360) indicates that there is a reciprocal association between fluent reading and the reading quantity engaged in by the reader. Fluent readers typically engage in extensive reading compared to less-fluent readers (Pikulski and Chard 2003, 510). Intense practice in which readers engage with large quantities of material is needed to develop reading fluency skills (Allington 1983, 557; Snow, Burns and Griffin 1998). Classroom practices that encourage consistent reading practices coupled with effective feedback improve this aspect of learners' reading expertise (National Reading Panel 2000, 193).

2.3.2.5 Reading comprehension

Reading comprehension is defined as a cognitive process of constructing meaning from the text through active interactions between the text and the reader (Woolley 2011, 15). Comprehension is considered the ultimate goal of learning to read (Snowling 2009, 1). Reading is meaningful if learners reach a point where they can understand what they read and integrate information from texts effectively (Jackson 2013, 5; Pretorius, 2000, 34). There are three types of models that explain the process of reading comprehension, namely, bottom-up, top-down, and interactive models (Griffiths, Sohlberg and Biancarosa 2011, 6). Bottom-up models view reading comprehension as a systematic process in which reading begins with the processing of smaller units and proceeds to the processing of larger units of text (Gough 1972). Readers start by recognising letters and word combinations before extracting meaning from those units (Treiman 2001, 3). The meaning of a text is contained in the text itself, and general world knowledge and contextual information are assumed to have little influence on the comprehension process (Yang 2009, 6). Critics of the bottom-up approach, however, suggest that reading comprehension is an active process that requires more active engagement on the part of the reader than a passive process that basically relies on low-level decoding skills (Hirotaka 2002, 12).

The top-down approach emphasises the importance of general world knowledge and contextual information from the passage, as readers start with the activation of prior knowledge, proceeding 'downward' to more specific information (Griffiths et al. 2011. 6). Readers do not use every piece of information in the text in understanding a text. Instead, Goodman (1976, 2) argues that readers select the fewest, most productive cues necessary to predict meaning. Woolley (2011, 15) describes the top-down approach as conceptually driven (i.e. the ideas that a reader brings to the text determine comprehension). This approach is criticised for neglecting the importance of decoding skills as it overemphasises the prediction of meaning using contextual cues (Eskey 1988, 93). The interactive approach views reading comprehension as an interactive process that requires both word recognition skills and general or contextual knowledge (Perfetti, Landi and Oakhill 2005, 228). The approach considers both bottom-up and top-down processes in contributing to reading comprehension. Mikulecky (2008, 1) insists that bottom-up and top-down processing are employed simultaneously and that they both complement one another and compensate for each other's deficiencies. Although bottom-up processes are the focus of this study, the researcher considers top-down processes to be equally important in understanding reading comprehension. The focus of this study was determined by the stage of literacy development of the learners (i.e. foundation phase, where bottom-up processes initially dominate) and by the fact that considering both types of processes would have created an unmanageable research scope.

Reading comprehension is a higher-level process that relies on the successful development of lower-level word reading processes. Perfetti et al. (2005, 242) argue that word reading and comprehension skills develop in tandem. Efficient and automatic processing at the word level reduces the cognitive load on a reader's working memory — this frees the reader to engage in higher-order comprehension skills (Scott 2010, 1; Woolley 2011, 17). Slow, inefficient and laborious word recognition slows down reading and takes up precious cognitive resources which should be used for understanding a text (Kuhn et al. 2010, 131; Yamashita 2013, 53). Importantly, Snowling (2009, 4) argues that successful decoding is no guarantee for successful reading comprehension. Word recognition skills are necessary but not sufficient for predicting reading comprehension. A child can have good word reading skills and yet fail to be successful at comprehension. The reason for this is that comprehension involves the integration of various cognitive and interactive strategic processes, including the activation of background knowledge, monitoring and clarifying, making predictions, drawing inferences, asking questions and summarising information (National Reading Panel 2000, 228; Perfetti et al. 2005, 230; Woolly 2011, 16).

The issue of whether phonological processing is necessary for accessing meaning is a controversial issue in the reading literature (Frost 1998, 83; Van Orden and Kloos 2005, 3). Obligatory phonological theories suggest that automatic phonological activation is crucial for reading comprehension (Coltheart, Patterson and Leahy 1994, 917; Hanely and Mcdonell 1997, 3). Van Orden and colleagues provide experimental support for phonological mediation when accessing word meaning (Van Orden 1987, 181; Van Orden et al. 1988, 371; Van Orden and Kloos 2005, 5). Their findings are supported by Patterson (1992, 314), who argues that access to phonology is crucial for successful reading comprehension. In addition, Patterson (1992) suggests that direct access to meaning from print and phonologically mediated access to meaning occurs in parallel. Phonological mediation may play a role in accessing meaning from print, but it is not obligatory (Hannely and McDonnell 1997, 6).

An alternative view is that phonological processes do not play an essential role in reading for meaning (Ellis 1984, 27; Humphreys and Evett 1985, 689; Patterson 1982, 32). In support of this view, scholars have put forward evidence from studies with patients with speech production impairments, where it was shown that such patients were able to comprehend the meaning of words despite making phonological errors when reading these words aloud (Ellis Miller and Sin 1983, 137). The implication is that it is possible to directly access the semantic system from print without activating phonological representations (Van Orden and Kloos 2005, 13). Dual route theorists also predict that skilled reading occurs without mediating phonology (Doctor and Coltheart 1980, 195). However, neither direct access nor mediating phonology can claim unequivocal empirical support for the role of phonological processes in reading comprehension (Van Orden and Kloos 2005, 13). The present study will add to this debate by considering the longitudinal predictive importance of phonological processing abilities in reading comprehension.

2.3.3 Spelling development

Spelling is the ability to use letter sequences to represent specific words that have an associated pronunciation and meaning within the mental dictionary (Berninger and Fayol 2014, 1). Before children attain spelling at a conventional level, they create invented spellings. Invented spellings typically refer to children's spontaneous or self-directed attempts to represent words in print (Gentry and Gillet 1993, 12) and are produced by young children (aged 3–7) before formal literacy instruction (Awramiuk 2014, 112). Knowledge of the phonological structure of spoken words and the ability to represent this structure in writing forms the foundation of spelling skills (Ferreiro and Teberosky 1982, 2; Geers and Hayes 2012, 3; Gentry 1982, 192; Kaefer 2012, 3; Pollo, Kessler and Treiman 2009, 410; Ouellette and Sénéchal 2017, 77; Samara and Caravolas 2014, 137; Treiman 2006, 581).

Spelling development in children is assumed to proceed sequentially through various developmental stages (Ehri 1997, 238; Frost 2001, 487; Ferreiro 2002, 23). For this reason, deviations from spelling norms are rarely considered accidental (Read 1986, 97) – they rather reflect the knowledge of the phonological structure developed by the writer at a particular point (Graham et al. 2002, 669). In the initial phases of invented spelling, young children know that writing conveys a message encoded in print symbols (Kaefer 2012, 3) without realising that these symbols are meaningful (Ouellette and Sénéchal 2017, 77). Children may begin by representing the first sound in a word (e.g. writing '*d*' for *dog* followed by random letters) (Gentry and Gillet 1993) and may then gradually learn to represent medial and final sounds. This is followed by a phonetic spelling stage where children can make use of letter names or sounds to spell (Ouellette and Sénéchal 2017, 78). Upon reaching the conventional spelling level, children can balance phonological demands with orthographic, morphological and semantic aspects of word identity to capture the spelling of different words (Rittle-Jonhson and Siegler 1999, 332). Thus, children draw knowledge from various cognitive-linguistic skills in spelling development (Korkeamäki and Dreher 2000, 349).

Spelling has often been a neglected component of general literacy skills (Geers and Hayes 2012, 3), but in recent years interest in this component of literacy has developed enormously, as evidenced by the growing number of research papers and articles (Hashemi and Ghalkhem 2016, 730). Three approaches have been put forward with regards to spelling development, which include: the phonological mediation hypothesis, the orthographic autonomy hypothesis and the dual-route approach. These three approaches are important for understanding the process of spelling development and are central to this discussion. The obligatory phonological mediation hypothesis assumes that spelling is phonologically mediated (Tainturier and Rapp 2001, 265; Hannely and McDonnell 1997, 7; Barry 1994, 320). There are two main assumptions to this hypothesis. The first assumption is that phonological words are translated into spellings by a sub-lexical phonology-to-orthographic conversion procedure (Tainturier and Rapp 2001, 265). This should be followed by a checking procedure involving the orthographic lexicon for words with low probability spellings such as *yacht* or *chef* (Perfetti 1997, 21). The second assumption is that word spellings are retrieved from the orthographic lexicon via direct links with the corresponding representations in the phonological lexicon (Tainturier and Rapp 2001, 265). In this case, there is no need for orthographic checks except maybe in cases of homophones like *nun-none* (Hannely and McDonnell 1997, 7). Some research evidence, however, failed to find support for phonological mediation in spelling development (Ellis 1982, 113; Ellis 1984, 26; Shallice 1981, 413).

The orthographic autonomy hypothesis assumes that spellings of words can be accessed from the orthographic lexicon through direct connections with semantics that bypasses phonology (Tainturier and Rapp 2001, 265). This process can occur successfully without activating the phonological representation since the orthographic representation of a printed word activates its lexical entry directly (Aaronson and Ferres 1983, 700; Paap, Newsome, McDonald and Schvaneveldt 1982, 573). Some research evidence indicates that spelling occurs via a direct involvement between the semantic and orthographic systems (Hanley and McDonnell 1997, 28). The dual-route approach asserts that spelling is achieved through lexical and sub-lexical routes (Coltheart et al. 2001, 204). The lexical route gives access to the spelling of whole words from long-term memory and is utilised in spelling familiar words (Afonso, Álvarez and Kandel 2015, 579). In other words, spellings are generated by retrieving stored spellings directly from the orthographic lexicon. Research evidence suggests that the lexical route also influence non-word spelling (Barry and Seymour 1988, 5; Campbell 1983, 253).

Contrary, the sub-lexical route makes use of phonological and orthographic links (Sprenger-Charolles et al. 2003, 195) and is used for spelling non-words or low-frequency words (Afonso et al. 2015, 581; Tainturier and Rapp 2001, 263). Although the existence of both lexical and sub-lexical processes is acknowledged, it is unclear whether or not their use is mutually exclusive (Tainturier and Rapp 2001, 270). Research evidence suggests that although the two processes may run in parallel (Kaefer 2016, 2), they are not fully independent (Shallice 1981, 143; Weekes and Coltheart 1996, 277). The three models of spelling (phonological mediation, orthographic autonomy and dual-route approach) provide insight into spelling development. While the orthographic autonomy hypothesis emphasises orthographic processing, the phonological mediation and dual-route approaches emphasise the importance of phonological processing in spelling development, which is central to this study. Phonological mechanisms seem to be more significant in the early stages of spelling acquisition than orthographic processing (Sprenger-Charolles et al. 2003, 208) and as such, the relationship between phonological processing skills and spelling will receive attention in this study, given the age of the learners.

Children's early attempts at spelling reflects their understanding of the alphabetic principle (Dixon, Stuart and Masterson 2002, 295; Ehri 2000, 19; Ouellette and Sénéchal 2008, 195; Sprenger-Charolles et al. 2003, 194). Pre-literacy skills such as alphabetic knowledge, knowledge of letter-sound correspondences and PA (Ehri 2000, 19; Ouellette and Sénéchal 2017, 77) based on an internal phonological system of a language (Geers and Hayes 2012, 3) are needed for spelling acquisition. Research shows a bidirectional relation between PA and invented spelling (Martins and Silva 2006, 41 Ouellette, Sénéchal and Haley 2013, 261). Invented spelling depends upon PA, and in turn, PA is accelerated through practice with invented spelling.

The ability to spell words is regarded as a major milestone in a child’s literacy acquisition process (Puranik et al. 2011, 465). Recent studies suggest that good spelling leads to a good perception of an individual’s overall writing abilities (Figueredo and Varnhagen 2005, 441; Kreiner et al. 2002, 15) and is considered a good predictor of children's reading skills (Richgels 1995, 96; Tangel and Blachman 1992, 153). Accurate spelling knowledge facilitates the accurate mental representation of a word (Snow, Griffin and Burns 2005, 86), which promotes the development of other literacy skills. Researchers believe that inaccurate spelling reduces the intelligibility of written work (Graham, Harris and Chorzempa 2002, 669). Poor spelling may thus hinder overall academic performance.

Individual differences in spelling development can be explained by the variances in writing systems and in phonological properties of a language (Seymour et al. 2003, 145). Studies reveal that the characteristics of a given language system (i.e. syllabic structure; regularity of correspondences, phonemic characteristics (voiced vs unvoiced), pronunciation problems, letter confusion or particularities of a language (e.g. double letters and complex graphemes) determine the degree of difficulty experienced in spelling acquisition (Écalle 1998, 28; Jaffré 1992, 27). Spelling development seems easier in more transparent languages (Borzone de Manrique and Signorini 1998, 499) than in deeper orthographies where a single phoneme can be represented by more than one grapheme (Morin 2007, 177; Moats 2005, 14). For instance, while some English words can be spelt accurately based on sound-symbol correspondences alone (e.g. *back*, *clay*, *book)*; these patterns are complex and must be learned (e.g. when to use /*ck*/ as in *back* and when to use /*k*/ as in *book*) (Moats 2005, 14). This means that children need to be well versed with the spelling conventions of the language they are learning to excel in spelling acquisition.

2.3.4 Early writing development

Writing represents a child's attempt at retrieving the visual shapes, numbers and names of letters (Puranik, Lonigan and Kim 2012, 466) and is accomplished through the activation of several temporal lobe regions, especially the visual form area and planum temporale (Brem et al. 2010, 7939; Dahaene et al. 2010, 1359). Alphabetic knowledge (Moats 2005, 12; Treiman 2006, 581) and knowledge about print and how it functions (Blair and Savage 2006, 4; Puranik et al. 2012, 466) are considered essential for early writing acquisition. For instance, children need to understand that print carries meaning; that the strings of letters between spaces are words and that words in print correspond to an oral version (National Association for the Education of Young Children 1998, 3). A central goal during preschool years is to enhance children's exposure to concepts about print (Stanovich and West 1989, 402).

Models of writing assume that children follow a similar course in writing acquisition (Ehri 2000, 20; Gentry 1982, 192). Children are assumed to proceed through four stages of writing development. The first stage is the preliterate or pre-communicative writing stage, and it involves the initial experiences of holding a pencil and the child's understanding that writing is not the same as drawing, but with no appreciation that writing relates to speaking (Awramiuk 2014, 114). This is followed by the semi-phonetic stage or partial alphabetic level, where the child is acquainted with letters and realises that they represent sounds in writing (Ehri 2000, 21). The child, however, still strives to understand the essence of an alphabetic system. This stage is characterised by difficulties in phonological segmentation of the words, visible in writing (Awramiuk 2014, 114). For instance, a typical error occurs in the confusion of the phonetic value of a letter with its name, e.g. writing the word *you* as /u/ (Gentry 1982, 193).
The next stage is the phonetic stage, where children can apply the phonological strategy but are not yet able to use orthographic or morphological knowledge (Awramiuk 2014, 114). Gradually, by learning to read, children start to use morphological knowledge and are able to recognise semantic relationships between words and spelling regularities (Gentry 1982, 193). Writing, therefore, involves the integration of different mechanisms, including phonological, orthographical, semantic, morphological processing strategies.

Stage models have been criticised for describing writing acquisition as a sequence of adopting different types of knowledge (i.e. from phonological to orthographical and morphological), which underestimate the abilities of children (Awramiuk 2014, 114). Children may simultaneously employ different strategies and types of information while learning (Bourassa and Treiman 2001, 172; Treiman and Cassar 1997, 61). In the initial phase of writing acquisition (between 3 and 7 years), learning to write seems to be more spontaneous than learned (Awramiuk 2014, 113). The conventional writing process begins when children begin to write letters or their names (Puranik et al. 2012, 465), which is an important benchmark in early literacy development (Welsch, Sullivan and Justice 2003, 757). The ability to write one's name is seen as an early indicator of alphabetic principal-based knowledge (Adams 1990, 275; Both-de Vries and Bus 2008, 183; Bloodgood 1999, 342) and of children's knowledge of print and of PA awareness (Blair and Savage 2006, 991). Name writing signals the onset of a child's formal (albeit still emergent) literacy skills (Levin et al. 2005, 463) and is one of the early foundations on which other conventional literacy skills are built (Bloodgood 1999, 342; Levin and Aram 2004, 219; Puranik et al. 2012, 14; Strickland and Shanahan 2004, 7). Letter writing represents a child's attempt at retrieving the visual shapes and letter names and is facilitated by a child's alphabetic knowledge (Puranik et al. 2012, 2). Knowing how to write letters beyond one's name may indicate an increased sensitivity to the alphabetic principle (Puranik et al. 2012, 14) and children's developing orthographic knowledge (Puranik and Apel 2010, 46). Letter writing is also an important predictor of spelling development (Berninger 1999, 99; Graham et al. 1997, 170).

Research suggests that characteristic errors of omission of certain letters during early writing are justified linguistically (Bourassa and Treiman 2001, 172; Morin 2007, 173). For instance, Morin (2007) examined the writing development of young French-speaking Canadians (202 preschool children; average age 6.0) in a task consisting of writing six words and the results indicated that the majority of mistakes made by children did not occur accidentally but illustrated their attempts to manipulate the language in the course of writing according to the phonological system. Deviations from stipulated writing norms can also reflect difficulties which arise from the nature of the writing system being learned (Ferreiro and Teberosky 1982, 289; Read 1986, 107). Writing is not an easy process, and being able to write is considered a great accomplishment for young children (Awramiuk 2014, 113; Puranik et al. 2012, 1). Although the focus on writing in the present study is small and limited to early writing only, the researcher will attempt to determine the role of phonological processing skills in children's early writing development.

2.4 Teaching strategies in early literacy acquisition

Various instructional approaches are used to enhance children's early literacy development, which includes phonics instruction, code-focused instruction and direct oral language instruction (National Early Literacy Panel 2009, National Reading Panel 2000). These instructional approaches, which are important for facilitating literacy development, will be discussed in this section.

Phonics refers to the relationship between phonemes and graphemes (Konza 2011, 3). Phonics instruction is a method of teaching that entails teaching learners that sounds are represented by letters of the alphabet, which can be blended together to form words (Goswami 2005, 279;

Konza 2011, 3; National Early Literacy Panel 2009, 20). Phonics instruction helps learners to understand how to map the sounds onto their corresponding letters to be able to read, spell and write (Gillon 2004, 21; Goswami 2005, 272). It seems logical then that phonics instruction can support learners to 'crack' the alphabetic code (Duff, Mengoni, Bailey and Snowling 2014, 2). Through phonics instruction, for instance, children are taught to translate unfamiliar words into their spoken familiar forms by learning that *'b'* is pronounced as /*b/*; that *'c'* can be pronounced as /*k*/ or /*s/*, and so on (Treiman 2001, 9). Phonics instruction needs to be systematic, explicit and direct for effective literacy acquisition (Wyse and Goswami 2008, 691). Systematic instruction means that instruction should be a planned sequence and not occasional and should form part of literacy instructional practices (National Reading Panel 2000, 86).

There are basically two approaches to explicit phonics instruction: synthetic phonics instruction and analytic phonics instruction (Goswami 2005, 273). The synthetic approach firstly involves the teaching of letter sounds, and then it builds up to blending these sounds together to achieve full pronunciation of whole words (Wyse and Goswami 2008, 692). For example, in the word *bat*, children learn to identify three individual phonemes: */b/ /a/ /t/* that can be blended back together to produce a word (Ehri et al. 2001, 393). The process involves the ability to synthesise and blend sounds to create whole words. Once learners know some sounds, they can use this knowledge to read words via decoding, or write words via encoding, as they can build up and break words down (Watson and Johnston 2005, 25). This instructional approach has also been referred to as the phoneme-based approach to literacy instruction (Goswami 2005, 279). Phoneme-based instruction was successfully incorporated within the National Literacy Strategy in the United Kingdom (1998), which emphasises direct literacy instruction from 5 years with an initial focus on phoneme strategies, which are later supplemented by rime-based strategies, but with a strong emphasis on phonemes.

Proponents of the synthetic approach argue that it is an effective method (Johnston, McGeown and Watson 2012, 1382; Johnston and Watson 2004, 437; Juel 1996, 759; Rose 2006, 19), which facilitates rapid progress in reading acquisition (Goswami 2005, 272; Wyse and Goswami 2008, 697). Studies reveal that programs that focus on explicit, intensive phonics instruction are effective (Adams 1990). However, some children may have difficulties in understanding phonics instruction and may leave the first grade unable to read due to lack of phoneme awareness (Treiman 1999, 10). Moats (1994, 81; 2005, 380) argues that many teachers do not have enough opportunities of learning about the phonological structure of language and may not provide optimal instruction as a result. Literacy instruction requires teacher expertise across several content domains, including phonology, orthography, morphology, semantics, syntax, discourse and pragmatics (Berninger and Richards 2002, 28; Joshi 2005, 45). Teachers, therefore, need to be sufficiently prepared to ensure that children benefit from phonics instruction (Treiman 2001, 12).

The analytic phonics approach (also referred to as the whole-word approach) (Goswami 2005, 280) is a method of teaching which involves teaching children to recognise whole words by sight. Children first learn words by sight and are introduced to segmenting and blending after all the letter sounds have been introduced (Johnston et al. 2012, 1382; Johnson and Watson

2004, 329; Moustafa and Maldonado-Colon 1998, 448). Children are taught to recognise words as holistic units, for example, through the use of flashcards (Goswami 2005, 280). Proponents of this approach assume that children analyse a word by taking clues from the recognition of the whole word, the initial sound and the context (Johnston et al. 2012, 1382) and that they draw from their perspectives and prior experiences to form the framework for new knowledge (Goswami 2005, 280). For example, if a child sees the word *table* written down together with the picture, the child is able to associate the word with the concept *table* (Johnston et al. 2010, 1384). Some studies, however, suggest that analytic phonics is not a successful method of literacy instruction (Johnston and Watson 2005, 25; Torgesen et al. 1999, 579). The most crucial argument against analytical phonics is discussed by Oakhill and Garnham (1988, 87), who argue that if readers cannot decode, they will lack phonemic awareness, without which they could not read an unknown word that they came across independently.

While analytic phonics goes from 'whole to part,' with an initial focus on larger grain sizes, synthetic phonics goes from 'part to whole,' with an initial focus on the smallest grain sizes[12] (Moustafa and Maldonado-Colon 1998, 448). Efforts to improve early literacy have been centred in a debate about which of the two teaching strategies produced better results (Bornfreund 2012, 3). Research has shown that synthetic phonics instruction has a greater effect on children's progress in reading (National Council for Curriculum and Assessment 2012, 150; Watson and Johnston 2005, 25) than whole word methods, which appear to result in slower learning, as children may forget words over time given the method's heavy dependency on memorisation (Joliffe and Waugh, 2012, 109; National Reading Panel 2000). Additionally, research has shown that boys tend to do much better with synthetic phonics than analytic phonics (Johnston et al. 2012, 1382). A cumulative body of research suggests a blended approach (Bornfreund 2012, 3) whereby synthetic phonics is used as the primary method of literacy instruction and is supplemented by analytical techniques (Juel 1996, 759).

Code-focused instruction involves helping children understand the alphabetic principle and to be able and manipulate the sounds in a word (National Early Literacy Panel 2009, 13). Code focused instruction focuses on PA instruction and alphabetic knowledge instruction. Research indicates that teaching PA strategies while also teaching children the alphabetic letters has a larger impact on children's later reading, writing and spelling abilities across diverse populations (National Early Literacy Panel 2009, 14). Effective code-focused instruction should be intentional, systematic, explicit and should include many opportunities for practice considering the cognitive operation and complexity of the language skills being taught (Bornfreund 2012, 5; National Council for Curriculum and Assessment 2012, 150).

Direct oral language instruction is another strategy for enhancing literacy development. Research indicates that oral language development influences the successful development of reading, writing, and spelling (National Early Literacy Panel 2009, 39). Some believe that

[12] Large grain sizes refer to the components of PA which include words, syllables and rimes whilst small grain sizes incorporate the phoneme and onset components of PA (Goswami 2005, 279).

language development occurs naturally and cannot be taught, but research indicates that it can indeed be taught and enhanced in a variety of ways (National Early Literacy Panel 2009, 33). Direct oral instruction allows children to learn the definitions of words, acquire new vocabulary and concepts, and utilise their rich language repertoire in meaningful contexts (National Early Literacy Panel 2009, 33).

Teachers need to be provided with evidence-based pre-service training and ongoing in-service training to select and implement the most effective instructional approaches (Moats 2005, 383; National Reading Panel 2000, 96). A crucial issue is that a 'one size fits all' approach may not be suitable for all learners (De Vos et al. 2015, 22) because a particular approach may suit some learners better than others (National Reading Panel 2000, 97). Teachers should assess the needs of the individual learners and tailor instruction to meet their specific needs (Moats 2005, 393; Hashemi and Ghalkhani 2016, 731). Policy mandates for improving literacy instruction should be coupled with greater efforts to improve teachers' knowledge and skill (Moats 2005, 393). One of the aims of the present study is to contribute to more informed literacy teaching practices in the South African context, as there is currently no agreement about how to teach reading in the African languages spoken in South Africa. Early literacy instruction in the South African education system is based on a balanced literacy approach, which emphasises the integration of phonics and whole language instructional approaches. It is, therefore, interesting to investigate how phonological processing and literacy acquisition progresses in the South African context considering this background.

2.5 Literacy development in more than one language

2.5.1 The concept of biliteracy and biliteracy development

Biliteracy is a term used to describe children's literacy (i.e. reading, writing, spelling, speaking, listening and thinking) competencies in two languages (Hopewell and Escamilla 2014, 187). Biliteracy is fostered either simultaneously or successively (Dworin 2003, 171). Simultaneous biliterates develop literacy abilities concurrently in their L1 and L2, whilst a sequential biliterate is an individual who acquires literacy in the L2 after L1 literacy has been established (Reyes 2006, 289; Reyes 2012, 312; Ríos and Castillón 2018, 86). Learners in this study are technically simultaneous biliterates, considering the fact that they are developing literacy skills in Northern Sotho and English simultaneously from Grade 1 onwards (according to the curriculum). It should be stressed, though, that, more broadly speaking, the learners in the present study are sequential bilinguals, given that many learners only start learning English when they enter Grade 1. Thus, literacy competencies may develop to various degrees throughout these biliterate learners' development, given that literacy instruction in English starts before learners have developed solid English language skills.

Biliteracy is regarded as a more complex form of literacy than monoliteracy (i.e. literacy acquisition in one language). The reason for this reasoning is that biliterate learners automatically try to navigate and negotiate linguistic resources from their two languages (Dworin 2003, 171; Hornberger and Link 2012, 239). While many scholars have argued that this process can be challenging for learners (Cummins 1981, 99), biliteracy is also associated with increased literacy achievement and greater cognitive flexibility, which promotes overall schooling achievement (Reyes 2006, 289). Studies have shown that biliterate learners have better academic achievement than monoliterate learners (Haneda and Monobe 2009, 8). If biliterate learners acquire literacy in their L1, they can use these linguistic resources and academic foundations to support the acquisition of L2 literacy (Cummins 2001, 19). Hence, learners who develop strong literacy skills in their L1 demonstrate the same skills and attitudes in L2 literacy acquisition (Jimenez et al. 1995, 67).

Clearly, it is essential to understand how learners become biliterate and how their languages are used to attain their goals in order to support them effectively (Garcia 2009, 140). Ríos and Castillón (2018, 86) and Cummins (2001, 19) argue that if biliterate learners are not nurtured, they are in danger of losing their L1 literacy skills and experiencing many difficulties in acquiring L2 literacy. The development of cognitive-linguistic and literacy skills in biliterate learners and the main theories associated with biliteracy will be discussed in more depth in Chapter 3.

2.5.2 Literacy acquisition in different orthographies

Two factors are crucial for explaining cross-language differences in literacy development. These factors are *differences in phonological structure* and *different orthographic characteristics* (Bourassa and Treiman 2001, 172; Spencer and Hanley 2003, 12; Goswami 2005, 273). The first factor involves the phonological complexity of the spoken language (Goswami 2010, 27). Children are thought to acquire literacy skills much faster in languages which follows a simple consonant-vowel (CV) structure, such as Italian and Spanish, than in languages which has a complex structure (Goswami 2005, 273; Goswami 2010, 27). Some languages like English, for instance, have comparatively few words with simple CV syllables. The most frequent syllable structure is the CVC (*dog*, *mat*), CCVC (*stop*, *pram*) CCCVC (*straw*), CVCC (*hold*), CCVCC (*stamp*), CCCVC (*spread*), and CCCVCC (*sprained*) (De Cara and Goswami 2002). Such complexities in the phonological structure may delay the literacy acquisition process (Goswami 2005, 276).

The second factor has to do with the consistency in letter-sound mapping correspondences (Ziegler, Stone and Jacobs 1997, 600). This process is complex in some orthographies, where one letter can have several pronunciations; for example, the sound /k/ is denoted as "c" (*can*), "k" (*kite*), or "ck" (*quack*) (Treiman 2001, 6). Literacy acquisition is more difficult for learners acquiring reading in opaque/deep orthographies (i.e. French and English) than for learners acquiring reading in a shallow orthography (i.e. German and Finnish) (Seymour et al. 2003). Seymour et al. (2003, 146) argue that deeper orthographies present more challenges to the readers as they also have to learn orthographic inconsistencies and complexities, irregularities, multi-letter graphemes, context-dependent rules and word memorisation strategies (in order to decode irregular words). On the other hand, learning a relatively shallow orthography, where there is a one-to-one mapping between phonemes and graphemes, involves a single process focused on the alphabetic principle (Goswami 2010, 39). Many scholars have suggested that acquiring literacy skills in a shallow orthography is therefore easier. A better understanding of cross-language similarities and differences is required to design language-specific teaching strategies for successful early literacy instruction (Goswami 2005, 273; Ziegler et al. 1997, 600). For instance, direct instruction at levels other than the phoneme may be required to facilitate effective reading in English due to complex syllabic structure and inconsistent spelling systems (Wyse and Goswami 2008, 693).

The two main theories that have been advanced to explain differences in literacy development in different orthographies are the 'orthographic depth hypothesis' and 'psycholinguistic grain size theory'. These theories will inform the theoretical framework of this study, considering the orthographical differences between English (more opaque) and Northern Sotho (more transparent). The orthographic depth hypothesis assumes that the orthographic structure of a language is a crucial factor in determining literacy acquisition (Frost 2006, 439; Frost, Katz and Bentin 1987, 104; Katz and Frost 1992, 2). The psycholinguistic grain size theory offers a systematic framework for understanding how different lexical, phonological and structural factors contribute to cross-language differences in literacy acquisition (Goswami 2010, 39), and it assumes that children have to overcome three problems in literacy development (particularly reading), namely consistency, availability and granularity of letter-sound correspondences (Ziegler and Goswami, 2005, 3). A problem of availability is caused by the fact that the phonological units required to form connections with units of print are not consciously accessible prior to reading (Goswami 2010, 35). For instance, while some phonological units, such as rhyme, are available to the child before reading starts, others, in particular phonemes, are not that readily available (Ziegler and Goswami, 2005, 3), and they can only become accessible when literacy instruction commences (Goswami 2010, 35).

Secondly, a problem of consistency can arise because some orthographic units can have multiple pronunciations while some phonological units can have various spellings (Ziegler et al. 1997; Ziegler and Goswami 2005, 3). Because these inconsistencies exist to varying degrees across different orthographies, they cause variation in literacy development for children in various languages (Ziegler and Goswami 2005). Finally, the granularity problem reflects the fact that children need to learn many orthographic units when access to the phonological system is based on bigger grain sizes (Ziegler and Goswami 2005, 3; Goswami 2010, 36). This is a challenge, particularly in deep orthographies that require the learning of many more and larger orthographical units (OECD 2005, 4). The efficiency with which these problems are dealt with varies across languages and determines literacy acquisition in different languages (Ziegler and Goswami 2005, 3)

The psycholinguistic grain size theory assumes that differences in literacy acquisition across orthographies are a result of various strategies employed in response to the orthography (Ziegler and Goswami 2005, 3). Children learning to read in languages that are orthographically more consistent rely heavily on grapheme-phoneme conversion strategies (Goswami 2005, 277), which is effective because these correspondences are relatively reliable (Ziegler and Goswami 2005, 4). On the other hand, children learning deep orthographies cannot use smaller grain sizes easily due to inconsistencies in phoneme-grapheme correspondences (Goswami 2005, 277). As a consequence, children learning deep orthographies employ multiple strategies. Grapheme-phoneme conversion strategies are supplemented with rhyme analogy strategies to access irregular words and whole-word recognition strategies (i.e. for unique spelling patterns such as *choir* and *people*) (Goswami 1986; 2005; 2010). Reading in inconsistent orthographies requires children to develop small and large unit strategies in parallel (Brown and Deavers 1999, 208; Goswami, Ziegler, Dalton and Schneider 2003, 235). Research suggests these children use phoneme-grapheme correspondences for learning regular words, but for reading irregular words, they need to learn about orthographic rules and different types of decoding strategies (Ehri 2005, 167; Wimmer, Mayringer and Landerl 2000, 669).

The discussed theories suggest that differences in linguistic structures between languages may lead to differences in literacy development in bilingual learners' languages. In the present study, the structural differences in Northern Sotho and English might indeed lead to differences in the literacy acquisition processes in the two groups of Northern Sotho-English bilingual learners. The consistent orthography of Northern Sotho might play a facilitative role in literacy acquisition since learners may rely on a single strategy, whilst the deep orthography of English might lead to difficulties since children have to implement different literacy strategies. Also, it should theoretically be the case that learners progress faster in Northern Sotho than in English, given that Northern Sotho is their L1 and has both a simpler phonological system and more orthographic transparency (in relation to English).

2.6 Conclusion

This chapter concentrated on the concept of literacy and the literacy development process. Different literacy components that include letter knowledge, letter reading, word recognition, reading fluency, reading comprehension, writing and spelling skills have been outlined and discussed. Different models of literacy development are central to this discussion. The chapter described various literacy instruction methods that can be used to facilitate literacy development in children. Finally, the concept of biliteracy and the factors that influence literacy development in different languages were outlined. Biliteracy is a complex phenomenon, and literacy achievement in a learner’s two languages can be affected by the phonological and orthographic differences that exist between languages. Differences in the literacy acquisition of Northern Sotho-English bilingual learners are expected in this study, considering the linguistic differences between Northern Sotho and English. The next chapter discusses the concept of phonological processing and its role in facilitating the literacy development of bilingual children. A brief outline of the linguistic properties of Northern Sotho and how these properties affect the literacy development process in relation to English, will also be given.

CHAPTER 3
PHONOLOGICAL PROCESSING AND LITERACY

The process of literacy development is complex (Antilla 2013, 9) and involves the development of many cognitive and linguistic abilities. Cognitive skills associated with literacy include short- and long-term memory, rapid processing, automatisation, inferencing, abstract reasoning and critical thinking (Richland, Frausel and Begolli 2016, 1). Linguistic skills associated with literacy development include vocabulary, morphological, orthographic, syntactic, semantic and phonological knowledge (Awramiuk 2014, 114; Catts and Kamhi 1987, 67; Verhoeven et al. 2011, 388). Children must incorporate and integrate knowledge from these different cognitive and linguistic domains to ensure literacy success (Kaefer 2016, 1; Perfetti and Hart 2001, 67; Taylor and Perfetti 2016, 1069). Different sets of skills are important at different stages of literacy development. For instance, phonological processing, orthographic knowledge and rapid processing need to develop during the earlier stages of literacy development to ensure successful decoding and fluent reading. In contrast, inferencing and critical thinking need to develop in more advanced readers to ensure that learners can read for meaning and comprehend more advanced texts.

The present study concentrates on one set of cognitive-linguistic skills, namely phonological processing skills. A vast body of research over the past three decades has confirmed that phonological processing skills are important for literacy development and that learners with sound phonological processing skills are at an advantage when it comes to acquiring early literacy skills. This chapter discusses the construct 'phonological processing' and explains its role in facilitating literacy development. Phonological theories of literacy development are also presented in this chapter. Furthermore, the impact of bilingualism on phonological processing and literacy acquisition will be discussed. A brief outline of the linguistic properties of Northern Sotho and how these properties affect the literacy development process in relation to English will be given, considering the linguistic differences between the two languages.

3.1 Cognitive-linguistic skills

Cognitive linguistics is a contemporary school of linguistic thought which emerged in the 1970s within the field of cognitive science (Evans and Green 2006, 5; Fillmore 1975, 123; Lakoff and Thompson 1975, 295; Rosch 1975, 192) in reaction to the generative (formal) paradigm in linguistics (Evans and Green 2006, 27; Gibbs 2006, 3). Cognitive linguistics is a functional approach to language that explains language facts in terms of their relations with cognitive mechanisms (Mompean 2017, 1; Van Heerden 2008, 11). The relationship between language and cognition is assumed to be very intimate (Hilferty 2001, 1; Lakoff 1990, 40; Mathewson 2005, 4). The guiding principle is that, when using language, we use similar cognitive functions to those used for other (non-linguistic) tasks (Evans and Green 2006, 5). Given this assumption, phonology and phonological processing, like other components of language, are assumed to operate on the same underlying cognitive mechanisms that are used by other faculties of the mind (Mompean 2014, 358).

The basic tenet of Cognitive Linguistics is the assumption that natural language is a non-autonomous, non-modular cognitive faculty that draws upon other, more general, psychological processes (Hilferty 2001, 3). This is contrary to formal approaches to language, which assume that language is autonomous and that various levels of linguistic analysis (i.e. syntax, phonology, semantics, pragmatics and morphology) form independent modules (Chomsky 1986, 18; Chomsky 1988; Harris 2000, 2; Ibarretxe-Antuñano 2004, 6). Cognitive linguists acknowledge that although it may be useful to treat linguistic areas as notionally distinct (Evans and Green 2006, 28), it is more convenient to investigate how various aspects of linguistic knowledge develop from a common set of human cognitive abilities upon which they draw (Gibbs 1996, 27; Lakoff 1990, 40). A practical implication is that general cognition, and a wide range of mental faculties should be considered when investigating distinct linguistic units (Antuñano 2004, 6; Mompean 2014, 372).

Psycholinguists are also interested in how cognition influences various components of language development, including vocabulary, syntax, morphology and phonology (Harris 1999, 3). Psycholinguistics forms part of the cognitive science field, which deals mainly with language production, language processing/comprehension and language acquisition (Elgsti 2013, 1).[13] Scholars working in this field concerns themselves with how the human brain acquires language, processes it, comprehends it and gives feedback or produces language (Balamurugan and Thirunavukkarasu 2018, 110). Psycholinguistics also includes the study of language processes in individuals who are acquiring or actively using more than one language (Harley 2005, 13). The present study adopted a psycholinguistic perspective to the development of literacy, in the sense that various cognitive-linguistic skills (albeit with a focus on phonological processing skills) will be considered. This study is also interested in how Northern Sotho-English bilingual children acquire phonological processing and literacy skills, and models and theories developed in the field of psycholinguistics form the basis for understanding these processes.

3.1.1 Phonology

Phonology is the study of how speech sounds (i.e. phonemes) are organised and used in a language (Crystal 2001, 4). This includes how speech is pronounced, speech patterns, how sounds are learned (phonological development), how sounds combine together into sound clusters, which sounds can be neighbours (or not), how words consist of syllables and discrete sound units, how words rhyme, the way distinctions in sound are used to differentiate linguistic items and how the sound structure of the 'same' element varies depending on other sounds in its context (Anderson 2001, 11386; Idsardi and Monahan 2016, 141). Traditionally, phonology has often been confused with phonetics (Ladd 2011, 350), but it is now clear that phonology and phonetics represent separate domains in the study of language (Demolin 2005, 95).

[13] Language production deals with the actual motor skills involved in speech or writing and the cognitive processes involved in creating an utterance. Language comprehension encompasses various processes, including: speech perception, word recognition, syntactic processing and pragmatic knowledge. Language acquisition focuses on the processes involved in child language learning and in second language acquisition (Elgsti 2013, 1).

Phonetics focuses on physical aspects of the speech stream (i.e. acoustic, auditory and articulatory properties of speech sounds), while phonology deals with properties of the sound signal that are distinctive (van der Hulst 2016, 4). In other words, phonetics is concerned with speech production and perception, while phonology describes the way sounds are used to encode meaning in a given language (Anderson and Ewen 1987, 5).

Phonemics is a prominent component of phonology (Ratner and Gleason 2004, 1199), and is closely associated with reading development. Phonemes are the smallest units of sound that differentiate the meaning of a word (Yopp and Yopp 2000, 130) and are the building blocks that speakers use when constructing words and sentences (Wagner et al. 1999, 1). Phonemes are contrastive, changing from one to another within a word, producing either a change in meaning or a non-word (Liberman and Shankweiler 1987, 204). For example, the */p/* in *pit* may contrast *pit* from other words, such as *sit, bit,* and *kit*, which are similar in all respects except that they begin with different phonemes (Ratner and Gleason 2004, 1199). Therefore, phonology makes it possible to construct an extensive set of words from a few linguistic units, allowing the communication of a vast array of meanings (Frost 1998, 73).

Traditionally, interest in phonology has been held mostly by linguists, speech pathologists and speech scientists (Liberman and Shankweiler 1987, 204). Over the past 40 years, however, scientists from various disciplines, including cognitive and developmental psychology, psycholinguistics, education and neuroscience, also developed the same interest and discovered that phonological abilities play an important role in reading and writing (Caravolas et al. 2012, 678; Treiman 2001, 1; Wagner and Torgesen 1987). Before the concept of phonological processing is discussed, the next section briefly focuses on the development of phonological aspects of language.

3.1.2 Phonological development

Phonological knowledge entails an understanding of the sounds of a language (De Casper and Spence 1986, 133) and is considered to develop even before birth (Anderson 2001, 11386; Seef-Gabriel 2003, 293). The process of phonological development is complex and involves two fundamental components: (i) a biological component associated with speech-motor skill development for language production and (ii) a cognitive-linguistic component involved in learning the phonological system of a language (Alqattan 2015, 15). These two components are assumed to be interactive and to co-occur simultaneously in shaping the child's phonological system (Anderson 2001, 11386).

Two contrasting theoretical approaches exist pertaining to phonological development. The generative (formal) approach considers phonological processes to be a hard-wired, innate human cognitive capacity (Chomsky 1988, 4; Chomsky and Halle 1968, 4; Prince and Smolensky 2004, 2–3). The emergentist (cognitive or functional) approach, on the other hand, proposes that phonology is emergent (i.e. not innately known) (Bentin 1992, 171; Vihman and Gathercole 2008, 2, Boersma 2010, 2; Nathan 1996), meaning that phonological patterns are a result of children's interaction and experience with the language and that it varies according to the demands of communication (Bybee 1994, 285; Bybee 1999, 237; Evans and Green 2006, 134). A child is assumed to play an active role in creating his/her own phonological categories based on the incoming speech data ((Alqattan 2015, 9; Boersman 2010, 2). Given these contrasting theoretical positions, the question of 'when' and 'how' phonological processes develop forms the subject of an ongoing discussion. A conciliatory view is that children construct phonological knowledge in terms of both innate knowledge and emergent experience with language (Pandey 2004, 1).

Researchers have theorised that there are two autonomous but mutually supportive routes to learning phonology, which include implicit and explicit learning (Vihman 2001, 2-8; Vihman 2002, 240; Vihman 2017, 14). Implicit learning begins in the womb, with infants being attuned to the melodic patterns of their native language, particularly their mother's speech rhythms (Hepper et al. 1993, 147; Moon et al. 1993, 495; Saffran et al. 1996, 126) and a gradual transformation to explicit learning (i.e. attentional and conscious learning) begins during the second half of the first year (Vihman 2017, 14). This establishes the foundation from which more detailed phonological knowledge is induced (Vihman 2002, 240). Direct tuition targeting the various correspondences between phonological and orthographic units transforms implicit phonological knowledge into explicit knowledge (Gombert 1992, 35), allowing children to be able to identify and produce various phonological units (Moon et al. 1993, 495). Phonological knowledge can be understood as the successful integration and complimentary use of implicit and explicit learning mechanisms (Ellis 2005, 305; Ellis 2002, 143).

Apart from learning sounds, phonological development further entails forming phonological categories and then combining sounds to build words (Vihman 2017, 108). Phonological categories are the distinct elements that make up a phonological representation.[14] These elements include: (i) temporal organisation (e.g. syllable, foot, mora, segment) and (ii) internal content (e.g. phonemes such as /*b*/ and /*p*/, or feature values such as [+nasal] [+back], [+high] and [+round]) (Boersman 2010, 1). Representations are compositional and involve the identification of units and their combinations at various levels (i.e. words, syllables, features, phonemes) (van der Hulst 2016, 5) and may also include the associated phonetic specifications (i.e. acoustic or motoric features) of the segments as well as auditory and visual information (Shuster 1998, 941; Stackhouse and Wells 1997, 6; Walley 1993, 286). Thus, phonological knowledge involves multiple levels of understanding of the sounds of a language that develop across different timelines (Dich and Corn 2013, 213) and are contained in the phonological lexicon (Stackhouse and Wells 1997, 6). Phonological representations are considered to be holistic or segmental. Holistic representations involve the manipulation of linguistic units as whole words (Sutherland 2006, 5), while segmental representations involve the manipulation of phonological information at a syllable, onset-rime or phoneme-level (Fowler 1991, 97).

Different theories hold different views on the basic units of phonological representation (Alqattan 2015, 10). The formalist approach takes the view that the segment or phoneme forms the basis of phonological representations (Blevins 2004, 24; Chomsky and Halle 1968, 5).

[14] The term phonological representation describes the underlying sound structure of specific words stored in long-term memory (Locke 1983, 3).

Contrary, the functionalist approach sees units linked to meaning and communication (whole-word forms) as the basis of phonological representations (Pierrehumbert 2003, 115; Port 2007, 144; Vihman 2001, 24; Vihman 2002, 242; Vihman 2017, 6). Whole word representation is assumed to precede more detailed, segmental representation. According to Walley and Flege (2000, 307), when a child's vocabulary size is small, words are represented holistically and not in a detailed manner. As memory storage requirements increase with vocabulary growth, representations are gradually segmented into smaller units of sound (i.e. syllables, onset, rimes and ultimately, phonemes) and distinctive characteristics of these sounds (i.e. voicing aspect, which allows the distinction of *b* and *d* sound) are also specified (Jusczyk 1993, 3; Metsala and Walley 1998, 89; Walley 1993, 286). In a normal developmental course, the phonological aspects of representations are re-represented many times, depending on vocabulary size and linguistic factors (such as the sonority profile of the syllable and neighbourhood density) (Goswami 2000, 135). The conceptualisations that phonological development begins with knowledge of phoneme segments or with whole words holistic representations seem quite divergent (Haspelmath 2000, 235), but it is assumed that each of these accounts is at least partially correct (Swingley 2009, 3617).

It is generally assumed that children's phonological representations become adult-like when they begin to produce their first words (Smith 1973, 3; Stampe 1969, 4). As children get older, phonological representations continue to develop and improve (Sutherland and Gillon 2005, 75). However, there is a great deal of variability in children's developmental paths (Alqattan 2015, 11), and they do not all develop accurate phonological representations at the same rate or with the same precision (Swan and Goswami 1997, 18). Children tend to follow different pathways in developing their phonological system. Successful performance on tasks that require speech sounds manipulation depends on accurate phonological representations (Elbro 1996, 453; Fowler 1991, 97; Snowling 2000, 9). Any inadequacies (i.e. lack of distinctness or segmental specificity) in the phonological representations impact negatively on tasks that require access to phonological knowledge (Fowler 1991, 115; Metsala 1997, 159; Sutherland and Gillon 2005, 28; Swan and Goswami 1997, 18; Tomson and Goswami 2010, 453).

While children are born with the capacity to acquire the representations of all sounds (Kuhl et al. 1992, 608; Werker and Tees 1984, 50), research shows that language-specific developments are evident around the age of ten (de Boysson-Bardies and Vihman, 1991, 297; Levitt et al. 1992, 19; Sebastián-Gallés and Soto-Faraco 1999, 111). Based on Lenneberg's (1967) critical period hypothesis, the acquisition of new phonemes not within the child's L1 repertoire becomes difficult as the child matures (Long 1988, 40; De Keyser 2000, 501). The older the learners are when first exposed to the L2, the more difficult they will find it to acquire the non-native L2 phonological system. However, not all researchers agree on the existence of a critical period (Best 1995, 171; Flege 2003, 4; Fledge and Kuhl 2000, 11854; Kuhl 2004, 840; Schirru and MacKay 2003, 469). Those who do not subscribe to the idea of the critical period assume that difficulties in establishing the L2 phonological system rather stem from the interference produced by the established L1 phonological system (Flege 2003, 8). Some research suggests that simultaneous acquisition of L1 and L2 phonological systems may reduce interference effects (Sebastian-Gallés et al. 2005, 252).

3.2 Phonological processing

Phonological processing is defined as the use of phonological information (i.e. the sounds of one's language) in processing oral and written language (Wagner et al. 1997, 456). From the above definition, phonological processing entails a 'sensitivity to' and ability to use various aspects of the incoming speech stream and the ability to manipulate speech sounds cognitively. Phonological processing involves the representation, manipulation, short-term storage and retrieval of speech sounds (Snowling 2000, 3). All children are assumed to possess a phonological processing system responsible for processing the sounds of a language (Eide and Eide 2011, 23). Research suggests that brain regions associated with phonological processing include the superior temporal gyrus and the inferior frontal gyrus (Jasinka et al. 2016, 14; McCandliss and Noble 2003, 196; Zatorre and Belin 2001, 946). A phonological processing deficit is thought to be caused by a disruption in the processing of phonological information due to a different functional system (i.e. under-activation in the posterior regions of the brain, compensated for by overactivation in the anterior part of the brain) (Shaywitz et al. 1998, 2636).

3.2.1 The role of phonological processing skills in literacy development

This section will discuss the three main constructs that appear in the phonological processing mode, namely PA, PWM and RAN. The section will also explain the role that these constructs play in literacy development.

3.2.1.1 The construct of PA

There are multiple definitions of PA in the literature (Geudens 2006, 25; Ziegler and Goswami 2005), partly because of the varied backgrounds and interests of researchers (Cockcroft 1998, 2). Terms such as phoneme segmentation, phonemic awareness, phonological analysis, phonological perception, linguistic awareness, segmental awareness and speech perception are used interchangeably in many studies to refer to the concept of PA (Ball 1993, 150). Stanovich (2000) argues that awareness implies the idea of 'consciousness' and suggests that the term 'phonological sensitivity' should be used instead of 'awareness'. Other researchers suggest that the single term 'phonological awareness' be replaced with the terms implicit and explicit awareness[15] (Geudens 2006, 25; Hulme et al. 2002, 20). These varied definitions of PA have resulted in a lack of consensus on how to measure the construct (Bentin 1992, 171, Cockcroft 1998, 3). The construct of PA is also often confused with phonics, which is a related but distinct aspect. PA is a measurable ability that each individual possesses (to a lesser or greater extent), whereas phonics is an instructional reading method that focuses on the associations of letter sounds with printed letters or groups of letters (Phillips et al. 2008, 1).

In the present study, PA is defined as one's ability to detect, apprehend or manipulate the sounds in one's language (Anthony and Francis 2005, 255; Kennedy and Flynn 2003, 100). PA encompass a broad range of skills which include syllable awareness (i.e. realising that the word *cowboy* has two syllabic units, *cow* and *boy*), onset/rime awareness (i.e. realising the word

[15] Implicit phonological knowledge refer to the knowledge about the speech sounds of a language that is acquired accidentally while explicit phonological knowledge refers to phonological information that is acqurired intentionally (Geudens 2006 25).

brush consists of an onset /*br* /and rime /*ush/*) and phoneme awareness (i.e. realising that word *brush* has four phonemes */b/, /r/,* /u/ and */ʃ/* (Anthony et al. 2002, 67; Anthony et al. 2006, 239). PA is operationalised by tasks such as elision, blending, rhyme sensitivity, and segmental awareness (Anthony and Lonigan 2004, 43; Anthony et al. 2008, 114; Lonigan 2009, 345). Controversy exists regarding whether the different PA levels represent one cognitive ability or distinct abilities (Vandewalle et al. 2014, 1054). While some conceptualise these various linguistic units as several distinct abilities (Anthony and Francis 2005, 256; Anthony and Lonigan 2004, 44; Cisero and Royer 1995, 275; Treiman and Zukowski 1996, 193), others consider PA skills as reflecting a single cognitive ability (Stanovich 1992, 307).

PA is a multilevel construct that can be described along at least two dimensions: the level of explicitness of a task and the size of the linguistic unit being processed (Anthony et al. 2003, 470). The first dimension of explicitness refers to the depth of metalinguistic reflection needed to complete a PA task (Schaeffer et al. 2009, 405). The more explicit a PA task is, the more cognitive processing is demanded (Treiman and Zukowski 1991, 19). Complex tasks, which require more steps to complete and which places a large burden on memory, tend to be difficult compared to simple tasks (Vandewalle et al. 2014, 1054). For instance, saying sounds in isolation or blending sounds to form a syllable or manipulating sounds (i.e. adding, deleting, and substituting) and reversing of phonological units are examples of complex tasks that may call for higher cognitive structures of language processing than simpler tasks such as sound matching (Vallar and Papagno 1993, 467). The degree of difficulty in PA tasks differs depending on the type of sound manipulation involved and depending on the size and location of the unit in the word (Lopez 2012, 372). Counting words in a sentence, as well as syllable identification, segmentation, syllable blending and manipulation, are the least explicit PA operations. Generally speaking, tasks that require phoneme discrimination are more difficult than tasks requiring the discrimination of syllables or words (Lopez 2012, 372; Schaefer et al. 2009, 405).

The second dimension of PA includes the different linguistic units on which a person is able to reflect, from the syllable, through onset-rhyme to phoneme units (Anthony and Francis 2005, 256; Goswami 2006, 4; Treiman and Zukowski 1991, 19; Ziegler and Goswami 2005, 4). PA is not an innate skill and is assumed to develop gradually over time (Bentin 1992, 172; Liberman and Shankweiler 1987, 207). Performance on PA depends on the linguistic level tapped by the task (Vandewalle et al. 2014, 1054). Syllables are more accessible than onset/rhymes, which in turn are more available than phonemes. Thus, PA is assumed to follow a hierarchical developmental trajectory, from larger, implicit linguistic units to smaller, explicit, and more cognitively demanding linguistic units (Treiman and Zukowski 1991, 19).

Research studies provide support for the universal developmental sequence of PA across languages (Anthony et al. 2003, 481; Goswami 2006, 4; Ziegler and Goswami 2005, 4). Cross-linguistic transfer studies on PA also provide support for the universal principle of PA acquisition (Durgunoglu, Nagy and Hancinbhatt 1993, 391). The progression from syllable to onset/rime awareness might occur automatically and spontaneously (i.e. without explicit instruction), as a result of non-alphabetic activities such as nursery rhymes or other forms of phonological word games (Bentin 1992, 172; Seymour and Evans 1994, 221; de Gelder et al. 1993, 315; Bryant and Bradley 1985, 3). On the other hand, alphabetic instruction is necessary to develop phoneme awareness (Alcock, Ngorosho, Deus and Jukes 2010, 55; Bertelson et al. 1989, 239; Goswami 2006, 4; Treiman and Zukowski 1996, 193). For instance, Morais and colleagues have found that pre-literate children, as well as adults who are illiterate, are unaware of phonemes, although they may manipulate phonology at the syllabic and word levels. Children are likely to become explicitly aware that words are composed of letters which represent sounds during the process of literacy instruction (Bentin 1992, 173). As children experience more literacy activities, they become aware of the sound structure of words (e.g. word/syllable boundaries, vowels, clusters), which facilitates a more explicit level of PA (Stackhouse et al. 2002, 28).

The difficulty experienced by pre-literate children in segmenting words into phonemes is attributed to the abstract nature of the phoneme (Ball 1993, 150). According to Liberman and Shankweiler (1991, 9), due to the automaticity in speech processes, people are not consciously aware of phonemes in words but are instead focused on word meaning. However, Ball (1993, 150) argues that even if conscious attention is paid to phonemes, these units are hard to separate from the speech stream because they do not correspond to articulatory units in a similar way to syllables. Fowler (1991, 99) suggests that the inability to manipulate phonemes is not due to a lack of conscious awareness of these units, but that phoneme manipulation is dependent on the maturation of the phonological system. Adequate development of phoneme manipulation skills thus seems to be dependent on adequate development of the phonological system and adequate development of literacy skills.

The questions of 'how' and 'when' PA skill appears is a subject of much controversy (Bentin 1992, 172). Several studies provide support for language-specific differences in PA development (Anthony et al. 2003, 471; Goswami 2010, 9). Some studies have shown that phonemes may appear prior to literacy in some cases, depending on the phonological structure and orthographic consistency of the language (Goswami 2010, 32; Ziegler and Goswami 2006, 452). Phoneme awareness tends to develop more quickly in a transparent language than in a less transparent language (Caravolas and Bruck 1993, 26). Orthographic and phonological differences may result in language-specific differences in the development of PA skills across languages.

One potentially important language-specific dimension at the level of PA is syllable saliency (Aidinis and Nunes 2001, 147). Children in a linguistic environment where syllables are highly salient develop an awareness of this skill earlier than children in a linguistic environment where these units are less salient (Anthony and Francis 2005, 256). For example, in languages (i.e. Greek and Italian) with simple syllabic structures (i.e. CV structure, limited vowel repertoires, few consonant clusters and better-marked syllable boundaries), children develop an awareness of syllables more quickly than children in languages (i.e. English) with complex syllable structures (Aidinis and Nunes 2001, 147; Durgunoglu and Oney 1999 282; Schaefer et al. 2004. 407). Syllable saliency causes variations in PA development across languages.

Developmental patterns of PA are also influenced by sonority profile and phonological neighbourhood density (Goswami 2010, 26). Sonority profile refers to the types of sounds in words (Goswami 2010, 26). Vowels are the most sonorant sounds followed in a decreasing order by glides (e.g. */w/),* liquids (e.g. */ɹ/* and */l/),* nasals (e.g. */n/* and */m/)* and lastly obstruents or plosives (e.g. */p/,* and */f/)* (Anthony and Francis 2005, 257). Sonority profile affects children's ability to segment syllables into smaller units (De Cara, Goswami and Fayol 2001). For example, it should be more difficult to separate sonorant consonant phonemes, like */l/,* from vowels than to separate obstruent phonemes like */t/* (e.g. it should be more difficult to separate *ill* than *it*) (Goswami 2010, 33). Languages vary in sonority profiles, which influence phonological representations across languages (Berent, Harder and Lennertz 2012, 2). For example, sonority profiles are similar for English and German syllables but different for English and French. These similarities and dissimilarities between languages affect the cross-linguistic transfer of PA and the acquisition of literacy (Goswami 2010, 33).

Phonological neighbours are words that sound similar to each other, usually because they differ only by one phoneme (Goswami 2010, 26). For example, the neighbours of the target word *ram* include *ramp, am* and *rim* (Goswami 2010, 26). The English words *bright, kite,* and *height* are also considered phonological neighbours because they rhyme the same (Anthony and Francis 2005, 257). The neighbourhood is considered to be dense; if many words resemble the target and is considered sparse, if few words resemble the target (Goswami 2010, 26). Studies have shown that children develop better PA of words in dense than sparse neighbourhoods (De Cara and Goswami 2003, 416). Phonological neighbourhood density is a syllable level language factor that may be similar for some languages and different for others (Thomson et al. 2005, 1210). This feature also affects PA development across languages.

Some have argued that the method of instruction used to foster literacy skills may also influence the developmental patterns of PA across languages (Ziegler and Goswami 2005, 14). Treiman (1992) suggests that instructional emphasis (i.e. whole word or phonics) may determine the developmental stages of PA skill. For instance, some researchers found that first-grade children taught via a phonics approach performed better on PA tasks than children taught via a whole-word approach (Alegria, Pignot and Morals 1982, 451; Vellutino 1991, 61). Thus, either the orthography or the instructional method, or a combination of both, may determine PA development (Cockcroft 1998, 22).

3.2.1.2 PA and literacy development

In alphabetic languages, children need to develop PA awareness in order to make sense of the alphabetic script, which underlies reading, writing and spelling (Stackhouse et al. 2002, 28). For instance, when spelling a new word, children have to segment a word before combining the appropriate letters together, and when reading an unfamiliar word, they have to decode the printed letters into segments before blending them together to form a word (Stackhouse et al. 2002, 28). Thus, a child has to be aware of the sound system of a language in literacy acquisition. If a child is unable to process speech sounds, then the child will have difficulties forming accurate letter-sound correspondences (Buckley, Bird and Byrne 1996, 119), which is a key requirement in literacy acquisition.

Research evidence shows that PA is a crucial predictor of reading acquisition (Antony and Lonigan 2004, 43; Bradley and Bryant 1983, 301; Castles and Coltheart 2004, 78; Catts et al. 2002, 509); spelling acquisition (Aidinis and Nunes 2001, 145; Ehri 2005, 167; Leong et al. 2005, 591; Moats 2005, 17; Rubba 2004, 1; Treiman 2006, 581) and writing acquisition (Blair and Savage 2006, 991; Both-de Vries and Bus 2008, 183; Caravolas, Volin and Hulme 2005, 107; Erdoğan 2011, 1508). Phoneme segmentation has emerged as one of the best predictors of literacy abilities in children during the earlier stages of literacy acquisition (Bryant et al. 1990, 429; Muter et al. 1997, 370; Nation and Hulme 1997, 154). However, due to the abstract nature of the phoneme, many children struggle with phoneme manipulation, and about 20% of children do not develop phoneme awareness at all without direct instruction or special intervention (Troia, Roth and Graham 1998, 8).

There is an ongoing debate in the literature about the nature of the relationships between PA and literacy skills. The question is whether PA is a prerequisite or consequence of successful literacy development (Castles and Coltheart 2004, 78; Goswami and Bryant 1990, 4; Hulme et al. 2005, 362). Some studies reveal that the relationship between PA and literacy acquisition is causal (Nation and Hulme 1997, 154; Hulme et al. 2005, 362). But many researchers have established that the association between PA and literacy development (reading, spelling and writing) is reciprocal (Alcock et al. 2010; Burgess and Lonigan 1998, 117; Ehri 2005, 165; Martins and Silva 2003, 14; Stackhouse, Wells, Pascoe and Rees 2002, 28). PA tasks facilitate literacy development, while in turn, performance on PA tasks may depend on literacy experience. An awareness of large phonological units of words (i.e. syllable and onset/rime awareness) develops spontaneously and is a precondition for literacy acquisition (Mann and Liberman 1984, 592; Stanovich et al. 1984, 175; Vellutino and Scanlon 1987, 321; Wagner and Torgesen 1987, 192) while awareness of small linguistic units (i.e. phonemes) is more likely to be a consequence of literacy instruction (Morais et al. 1986, 45; Morais et al. 1987, 347; Wagner et al. 1994, 85; Wimmer, Landel, Linortner and Hummer 1991, 668).

The association between PA abilities and literacy achievement also depends on the learners' levels of linguistic proficiency and literacy acquisition phase (de Jong and van der Leij 1999, 450). PA appears to be more influential in literacy development during the first few years of formal schooling when children learn to read, spell and write (Anthony et al. 2006, 242; Lopez 2012, 375; Vandewalle et al. 2014, 1053). Early PA difficulties negatively impact the development of subsequent literacy skills (Vandewalle et al. 2014, 1053). For instance, difficulties in PA can manifest in word decoding problems, thereby hindering the process of reading new and unfamiliar words (Yeong, Fletcher and Bayliss 2014, 1108). Research has proven that specific intervention can improve PA skills (Elbro and Petersen 2004, 660; Laing and Espeland 2005, 65) and subsequent literacy abilities, particularly word recognition and spelling skills (Bradley and Brant 1993, 419; Tangel and Blachman 1995, 153; Vellutino and Scanlon 1987, 321). However, some studies found that although PA training improved children's PA skills, there was no carryover to literacy performance (Hatcher, Hulme and Ellis 1994, 4).

Research studies focused on PA training suggest that PA training coupled with explicit literacy instruction will significantly promote literacy development (Hatcher and Hulme 1999, 130; Hatcher et al. 1994, 41; Torgesen and Davis 1996 19). Phonological training coupled with alphabetic training has also been found to be effective in improving certain literacy difficulties (Bradley and Bryant 1983, 419; Hatcher et al. 1994, 42). In addition, Stackhouse et al. (2002, 29) suggest that the underlying speech processing skills (i.e. auditory, articulatory and orthographic skills) necessary for PA development must be specifically targeted to yield effective results in PA training programmes. Difficulties in the speech processing system may lead to speech difficulties and problematic PA development, which ultimately affects literacy performance (Stackhouse and Wells 1997, 378).

3.2.1.3 The construct of PWM

PWM refers to the coding of information in a sound-based representation system for temporary storage (Anthony et al. 2006, 240; Baddeley 1986, 2). PWM is responsible for the ongoing processing and temporal storage of phonological information. The PWM system can hold onto phonemes and words in speech until they need to be recalled or integrated into meaningful ideas (Logie and Cowan 2015, 315). For instance, children who are attempting to sound out (decode) a printed word with which they are unfamiliar often rehearse the sounds associated with the letters, either overtly or covertly. Once they reach the end of the word, they must recall all of the sounds which they have stored temporarily in their PWM (Preston 2008, 29). The information in the PWM system can be contrasted with information in one's long-term memory system[16], most of which can be retrieved only when the right cues emerge (Logie and Cowan 2015, 315). Functional magnetic resonance imaging studies indicate that the prefrontal region, anterior cingulate and the superior parietal lobule are some of the areas activated during PWM performance (Kharitonova, Martin, Gabrieli and Sheridan 2013, 61; Schulze, Zysset, Mueller, Friederici and Koelsch 2011, 781).

One of the influential models of PWM in the field of cognitive science was developed by Baddeley and colleagues (Gathercole and Baddeley 1993). The model undertakes that the working memory mechanism consists of three subcomponents, including the 'phonological loop' (i.e. PWM or short-term phonological memory), the 'central executive system' and the 'visuospatial sketchpad' (Gathercole 1998, 1). Of these systems, the phonological loop is relevant to the present study. The phonological loop is believed to occupy the left temporoparietal brain region (Baddeley 2003, 831) and has two subcomponents: the short-term phonological store and the articulatory control process (Baddeley and Hitch 1974, 48). The phonological store is the storage location for activated material and is assumed to have approximately a two seconds decay time (Gathercole and Baddeley 1990, 337) and as such phonological material can only be stored for a short period before it is forgotten. The articulatory rehearsal system compensates for this shortfall through constant rehearsal and refreshing, to keep information in an activated, accessible mode (Baddeley 2000, 3; Cowan

[16]Long term memory is a long term system where information is stored in the entire course of life and it persists such that it can be retrieve any time (Cowan 2008, 4).

1992, 668; Logie 1995). Information is assumed to enter the phonological loop system through two main paths: the direct path whereby auditory input is granted direct access into the phonological store, and the indirect path (i.e. visual input), where information is accessed indirectly through the rehearsal system (Baddeley 2000, 5; Gathercole 1998, 1).

A more recent working memory model, the Serial Order in a Box-Complex Span model, rejects the idea of a rehearsal system, arguing that information in working memory can be maintained effectively by actively removing distractors instead of strengthening memory traces (Oberauer, Lewandowsky, Farrell, Jarrold and Greaves 2012, 779). In other words, memory traces do not suffer from decay. Hence, there would be no need for a rehearsal mechanism. The rehearsal system is assumed to serve as a mere epiphenomenon without any causal role in maintenance (Lewandowsky and Oberauer 2012, 3). However, some researchers still maintain that working memory performance needs a rehearsal mechanism (Lucidi, Langerock, Hoareau, Lemaire, Camos and Barrouillet 2016, 198).

An individual's PWM capability is often operationalised by auditory span measures such as digit span and NWR tasks (Anthony et al. 2006, 240). NWR is assumed to provide a more profound estimate of PWM compared to digit span (Gathercole, Willis, Baddeley and Emslie 1994, 104) because NWR tasks are assumed to reduce long-term memory and lexical knowledge influence (Gathercole 1999, 415; Ibertsson et al. 2008, 10). In other words, NWR assesses the encoding, storage and retrieval of novel phonological information, independent of prior stored lexical knowledge (Flagge 2016, 1211; Gathercole 1995, 83). Contrary evidence suggests that long term phonological, lexical and semantic knowledge mediate the NWR performance since listeners can rely on the memory of similar strings or real words that are similar to non-words (Acheson et al. 2010, 17; Kornacki 2011, 19; Freedman and Martin 2001, 193; Gathercole and Adams 1994, 674; Hulme et al. 1997; 1219; Meltzer et al. 2016, 318; Miettinen 2012, 162; Shivde and Anderson 2011, 1342). Some studies have also indicated that NWR is less valid when conducted in the L2 (Engel et al. 2012, 640; Masoura and Gathercole 2005, 385) and that the NWR task alone may not accurately reflect the nature of PWM in children older than five years (Bowey 2001, 441; Metsala 1997, 159; Vandewalle et al. 2014, 1056).

Research evidence suggests that PWM performance is influenced by knowledge stored in long-term memory, such as semantic and lexical knowledge (Schweickert 1993, 168). For example, children tend to recall words better than non-words (Besner and Davelaar 1982, 701; Hulme, Maughan and Brown 1991, 698), words that frequently occur are recalled better than less frequent ones (Hulme et al. 1997, 1217), and words that are concrete are remembered better than abstract words (Romani, McAlpine and Martin 2008, 292; Walker and Hulme 1999, 1256). This can be explained by the fact that, although phonological representation stored in the PWM may decay overtime; long-term lexical/semantic representations can compensate by reconstructing the short-term representations (Hulme et al. 1991, 1217; Schweickert 1993, 168) or through ongoing interactions between short and long-term memory (Jefferies Frankish and Lambon-Ralph 2006, 81; Patterson, Graham and Hodges 1994, 57). In addition, phonotactic information also contributes to short-term phonological retention (Tanida, Ueno, Lambon

Ralph and Saito 2015, 501). Words that are phonologically dissimilar are recalled better than similar words (Baddeley 1966, 362; Conrad and Hull 1964, 429), non-words which consist of frequently occurring phoneme combinations are remembered more accurately than those with less frequent combinations (Gathercole et al. 1999, 84; Thorn, Gathercole and Frankish 2005, 133), and words that have a short duration span are recalled better than a word with a long duration (Baddeley, Thomson, and Buchanan 1975, 575).

3.2.1.4 PWM and literacy development

PWM is associated with literacy acquisition, including reading (Brady 1991, 9; Wagner and Torgesen 1987, 197), spelling (Griffiths and Snowling 2002, 34; Rohl and Pratt 1995, 327; Yeong et al. 2014, 1107) and writing acquisition (Gathercole and Pickering 2000, 377; McCutchen 2000, 13; Oakhill and Kyler 2000, 161; Olive 2004, 32; Swanson and Berninger 1996, 358). The working memory system provides a temporary memory register for storing transient information in the process of performing reading, spelling and writing operations (McCutchen 2000, 13). For example, while writers are transcribing a sentence, they may need to keep in mind an idea that they just thought about or to memorise a long sentence temporarily while beginning to write it down (Olive 2011, 485).

Studies have shown that PWM plays a critical role in spelling and writing accuracy (Rohl and Pratt 1995, 327; Swanson and Berninger 1996, 358). With regards to reading acquisition, PWM is thought to play a more important role in word decoding (Gathercole et al. 1991, 349; Kibby 2009, 485) than in fluency (Puolakanaho et al. 2008, 353) or comprehension (Kibby and Cohen 2008, 525). An efficient phonological memory system allows children to maintain an accurate representation of the phonemes associated with the letters of a word during the literacy acquisition processes (Lonigan et al. 2009, 345). There is little evidence, however, that PWM explains unique variance in word decoding beyond that provided by PA (Wagner et al. 1997, 468).

Poor PWM is associated with a weak phonological store (Holmes and Gathercole 2014, 440). Research indicates that children with literacy difficulties have difficulties on tasks requiring the short-term retention of ordered information, which signals an inefficient phonological rehearsal processing (Sandberg 2001, 11; Thorn and Gathercole 1999, 303; Thorn, Gathercole and Frankish 2002, 1363). Thus, if a child has processing deficits associated with the phonological system, he/she might be unable to store phonological information temporarily as well as establishing more permanent memory presentations (Baddeley, Gathercole and Papagno 1998, 158; Chiappe, Siegel and Wade-Woolley 2002, 369). Children with relatively poor phonological memory are likely to be less successful in learning the sound structure of new words (Chiappe and Siegel 2006, 135; Lesaux and Siegel 2003, 1005).

Research indicates that PWM training leads to improved literacy skills (Looslie, Buschkuehl, Perrig and Jaeggi 2011, 15) and overall academic performance (Holmes and Gathercole 2014, 440; Studer-Luethi, Bauer and Perrig 2016, 171). It should be noted though, that for such training to be effective, learners have to have sufficient self-regulative abilities (i.e. controlled attention, goal setting and goal monitoring) and emotional stability (Studer-Luethi et al. 2016, 171). On the other hand, some studies have failed to find any significant gains in children's literacy skills (National Early Literacy Panel 2009, 7) and academic performance (Dunning et al. 2009, 106) following working memory training.

3.2.1.5 The construct of RAN

RAN is an indication of the automaticity or efficiency with which phonological codes are retrieved from memory (Anthony et al. 2006, 240; Pennington, Cardoso-Martins, Green and Lefly 2001). Some suggest that RAN reflects the automisation and efficient access to visual-verbal associations (Moll et al. 2009, 23; Willburger, Fussenegger, Moll, Wood and Landerl 2008, 224). Many definitions of RAN are overlapping, and many of them reflect on phonological and orthographic processing (Heikkilä 2015, 11). Research evidence suggests that left-hemispheric areas, including the left inferior and posterior frontal gyrus and inferior occipital areas, are involved in RAN performance (Lervåg and Hulme 2009, 1046; Misra, Katzir, Wolf and Poldrack 2004, 241).

There is no clear consensus among researchers on what precisely constitutes RAN. Some researchers have linked RAN to a more general cognitive skill, suggesting that RAN is a measure of general processing speed or general automatisation (Kail, Hall and Caskey 1999, 303; Nicolson and Fawcett 1990, 159). Therefore, RAN has both been conceptualised as a linguistic skill (Torgesen et al. 1997, 161) and/or as a more general cognitive skill (Heikkilä 2015, 11). Denckla and Cutting (1999) suggest that RAN is associated with both the language domain and the processing speed domain (executive domain). It is generally agreed that many connected and partly overlapping processes affect naming speed (Heikkilä 2015, 12).

The process of RAN involves (a) attention to the stimuli, (b) visual processes responsible for identifying the target, (c) the integration of visual stimuli with phonological and orthographic representations in long-term memory, (d) lexical processes, which involves accessing and retrieval of phonological labels, (e) integration of semantic and conceptual information and (f) organisation of articulatory output (Wolf and Bowers 1999, 418). Rapid processing mechanisms are needed in the integration of these sub-processes to make the process efficient (Wolf and Bowers 1999, 418). Attentional processes such as inhibition are critical for serial processing, whereby previous and upcoming responses are suppressed while the current response is planned (Arnell, Joanisse, Klein, Busseri and Tannock 2009, 173). RAN is, therefore, a multicomponent skill (Bowers and Ishaik 2003, 142; Liu and Georgiou 2017, 465; Wolf et al. 2000, 388), and no single cognitive perspective view of RAN can fully capture the nature of the construct (Heikkilä 2015, 12).

RAN comprises of alphanumeric (i.e. number, letter) and non-alphanumeric (i.e. colour, object) RAN (Willburger et al. 2008, 225). RAN is typically operationalised by tasks in which individuals verbally identify common objects, letters, colours or numbers as quickly as possible (Anthony et al. 2006, 240; Anthony et al. 2008, 113; Preston 2008, 32). Children recall non-alphanumeric stimuli faster than alphanumeric stimuli before formal schooling (Braisby and Dockrell 1999, 23). After some formal instruction, when learners are acquainted with letters and numbers, alphanumeric stimuli are recalled faster than non-alphanumeric stimuli (Cronin and Carver 1998, 447), possibly due to increased exposure or semantic priming (Reynvoet, Brysbaert and Fias 2002, 1127). Studies suggest that the processing of non-alphanumeric stimuli requires more efficient semantic and perceptual processing than alphanumeric stimuli (Braisby and Dockrell 1999, 23; Moore and Price 1999, 943). Findings from functional imaging studies suggest that different brain activation patterns exist for alphanumeric and non-alphanumeric RAN tasks (Cummine et al. 2014, 157). Areas such as the precuneus, supramarginal gyrus, nucleus accumbens and thalamus are activated during alphanumeric RAN (Waber, Wolff, Forbes and Weiler 2000, 251), while the only region unique to non-alphanumeric RAN is the bilateral fusiform, which is associated with object processing (Cummine et al. 2014, 157).

3.2.1.6 RAN and literacy development

Research suggests that there is a significant relationship between RAN and various aspects of literacy, including reading (Kirby, Parilla and Pfeiffer 2003, 453; Schatschneider et al. 2004, 265; Wimmer et al. 2000, 668), writing (Landgref et al. 2012, 129) and spelling skills (Georgiou et al. 2012, 321; Savage et al. 2005, 12; Savage, Pillay and Melidona 2008, 235; Torppa Georgiou, Salmi, Eklund and Lyytinen 2012, 287; Wimmer et al. 2000, 668). The ability to access lexical information efficiently allows easy retrieval of phonological information associated with letters and words (Lonigan et al. 2009, 346), which is key for effective literacy acquisition.

Studies reveal that RAN contributes significantly to word spelling and writing accuracy (Berninger 1996, 129; Savage et al. 2008, 235; Stainthorp, Powell and Stuart 2013, 377). RAN also appear to be significant independent predictors of word-decoding skills (Lonigan et al. 2009, 346), but it is not clear how the cognitive processes underlying RAN affect reading processes (Park 2008, 43). Several studies suggest that alphanumeric RAN is more related to decoding compared to non-alphanumeric stimuli (Georgiou and Parrila 2013, 169; Kirby, Georgiou, Martinussen and Parrila 2010, 341). Non-alphanumeric RAN, in contrast, is more related to general processing speed (Catts et al. 2002, 509), reading comprehension (Badian 1997, 69), attention and executive functions (Stringer, Toplak, and Stanovich 2004, 891). Some studies reveal that the RAN-reading relationship seems weak among young readers (Vaessen, Bertrand, Tóth, Csépe, Faísca and Reis 2010, 827; Zeigler, Pech-Georgel, Dufau and Grainger 2010, 8) and that RAN is more important for fluent reading and reading comprehension (van den Bos, Ruijssenaars and Spelberg 2008, 325). Researchers generally agree that RAN is a more robust predictor of fluent reading (Georgiou and Parrila 2013, 169; Kirby et al. 2012, 427; Parrila 2010, 341).

Non-alphanumeric RAN skills (before the onset of literacy instruction) has been found to be a reliable indicator of later literacy skills and literacy difficulties (De Jong and van der Leij 2003, 22; Lervåg and Hulme 2009, 1040; Schatschneider et al. 2004, 265). After the onset of literacy instruction, alphanumeric stimuli relate more strongly with literacy abilities than non-alphanumeric RAN (Lervåg and Hulme 2009, 1040). In addition, an orthographic-based explanation supports a greater association between alphanumeric RAN and literacy compared to non-alphanumeric RAN because letters and digits carry more orthographic information than objects and colours (Araújo, Faísca, Petersson and Reis 2011, 225). Slow performance on RAN tasks is due to poorly unspecified phonological representations (Kirby et al. 2003, 453; Stringer et al. 2004, 891) or general underlying impairments with respect to the processing of information presented rapidly (Wolf and Bowers 1999, 435). Studies have shown that RAN training is unlikely to benefit children's future literacy skills (National Early Literacy Panel 2009, 7) – it seems to be more the case that RAN skills improve as general cognition and speed of processing become more mature.

3.3 Theoretical approaches to phonological processing

There are three theoretical approaches that explain the phonological processing system and deficits that interfere with the functioning of the system, namely the phonological processing theory, the core phonological deficit theory and the double deficit theory. Given the centrality of the phonological processing system in literacy development, these approaches not only provide an understanding of the construct, but also explain its importance in the development of literacy skills.

3.3.1 Phonological processing theory

Wagner and colleagues (Wagner and Torgesen 1987; Wagner et al. 1999) proposed a framework of phonological processing that encompasses three related but distinct skills, namely PA, PWM and RAN. The basic claim of the phonological processing theory is that all writing systems are phonological in nature and that their primary aim is to convey phonological structures (Frost 1998, 89; Mattingly 1992, 11). Children are assumed to bring to the literacy acquisition task considerable knowledge of the phonological structure, derived from experience with spoken language (Ham and Seidenberg 1999, 2). This knowledge is crucial as it affects the phonological representation of words and the linguistic grain size that is more accessible for literacy acquisition in a particular language (Goswami 1999, 51). For example, while the syllable is a more prominent unit in French, phonemes are more prominent in English (Cutler, Mehler, Norris and Segui 1986, 385). From the perspective of a phonological model, phonological representations are necessary attributes that facilitate the processing of printed words (Bradley and Bryant 1983, 419; Mann 1984, 117). Children need to store the phonological representations of words in a detailed and well-specified manner (Thomson and Goswami 2010, 453) to facilitate the learning of letter-sound associations, which is an important step in early literacy acquisition (Goswami 2000, 4).

The phonological theory assumes that phonological processing is mandatory or automatic (Frost 1998, 76) for the literacy acquisition process. The framework is supported by a number of studies which indicate that PA, PWM, and RAN skills all play a role in initial and subsequent reading acquisition (Anthony et al. 2006, 239; Anthony et al. 2008, 113; Catts and Kamhi 1987, 67). Both beginning and skilled readers rely on phonological information in word identification (Jared, Levy and Rayner 1999, 219; Jared and Seidenberg 1991, 358; Perfetti and Bell 1991, 473; Seidenberg and McClelland 1989, 523) and reading comprehension development (Pollatsek, Lesch, Morris and Rayner 1992, 148). Some studies show that phonological processing skills are also crucial for learning to write and spell (Byrne 1998, 32; Stuart and Masterson 1992, 168).

Several longitudinal studies suggest a causal link between phonological processing and later progress in literacy acquisition (Bradley and Bryant 1983, 419; de Jong and van der Leij 1999, 450; Mann 1984, 117; Olson et al. 1989, 339; Wagner et al. 1997, 468). Some studies provide evidence that phonemic representations are altered by alphabetic knowledge (Morais et al. 1986, 4; Morais et al. 1979, 323; Morais et al. 1987, 347), suggesting that the relation between phonological processing and literacy is probably reciprocal (Perfetti et al. 1987, 283; Wagner et al. 1994, 73; Ziegler and Goswami 2005, 131). Though phonological processing knowledge facilitates literacy acquisition (Caravolas and Bruck 1993, 26; Durgunoglu and Öney 1999, 281), literacy knowledge further promotes phonological processing growth (Hulslander et al. 2010, 111; Perfetti et al. 1987, 283; Rayner et al. 2001, 31; Yeong et al. 2014, 1108).

The findings regarding the long-term effect of phonological processing on literacy abilities remain inconclusive (Yeong et al. 2014, 1108). Some researchers argue that phonological processing changes with reading skill such that it becomes even more important with increasing age and reading expertise. This would imply that both beginning readers and skilled readers rely on phonological processing to a certain extent (Blythe et al. 2015, 1244; Booth, Perfetti, and MacWhinney 1999, 4; Chace, Rayner and Well 2005, 209; Jared et al. 1999, 219; Perfetti and Hart 2002, 68; Stuart and Masterson 1992, 168; van Orden 1987, 181; van Orden et al. 1988, 371). Others suggest that the impact of phonological processing skills may be time-limited, as their influence has been found to decrease over time in some cases (de Jong and van der Leij 1999, 450; de Jong and van der Leij 2002, 51). For instance, Roman, Kirby, Parrila, Wade-Woolley and Deacon (2009, 96) found that older children (age nine years) shifted from using phonological skills to using orthographic skills when reading real words. This is consistent with Ehri's phase reading model, which suggests a shift from phonological to orthographic skills usage in the course of literacy development (Ehri 2005). The emergence of orthographic knowledge may replace phonological processing skills usage in literacy acquisition (Scarborough, Ehri, Olson and Fowler 1998, 115). Some studies have shown that phonological processing skills may contribute to constructing the orthographic lexicon (Share 1999, 97; Sprenger-Charolles et al. 1998b, 134; Rack et al. 1994, 42).

An alternative view is that phonological activation occurs more slowly than orthographic activation, in fact so much slower that the impact of phonological processing is delayed or even completely absent in word identification (Seidenberg and McClleland 1989, 523; Waters et al. 1984, 293). This suggests a far less prominent role for phonological processing skills in early literacy acquisition. A more accommodating argument is that children develop and use both phonological processing and orthographic knowledge in parallel (McClelland and Rumelhart 1981, 371; Ziegler and Goswami 2005, 4). Given the mixed results, it remains unresolved as to how phonological processing skills influence literacy outcomes over time as children get older and become more proficient in reading (Yeong et al. 2014, 1108).

This study seeks to investigate the interrelationship between phonological processing skills (PA, PWM and RAN) as well as the association between phonological processing and literacy abilities (letter knowledge, reading, spelling and writing) in Northern Sotho-English bilingual learners. No prior longitudinal study has investigated these relationships in-depth in this specific learner population in South Africa. Figure 3.1. below is a conceptualisation of the various relationships that this study hopes to shed some light on – the diagram is based on available evidence from cross-sectional studies with Northern Sotho-English learners (Makaure, 2016; Wilsenach, 2013; Wilsenach, 2019) and on our current understanding of the relationships that exist between these variables in other languages.

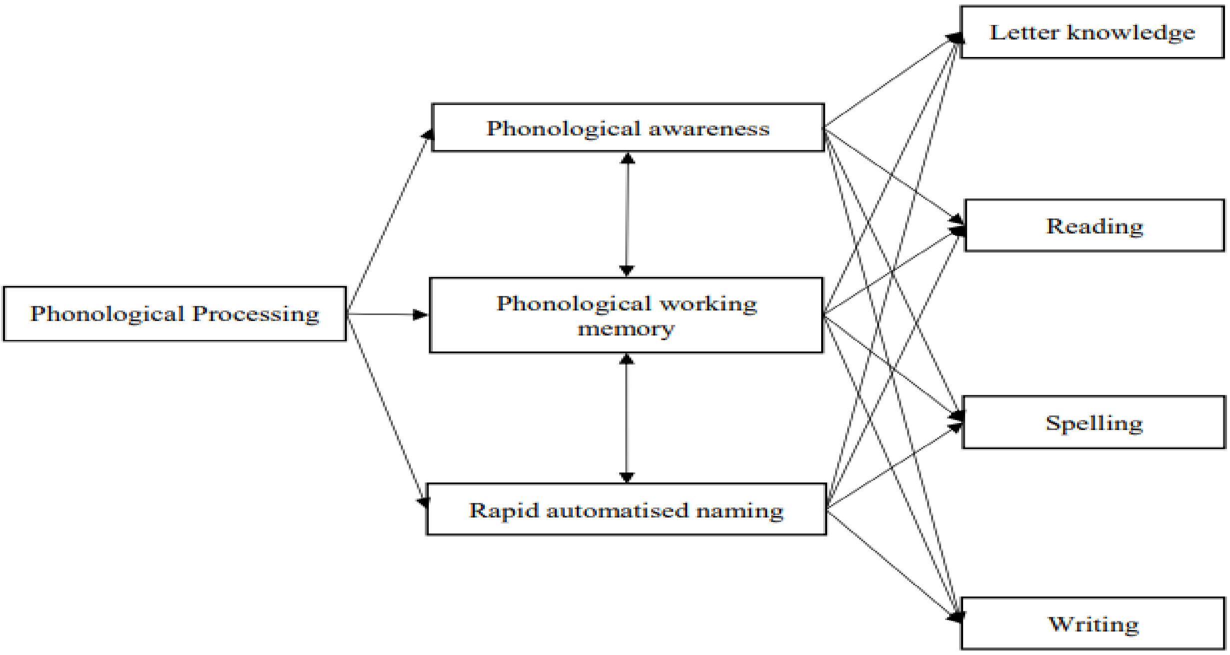

Figure 3.1 The relationship between phonological processing and literacy

An investigation of the relationships between the various phonological and literacy skills is crucial for developing a better understanding of the role that phonological processing plays in literacy development in Northern Sotho-English emergent bilingual children. Vocabulary knowledge (i.e. knowledge of the meanings of individual words) is fundamental for the development of some phonological processing (e.g. PA) skills (Dillon, de Jong and Pisoni 2012; Phillips et al. 2008) and subsequent literacy skills (Quinn, Wagner, Petscher and Lopez 2015; Wilsenach 2015). For instance, some studies suggest that the larger a child's vocabulary becomes, the more likely a child is to cognitively grasp the concept that words are made up of sound components, which is a key insight needed for PA growth (Metsala and Walley 1998). Hence, children need adequate development of vocabulary knowledge for sufficient phonological knowledge acquisition, which will ultimately impact their literacy development. This study will also investigate the contribution of vocabulary knowledge to literacy acquisition in Northern Sotho-English bilingual children.

3.3.2 Phonological core deficit theory

The phonological core deficit theory assumes that literacy difficulties are caused by a specific deficit within the phonological processing system (Stanovich and Siegel 1994, 24; Vellutino and Scanlon 1987, 321) mainly due to impairments in the representation (i.e. poor specified representations) or processing of phonological information (Manis et al. 1996, 157; Snowling

2000, 23). Literacy acquisition requires a child to learn letter-sound correspondences in a particular language (Share 1995, 151), which is a critical process in early literacy acquisition. If speech sounds are poorly represented, stored or retrieved, then learning of letter-sound correspondences will be affected (Vellutino and Fletcher 2007, 362). When this is the case, literacy acquisition can become a difficult process.

A phonological processing deficit is characterised by a delay in one or more of the three phonological processes (PA, PWM and RAN) (Lonigan et al. 2009, 346; Wagner and Torgesen 1987, 192). A deficit in PA is believed to impair the mapping of written letters onto the corresponding sounds and the subject's ability to manipulate the constituent sounds of the words (Renvall 2003, 4). A PWM deficit represents a difficulty in the efficient storage of phonological information, while a RAN deficit represents a delay in the efficient (automatic) retrieval of phonological codes from memory (Stanovich and Siegel 1994, 24). The performance on PA, PWM and RAN is determined by the quality and distinctness of the underlying phonological representations (Elbro 1996, 453). When children suffer a phonological processing delay, the sound system may develop slowly, leading to speech production and auditory processing delays (Rvachew, Nowak and Cloutier 2004, 250). Research findings have provided ample support for the notion that a core phonological deficit theory (Law et al. 2014, 10; Mann 1984, 117; Thomson and Goswami 2010, 453) causes literacy difficulties, especially in a clinical population such as dyslexics and in children at risk of not developing literacy abilities, such as children in high-poverty communities. Even so, scholars have also argued that a phonological deficit cannot always explain difficulties in literacy development (Mody, Studdert-Kennedy and Brady 1997, 199; Studdert-Kennedy 2002, 11), leaving room for other underlying causes that delay literacy development. The present researcher does not dismiss the possible role of other factors but chose to specifically focus on the causative role of phonological processing in literacy delays in Northern Sotho-English children.

3.3.3 Double deficit theory

The double-deficit theory acknowledges that impaired PA seems to be a core deficit in many children with literacy difficulties but proposes that there is a second independent core deficit that explains literacy delays, indexed by RAN (Wolf and Bowers 2000, 322; Wolf et al. 2002, 43; Bowers and Ishaik 2003, 140). The double deficit theory considers RAN as an independent predictor of literacy difficulties apart from PA deficit. Children with literacy difficulties can suffer either from a phonological deficit, a naming speed deficit, or a double deficit (where both deficits are present) (Wolf and Bowers 1999, 415; Wolf et al. 2002). Reading and spelling impairments are assumed to be more severe in children with a double deficit (Heikkilä 2015, 21; Park 2008, 168; Vandewalle et al. 2004, 1055). The double deficit theory is supported by three main sets of findings (mainly from studies with dyslexics): (i) some dyslexics have RAN difficulties but with intact PA skills (Araújo et al. 2011, 199; Di Filippo et al. 2006, 141; De Luca et al. 2010, 1271); (ii) evidence for an independent association between RAN and reading competence in people with dyslexia after controlling for the impact of PA (Georgiou, Papadopoulos, Fella and Parrila 2012, 1; Georgiou, Tziraki, Manolitsis and Fella 2013, 481; Parrila, Kirby and McQuarrie 2004, 24; Poulsen et al. 2015); and (iii) evidence that RAN and other phonological processing measures are not always reliably correlated (Araújo et al. 2010, 433).

Not all available evidence supports the double deficit hypothesis (Vukovic and Siegel 2006). Experimental studies have not always provided solid evidence for the hypothesis that the double-deficit group is characterised by the most severe literacy disabilities (Georgiou and Parrila, 2013). Research testing the validity of the outlined subtypes (i.e. a phonological deficit, naming speed deficit and double deficit) has also not been consistent (Araújo et al. 2011, 204). Some studies have identified the predicted subtypes (Manis et al. 2000, 325; Papadopoulos et al. 2009, 528; Powell et al. 2007, 46), while others have cases where children have RAN deficits without affected PA skills (Badian 1997, 69; Vaessen et al. 2009, 202). Another criticism levelled against the double deficit hypothesis is that RAN may rather reflect the processing speed in the integration of phonological and orthographic information, a process also represented in PA (Heikkilä 2015, 22). This is supported by studies where timed measures of PA have accounted for part of the variance of RAN (Arnell, Raymond, Klein, Busseri and Tannock 2009, 173) and reduced the shared variance between RAN and reading (Vaessen et al. 2009, 202). However, timed phonological processing measures have not been able to outperform RAN in explaining reading speed in these studies, which provides continued support for a unique RAN-reading speed relationship (Heikkilä 2015, 22).

3.3.4 Implication of the phonological theories on literacy acquisition

The three phonological theories (phonological processing theory, phonological core deficit theory, double deficit theory) all acknowledge the role played by the phonological processing system in literacy development. The three theories agree that children incorporate knowledge from different phonological processing levels in acquiring literacy skills. The common assumption is that phonological processing is a foundational skill that children have to acquire first in order to facilitate literacy development. The three theories differ in that while the phonological processing theory and the phonological core deficit theory postulate that PA, PWM, and RAN constitute the phonological processing skills, the double deficit stipulates that RAN represents a separate processing skill to a certain extent. The three theories provide a good foundation for understanding the role that is played by phonological skills in literacy acquisition in this study.

3.4. Relationship between phonological processing skills

Research addressing the pattern of the underlying relations among PA, PWM and RAN is contradictory (Brady 1991, 1). Some scholars have indicated that phonological processing abilities represent separate but correlated/interrelated abilities (Anthony et al. 2008, 131, Vandewalle et al. 2014, 1054). For instance, some studies suggest that it is better to conceptualise PWM as a PA component rather than as an independent phonological processing skill (Brady 1991, 17; McBridge-Chang and Ho 2000, 54). Research evidence reports significant correlations between PA and PWM tasks (Brady 1986, 138; Gathercole et al. 2006, 17; Mann and Liberman 1984, 592; Wagner and Torgesen 1987, 206), indicating that PA and PWM may be tied to a common factor (Anthony et al. 2008, 131; McBride-Chang 1995, 179). In this view, PA tasks may rely heavily on the efficiency of the PWM. On the other hand, some studies failed to find significant correlations between PA and PWM measures (Alegria, Pignot and Morais 1982, 451; Mann 1984, 117) or evidence from factor analysis that they load onto a single factor (Mann and Ditunno 1990, 105). Significant correlations have also been reported between naming speed and memory span (Spring and Perry 1983, 141; Torgesen and Houck 1980, 141). An alternative view suggests that although these measures are constrained by the phonological processing system, they reflect distinct cognitive systems (Alloway et al. 2005, 424; Gathercole et al. 1991, 365; Milwidsky 2008, 94). Though all are phonological, each may represent a separate ability.

Scholars also have diverging opinions as to whether RAN should be conceptualised as a phonological processing skill, where PA, PWM and RAN are independent cognitive skills that jointly tap on phonological processing (Pennington et al. 2001; Pennington and Lefly 2001) or whether RAN should be seen as a skill independent from phonological processing. The first view subsumes RAN within the phonological processing domain, along with PA and PWM (Kibby, Lee and Dyer 2014, 6; Ramus 2014, 274; Savage, Pillay and Melidona 2007, 129; Ramus and Szenkovits 2008, 129; Vellutino et al. 2004, 2). Researchers who conceptualise RAN as a phonological process suggest that RAN tasks primarily reflect an ability to retrieve phonological representations efficiently from long term memory (Araújo et al. 2011, 203; Chiappe et al. 2002, 73; Pennington et al. 2001, 709; Schatschneider et al. 2002, 245; Park 2008, 168). Some studies provide evidence suggesting that RAN and PA load together in factor analyses (Savage et al. 2005, 25; Savage et al. 2007, 143). Studies with discrete naming paradigms also provide support for RAN as an independent phonological skill (Nation, Marshall and Snowling 2001, 241; Truman and Hennessey 2006, 361). Correlation studies also indicate RAN as a component of phonological processing (Anthony et al. 2008, 113; Barker, Sevcik, Morris and Romski 2013, 373). However, many meta-analysis studies indicate that the correlations between RAN and other phonological abilities have been modest (Swanson, Trainin, Necoechea and Hammil 2003, 407).

As mentioned in the previous paragraph, many scholars believe that although RAN shares some characteristics with phonological processing skills (Denckla and Cutting 1999, 29), these characteristics are not adequate to explain the RAN-reading relationship (Jones, Branigan, Hatzidaki and Obregón 2010, 56; Powell et al. 2007, 46). These scholars have put forth a second perspective on RAN, which assumes that RAN represents a separate cognitive skill (Wolf et al. 2000, 387; Wolf et al. 2002, 43). Existing research often indicates that RAN makes an independent contribution to reading (i.e. independent from PA and PWM contributions) (Georgiou et al. 2013, 481; Manis et al. 2000, 325; Parrila et al. 2004, 24). The fact that RAN and PA have been associated with separate reading aspects (i.e. PA is proven to have stronger associations with reading and spelling accuracy while RAN has primarily been associated with reading speed and fluency) has also been used to support the independence of RAN (Compton, DeFries and Olson 2001, 125; Pennington et al. 2001, 707; Torppa et al. 2012, 287). In addition, neuroimaging studies (Norton et al. 2014, 235) and genetic studies (Byrne et al. 2005; Naples, Chang, Katz and Grigorenko 2009, 226) suggest a separate biological basis for RAN and PA. Finally, interventions based on phonological processing have failed to improve naming speed (Regtvoort and van der Leij 2007, 35), rendering support for RAN as a unique construct.

Many researchers argue that RAN is not exclusively a phonological skill and that it requires several other skills, including executive functioning (Denckla and Cutting 1999, 29), global processing efficiency (Kail and Hall 1994, 949; Kail et al. 1999, 303), attention skill (Neuhaus, Foorman, Francis and Carlson 2001, 359) and the ability to detect and symbolise orthographic redundancy (Araújo et al. 2011, 199; Di Filippo et al. 2006, 141; Georgiou, Parrila, Kirby and Stephenson 2008, 325; Wolf and Bowers 1999, 415). This implies that although RAN contains a phonological aspect to some extent, it involves other processing mechanisms that are independent of phonology. In this study, one of the aims of the researcher is to establish the relationships between PA, PWM and RAN in Northern Sotho-English bilingual learners.

3.5 Phonological processing development in bilingual children

Bilingualism is the mastery and use of two languages (Kohnert and Bates 2002, 347). Bilinguals can be broadly classified into simultaneous or sequential bilinguals. A simultaneous bilingual is a person who develops two languages concurrently from the period of birth (Butler and Hakuta 2006, 118). A sequential bilingual acquire the L2 at a certain stage (typically after the age of three) after the L1 has developed substantially (Meisel 2004, 91). The Northern Sotho-English bilingual learners in this study could be categorised as sequential bilinguals. The children have had oral experience in Northern Sotho at home. Although English is the official business language in South Africa and the language of secondary and higher education, the children in this study will typically only be exposed to English through formal learning.

It is important to delineate between early and late sequential bilinguals. Early sequential bilingual children are introduced to their second language during the first five years of life (Kohnert and Bates 2002, 347), whilst late sequential bilinguals are introduced to their second language in late childhood or adulthood (Hemsley 2015, 4). Sequential bilinguals often have a home language that differs from the language of instruction at school (Gort 2014, 10). Hence, most bilingual learners are faced with the challenge of learning academically through the medium of the classroom (Seef –Gabriel 2003, 292), which differs from their home language. The learners in the present study could be classified as late bilinguals, as they would typically only be exposed to English in the first grade (age 6).

In terms of the development of phonological processing skills, existing research on bilingual children provides conflicting results. While some studies suggest that bilingual children follow a similar developmental trajectory to that of monolingual children in phonological development (Holm and Dodd 1999, 349), others have suggested that bilinguals' phonological development may be subtly different from that of monolinguals (Dodd et al. 1996, 137; Holm and Dodd 1999, 349; Marecka et al. 2015, 4; Vihman 2002, 244). For example, studies on Cantonese-English sequential bilingual children revealed that sequential bilinguals exhibited different phonological development patterns from monolinguals (Dodd et al. 1996, 137; Holm and Dodd 1999, 349).

The issue of whether bilingual children have one or two phonological systems has dominated the bilingual phonological development literature (Deuchar and Quay 2000, 7; Lanza 1997, 21). Although bilingual children are believed to have two separate phonological systems (Beckman and Edwards 2000, 215; Johnson and Lancaster 1998, 265; Paradis, 2001, 34; Schnitzer and Krasinski 1996, 547; Vihman 2002, 244), the two systems may not be completely autonomous, and interactions may occur (Deuchar and Clark 1996, 351; Hazan and Boulakia 1993, 17; Paradis 1997, 331; Schnitzer and Krasinski 1994, 585; Vogel 1975, 3). However, the extent to which they interact is as of yet unclear (Paradis and Genesee 1996, 23). For instance, research on bilingual children's discriminative abilities indicates that bilinguals find it difficult to make sharp phonetic contrasts between their L1 and L2 sounds (Bosch and Sebastian-Gallés 2005, 355; Bosch et al. 2000, 183; Fledge et al. 2003, 469), indicating that they cannot fully separate their L1 and L2 phonological systems. The L1 and L2 phonetic subsystems are believed to occupy a "common phonological space" (Flege 2003, 8), which makes it difficult to make sharp contrasts between sounds (Paradis 2001, 21). Native-like competence with respect to the acquisition of a second phonological system is difficult to reach (Brown 1999, 5).

Furthermore, research on bilingualism has shown that bilingual children have cognitive-linguistic (i.e. a better understanding of language structures) advantages (Galambos and Goldin-Meadow 1990, 52), which may affect the way in which bilingual children acquire an L2. Differences between their two languages presumably allow bilingual children to become more aware of language structures (Bialystok 1986, 498; Bialystok 2002, 197). Some studies suggest that bilingual children excel on tasks that require controlled attention (e.g. working memory) (Namazi and Thordardottir 2010, 597; Sanchez, Wiley, Miura, Colfesh, Ricks, Jensen and Conway 2010, 488) and have more advanced PA skills (Bruck and Genesee 1995, 307; Marinova-Todd, Zhao and Bernhardt 2010, 396; Yelland, Pollard and Mercuri 1993, 423) when compared with their monolingual peers. In this study, the researcher seeks to shed light on the developmental trajectories of Northern Sotho-English bilingual children on phonological processing and literacy abilities in both Northern Sotho and English languages.

3.5. 1 Cross-linguistic transfer of phonological and literacy abilities

Cross-linguistic transfer entails the use of linguistic knowledge from one language to leverage the learning of another language (Yang, Cooc and Sheng 2017, 1). Research studies provide evidence of cross-linguistic transfer of phonological processing (i.e. PA skills) and literacy skills from one language to another (Geva and Siegel 2000, 1; Gottardo 2002, 46; Gottardo, Siegel, Yan and Wade-Woolley 2001, 530). For instance, Lafrance and Gottardo (2005, 559) investigated the associations between phonological processing and reading in French-English bilinguals and found a relationship between PA in both L1 and L2 and reading ability in both languages. This study proves that the transfer of skills can be bidirectional such that L1 skills can benefit L2 while, in turn, L2 skills can facilitate L1 development. Research studies observed cross-linguistic transfer effect of PA and literacy abilities, between alphabetic languages (Durgunoðlu et al. 1993, 453; Gottardo et al. 2001, 530) and also between alphabetic and non-alphabetic languages such as English and Chinese (Gottardo et al. 2001, 530; Chow et al. 2005, 87). For instance, Chow et al. (2005) study found out that Chinese syllable deletion skills were able to transfer and influence English word reading abilities in Cantonese–English bilingual children. Cross-linguistic transfer effects of PA appear not to be restricted to alphabetic languages (Marinova-Todd et al. 2010, 387).

Based on the evidence of a positive transfer of phonological and literacy skills across languages (Cummins 1991, 70; Durgunoðlu 2002, 189; Durgunoðlu et al. 1993, 453) and the findings that if there are weak cognitive and language skills in L1, then there are correspondingly similar deficits in L2 (Keung and Ho 2009, 103; Aquino 2012, 3) universal models of phonological processing and literacy development have been proposed (Fox 2000, 12; Lekgoko and Winskel 2008, 58). These models include the central processing hypothesis and the linguistic interdependence hypothesis. The central processing hypothesis assumes that cognitive-linguistic skills (PA, serial naming, working memory, verbal ability and processing speed) transfer across languages (Geva 2006, 1), and they facilitate literacy acquisition in any language regardless of the orthographic differences between languages (Geva and Siegel 2000, 2). Cognitive and linguistic skills in one language are assumed to transfer and play a facilitative role in learning another language. Individuals with underdeveloped cognitive and linguistic skills are assumed to experience literacy difficulties, regardless of the language involved (Aquino 2012, 3).

Another universal framework, the linguistic interdependence hypothesis, assumes that L1 and L2 literacy abilities are mutually dependent such that L1 literacy skills transfer and inform L2 literacy acquisition (Cummins (2005, 4). This transfer is believed to occur automatically (Cummins 1991, 84) such that once a child acquires an ability in the L1, he/she does not need to relearn it in the L2 (Bernhardt and Kamil 1995, 17). The hypothesis predicts that this transfer could be bidirectional such that L2 skills can also support the acquisition of L1 skills (Cummins 2005, 4). The linguistic interdependence hypothesis predicts that adequate development of L1 is key for L1 knowledge to support L2 learning effectively. A contrary theory, the linguistic threshold hypothesis, proposes that L2 language proficiency is key for L1 skills to benefit L2 literacy acquisition effectively. According to the linguistic threshold hypothesis, a threshold level of L2 proficiency has to be reached by L2 learners before they are able to transfer L1 skills to L2 (Bosser 1991, 48). Before this threshold level is reached in the L2, L1 skills do not significantly impact on learners L2 development (Bosser 1991, 48; Clarke 1980, 120; Taillefer 1996, 475). In other words, L2 language proficiency must be developed sufficiently for L1 skills to benefit L2 acquisition.

There is also evidence of language-specific factors (i.e. orthographic depth) that facilitates phonological processing and literacy acquisition (Lafrance and Gottardo 2005, 559; Wade-Woolley and Geva 2000, 295; Wang and Geva 2003, 17). According to the script dependent hypothesis, literacy acquisition is expected to vary across languages due to orthographic differences between languages (Geva and Wade-Woolley 1998, 85). Differences in orthographic transparency influences the rate and pattern of phonological and literacy development between languages (Geva 2006, 2; Gorman 2009, 249). The more similar the two languages, the easier the transfer, while the more the dissimilarities between the two languages, the more it will be difficult the transfer skills (Gorman 2009, 249). The theory also assumes that phonological and literacy abilities progress quickly in a transparent language than in a language with less transparent orthographies (Caravolas and Bruck 1993, 25). The complexity of each orthography alters literacy development such that faster rates of acquisition are more apparent in a transparent than less transparent orthography (Veii and Everett 2005, 250). The four theories discussed in this section (linguistic interdependence hypothesis, central processing hypothesis, linguistic threshold hypothesis and script dependent hypothesis) will be considered in this study to facilitate an understanding of the nature of bilingual literacy acquisition of Northern Sotho-English bilingual children.

3.6 Northern Sotho language

Northern Sotho (Sesotho sa Leboa) is a South-Eastern Bantu language belonging to the Sotho group (Faaß 2010, 2; Fox 2000, 12; Lekgoko and Winskel 2008, 57). The Sotho group comprises of Sepedi (Northern Sotho), Tswana (Western Sotho) and Sesotho (Southern Sotho). Although the three languages share basic vocabulary and linguistic structure (i.e. they are mutually intelligible) (Nkosi, Manamela and Gasela 2012, 1; Zerbian and Barnard 2009, 361), they also have segmental, tonal, morphological and syntactic differences (Demuth 2007, 528).

Northern Sotho is one of South Africa’s official languages and is spoken by about 4,208,980 (9.1%) of the total South African population (Nkosi et al. 2012, 1; Taljard and Bosch 2006, 1; van der Merwe and le Roux 2014, 2). It is a standardised written form of about 30 dialects (which are mutually but not wholly intelligible) of the North-Eastern area of South Africa, which encompass North-East of Tshwane, parts of Gauteng, Limpopo and Mpumalanga and the very south of Botswana (Faaß 2010, 2; Madiba 2013, 23). The Sepedi dialect, which is historically one of the strongest tribes, forms the basis of standard Northern Sotho (Webb, Lepota and Ramagosi 2004, 3; Ziervogel 1988, 1).

This section will highlight some of the phonological and orthographic structural properties of Northern Sotho. So far, there have been a number of researches and publications concerning the linguistic structure of Northern Sotho in terms of grammatical (syntax) (Lourens 1991; Poulos and Louwrens 1994; Zerbian 2006) and morphosyntactic structure (Anderson and Kotze 2006; Faaß 2010; Nkosi et al. 2012; Taljard and Bosch 2006; Zerbian and Barnard 2009); semantics (Mojela 1999), as well as studies that have described the phonology aspects (Kgasago 2001; Magodie 2003; Price and Gee 1988) of Northern Sotho. However, it seems that literature on the phonological structure of Northern Sotho is still very scarce.

3.6.1 Phonemic and syllabic aspects of Northern Sotho

Northern Sotho has a simple vowel system which comprises of seven vowel phonemes represented orthographically as /*a*/ (open front unrounded), /*i* / close front unrounded, /*e*/ mid-close font unrounded, /*ê*/ semi-open front, /*o*/ mid-close back rounded, /*ô*/ mid-close back rounded, /*u*/ close back vowel (De Schryver 2007, S24-S25; Poulos 1994, 427-435; Thamaga 2012, 30). In contrast, the English vowel system is complex, with approximately 25 vowel phonemes or more (McKay 2012, 11; Seef-Gabriel 2003, 292). A Northern Sotho-English bilingual learner is thus expected to acquire at least seven vowel sounds in Northern Sotho and approximately 25 vowels in English. Similarly to English (Johnson 2010, 208), vowel clustering (where vowels can be doubled consecutively in a word) is a prominent feature in Northern Sotho (e.g. *meetse, kol*oi, *diphoofolo)* (Price and Gee 1988, 481). Doubling of vowels in Northern Sotho can occur word-initially (e.g. *eupša* 'but'), word medial (e.g. *meetse* 'water', *ineela* 'surrender') and word-final position (*koloi* 'car', *seswai* 'eight'). However, instances of vowel clustering in Northern Sotho appear not to be so frequent as is the case in the English language. Johnson (2010, 208) argues that vowel clusters impose difficulties for beginner readers, as it compromises the letter-sound correspondence decoding routine. The complex nature of vowel clustering in English might therefore pose a challenge to Northern-Sotho English bilingual children learning to read, spell and write in an L2 in this study.

Due to the tonal nature of Northern Sotho (Cole 1992, 470; Zebian and Barnard 2009, 357), vowels in Northern Sotho can be used to represent tone to mark both lexical meanings: (e.g. *bóna* 'to see' *and bona* 'they'; *lapá* 'court-yard', *lapa* 'become tired') and grammatical meaning (e.g. *re rútá* 'we teach' and *ré rúta* 'while we teach' (Demuth 2007, 530; Faaß 2010, 8; Ziervogel, Lombard and Mokgokong 1969, 134). The same word can have different meanings, depending on whether a high or low tone is employed. High tones are assumed to be specified underlyingly (i.e. have an underlying phonological representation), while low tones are inserted by default (Zerbian 2006, 44). English, on the other hand, is non-tonal (Duanmu 2004, 895). Although tonal differences in Northern Sotho's phonological structure are interesting to consider, they fall beyond the scope of the current study. Northern Sotho has a large consonant inventory in comparison to English. English has approximately 25 consonantal /*p, b, d, h, l, t, k, g, m, n, ŋ, f, v, θ, ð, s, z, ʃ, ʒ, ʧ, ʤ, w, r, j*/ phonemes (Musk 2005, 2), while Northern Sotho has approximately 38 consonant sounds which include /*p, b, d, g, t, k, f, m, n, l, r, h, ŋ, j, s, w, y, ph, fs, ps, psh, fš, bj, pš, pšh, th, tl, tlh, hl, ts, tsh, š, tš, tšh, ny, kh, ng, kg/* (De Schryver 2007, S24-S25; Poulos 1994, 435;). The consonants in Northern Sotho are considered to be both rich and complex as several of the consonants are orthographically spelt with more than one letter (Nkosi et al. 2012, 3). There are as many as 18 single letter combinations, 15 two-letter combinations and four three-letter combinations in Northern Sotho.

Although there is some disagreement on the existence of consonant clusters/blends (i.e. a series of consonants in a word) in Bantu languages (Cole 1992, 472; Demuth 2007, 553; Naidoo et al. 2005, 63), consonant clusters are a prominent feature in Northern Sotho (Makaure 2016, 83; Price and Gee 1988, 430;). Consonants diagraphs (e.g. *sk, hl,*) trigraphs (e.g. *kgw, pšh*), quadgraphs (e.g. *tšhw mpšh*) and pentagraphs (e.g. *ntšhw*) combinations exist in Northern Sotho. However, they are not so frequent relative to English which has approximately 166 consonant clusters appearing in word-initial, middle and final positions (Gregova 2010, 80-81). The table below lists the consonant inventory of Northern Sotho in terms of the manner of production and place of articulation based on the information taken from Poulos (1994).

Table 3.1 Classification of Northern Sotho consonants

Manner of articulation		Place of articulation							
		Labial			Alveolar		Post alveolar	Velar	Glottal
		plain	pre-palatal	alveolar	plain	lateral			
Stop	ejective	pʼ	pʃʼ	psʼ	tʼ	tlʼ		kʼ	
	aspirated	p^h	pʃ^h	ps^h	t^h	tl^h		k^h	
Nasal	voiced	m			n		ɲ	ŋ	
	voiced	m			n		ɲ	ŋ	
Affricate	ejective				tsʼ		tʃʼ		
	aspirated				ts^h		tʃ^h	kx^h	
Fricative	voiceless	f	fʃ	fs	s	ɬ	ʃ		h~ɦ
	voiced	β	βʒ				ʒ	ɣ	
Rhotic					r	ɪ			
Approximant		w				l	j		

Northern Sotho consonant inventory based on Poulos (1994).

According to Diemer (2015, 16), the implication of having many letter groups is that some words can be many letters long, which affects the decoding process in the early stage of reading. Complex consonants clusters have been found to be problematic for beginner readers (Stuart 2005, 39; Treiman and Weatherston 1992, 174). Learners whose L1 has simpler consonant structures can face some difficulties in acquiring a complicated consonant clustering system in an L2 language (Khanbeiki and Abdolmanafi-Rokni 2015, 2; Rungruang 2017, 216) like English.

Contrary to English, which contains complex closed syllables (with consonant-vowel-consonant (CVC) pattern as the most prominent syllable[17] shape is the as in *rat* and dog) (McKay 2012, 11; Ramus, Dupoux and Mehler 2003, 337), Northern Sotho employs a simple, open syllable structure with most syllables ending with a vowel (Demuth 2007, 529; Endemann 1964, 6; Kgasago 2001, 13). There are five canonical forms of the syllable structures in Northern Sotho which include: (a) vowel (V- */e/ma/* and */e/ng/)* (b) consonant-vowel (CV *-/we-na/* or */yo-na/)* (c*)* consonant-/glide/-vowel (CwV-/nwa/, which appear in cases where the glide is normally fused with the preceding consonant when the preceding consonant is labial or as a final syllable in certain consonant combinations (d) nasal-consonant-vowel (NCV - /nt^{h}o/) (e) nasal-consonant-glide-vowel (NCwV - /nt^{h}wa/na) (Endemann 1964, 6; Kgasago 2001, 13; Van der Merwe and le Roux 2014,4). The most preferred syllable structure in the Northern Sotho language is the CV structure (Endemann 1964, 6).

Consonant only syllables are also possible in Northern Sotho (C, e.g. */mp^{h}a/* 'give me', or *ntšhi* 'fly'). The syllabicity of such consonants can be determined by different phonetic environments (Coetzee 2001, 1). For instance, the nasals can be syllabic when followed by a variety of

[17] The syllable is an component of speech, consisting of a vowel, a syllabic consonant or vowel + consonant combination (Coetzee 2001,1).

consonants (e.g. /*ntlo*/ 'house') whilst others are syllabic only when followed by identical consonants (Mahura and Pascoe 2016, 534) as in (e.g. /*nna*/ 'i' or /*mme*/ 'my mother', /*lle/* 'ate'). The velar syllabic /*ŋ*/ is the only consonant that constitutes a syllable word-finally in Northern Sotho (Makaure 2016, 79). In cases where loan words are borrowed from other languages, the borrowed words are subjected to the Northern Sotho syllabic (CV) structure (i.e. English words (e.g. school /*sekolo*/, book /*puku*/ and also Afrikaans words (e.g. drom /*teromo*/) (Mojela 1999, 47). According to Mojela (1999, 47) the loan words conform to the Northern Sotho linguistic structure in terms of phonological, morphological, syntactical, lexical adaptations of the loanword.

Words in Northern Sotho are more likely to be multisyllabic with complex morphological structure (De Vos, van der Merwe and van der Mescht 2014) as a result of the agglutinating nature of Northern Sotho (Taljard and Bosch 2006, 429; Zerbian 2006, 44; Zerbian and Barnard 2005, 358). For instance, words in Northern Sotho may contain five or six syllables (e.g. *sepelelana '*walk towards', *seretotumišo* 'praise poem'). A variety of affixes (prefix, infix and suffixes) are used extensively in word-formation to alter the basic meaning of a root word (Spaull, Pretorius and Mohohlwane 2018, 3; Zerbian and Barnard 2005, 358). For instance, in Northern Sotho, the word *dipuku* 'books', consist of the morpheme /*di*- /representing class 10 prefix and the root /*–puku/,* which conveys the semantic significance of the word and by adding the suffixes /*–ng*/ to the noun, a locative meaning is conveyed /*dipukung/* 'in the books') (Taljard and Bosch 2006, 431). A single word may, in fact, be a more comprehensive description of each affix, adding meaning to a word stem or root (Van der Merwe and le Roux 2014, 4). On the other hand, English words are monosyllabic (i.e. *can, sun, mat*) (Jehjooh 2005, 138). The implication is that a clause made up of monosyllabic words, such as '*the cat sat on the mat'* might not be easy for the speaker of an African language (De Vos et al. 2014, 14), which may have consequences for the literacy acquisition process.

Syllables in English consists of onset and rime aspects (*cat* consists of onset */c/* and rime /*at*/. The onset consists of a single consonant or cluster of consonants which appear before a vowel in speech, whilst the rime consists of a vowel and any consonant or consonant cluster (i.e. the coda) (Ziegler and Goswami 2005, 4). Although in English, a certain combination of consonants and vowels would be acceptable as either the onset or the rime, this might not be the case for an African language (Brink 2016, 84). In Northern Sotho, the onset can be a vowel only, whilst the rime could consist of consonant and vowel. For instance, the word *ema* in Northern Sotho could be separated into onset and rime parts (e.g. *e-ma*).

While English is considered a stress-timed (i.e. syllables vary in duration from one to another language (Treiman and Weatherston 1992, 174). Northern Sotho is considered as a syllable-timed language (Wilsenach 2013, 4). For instance, in a Northern Sotho sentence like *Ba swa-ne-tše go ntu-ša* (*They are supposed to help me)*, the syllables making up the whole sentence have the same duration (Makaure 2016, 77). Stress is a less prominent feature in Northern Sotho. However, there is syllable lengthening, which happens in the penultimate point of a word (Zerbian 2006, 109) as in /dume: la/, /dumela: ŋ/. Literacy development is assumed to progress quickly in languages with simple than complex syllabic structures (Seymour et al.

2003, 146).

3.6.2 Northern Sotho orthography

Orthography refers to how spoken language is represented in writing (Brink 2016, 92), and it also includes spelling, punctuation, capitalisation and other basic rules of written language (Matoušek, 2015, 12). The development of Northern Sotho orthography was started as early as 1859 by the Berlin missionary society (Mojela 1999, 18), and the first authoritative grammar book on Northern Sotho compiled by Karl Endemann appeared in 1876 (Zerbian 2006, 42). In 1957, the Bantu Language Board was established, and an official orthography for Northern Sotho was developed. To date, the basic document on Northern Sotho orthography is the Northern Sotho Terminology and Orthography no. 4 produced in 1988 by the Northern Sotho Language Board (Louwrens 1994, 183), and it contains a list of terms and rules of spelling/orthography of Northern Sotho (Webb et al. 2004, 7). Thus, standard Northern Sotho is based on the resolves of the Northern Sotho Language Board concerning (i.e. spelling rules and word division) (Mojela 1999, 13). However, the document is outdated since no effort has been made to revise the document since 1988 (Prinsloo and De Schryver 2002, 166). According to Taljard (2002, 2), the guidelines on the document are inadequate, and the spelling rules are not clear, consistent or phonologically sound. The document is, therefore, in need of revision.

The CAPS Northern Sotho home language document is a reflection of how little is known about the orthographic system of Northern Sotho (Department of Basic Education 2015b). The document is based on the English alphabet, an approach which disregards the differences in linguistic structures that exists between these languages. Madiba (2013, 25) argues that, while this approach establishes some form of standardisation, it runs the risk of overlooking certain aspects of African languages that are essential for the purposes of facilitating literacy development. Taljard and Bosch (2006, 2) argue that a lot still needs to be done to ensure that that the South African Bantu languages are fully standardised with regard to orthography, terminology and spelling rules.

The Northern Sotho orthography is disjunctive (Zerbian 2006, 47), which means that the subject agreement marker is written separately (disjunctively) from the verb (Louwrens 1991; Poulos and Louwrens 1994, 7). Certain elements that may belong to one and the same category are written as separate words (Poulos and Louwrens 1994, 7). For instance, in Northern Sotho, words such as *ke a ba rata* ‘I like them’, four orthographic elements making up a one-word category (i.e. verb), are written as separate orthographic entities (Anderson and Kotze 2006, 1906; Taljard and Bosch 2006, 433). In other words, linguistic units which constitute a single word are written as separate entities. In contrast, English is considered an analytic language which particularly emphasises on word order to understand the meaning (Bosch, Jones, Pretorius, Anderson 2006, 23). Analytic languages have sentences composed entirely of free morphemes, where each word consists of only one morpheme (Manker 2016). For instance, English orthographic words *'we like it'* are three independent words that each have their own meaning and can stand alone (Bosch et al. 2006, 23).

Northern Sotho speech sounds are represented by means of letters of the Roman alphabet or

Table 3.2 Northern Sotho orthography

Orthographic symbols	IPA symbols	Example
A	a	rata (love, like)
B	β	bina (dance)
bj	βʒ	bjala (plant)
D	d ɺ	dira (do, make)
E	e	ema(stand up)
ê	ɛ	rêka(buy)
f	f	fela (only, but)
fs	fs	bofsa (youth)
fš	fʃ	bofšega (cowardice)
g	g	gape (again)
h	h	hema (breathe)
hl	ɬ	hloga (sprout)
j	j	jewa (be eaten)
k	k’	koloi (car)
kg	kxʰ	kgetha (choose)
kh	kʰ	khora (become full)
l	l	lala (lie down)
m	m	mona (jealousy)
my	my	myemyela (smile)
n	n	nago (together)
ng	ŋ	moeng (visitor),
ny	ɲ	nyala (marry)
o	o	noka(river)
ô	ɔ	nôga (snake)
p	p’	pasa (identity)
ph	pʰ	phala (be better than)
ps	ps’	
pš	pʃ ’	upša (rather)
psh	psʰ	mpsha (young)
pšh	pʃʰ	pšhatla (crush)
r	r	rata (love, like)
s	s	seka (try a case)
š	ʃ	sešebo (side dish)
t	t'	taga (make drunk)
th	th	tharo (three)
tl	tl’	tlaba (surprise, astonish)
tlh	tlh	tlhago (nature)
ts	ts’	tsebišo (notice, announcement)
tsh	tsʰ	tshela (jump over)
tš	*tʃ ’*	tšea (take)
tšh	*tʃh*	tšhego (povery)
w	w	wena (you)
y	ɣ	yena (she/he)

Orthographic symbols of Northern Sotho consonants and vowels and their corresponding IPA symbols.

letter combinations (De Schryver 2007, S25; Price and Gee 1988; 480). Northern Sotho, being an alphabetic language, incorporates letters/graphemes to represent phonemes similarly to English. A grapheme is a letter or a number of letters that represent a sound (phoneme) in a word (Berndt, Lynne D'Autrechy and Reggia 1994, 977). The alphabetic system of Northern Sotho consists of forty-five letters of the alphabet [a,*b, bj, d, e, ê, f, fs, fš, g, h, hl, i, j, k, kg, kh, l, m, my, n, ng, ny, o, ô, p, ph, ps, pš, psh, pšh, r, s, š, t, th, tl, tlh, ts, tsh tš, tšh, u, w, y*] as presented in their alphabetic order (De Schryver 2007, S25). The Northern Sotho writing system thus consists of about 24 one letter graphemes (i.e. *a, b, d, e, ê, f, g, h, i, j, k, l, m, n, o, ô, p, r, s, š, t, u, w, y*); fifteen two-letter graphemes (i.e. *bj, fs, fš, hl, kh, kh, my, ng, ny, ph*) and five three-letter graphemes (i.e. *psh, pšh, tlh, tsh, tšh*). Northern Sotho and English share the following letters of the alphabet: /*a, b, d, e, f, g, h, i, j, k, l, m, n, o, p, r, s, t, u, w, y* /. Table 3.2 above shows the orthographic symbols of the Northern Sotho language based on information taken from Poulos (1994) and Poulos and Louwrens (1994).

Northern-Sotho is considered a consistent and transparent language (De Schryver 2007, S24) in the sense that letters represent specific sounds in a one-to-one mapping relationship (Spaull et al. 2018, 3). This finding is contrary to English, which consists of an opaque/deep orthography since there is no one-to-one correspondence between letters and sounds (Gottardo and Lafrance 2005, 563). For example, in English a single letter can represent different sounds (e.g. the grapheme /*c*/ denotes the phoneme /*k*/ in *cake* and /s/ in *centre)* (Siok and Fletcher 2001, 32) while the same phoneme can have different letter representations (e.g. the letter /*f*/ is represented by /*f/ in frog /ph/ in phone and* /*gh*/ in *cough*) (Spaull et al. 2018, 3). English is highly irregular in terms of phoneme-grapheme mapping system as compared to Northern Sotho. The mapping relationship between phonemes and graphemes is an important factor in alphabetic literacy acquisition (Geva and Siegel 2000).

Northern Sotho is considered an agglutinating, syllabic language with a transparent orthography, as opposed to English being a partially analytic, stress-timed language with an opaque orthography (Spaull et al. 2018, 1). The degree of differences between English and Northern Sotho phonology and orthography is likely to affect the literacy acquisition process of Northern Sotho-bilingual children in this study. Given the simple phonological and orthographic structure of Northern Sotho, the phonological and literacy skills of children receiving L1 instruction can be expected to develop differently from those of children receiving L2 instruction. The differences in language structure could impact negatively on the development of literacy abilities of children who have an African language as the first language and who are learning to read in a language with a different structure (Brink 2016, 83), such as English.

3.7. Existing evidence on the development of phonological processing and literacy skills in South African languages

It is only in the last decade that scholars started investigating literacy development in the South African languages from a more psycholinguistic perspective. Before this, problems in educational attainment was investigated mainly from a sociolinguistic or educational perspective. Since 2010, various cross-sectional studies have examined the development of, and associations between, phonological processing and literacy abilities in African learners in South Africa. In this section, an overview of existing evidence in relation to the Sotho languages will be provided first, followed by an overview of studies conducted in the Nguni languages.

3.7.1 Phonological processing and literacy acquisition in Sotho languages

Wilsenach (2013) assessed 50 Grade 3 Northern Sotho-English bilingual learners to determine the role of PA (syllable deletion) and PWM (NWR and digit span) in word and fluent reading development. Similar to the present study, the Northern Sotho-English bilingual sample were allocated into two groups, depending on their LoLT (Northern Sotho or English). The findings showed that phonological processing abilities significantly predicted reading outcomes. Furthermore, the Northern Sotho LoLT group performed significantly better on various phonological (syllable deletion, NWR) and reading (word and fluent reading) measures than the English LoLT group. Regarding the overall reading trajectory, the Northern Sotho LoLT group read more fluently in Northern Sotho than in English, whilst the English LoLT group could hardly read in Northern Sotho and could not read very well in English. The study was pioneering with regards to studying Northern Sotho literacy development from a psycholinguistic perspective in the South African context, but its power was limited due to the small sample size and the limited scope (not all constructs in the phonological processing domain were measured, and those that were measured, were not measured in sufficient depth).

Building on Wilsenach's (2013) study, Makaure (2016) assessed the development of phonological abilities (PA, PWM, RAN) and reading (word reading, fluent reading) skills in both Northern Sotho and in English in a group of Grade 3 Northern Sotho-English bilingual learners. To observe the effect of the medium of instruction, the study included two groups of learners (i.e. a Northern Sotho LoLT group and an English LoLT group). Makaure found that PA and RAN were robust predictors of reading outcomes in English and in Northern Sotho. PA was the strongest cross-linguistic indicator of word and fluent reading abilities in Northern Sotho and in English, and its influence was bi-directional. Makaure's study represented a first attempt to assess a wide range of phonological processing abilities in English and Northern Sotho in learners in the foundation phase and made a significant contribution, especially in terms of test development. However, the study was also limited since it was cross-sectional and since the literacy measures only included word and fluent reading. Given these limitations to the design and scope, it was still not possible to draw conclusions regarding the causative role of phonological abilities in the literacy acquisition of Northern Sotho-English bilingual learners, and specifically, no information on the role of phonological processing skills in reading comprehension was gathered. In a sub-analysis of Makaure's (2016) data, Wilsenach and Makaure (2018) reported on the development of phonological processing skills (phoneme isolation, elision, NWR, digit span, RDN, RLN, RON, RCN) and reading (word reading, fluent reading) in boys and girls. They found that girls performed significantly better than boys on some aspects of phonological processing and on all the reading measures.

More recently, Wilsenach (2019) assessed the contribution of various levels of PA to reading (phoneme isolation, phoneme elision, syllable elision, word and fluent reading measures). The results revealed that Northern Sotho learners manipulated syllable-based tasks better than phonemes, but that phoneme awareness predicted reading outcomes better than syllable awareness. Contrary to the psycholinguistic grain size theory, the findings suggested that phoneme awareness does not necessarily develop automatically in languages with a transparent orthography like Northern Sotho, and the importance of explicitly teaching phoneme-grapheme correspondences to Northern Sotho learners was highlighted.

A few studies have also examined PA and literacy skills in Setswana, a sister language of Northern Sotho. Legkoko and Winskel (2008) assessed letter knowledge, PA, word reading and pseudoword reading abilities in 36 Grade 2 Setswana-English bilingual children. The researchers reported that letter knowledge and PA predicted reading abilities in both Setswana and in English. Furthermore, the findings also supported evidence of cross-linguistic transfer between the two languages. English letter knowledge skill was a cross-linguistic indicator of word and pseudoword reading abilities, whilst Setswana PA predicted reading of English pseudowords. However, Setswana letter knowledge and English PA did not show any cross-language transfer effects.

Malda, Nel and van de Vijver (2014) examined the reading and cognitive skills profiles of 358 Grade 3 South African children from schools that differed in terms of the transparency of the medium of instruction. The learners were divided into three groups (Afrikaans, Setswana and English) based on their LoLT. The sample consisted of 122 Afrikaans learners, 109 Setswana and 127 English learners. Afrikaans and Setswana represented the transparent orthographies, whilst English represented the opaque orthography. The findings revealed that there were different associative patterns between cognitive-linguistic and reading skills in the three languages. PA was more predictive of reading abilities in Afrikaans and Setswana, while vocabulary and working memory significantly predicted English reading. The findings indicated that there were similarities in terms of cognitive and reading trajectories of learners across the three orthographies. Finally, Le Roux et al. (2017) assessed the performance of twelve English L1 and 15 English L2 (Setswana L1 speaking) children (8 to 10 years) on PA (phoneme blending, segmentation) and literacy (reading, spelling) tasks. They found that phoneme blending and phoneme segmentation related directly to literacy success. Furthermore, there were performance differences between English L1 and English L2 participants; and English L2 children displayed more significant challenges in phonological blending and segmentation tasks than EL1 children. Unfortunately, phonological processing skills were not assessed in Setswana in this study.

3.7.2 Phonological processing and literacy development in Nguni languages

Focusing on isiZulu-English bilingual learners, Soares et al. (2010) assessed the impact of PA (syllable segmentation, onset-rime detection, phoneme deletion) on spelling in thirty monolingual English children and thirty isiZulu-English bilingual children. Their study provided evidence for the supportive role of PA skills in spelling acquisition in both isiZulu and English. IsiZulu PA and spelling skills also predicted English spelling skills, suggesting that well-developed PA skills in the L1 can support L2 literacy development, even in dissimilar orthographies such as English and isiZulu. Soares De Sousa and Broom (2011) assessed the associations between English PA (onset-rime detection, phoneme deletion) skills and reading acquisition (word reading, reading comprehension) in 100 English monolinguals and 100 isiZulu-English bilingual children. They found that isiZulu PA skills were associated with the reading abilities of learners in isiZulu, and once again, the data provided support for the cross-linguistic supportive role of L1 PA skills, in that isiZulu PA skills predicted English literacy abilities.

Diemer (2015) studied the role of PA (segmentation, identification, deletion) and naming speed in the literacy (oral reading fluency, silent reading, comprehension, spelling development) of fifty-two isiXhosa speaking Grade 3 children. The findings indicated that PA was the most robust indicator of accurate reading, reading fluency, comprehension and spelling abilities. The role of naming speed was narrower, contributing to the fluency and accuracy of reading only in the group with poor PA. Diemer et al. (2015) tested 31 Grade 4 (mean age: 10 years) isiXhosa children on blending, segmentation and substitution tasks, consisting of a syllable and phoneme component. They established that the children performed well in syllable than phoneme sensitivity tasks. Similarly, Probert (2016) assessed 74 Grade 3 and 4 learners on PA (segmentation, deletion, identification) and reading comprehension measures to determine the linguistic grain size used by Setswana (disjunctive orthography) and isiXhosa (conjunctive orthography) learners in word recognition. The PA measures were administered at the syllable and phoneme levels. Echoing previous results, Probert found that syllables were the dominant grain size in both Setswana and isiXhosa. Probert (2019, 11) compared the performance of 74 Grade 3 and Grade 4 isiXhosa learners on PA (segmentation, isolation, deletion) and reading fluency measures. The PA measures were administered at the syllable and phoneme levels. The results revealed that Setswana learners performed better on PA tasks than the isiXhosa learners and, as in previous studies, those syllables were the dominant linguistic grain size in Setswana and isiXhosa.

Although valuable research emerged over the last decade on the progression of phonological processing skills in the African languages spoken in South Africa, and on the role of phonological processing skills in literacy development in African languages, these studies typically adopted cross-sectional designs and are focused mostly on one age group. Most studies in South Africa have also primarily dealt with the association between phonological processing and reading and neglected other literacy components, such as writing and spelling. Given this, the present study clearly fills a research gap, in that it represents a first attempt to identify long-term associations between a wide array of phonological processing and literacy skills.

3.8 Conclusion

The concepts of phonology and phonological processing, as well as their development, have been discussed in this chapter. The chapter also discussed the role that phonological processing plays in facilitating literacy development. Theories of phonological processing and literacy development have been outlined and discussed. The chapter also focused on phonological and literacy development in bilingual children and introduced theories of bilingual phonological and literacy development. A brief outline of the linguistic (phonological, orthographical) properties of Northern Sotho and how these properties might affect the literacy development process in Northern Sotho-English bilingual learners was presented. Finally, the chapter presented an overview of previous research studies that investigated the development of phonological processing skills in the African languages spoken in South Africa.

CHAPTER 4
RESEARCH METHODOLOGY

This chapter outlines the methodology utilised in this study. It provides a description of the research approach (quantitative) and research design (quasi-experimental, longitudinal and correlational), participants of the study, data collection instruments and data collection procedure. The chapter also focuses on aspects of the pilot study, ethical considerations and issues of research reliability and validity. The chapter finally outlines the data presentation and methods of analysis for the study.

4.1 Research approach and design

The researcher used a quantitative approach and longitudinal research design to assess the impact of phonological processing abilities in the literacy acquisition of Northern Sotho-English bilingual learners. Babbie (2014, 437) defined quantitative research as the numerical representation and manipulation of observations for describing and explaining a phenomenon. Quantitative analysis is appropriate in this study based on its ability to establish, confirm, or validate associations among measured variables (Dörnyei (2007, 24). This study is both descriptive and explanatory. Descriptive studies attempt to identify and describe an event as accurately as possible (Leedy and Ormrod 2015, 154). The researcher used a descriptive approach to demonstrate the relations between phonological skills and literacy development. This approach also established the associations between the phonological processing variables. The explanatory nature of this study lies in its potential to demonstrate the causal association between phonological processing and literacy acquisition (Babbie 2014, 96).

Dörnyei (2007) provides a useful overview of the main characteristics of quantitative research – these characteristics, which also accurately describe the methodology of the current research, are as follows:

1. Quantitative research studies gather data as numbers. Variables are represented by a range of numerical values (of which the range has to be specified exactly by the researcher). The various quantitative approaches that are used aim to identify associations between variables by evaluating them numerically and by manipulating them.
2. Researchers conducting quantitative data specify the categories and values of numbers before conducting the actual study. This is known as prior categorisation, and it means that if a researcher wants participants to circle figures in response to a questionnaire item, then they must precisely know what category/concept is represented by those figures.
3. Quantitative research studies pay less attention to individual features, and rather focus on common characteristics of groups of people. Therefore, contrary to qualitative research (i.e. involving data collection procedures that result in open-ended, non-numerical data analysed through non-statistical means), quantitative methods focus on the variables that capture these common features and which are quantified by counting, scaling or through assigning values to categorical data (Dörnyei (2007,33).

4. Quantitative data is, for the most part, analysed using statistical methods and statistical software programmes.
5. In quantitative research, the researcher takes preventive measures to avoid any individually based subjectivity. This is done by establishing an appropriate framework for the research in line with the objectives. The quantitative methodology often adopts standardised research procedures and instruments to ensure that the data collection remain stable across investigators and across participants. For this reason, when different researchers observe the same phenomenon using standardised measures, their findings should show a degree of agreement and convergence.
6. Another salient characteristic of some quantitative studies is that the results can be generalised to a particular sample or population (and sometimes to the entire population). It should be noted that given the specific research design adopted in this study (i.e. a quasi-experimental design, the characteristic of generalisability is not applicable here.

The researcher adopted an experimental design because of its appropriateness in establishing group differences and significant associations between the dependent and independent variables (Dörnyei 2007, 115; Singh 2006, 171). In this study, measures of phonological processing were treated as independent variables when predicting literacy development, but as dependent variables when the effect of the LoLT was determined. An experimental approach also allowed the researcher to set up a framework for testing the interrelationships among phonological processing skills. The type of experimental design adopted in this study is a quasi-experimental design. The researcher used this design because the research fails to meet the principle of randomisation (Neumen 2014, 293); since existing groups in two pre-selected schools (which differed in terms of LoLT) were used. In other words, the process of assigning the individual participants at random to the stipulated groups was less-than-rigorous (Creswell 2014, 215) in this study. Quasi-experimental, in this instance, therefore implies that the researcher assigned the learners to different LoLT groups based on the language policies adopted by the schools participating in the study.

The researcher used a longitudinal design to observe the predictive value of various phonological processing skills in relation to literacy development over a period of 21 months. A longitudinal design permits the observations of the same phenomenon over an extended period (Babbie 2014, 110; Dörnyei 2007, 82), hence enabling us to observe changes in variables which may occur over time (Litosseliti 2010, 57; Mernard 2002, 2). The researcher collected data three times from the same sample of learners in Grade 2 and Grade 3. Phonological processing and literacy skills were assessed twice at the beginning and end of Grade 2, whilst literacy skills were measured once in Grade 3 (end of the school year). The three data collection points will be henceforth be referred to as measuring points 1, 2 and 3, respectively. There was a six months period between point 1 and 2 data measuring point and an eleven months period between point 2 and 3 measuring points. More information about each measuring point will be given in later sections of this chapter.

Data analysis involved the comparison of data over this period. A longitudinal approach is appropriate to establish the patterns of change in phonological processing and literacy skills. As recommended by Field (2013, 127), the researcher included a measure of language ability (i.e. receptive vocabulary knowledge) as a control variable to establish strong cause-effect associations. Castles and Coltheart (2004, 85) emphasised the necessity of controlling 'third variables' such as age, general language ability, and intelligence quotient (IQ)[18], in establishing the causal relationship between phonological processing and literacy variables.

4.2 Research setting

The researcher conducted the study in the community of Atteridgeville, South Africa. Atteridgeville is a township located in the south-west of the Pretoria central business district (Moodley, Matjila and Moosa 2012, 2). There are 21 primary schools in Atteridgeville (Gauteng Department of Education 2011), and the researcher randomly sampled two primary schools to participate in this study. The learner-educator ratios in these schools range from 30:1 to 35:1 (Department of Basic Education (DBE) 2016, 5; Statistics South Africa 2015, 26). The sizes of the classes are relatively big compared to the United States and other developed countries (UNESCO 2006, 79). Most households in Atteridgeville are classified as low-income earners (van Averbeke 2007, 337). Thus, most of the learners in Atteridgeville emanate from the same socioeconomic background.

Northern Sotho is spoken as the first language (L1) by the majority of people in this area. According to Frith (2011, 1) there are eleven languages spoken in Atteridgeville, with Northern Sotho as the dominant language (approximately 41% of the population speak it as L1). Apart from Northern Sotho, Setswana (17% of the population), Sesotho (12% of the population) and isiZulu (7% of the population) are commonly used languages in the area. In other words, Atteridgeville is a multilingual community. English is hardly ever used as an L1 in the area, and the participants in this study are unlikely to have had much contact with English outside the school setting.

According to Taylor and Coetzee (2013, 4) the constitution of South Africa makes provision for learners and/or their parents to choose their LoLT. In most cases, however, the LoLT is selected by a school's governing body in consultation with parents. Some of the primary schools in this area adopted the use of an African language, such as Northern Sotho or isiZulu, as the LoLT from Grade 1-3, while offering English as a subject. In these schools, English becomes the LoLT from Grade 4 onwards, and children then learn Northern Sotho (home language) as a subject throughout primary school. Other schools in this area adopted a straight for English approach from Grade 1. English is used as the LoLT starting from the children's inception in Grade R (reception year) or Grade 1, and Northern Sotho is used as a subject from Grade 1 onwards. The researcher selected one school which offers Northern Sotho LoLT and

[18] In the original research plan, time was set aside to measure the participants' IQ, but it was impossible to gather this data as a result of the COVID-19 pandemic. For this reason, only general language ability (i.e. receptive vocabulary) was included as a control variable.

one school which offers English LoLT at the foundation phase of learning for participation in this study. In terms of infrastructure, the two schools are comparable since they both have well-maintained buildings, functioning libraries, a functioning administrative office, a principal that manages the day-to-day business of the school and a qualified teachers' corps. The Northern Sotho LoLT School was considered a quintile one school, whilst the English LoLT School was classified as a quintile two school.[19] Both schools have a feeding programme for learners, which entails that learners receive a cooked meal during break time.

4.3 Participants

The researcher sampled and followed 134 participants from two schools for a period of 21 months in this study. The sample size was determined by the number of learners that returned their informed consent forms – learners who did not return their ethical clearance forms were excluded from the sample in order to avoid violation of ethical procedures. The Northern Sotho LoLT group comprised of Northern Sotho-English bilingual learners who were receiving their foundation phase instruction in the Northern Sotho language. The second group also consisted of Northern Sotho-English bilingual learners, but these learners received their foundation phase instruction in English. The study excluded learners who were repeating a grade and those with significant learning difficulties. Since learners with learning difficulties are often not formally diagnosed in the research setting, the researcher relied on school reports and/or teachers' insights to identify and exclude any learners with significant learning problems. In other words, an earnest attempt was made to exclude learners with developmental delays, as such delays might mean that learners experience difficulties during (language) assessments (Puranik et al. 2012, 6).

As mentioned above, the longitudinal nature of the study meant that the researcher collected data from the same learners at three points (Point 1, Point 2 and Point 3). A total of 134 participants took part at Point 1.[20] The Northern Sotho LoLT group at this point consisted of 69 learners. The English LoLT group consisted of 65 learners. Point 2 data was gathered from 131 Grade 2 Northern Sotho-English bilingual children. The Northern Sotho LoLT group consisted of 68 learners, while the English LoLT group comprised of 63 learners. Thus, a total of three learners were not available for testing at Point 2 as a result of transferring to other schools. Point 3 data was gathered from 106 learners, with 53 learners comprising each LoLT group. Thus, a total of 30 learners were not available for testing at the third data measuring point.

In the Republic of South Africa, learners are enrolled in Grade 1 at the age of 6, and they complete Grade 7 at the age of 13 (Howie et al. 2012, 2). The participants in this study had an age range of 7-8 years. Most of the participants are likely to have attended pre-school before

[19]The public schools in South Africa are classified into five quintiles for the purpose of allocating financial resources, as a means to address socioeconomic status issues and disparities in access to education. Quintile 1 schools are considered economically disadvantaged (poorest) whilst quintile 5 schools are economically advantaged. Quintile 1 to 3 schools are non-fee-paying schools and receive more governmental funding per learner as compared to the least economically disadvantaged schools (quintile 4 and 5) (Dass and Rinquest 2017, 5).

[20] The mean ages, and number of girls and boys in each of the two LoLT groups (at each point) are provided in Chapter 5, where biographical data of the groups are provided as part of the main analysis.

the age of 6. The South African pre-school system comprises of two main programs: Pre-Grade R (intended for children between an age range of 0-4) and Grade R (reception year program, which is appropriate for children with an age range of 5-6 years) (Expatica 2021). According to Hoadley (2013, 74), formal teaching of literacy in South Africa begins in Grade 1, guided by the national curriculum and assessment policy statements (CAPS)[21]. In the foundation phase (Grade 1-3), the curriculum content and learning activities are built around literacy development (i.e. reading, writing, spelling), numeracy and life skills (Howie et al. 2012, 12). Phonological processing skills that could be taught (i.e. PA skills) are expected to develop incidentally during a child's schooling period. However, the CAPS does emphasise some phonics instruction for the development of literacy skills in the foundation phase (Department of Education 2008a, 13; Madiba 2013, 25).

Learners in the foundation phase have 25 hours (Grade 1-2) to 28 (Grade 3) hours instructional time per week, of which seven or eight hours (Grade 1-3) is allocated for home language subject teaching, whilst two to three hours (Grade 1-2) and 3 to four hours (Grade 3) is set aside for FAL subject teaching (DBE 2013c, 11). Based on this allocation, the home language subject tends to receive more time than the additional language. This implies that learners in the Northern Sotho LoLT group received approximately 22-23 hours (Grade 1-2) and 22-24 hours (Grade 3) of Northern Sotho home language instruction per week (including the time allocated for Northern Sotho subject teaching). With regards to English, the Northern Sotho LoLT group had limited exposure to English in the school context.

On the other hand, learners in the English LoLT group had approximately 17-18 hours (Grade 1-2) and 20-21 hours (Grade 3) of English instructional time per week (including the time allocated for English subject teaching). With regards to Northern Sotho, this group had limited exposure to Northern Sotho language instruction in the school context. While learners in both LoLT groups were exposed to the Northern Sotho mother language (i.e. at home and school), they may hardly ever have had interaction with English outside the school context. However, they are likely to see English writing on billboards, packets of food and advertisements on buses etc.

4.4 Data collection instruments

The researcher divided the tasks into three broad categories, namely: phonological processing, literacy and vocabulary tasks. The following section explains the structure of these tasks and how they were used to generate appropriate data for the study.

4.4.1 Phonological processing tasks

The researcher used the Comprehensive Test of Phonological Processing (CTOPP) (Wagner et al. 2013) to measure the phonological processing abilities of learners in English.[22] Northern

[21] A National Curriculum and Assessment Policy Statement is a single, comprehensive, and concise policy document for all the subjects listed in the National Curriculum Statement Grades R – 12 (Department of Basic Education 2018).

[22] The CTOPP tasks were not reproduced in the thesis, because of copyright restrictions, and more information concerning these standardised tests can be obtained online on the publisher's website:

Sotho measures were custom-made or adopted from the Early Grade Reading Study (2018), or from Wilsenach (2015) and Makaure (2016). The Northern Sotho phonological processing tests are presented in Appendix G. Sound matching, blending, and elision tasks were used to assess PA; NWR and digit span evaluated PWM, while rapid letter naming, rapid digit naming, rapid object naming and rapid colour naming measured RAN.

4.4.1.1 Sound matching task

Sound matching tasks measure the extent to which an individual can match sounds (Wagner et al. 2013, 6). This task required participants to identify and match the initial or final sounds of a target item with one of the test items (by pointing to the correct/matching item in a picture book). To administer this test, the fieldworker presented a target word to a participant, followed by three alternative answers while pointing to drawings depicting all four words. The participant had to select the picture showing the correct answer. In the English task, for the first 13 items, the participants had to recall images that correspond to the words starting with the first sound provided. For instance, the fieldworker would say, *"Look at this first picture. This is a sock. Now, look at these two pictures. This is a sun, and this is a bear. The word sock starts with the /s/ sound. Which of these words starts with the /s/ sound like sock: sun or bear?* (Wagner et al. 2013, 22). In the last 13 items, the participants had to identify the pictures of the word that ends with the last sound as the targeted word provided. The field worker, for example, would point to the picture of a *can* and say, "*This word end with the /n/ sound. Which of these words ends with the /n/ sound like can? Pot or sun?"* (Wagner et al. 2013, 22). The test consisted of 26 testing items, and one mark was given for each correct answer. The maximum raw score was 26 at the two measuring data points. The field workers stopped testing if the participant failed three consecutive items.

The researcher used custom made tasks to assess sound matching in Northern Sotho. For instance, the participants were presented with a Northern Sotho word like /*katse/* and asked to indicate a picture with the word starting with the sound /*k*/ from a set of three alternatives like /*kefa*/, /*tonki*/ and /*puku*/. The same procedure was followed for the last part of the test requiring learners to identify word-final sounds. For instance, learners had to indicate a picture with the word ending with the /i/ sound as in the word /*koloi*/ from alternatives such as /*meetsi/; /kaušu*/ and /*sekepe*/. The test consisted of 10 testing items, and one mark was awarded for each correct answer. The maximum raw score was ten at the two measuring data points. The fieldworker stopped testing if the participant failed three consecutive items. For the sound matching tasks, each child participated in two separate testing sessions for Northern Sotho and English, each lasting about five minutes.

4.4.1.2 Blending task

The blending task measures an individual's ability to combine sounds to form words (Wagner et al. 2013, 6). The English task required participants to listen to a series of audio-recorded

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https://www.pearsonclinical.co.uk/AlliedHealth/PaediatricAssessments/PhonologicalAwareness/ComprehensiveTestofPhonologicalProcessing(CTOPP)/ComprehensiveTestofPhonologicalProcessing(CTOPP).aspx#:~:text=The%20Comprehensive%20Test%20of%20Phonological,than%20those%20who%20do%20not.

separate sounds (provided on CD as part of the CTOPP testing materials) and to blend the sounds together into a whole word. The first eight items of the English test required participants to listen to syllables and then blend those together. For example, the examiner would say, *What word do these sounds make: cow-boy?* The correct response would be */cowboy/.* The next 25 items required the participants to listen to phonemes and to blend the parts, e.g. the sounds */m-a-d/* and */m-oo-n/* were presented. The correct response would be *mad* and *moon*. This task also required learners to deal with words at the onset-rime level. For example, learners had to blend onset and rime segments (i.e. /*s-un*/, /*t-ak*/ and /t-*oy*/ into whole words. The test consisted of 33 testing items, and one mark was awarded for each correct answer. The maximum raw score was 33 at the two measuring data points. The field workers stopped testing if the participant failed three consecutive items.

The researcher used custom made Northern Sotho items to assess blending. The first part of the Northern Sotho task required participants to blend syllables into words. For instance, the learner had to blend syllables like /*ba-sa-di/* and /*pe-di/* into the words */basadi/* and */pedi/* respectively. The second part required the participants to blend phonemes in words, like /b-*i-n-a/*, into the whole word /*bina/*. The last part of the task required participants to manipulate sounds at the onset-rime level. In this part of the Northern Sotho blending test, the learners had to blend sounds into words in a manner that resembles blending at the onset-rime level in English. For example, the respondents had to blend items like /e-ma/ into whole words /ema/. Northern Sotho does not have onset-rime patterns in the same way as English. However, the structure of the words selected for the Northern Sotho task enabled the respondents to manipulate the task in the same way they would be required to do in the English language. The Northern Sotho blending task was not recorded; rather, the field workers administering the task presented the relevant phonemes or syllables themselves, after extensive training on how this should be done. This was deemed acceptable, as the same procedure was followed during the pilot study, where it was suggested that the Northern Sotho blending task was very reliable. The test consisted of 15 testing items, and one mark was awarded for each correct answer. The field workers stopped testing if the participant missed three consecutive items. The maximum raw score was 15 at the two measuring data points. For the blending tasks, each child participated in two separate testing sessions for Northern Sotho and English languages, each lasting about five minutes.

4.4.1.3 Elision task

The elision test measures the extent to which a participant can say a word and repeat the word after dropping certain sounds (Wagner et al. 1999, 6). The English test required participants to manipulate the syllable and phoneme parts of words. Syllable deletion tasks required participants to remove initial, middle or final syllables from the words. For example, the participant had to say the word *cowgirl* and to say the remaining word after deleting a target syllable (Now say *cowgirl* without saying, *girl*). The phoneme deletion section required respondents to say a word (Say *farm*) and then to repeat the remaining word after removing a phoneme (Now say /*farm/* without saying /*f*/). The test consisted of 34 testing items, and one mark was awarded for each correct answer. The maximum raw score was 34 for this task. The field workers stopped testing if the participant missed three consecutive items.

The researcher adopted the Northern Sotho elision task from Makaure's (2016) study. In the Northern Sotho syllable deletion tasks, for example, the participants had to say a word like */bolelo/* and repeat it after dropping the syllable */bo/.* Participants had to drop syllables from either the beginning, the middle or the end of the word. The phoneme deletion part of this task required participants to say a word (e.g. *wena)* and repeat the word without the /*w*/ sound. The test consisted of 20 items, and one mark was given for each correct answer. The maximum raw score was 20 (Point 2) for this task. The field workers stopped testing if the participant missed three consecutive items. For the elision tasks, each child participated in two separate testing sessions for Northern Sotho and English, each lasting about five minutes.

4.4.1.4 Digit span task

The digit span task measure the extent to which a participant can repeat a series of digits with lengths ranging from two to nine digits (Wagner et al. 1999, 7). The English digit span task required the participants to listen to a digital recording of numbers (provided on CD as part of the CTOPP testing materials) and to repeat the numbers in the correct order. For instance, the children had to repeat subsequent digit sets such as (*7 3*) or (*9 2 8 1 3 7 5 4 6*) in the exact order. One mark was awarded for each correct answer, and the maximum raw score was 28 at the two measuring data points. The field workers stopped testing if the participant missed three consecutive items.

The Northern Sotho task required an individual to repeat randomly arranged digits in Northern Sotho. For instance, the participants had to recall a set of numbers, such as (*hlano-pedi* or *hlano-pedi-tee*). The researcher excluded some Northern Sotho digits due to their length (in syllables). For example, whereas *nine* in English contains one syllable, the Northern Sotho translation *senyane* consists of three syllables. Since differences in the syllable length of digits may affect children's performance on this task, Northern Sotho digits consisting of more than two syllables in Northern Sotho were not used in the design of the test. Only those Northern Sotho digits that have one or two syllables (i.e. *tee, nee, pêdi, hlano, tharo, šupa, tshela*) were used. The researcher employed a Northern Sotho L1 speaker to record the Northern Sotho digits that were used in this task. The recordings were edited using the free, open-source audio software programme *Audacity* (Audacity, 2020). During editing, the silence between each digit was manipulated to be exactly the same, to ensure that the test items progressed in exactly the same manner for each learner. One mark was awarded for each correct answer. The maximum raw score was 21 for both measuring points. The field workers stopped testing if the participant missed three consecutive items. For the digit span tasks, each child participated in two separate testing sessions for Northern Sotho and English.

4.4.1.5 Non-word repetition task

The non-word repetition task measures an individual's ability to repeat non-words ranging from three to fifteen sounds (Wagner et al. 2013, 7). For the English non-word repetition task, the participants had to listen to a digital recording of non-words (on a CD, which is part of the CTOPP testing materials) and repeat the non-words in the order in which they appear. Test items ranged from short non-words like /*ral/* or /*teeg*/, to long non-words such as /*wulanuwup*/

or /*mesidospregoudegounjopnas*/. All non-words were played once only. The test consisted of 30 testing items, and one mark was awarded for each correct answer. The maximum raw score was 30 at the two measuring data points. The field workers stopped testing if the participant missed three consecutive items after getting feedback from the field worker.

The researcher adapted the Northern Sotho version of this task from Wilsenach (2016). In Northern Sotho, the participants had to repeat non-words like /tšhupeng/ and /*tlapo*/ in the order in which they appear. As noted by Wilsenach (2016), the non-words do not correspond to any lexical items but comprised phonemes, and syllable types acquired early in literacy acquisition. The task consisted of 21 items (1 training item and 20 test items), ranging from short non-words with four syllables like /*sêlumaka/ or* /*sêpokari*/ to lengthy seven-syllable non-words like /*narulongwakhubasi/* or /*nasibhekarabile*/. The Northern Sotho non-words were recorded by an L1 speaker of Northern Sotho. The recordings were edited using the free, open-source audio software programme *Audacity* (Audacity, 2020). During editing, audible breathing before items were removed. The fieldworker played the pre-recorded non-words only once, one word after the other, with a pause in between to allow participants some time to respond. The test consisted of 20 testing items, and one mark was awarded for each correct answer. The maximum raw score was 20 at both measuring points. The field workers stopped testing if the participant missed three consecutive items. For the non-word repetition tasks, each child participated in two separate testing sessions for Northern Sotho and English, each lasting about five minutes.

4.4.1.6 Rapid naming tasks (digit, letter, object and colour naming)

Rapid naming was measured using digit, letter, object and colour naming tasks. The rapid naming tasks measure the automaticity or efficiency in retrieving phonological codes from memory (Anthony et al. 2006, 240). Rapid letter naming (RLN) assesses the speed at which a participant can identify letters (Wagner et al. 2013, 7). The English task required the participants to name letters (as quickly and as accurately as possible) presented on a card. The letters were arranged in 4 rows and 9 columns and comprised 6 letters arranged randomly (i.e. *a, c, k, n, s, t*). The time taken to name all the letters was recorded as seconds on the assessment sheet. Letter naming abilities were also assessed in Northern Sotho. The researcher adopted the letter naming task from the Early Grade Reading Study (2018). The test consisted of 6 letters (a, b, e, o, l, t) arranged randomly in 4 rows and 6 columns. The researcher ensured that all these letters existed in the Northern Sotho vocabulary. The time taken to name all the letters was recorded as seconds on the assessment sheet.

The rapid object naming (RON) subtest assesses the speed with which a participant can identify objects (Wagner et al. 2013, 8). The English task required individuals to name objects on a card, arranged randomly into 4 rows and 9 columns. The items portrayed on the card are *a star, a chair, a fish, a pencil, a boat* and a *key*. The children had to name every object from left to right in each row. The time taken to name all the objects was recorded as seconds on the assessment sheet. The Northern Sotho version of the task followed the English format. The researcher adopted the Northern Sotho object naming task from the Early Grade Reading Study (2018). The participants were required to name 36 objects arranged randomly on a picture book in the Northern Sotho language. The picture book has six objects, which include (i.e. *setulo*, *puku*, *kolobe, lesedi, tafola, mpša*). In cases where participants used different (but correct) Northern Sotho lexical items to refer to an object in Northern Sotho, the researcher considered any of those alternative lexical items as correct answers. The time taken to name all the objects was recorded as seconds on the assessment sheet.

The rapid colour naming (RCN) task assesses the speed at which a participant can identify colours (Wagner et al. 2013, 8). This test required individuals to identify colours randomly presented on a colour card in four rows and nine columns (i.e. *black, green, red, blue, yellow* and *green*) from left to right. The time taken to name all the colours was recorded as seconds on the assessment sheet. Rapid digit naming (RDN) assesses the speed with which a participant can identify numbers (Wagner et al. 2013, 07). The task required individuals to say the numbers presented on a number card as quickly as possible. The test consisted of 36 test items comprising of 4 rows and 9 columns which included 6 numbers randomly arranged (i.e. *2, 3, 4, 5, 7* and *8*). The time taken to name all the digits was recorded as seconds on the assessment sheet. RCN and RDN tasks were assessed in the English language only. The decision to use these tasks in English only was made based on the results of the pilot study, which indicated that the majority of participants had not lexicalised colours and digits in Northern Sotho.[23]

The researchers used a stopwatch to time the responses of each individual on all naming tasks. Timing commenced when an individual started pronouncing the first item, and it was stopped when the participant finished pronouncing the final item. The field workers stopped testing if the participant made more than four errors consecutively during testing. For the rapid naming tasks, each child participated in two separate testing sessions for Northern Sotho and English languages, each lasting about three minutes.

4.4.2 Literacy tasks

Literacy skill was assessed using letter knowledge, letter reading, word reading, oral reading fluency, reading comprehension, spelling and early writing tasks. To assess English word reading, the Diagnostic Test for Word Reading Processes was used (FRLL, Institute of Education (2012)[24], while English reading comprehension was assessed with an adapted task from DBE Annual National Assessments (2015). Oral reading fluency in both languages was assessed using graded readers. Northern Sotho literacy measures were custom-made or adopted

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[23] During pilot testing, the learners were unable to name colours using Northern Sotho colour terms, though they could name colours in English. The length of digits in Northern Sotho also made it difficult for the participants to complete the digit naming task in Northern Sotho. The tasks required rapidness in naming the items, which proved very difficult in Northern Sotho, especially in the English LoLT group. Based on these observations, it was deemed appropriate to exclude the colour naming and letter naming tasks from the Northern Sotho test battery as the results would not have been comparable with the English results.

[24]English word reading test are not reproduced in the thesis, because of copyright restrictions. More information about this standardised test can be obtained online on the publisher's website: https://www.gl-assessment.co.uk/products/diagnostic-test-of-word-reading-processes/

from the Early Grade Reading Study (2018) and DBE Annual National Assessments (2014). The Northern Sotho literacy tasks are found in Appendix F. Details about the tasks included at various grade levels are discussed in detail in the following sub-sections.

4.4.2.1 Letter knowledge

The study utilised a letter knowledge test to assess the children's preliminary literacy skills. The letter knowledge task comprised of lower and upper-case letters of the alphabet presented individually on a flashcard in random order. The researcher selected letters that existed in the Northern Sotho vocabulary. The letter knowledge test consisted of 15 test items: ten monographs (b, f, k, m, o, I, p, u, g, e), three digraphs (ng, ts, kg) and two trigraphs (ngw, tlw). The examiners accepted responses with either a letter name or letter sound as the correct answer. The task comprised of 15 test items, and one mark was awarded for each correct answer. The total number of letters identified correctly by the learners was recorded as a score for each individual. The maximum raw score was thus 15 for this task.

4.4.2.2 Reading tasks (letter reading, word recognition, fluency and comprehension)

The researcher used a letter reading task to test the letter reading abilities of learners. The researcher adopted the letter reading test from the Early Grade Reading Study (2018). The letter reading was assessed in Northern Sotho and was a one-minute timed test. The task consisted of one-letter graphemes (i.e. *m, h, w, k*), two-letter graphemes (i.e. ng, kg, ph gw), three-letter graphemes (i.e. *ngw, tšh, nts*) and four-letter graphemes (*tshw*). The letters were organised on a sheet of paper, in eleven rows and ten columns. The task consisted of letters and letter combinations that existed in the Northern Sotho vocabulary. The number of letters read correctly in a minute was considered as a score for letter reading. One mark was awarded for each correct response.

The study utilised the standardised Diagnostic Test of Word Reading Processes (DTWRP) to assess English word reading abilities. The DTWRP is a test administered individually and is suitable for children aged five years to twelve years, eleven months (FRLL, Institute of Education, 2012, 8). The DTWRP comprises of regular word reading, non-word reading and exception word reading tasks. The researcher used all three subsets to test word reading abilities in this study. The regular word reading task required individuals to read simple words such as /*up*/ /*us*/ or /*sun*/ and complex regular words like /*experimental*/ or /*concentrate*/ from the reading card. The non-word reading task required individuals to read non-word items (such as *pertle*, *gouse and wilderdote*). In the exception word reading task, the participants had to read exception words like /*miscellaneous*/ or /*treacherous*/. These three reading tasks consisted of 30 reading items each. The total number of words read correctly was the individual score. One mark was awarded for each correct answer. The maximum raw score for each sub-test was 30 at two data measuring points. The examiners discontinued the word reading task if the participant made five consecutive errors.

The researcher used a custom-made task to assess Northern Sotho word recognition skills. The task required participants to read Northern Sotho words ranging from simple words to more complex words, (e.g. *ema, bana, lebala, batswadi*). The individual raw score was the total number of words read correctly. One mark was awarded for each correct answer. The maximum raw score was 20. The examiners discontinued the word reading task if the participant made five consecutive errors.

The researcher used oral reading fluency tasks to assess the fluent reading of learners in Northern Sotho and in English. Oral reading fluency was assessed using a one-minute test in both languages. These tasks demanded that participants read loudly from Northern Sotho and English graded readers, for a minute. The number of words read correctly in a minute were considered as a measure for reading fluency. The texts chosen for participants were deemed age-appropriate and within the learners' cognitive abilities. The Northern Sotho reader was *Ngwana yo moswa*, and is published by New Readers Publishers (Brain and Rankin 2002). The English reader was titled *Honeybee: the beehive scheme book 2,* and is published by Juta Gariep (Lawrence and Okonsi 2006).

Reading comprehension was assessed by asking the learners to read a word passage silently and then answer questions based on the text. The task was an in-class assessment, and it took about 30 minutes per language to complete. Because of the COVID-19 pandemic, the researcher had no opportunity to pilot the reading comprehension tasks. For this reason, it was decided to use existing instruments, which had previously been used on a large scale by the DBE. The English reading comprehension task was adopted from the DBE Annual National Assessments (2015). The Northern Sotho reading comprehension task was adopted from the DBE Annual National Assessments (2014). Refer to Appendix G for the English reading comprehension task. The English and Northern Sotho reading comprehension measures consisted of six questions: comprising of multiple-choice questions (each with four possible answers based on the text), some fill-in questions, and at least one question which required analytical thinking. One mark was awarded for each correct response. The maximum raw score for this task was 7 for English (the last question for English carried two marks) and 6 for Northern Sotho.

4.4.2.3 Spelling test

The study used English and Northern Sotho spelling tests to assess the learners' spelling abilities in both languages. Refer to Appendix F for the Northern Sotho spelling task and Appendix G for the English spelling task. The assessment required the participants to write every word presented orally in isolation by the researcher or fieldworker on an answer sheet. The task was completed in class by all participants simultaneously. The field workers read each word aloud twice for the participants. The researcher selected the spelling words from the children's Grade 3 English and Northern Sotho workbooks. The English spelling task, for instance, required learners to write simple consonant vowel consonant (CVC) words such as *pen* and *fish* to a bit more complex words (i.e. *elephant, mountain*). For the Northern Sotho task, simple words with a vowel-consonant-vowel (VCV) structure (i.e. *ema*) and more complex words with consonant-vowel-consonant-vowel (CVCV) structure (i.e. *mošemane, sepela, hlokomela)* were included. The examiners assigned one point for each word spelt correctly. Both tests consisted of ten test items, and the maximum possible raw score for spelling in both languages was thus 10.

4.4.2.4 Early writing

The study utilised name and word writing tasks to assess the early writing skills of learners. In the name writing task, the participants had to write down their names and surnames on a piece of paper. The scoring criteria described in Wilsenach (2015), (i.e. awarding participants 100% (for both name and surname correct); 50% (name or surname correct); 0% (neither correct) was used for scoring. The word writing task required the participants to identify a picture (in this case, a car (*koloi*) and then write the name down in the Northern Sotho language. The examiners assigned one mark for each correct formed letter in the correct order. The maximum raw score for this task was 5.

4.5 Control tasks

Although the main focus is on phonological processing variables and their relations with literacy achievement in English and Northern Sotho, a measure of receptive vocabulary were incorporated as a control task.

4.5.1 Receptive vocabulary

The study utilised the Peabody Picture Vocabulary Test 4 PPVT[25] to assess the vocabulary knowledge of the participants. The PPVT-4 is a norm-referenced, broad range instrument that is untimed and individually administered (Dunn and Dunn 2007, 1). Each PPVT-4 item consists of the stimulus word and a set of four pictures. The examiners presented a card with four pictures to participants and asked participants to point to an image depicting the stimulus word. Form B of the PPVT was used to assess English receptive vocabulary. To assess Northern Sotho receptive vocabulary, the study used the receptive vocabulary task described in Wilsenach (2015, 8). This entailed that the Northern Sotho receptive vocabulary was adapted by translating Form A of the PPVT-4 test items into Northern Sotho. The Oxford Bilingual School Dictionary (Northern Sotho-English) and the online dictionary site for African languages[26] were used to translate the first 108 items from the English PPVT. The translation was done by a certified, professional translator, and problematic items were dealt with individually, as discussed in Wilsenach (2015). Three mother-tongue Northern Sotho teachers were consulted to check for any inaccuracies in the translated items. Furthermore, the translated items were piloted with five learners, and further adjustments were made based on their responses (Wilsenach 2015, 4). The researcher also used feedback from the fieldworkers, who are Northern Sotho L1 speakers, to clarify and ensure that the semantic content of the original text was not lost during the translation process. The modified version of the Northern Sotho vocabulary task was used to test the vocabulary abilities of children in this study. The raw scores for the English and Northern Sotho vocabulary tasks were calculated by adding up the number of correct responses to each task. The maximum raw scores for this task were 228 for

[25] The English receptive vocabulary test are not reproduced in the thesis, because of copyright restrictions. More information about this standardised test can be obtained online on the publisher's website: https://www.pearsonassessments.com/store/usassessments/en/Store/Professional-Assessments/Academic-Learning/Brief/Peabody-Picture-Vocabulary-Test-%7C-Fourth-Edition/p/100000501.

[26] The online dictionary for African languages wasobtained from (http://africanlanguages.com/northern_sotho/). This online dictionary is currently offline.

English and 108 for Northern Sotho. The examiners discontinued testing when the participant made eight or more errors on the highest item set.

4.6 Data collection procedure

The researcher administered the battery of phonological processing and literacy assessments described above at three data collection time points. All groups were initially assessed in February of their Grade 2 year (Point 1) and retested again later in August/October at the end of Grade 2 (Point 2). Finally, the children were assessed in November at the end of Grade 3 (Point 3). The researcher used 13 tasks to assess phonological and literacy abilities at Point 1, including sound matching, blending, NWR, digit span, rapid naming (letter, colour, digit, object), letter knowledge, letter reading, word reading, fluent reading and name writing. At this point, children had been exposed to at least one year of literacy instruction and had acquired some knowledge about the writing and reading conventions of Northern Sotho and English. Likewise, 13 measures were used for data collection at Point 2, including sound matching, blending, elision, NWR, digit span, rapid naming (digit, letter, object, colour), letter reading, word reading, oral reading fluency and word writing.

At Point 1 and Point 2, participants were tested individually on both English and Northern Sotho measures. Practice trials with feedback were given in all the tasks to ensure that the children understood the procedure. The Northern Sotho test items were administered by two trained research assistants who were L1 speakers of Northern Sotho. The researcher administered the English phonological processing and literacy measures. The total number of scores for each individual were recorded on a score sheet. Raw scores were calculated for each participant for all the Northern Sotho and English tasks. At Point 3, only spelling and reading comprehension tasks were assessed. Initially, the researcher had also intended to measure the phonological processing skills of learners at Point 3. However, this was not viable due to Coronavirus (Covid-19) pandemic constraints, which made it impossible to conduct research in schools (between April and November of 2020). When lockdown restrictions eased somewhat in October, the researcher had to re-negotiate an alternative with the schools to complete her research. Given the amount of instruction time that children lost as a result of the pandemic, it was not feasible to repeat the individual learner assessments that were done at Point 1 and Point 2. For this reason, only in-class literacy assessments could be completed at Point 3. This means that early phonological processing measures administered at the beginning of Grade 2 were utilised to predict future literacy performance (spelling and reading comprehension) at the end of Grade 3. By so doing, the researcher was able to establish the nature of the longitudinal associations between phonological processing and literacy skills based on the two measuring points. This design is not unique – it has been employed in several research studies (Schatschneider et al. 2004; Schaars, Segers and Verhoven 2019; Utchell, Schimmitt, McCallum, McGoey and Piselli 2015) to establish longitudinal associations between variables. For instance, Schatschneider et al. (2004), utilised this design to determine the extent to which early phonological (PA and naming speed) measures obtained at kindergarten predicted future reading outcomes at the end of Grade 1 and 2.

At Point 1 and Point 2, the CTOPP and DTWRP were administered as prescribed in the test manuals. Three testing stations were set up in the school library, with three learners rotating between the testing stations. Learners listened to auditory stimuli through earphones; so that ‘noise’ from one station would not interfere with testing at another station. With regards to the assessment of receptive vocabulary, the researcher and field workers again followed the instructions exactly as they provided in the PPVT manual, to ensure that the task was administered correctly to all learners.

4.7 Ethical considerations

Ethical considerations are one of the researcher’s primary research concerns (Drew, Hardman and Hosp 2007, 56). In the present study, the researcher conducted appropriate steps to protect the rights and dignity of the participants in this study. The researcher sought ethical research clearance from the University of South Africa (UNISA) and the Gauteng Department of Education (DoE). These clearance certificates are found in Appendix E and F, respectively. Obtaining ethical approval is a research requirement of UNISA and the Gauteng DoE in minimising risks posed to participants (Unisa 2007, 1; Gauteng DoE 2018, 2).

The researcher obtained informed consent from participants, parents and school authorities. These consent letters are provided in Appendix A and B. Fouka and Mantzorou (2011, 4) and Grant and Sugarman (2004, 725) emphasise the need for researchers to explain to the participants and other responsible authorities; the main aims, benefits and risks of participating in the study. The researcher ensured that the parents and school authorities received adequate information concerning the study. The written consent was only obtained from parents, using an informed consent letter that provided information in both English and Northern Sotho, as the learners in this study did not have the necessary literacy skills to provide written consent. The learners provided verbal assent to participate in the research before each measuring point. Participation was made voluntary, and the researcher explained the participants’ right to withdraw from the study at any stage. Babbie (2014, 64) emphasise that this should be exercised without any negative implications for participants. Before testing, the researcher explained the purpose of the study, the expected duration of the subject’s participation and the testing procedures. As argued by Hammersley and Traianou (2012, 3) and Spriggs (2010, 8), allowing the participants to decide and confirm verbally their participation in the research is a way of respecting and protecting their dignity.

The researcher ensured that no psychological or emotional risks were posed to the participants. Drew, Hardman and Hosp (2007, 64) stress that one of the most fundamental concerns in all research is to ensure that no individual is harmed by serving as a participant. The researcher guaranteed the participants’ confidentiality and anonymity by removing any personal identifiers (name, age, grade) in the description of the data. Tasks were discontinued if the learner clearly could not complete them. The learners were assessed in two separate sessions to minimise the amount of time they spent outside the classroom. The researcher was assisted by field workers who were L1 speakers of Northern Sotho at each data collection point, to ensure that the participants understood what was expected of them in each task. Data analysis and reporting of data were done at a group level in this study. Any information concerning the study was shared in a way that does not compromise the participants’ identity. Data were processed by the researcher, and only the researcher and her supervisor had access to the data. Data were not shared with any statistician, as the researcher did the statistical analyses herself. There is, however, an exception of the Northern Sotho Grade 3 literacy tasks, which had to be scored by a Northern Sotho speaking fieldworker, as the scorer had to be an L1 speaker. Once the initial data processing was completed, the learner assessment sheets were locked in a cupboard in the supervisor's office, who took responsibility for the safekeeping of the data. Moreso, the researcher reported the research findings accurately and truthfully without any misleading interpretations. As suggested by Leedy and Ormrod (2015, 124) academic work of other researchers was acknowledged through citation and referencing.

4.8 Research reliability and validity

Reliability means that the same tasks should consistently yield the same outcomes under various conditions (Drost 2011, 106). By implication, if one uses the same tests used in this study, at various points (or in a different research setting, by a different researcher), then similar results would be expected (Field 2005, 666). Validity meant that an instrument measures accurately what it is intended to measure and to which theory and evidence support the interpretation of data (Lynch 2003, 149; Whiston 2005, 43). The researcher took various measures to ensure the reliability and validity of the study, which will be explained in this section.

The English tasks (CTOPP, DTWRP and the PPVT) adopted in this study are standardised measures and have at least a reliability coefficient of .80 or more (Wagner et al. 1999, 54; FRLL, Institute of Education 2012, 52; Dunn and Dunn 2007, 53). As recommended by Rosnow and Rosenthal (1991, 65), the measuring instruments adopted for data collection must have at least a correlation coefficient measure of .80 or more. A correlation coefficient of 0.80 is preferable to ensure that comparable responses will be produced (Bowling 2009, 162; Drost 2011, 110), but most scholars agree that a coefficient of .70 is also acceptable (Cortina 1993, 98). The researcher ensured the reliability of the Northern Sotho items by conducting a measure of equivalence[27] and by conducting a Cronbach Alpha analysis for each measurement. The researcher designed and tested the participants with two different, but equivalent tasks and the results were correlated. According to Ary et al. (2010, 243) a correlation coefficient of .80+ shows that the two tasks measure the same skill. This information guided the researcher in deciding items to delete or retain.

The researcher enacted procedures to moderate the degree of difficulty of tasks by ensuring that the custom-made Northern Sotho tasks were age- and cognitive-appropriate. Whenever possible, the Northern Sotho test items were made following a similar format to English test items, to ensure uniformity and to allow comparisons. Some task items in the Northern Sotho were previously used by Wilsenach (2015), Makaure (2016) and Early Grade Reading Study (2018) studies, as well as DBE Annual National Assessments (2014). The researcher and field

[27] Equivalence can be measured through a parallel forms procedure in which one administers alternative forms of the same measure developed using the same content domain, the same test specifications, the same number of items, the same items format and similar difficulty and discriminating indices (Ayodele 2012, 396) to either the same group or different group of respondents at the same time or following some time delay (Miller 1995, 1).

workers maintained consistency in administering the tasks as well as in scoring and analysis of the data. Leedy and Ormrod (2015, 13) emphasise the need for consistency in the research procedures and analysis of the data. The researcher avoided including many test items when designing the Northern Sotho tasks. Rosenthal and Rosnow (1991, 47) argue that including many task items produce inconsistencies in task responding. Hence, the overall length of the tasks is an aspect to consider in ensuring the reliability and validity of tasks.

As advised by Pilot, Beck and Hungler (2001, 467) and Thiétart (2007, 175), the researcher subjectively assessed whether the task items were relevant, reasonable, unambiguous, clear and contained a fair sample of the total content. This procedure was done during a pilot study and through consultations with various linguists and language research experts, which included the researcher's supervisor. The researcher selected and designed the Northern Sotho tasks guided by the South African curriculum and assessment policy statements document. The testing and scoring of Northern Sotho tests were done by fieldworkers who were Northern Sotho L1 speakers and who were trained to administer the tests before each data collection point. The data collection sessions were recorded to allow the researcher to check the quality of the data and the scoring at a later stage.

The researcher also considered the SES of participants in selecting and designing tasks. Participants were from the same geographical area with almost the same socioeconomic features, and thus, it is unlikely that there are significant socioeconomic differences between the groups. As advised by Keele (2012, 43) and Hillygus and Snell (2015, 21) the researcher considered some measures to reduce threats of attrition, which included motivating participants to participate throughout the study and making testing sessions as short and as exciting as possible for participants.

The researcher utilised SPSS software to aid data analysis. Field (2013) describes SPSS as one of the most reliable software programmes in data analysis. In short, appropriate steps were taken throughout the study to guarantee the reliability and validity of the results.

4.9 The pilot study

A pilot study is a trial study conducted before a larger piece of research to determine the appropriateness of research instruments and procedures (De Vos, Strydom, Fouché and Delport 2011, 237; Welman Kruger and Mitchell 2009, 148) and to determine whether the research hypothesis is testable (Hassan et al. 2006, 7). A pilot study also assesses the feasibility of the tasks and testing procedures (Hazzi and Maldaon 2015, 53; Blaxter, Hughes and Tight 1996, 121; Simon 2011, 1).

The researcher carried out a pilot study in 2018 to assess the reliability of the Northern Sotho research instruments and to ascertain what the best procedures for this study would be. Although some have concluded that a formal sample size calculation for pilot studies may not be appropriate (Billingham, Whitehead and Julious 2013, 1), generally 10-20% of the main sample size is considered appropriate (Baker 1994, 183). Twenty four participants participated in the pilot study in this study, representing the 134 participants in the main study. As mentioned already, the main aim of the pilot study was to assess the reliability and feasibility of the custom-made Northern Sotho and some English standardised tasks. The results of the pilot study helped in fine-tuning the test items for the final study. The researcher also used the information from the pilot study in fine-tuning the research procedures.

4.9.1 Internal consistency and construct validity of Northern Sotho pilot data

The researcher performed Cronbach's alpha and Exploratory Factor Analysis to assess the appropriateness of the Northern Sotho test items in both pilot tests. These statistical analytical tools are described as the most important statistical analysis methods in research involving test construction and use (Cortina 1993, 98). The researcher created two Northern Sotho test versions of each measure (i.e. pilot test one and pilot test two), except for non-word repetition and letter knowledge, where only one test was piloted. The results from Cronbach's alpha and exploratory factor analysis are presented in Table 4.1 below.

Table 4.1 Internal consistency and construct validity of Northern Sotho pilot tests

Variable	Cronbach's alpha	Factor analysis (cumulative %)
Sound matching one	.989	94.397
Sound matching two	.997	98.217
Blending one	.976	91.387
Blending two	.990	94.106
Non word repetition	.991	96.681
Letter knowledge	.996	98.140
Word reading one	.985	98.362
Word reading two	.983	95.671

4.9.1.1 Internal consistency of Northern Sotho pilot data

Reliability analysis was carried out on the Northern Sotho measures sound matching, blending, non-word repetition, letter knowledge and word reading. Cronbach's alpha was used to check the internal reliability of the Northern Sotho measures. Cronbach's alpha is used to provide a measure of the internal consistency of a test or scale, and it describes the extent to which all the items in a test measure the same concept or construct (Tavakol and Dennick 2011, 53). In this pilot study, the Cronbach's coefficient α was used to calculate the internal consistency of 8 Northern Sotho tests (sound matching test one, sound matching test two, blending test one, blending test two, non-word repetition, letter knowledge, word reading test one, word reading test two). The findings revealed that the tests had a reliability of $\alpha > 0.90$, indicating a scale of high reliability. The correlation between the test items was more than 0.8.

According to Gliem and Gliem (2003, 87), Cronbach's alpha reliability coefficient normally ranges between 0 and 1. The closer Cronbach's alpha coefficient is to 1.0, the greater the internal consistency of the items, while the closer the alpha coefficient is to .0, the lower the internal consistency of items. George and Mallery (2003, 231) provide the following rules of thumb: *"> .9 – Excellent, > .8 – Good, > .7 – Acceptable, > .6 – Questionable, > .5 – Poor, and < .5 – Unacceptable".* Thus, a Cronbach's alpha of more than $\alpha > 0.90$ for the tests (sound matching test one, sound matching test two, blending test one, blending test two, non-word repetition, letter knowledge, word reading test one, word reading test two) indicated that the items have high internal consistency.

Reliability analysis was carried out on the sound matching tests (test one and two), comprising ten items each. The results showed that each test reached acceptable reliability, α = >0.90. All items for sound matching one and two appeared to be worthy of retention. The Cronbach's alpha for blending test one and blending test two comprising of 15 items each revealed a value of α = >0.90. However, a closer analysis of the data shows that items 7, 8, 9, 10, 11, 12, 14 and 15 for blending test one and test items 7, 8, 9 and 11 for blending test two were somewhat less reliable. The Cronbach's alpha coefficient for non-word repetition consisting of 17 items reached a value of α = >0.90. However, items 9, 11, 12, 13, 14, 15, and 17 appeared somewhat problematic. The Cronbach's alpha for letter knowledge comprising 15 items was α = >0.90, and all items appeared worthy of retention. Cronbach's alpha showed that word reading one and word reading two tasks consisting of 20 items each reached acceptable reliability of *α = >0.90*. However, the test items 11-20 for word reading one and test items 15, 16, 17, 18, 19 and 20 for word reading two appeared somewhat less reliable. A visual inspection of the data also confirmed that these items appeared too difficult as most children did not attempt to read these words.

4.9.1.2 Construct validity of Northern Sotho pilot data

Exploratory factor analysis was conducted in the pilot study to check the construct validity of test items. Exploratory factor analysis determines the extent to which the items measure the intended constructs (Tabachnick and Fidell 2007) and can detect the factors that underlie a dataset based on the correlations between variables (Field 2005). As such, it is useful for studies that involve questionnaires or a battery of tests to identify, reduce and organize a large number of test items into a manageable size, to get at an underlying concept, and to facilitate interpretations (Yong and Pearce 2013, 79; Field 2005, 219). Exploratory factor analysis for this pilot study was conducted for eight tests using SPSS version 23, and varimax rotation was applied. According to Field (2005, 638), to achieve a reliable factor analysis, the sample size needs to be big enough. A common rule of thumb is that a researcher at least needs 10-15 participants per item (Hof 2012, 3). Thus, all the test items in this pilot study were within the 10-15 required range. It was deemed necessary to conduct factor analysis for this pilot study to determine the factor structure of test items.

The factor analysis results of the pilot study revealed that all the Northern Sotho tests (sound matching test one, sound matching test two, blending test one, blending test two, non-word repetition, letter knowledge, word reading test one, word reading test two) explained a cumulative percentage value of above 90%. The factor loading values for each individual test items, for all the tests, are > .80, indicating strong associations between items and constructs. A factor loading for a variable is a measure of how much the variable contributes to the factor; thus, high factor loading scores indicate that the dimensions of the factors are better accounted for by the variables (Yong and Pearce 2013, 81; Scharf and Nestler 2018,121). The closer the value to *-1* or *+1*, the stronger the relationship and the closer to zero, the weaker the association between items and construct (Yong and Pearce 2013, 84). High factor loadings for items in this pilot study indicated that the items represented the underlying constructs very well. However, the factor loading results also confirmed that some of the tests items (previously mentioned in section 4.9.1) were less reliable. However, the analysis provided sufficient evidence that these somewhat less reliable items did not affect the extent to which the test items were valid measures of the underlying constructs.

Overall, the piloted Northern Sotho test items were valid and reliable instruments for measuring the phonological processing and literacy abilities of Northern Sotho-English bilingual children. For those constructs (sound matching, blending, word reading) with two equivalent tests, the researcher selected the most reliable items to create one refined final test, which was used in the main study. The researcher checked the test item means and excluded those items that learners performed very poorly on, as these items were arguably too difficult. The Cronbach alpha and factor loading results were also considered in the elimination process since they indicated problematic items in each test. According to Reynaldo and Santos (1999, 3) running Cronbach's alpha and exploratory factor analysis is a good method of screening for efficient items for a study. Hence, the pilot study results allowed the researcher to ensure that all the custom-made instruments were reliable, and adjustments were made to fine-tune the Northern Sotho measures for the final study.

4.9.2 Internal consistency and construct validity of English pilot data

The researcher also calculated the reliability and construct validity of English standardised measures (sound matching, blending, elision, digit span, non-word repetition, regular word reading, exception word reading and non-word reading) to establish their feasibility in the Northern Sotho-English bilingual population. As previously discussed in Section 4.8 above, the reliability and validity analysis for these tasks was conducted on English L1 speakers, and it was worthwhile to establish their feasibility in an English L2 bilingual population. Fifteen participants were considered for this analysis. Table 4. 2 below shows the Cronbach's Alpha and Exploratory Factor Analysis results for English test items.

Table 4.2 Internal consistency and construct validity of English pilot tests

Construct	Cronbach Alpha	Factor analysis (cumulative %)
Elision	.858	96.7
Blending	.959	91.5
Sound matching	.980	96.1
Digit span	.828	79.4
Non-word repetition	.862	95.5
Regular word reading	.900	93.4
Exception word reading	.745	87.9
Non-word reading	.700	95.8

Reliability analysis was carried out on the sound matching (comprising 26 items), blending (comprising 33 items), regular word reading (comprising 30 items) measures and the tests reached an excellent Cronbach's Alpha of α = *>0.90*. The Cronbach's Alpha for blending (comprising 33 items), digit span (comprising 28 items) and non-word repetition (comprising 30 items) was α = *>0.80.* Exception word reading and non-word reading tasks comprising 30 items each reached an acceptable Cronbach's Alpha of α = *>0.70*. Factor analysis results for the elision, blending, sound matching, non-word repetition, regular word reading and non-word reading measures revealed that the items explained a cumulative percentage of >90%. Digit span test items explained a cumulative percentage of 79%, whilst exception word reading had a factor loading of 88%. The factor loading values for each individual test item for all the piloted English measures were closer to *+1*, indicating strong associations between items and constructs. Based on these statistical results, all the English standardised measures were deemed to be reliable for use in the current population. All test items were retained and assessed in accordance with the CTOPP and DTWRP specifications and guidelines.

4.10 Data presentation, analysis and interpretation

The researcher adopted the quantitative approach for data analysis in this study. Quantitative analysis involves the formulation and testing of research hypotheses (Dörnyei 2007, 31), which can be used to confirm or refute a theory at a later stage in the research cycle (Creswell 2003, 153; Leedy and Ormrod 2015, 102). The study tested several hypotheses formulated within the conceptualised phonological processing model of literacy development. Standardised English tasks, as well as custom-made Northern Sotho phonological and literacy tasks, were used to generate numerical data.

The researcher adopted statistical procedures to analyse and draw conclusions from the data. The research data was captured in MS Excel and analysed using SPSS. The purpose of the statistical methods is to summarise the raw data in such a manner that meaningful information could be extracted from it (Leary 2001, 37; Gall, Gall and Borg 2003, 295; Louw 2005, 4). Descriptive statistics and inferential statistical models were implemented to describe and explain the associations between phonological processing and literacy variables in this study to determine differences between the two LoLT groups on these variables. The study used different inferential statistical analytical tools, which included multivariate analysis of variance (MANOVA), chi-square, Cohen's *d* test, repeated-measures ANOVA, correlations, multiple regression and path analyses. Before the primary analysis, the researcher checked whether the data satisfied the assumptions (i.e. normality, multicollinearity, homogeneity of variance, sphericity, independent observations) for conducting inferential statistics analysis. It is important to check whether data meets certain assumptions before conducting parametric tests (Field 2013, 63).

Descriptive statistics examined group differences and associations between variables. The mean and standard deviation values for phonological processing and literacy measures were calculated in each group. General information about the age and home language of the participant was sought by the researcher during testing to yield descriptive details about the sample. MANOVAs, chi-square and Cohen's *d* tests were used, following the preliminary analyses, to assess main group effects. A MANOVA is a useful statistical tool in situations where there are several correlated dependent variables that have to be analysed simultaneously (Carey 1998, 1; Creswell 2013, 212). The researcher analysed the data on group differences within the framework of bilingual theories on literacy acquisition.

Correlation analyses assessed the relationships between phonological processing and literacy variables. Correlation is an empirical relationship between variables such that a change in one variable is associated with a change in the other (Babbie 2014, 97; Creswell 2013, 41). The researcher used Spearman’s correlations to test whether phonological processing skill (independent variable) has any effect on literacy (dependent variable) and to establish the associations between the independent variables. However, a correlation is not sufficient to imply causation (Statistics Solutions 2017, 1). Regression and path analysis established the predictive power of phonological processing skills in terms of literacy development in Northern Sotho-English bilingual children. Path analysis allows one to examine the causal relationships among two or more variables (Field 2013, 157; Zou, Tuncali and Silverman 2003, 168), which make it suitable for this study. This data was analysed within the framework of the phonological processing model by Wagner et al. (2013).

The repeated-measures ANOVA was used to establish the developmental pattern of phonological and literacy measures from Point 1 to Point 2. Repeated-measures ANOVA is a statistical tool conducted on any design in which the independent variables have all been measured using the same participants in all conditions (Field 2013, 428). Hence, the test was used to identify any statistically significant developmental changes that had occurred over time in terms of phonological processing and literacy skills.

4.11 Conclusion

This chapter described the methodology utilised in investigating the impact of phonological processing in the literacy acquisition of Northern Sotho-English bilinguals. A comprehensive description of the research approach and design, selection of subjects, data collection materials and procedures have been provided. Statistical issues relating to issues of research reliability and validity have been discussed in this chapter. The chapter also discussed ethical considerations and the necessity of conducting a pilot study before the actual data collection process. The researchers also specified the analytical strategy for the study. The next chapter will present the first part of the results, where the focus will be on group differences between the LoLT groups at Point 1 and 2, as well as on the associations between all the measures at these individual points.

CHAPTER 5
RESULTS PART 1
GRADE 2 GROUP DIFFERENCES, CROSS-LINGUISTIC RELATIONSHIPS AND CORRELATIONS BETWEEN PHONOLOGICAL PROCESSING AND LITERACY

This chapter presents the findings of the first and second measuring points. The results of this study are presented in two parts due to the extensive nature of the data gathered in this study, the scope of the research questions and the multitude of statistical techniques. Chapter 5 (this chapter) focuses on differences between the two LoLT groups, on cross-linguistic relationships as they manifested in the two groups and on the relationship between phonological processing and literacy skills at measuring point 1 and measuring point 2. Chapter 5 also presents the receptive vocabulary data obtained in both LoLT groups. The second part of Chapter 5 presents a more in-depth analysis of the PA component of phonological processing, by looking into PA at the syllable and phoneme levels at measuring point 2. For this part of the analysis, syllable and phoneme awareness scores were extracted from the blending and elision tasks. Although these scores collapsed into one score at measuring point one to avoid floor effects, they are represented both as one PA score and as separate phoneme and syllable awareness scores at measuring point two.

Chapter 5 offers a (cross-sectional) analysis of each data point and proceeds as follows: first, the vocabulary data is presented. This is followed by a presentation of data on phonological processing and literacy data obtained at measuring point one (beginning of Grade 2). Finally, the phonological processing and literacy data obtained at measuring point two (end of Grade 2) are presented.

5.1. Results receptive vocabulary

This section presents the receptive vocabulary results for Northern Sotho and English. The receptive vocabulary measures were conducted with 130 Grade 2 Northern Sotho-English bilinguals in July 2019. The sample is divided into two groups (NS LoLT and English LoLT) depending on the medium of instruction of the school. The NS LoLT group consisted of 67 participants, while the English LoLT group had 63 participants. The PPVT was used to operationalise the receptive vocabulary variable in this study. Table 5.1 shows the results of the descriptive statistics for receptive vocabulary for the entire sample and each group.

Table 5.1 Descriptive statistics for receptive vocabulary

	NS LoLT Group (N=67)						English LoLT Group (N=63)						Entire sample					
NS & ENG TASKS	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coefficient	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coefficient	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coefficient
Eng receptive vocabulary	36.0	14.2	15-75	60	.650	.077	59.4	20.6	26-106	80	.309	-.593	47.9	21.2	15-106	91	.690	-.083
NS receptive vocabulary	64.1	16.6	0-6	6	-.135	-1.03	61.9	15.1	31-99	68	.279	-.296	63.0	15.9	31-99	68	.050	-.775

Note: NS-Northern Sotho, Eng-English, M-mean, SD-standard deviation.

5.1.1. Northern Sotho and English vocabulary

Descriptive statistics results revealed that the English LoLT group performed better than the Northern Sotho LoLT group on English receptive vocabulary. The Northern Sotho group performed better than the English group on the Northern Sotho receptive vocabulary. When the raw scores were converted into scaled scores, findings based on the entire sample revealed that the Grade 2 children obtained an average scaled score of 55 (95% confidence interval 49-64). This is 3.0 Standard Deviations below the norm and classified as an extremely low score for L1 speakers of English. The NS LoLT group obtained an average scaled score of 47 (95% confidence interval 42-56). This is 3.5 Standard Deviations below the norm and classified as an extremely low score for L1 speakers of English. The English LoLT group obtained a scaled score of 61 (95% confidence interval 55-70). This is 2.5 Standard Deviations below the norm and classified as an extremely low score for L1 speakers of English. The findings show apparent evidence for the influence of LoLT in terms of performance on the receptive vocabulary task.

Skewness and kurtosis coefficient results were checked for normal distribution of the data sample. Skewness assesses the extent to which a variable's distribution is asymmetry, while kurtosis is a measure of whether the distribution is too peaked (Hair, Hult, Ringle and Sarstedt 2017, 61). The general rule for skewness is that any value which is less than *-1* and greater than *+1* is an indication of skewed distribution (Hair et al. 2017, 61). This rule implies that values within the range of *-1 to +1* are acceptable for normal distribution. The findings for the entire sample revealed that English vocabulary and Northern Sotho vocabulary have acceptable skewness values. For kurtosis, an acceptable value for a normal distribution is 3 (Hair et al. 2017, 61). The findings for the entire sample revealed that English and Northern Sotho receptive vocabulary fell out of the acceptable kurtosis range.

Within-group statistics for NS LoLT revealed that English receptive vocabulary has an acceptable skewness value while Northern Sotho receptive vocabulary is negatively skewed. Kurtosis results indicated that both English and Northern Sotho receptive vocabulary fell outside the acceptable kurtosis range in this group. Statistics for the English LoLT group revealed that both English and Northern Sotho are within the acceptable skewness range. Kurtosis results for the group suggest that both variables fell out of the kurtosis acceptable range. Taken together, these findings suggested that some of the data may not be normally distributed. However, the sample in this group ($n=130$) may be large enough to assume normality of the data sample (Ghasemi and Zahediasl 2012, 486). An independent samples T-test was conducted to establish whether there were significant mean differences in vocabulary. Group was used as the independent variable, and English vocabulary and Northern Sotho vocabulary as dependent variables. The findings revealed that there were statistically significant group differences between the NS LoLT and English LoLT groups on English receptive vocabulary ($t\ (128)=-7.48,\ p=<.001$). The English LoLT group ($M=58.7,\ SD=20.3$) performed significantly better than the NS LoLT group ($M=36.2,\ SD=13.6$) on English receptive vocabulary. However, the mean difference between groups on Northern Sotho vocabulary was not statistically significant. Further interpretation based on this data was carried out in Chapter 6.

5.2. Results phonological processing and literacy: measuring point one

Data gathered from 134 Grade 2 Northern Sotho-English bilingual children were analysed for measuring point 1. The data represent the learners' phonological processing and literacy skills at the beginning of Grade 2 (February 2019). All the learners spoke Northern Sotho as a home language, and they were categorised into two groups based on the LoLT. The first group's (*Group 1, N = 69*) LoLT was Northern Sotho (from Grade 1-3), whereas the second group's (*Group 2, N= 65*) LoLT was English (beginning of Grade 1-3). The mean age of the children in both groups was 7; 3 years. Group 1 comprised of 46 girls and 23 boys, while Group 2 comprised of 33 girls and 32 boys. PA was assessed using sound matching and blending tasks. PWM was measured using NWR and digit span. RAN was assessed using object, colour, letter and digit naming tasks. Literacy development was measured using letter knowledge, letter reading, various word reading tasks, oral reading fluency tasks and early writing tasks. More information concerning these tasks was provided in Chapter 3.

Standardised measures were used for all the English phonological and literacy tasks. Northern Sotho phonological and literacy tasks were custom-made since no standardised measures exist in Northern Sotho. Data were analysed using the Statistical Packages for Social Sciences (SPSS) software. Preliminary analysis was performed to check for parametric assumptions as well as for construct validity and reliability. Group differences were assessed via a Pearson Chi-square test, error bars, MANOVA and Cohen's d analyses. Spearman's correlations, multiple regression and AMOS path analysis, were used for establishing relations between variables.

5.2.1. Parametric assumption analysis

According to Garson (2012, 8), parametric tests form part of preliminary data analysis and are performed to determine an appropriate statistical model for data analysis. Three tests, which include the Shapiro-Wilk test of normality, multicollinearity and homogeneity of variance, were conducted for parametric testing. The results of these tests are given in Table 5.2 below.

The Shapiro-Wilk test of normality determines whether the sample or population mean *(μ)* is normally distributed (Mordkoff 2016, 1; Das and Imon 2016, 1). The Shapiro-Wilk test of normality was considered in this study because it is more robust in smaller sample sizes (Ghasemi and Zahediasl 2012, 489). With the Shapiro-Wilk test, normality is achieved at $p > .05$. In the entire sample, normality was met by the Northern Sotho non-word repetition task. In the Northern Sotho group, normality was assumed for English sound matching and Northern Sotho digit span and non-word repetition tasks. In the English group, normality was met for English sound matching and RON, as well as Northern Sotho non-word repetition, RON and letter knowledge. Several variables violated the normality assumption. However, the sample size *(N = 134)* is large enough for the results of parametric tests to be robust (Pallant 2007, 179; Elliot and Woodward 2007; Garson 2012, 17), and hence the violation of normality was assumed not to jeopardise the results in this study. Ghasemi and Zahediasl (2012, 486) even suggested that a sample larger than 30 is sufficient for the data to be considered normal despite the distribution pattern.

Levene’s test was used to test for the homogeneity of variance assumption. Levene’s test assesses the hypothesis that the variances in the groups are equal and is achieved when the p-value is non-significant ($p > .05$) (Field 2005, 98). The majority of the variables English (blending, sound matching, digit span, RDN, RCN, word reading) and Northern Sotho (blending, sound matching, digit span, non-word repetition, RLN, letter knowledge, early writing, word and fluent reading) abilities met this assumption. This finding means that the variability in scores for each LoLT group was the same. However, some tasks, which include English letter reading, RON and fluent reading, as well as Northern Sotho RON and letter reading, failed to meet the homogeneity assumption, implying that the variability in the scores for each LoLT group was not the same

Table 5.2: Test of normality, homogeneity of variance and multicollinearity

English and Northern Sotho tasks	NS LoLT Group		English LoLT Group		Entire Sample		Homogeneity of variance		Collinearity statistics	
	Shapiro-Wilk test p.value	Sig.	Shapiro-Wilk test p.value	Sig.	Shapiro-Wilk test p.value	Sig.	P value	Sig	Tolerance	VIF
Eng blending	.88	.000	.93	.001	.91	.000	.27	.602	.661	1.51
Eng sound matching	.98	.345	.97	.102	.98	.032	3.40	.068	.638	1.59
Eng digit span	.95	.006	.95	.015	.96	.001	.11	.746	.765	1.32
Eng non-word repetition	.93	.001	.91	.000	.89	.000	20.1	.000	.797	1.26
Eng RLN	.84	.000	.73	.000	.71	.000	14.2	.000	.709	1.41
Eng RDN	..90	.000	.94	.003	.93	.000	.32	.574	.686	1.46
Eng RCN	.87	.000	.80	.000	.83	.000	1.14	.288	.694	1.44
Eng RON	.89	.000	.97	.100	.91	.000	6.73	.011	.856	1.17
Eng word reading	.82	.000	.72	.000	.76	.000	3.3	.073		
Eng fluent reading	.64	.000	.72	.000	.68	.000	7.8	.006		
NS blending	.71	.000	.86	.000	.79	.000	.73	.393	.671	1.49
NS sound matching	.95	.005	.93	.030	.96	.000	.79	.402	.694	1.44
NS digit span	.97	.086	.96	.034	.97	.005	.001	.971	.655	1.53
NS non-word repetition	.97	.094	.97	.172	.98	.097	.13	.720	.748	1.34
NS RON	.95	.007	.97	.197	.97	.007	7.5	.007	.873	1.15
NS RLN	.75	.000	.73	.000	.75	.000	.03	.867	.800	1.25
NS letter knowledge	.96	.016	.98	.084	.97	.002	3.72	.056		
NS letter reading	.92	.000	.92	.000	.92	.000	4.03	.047		
NS word reading	.84	.000	.78	.000	.84	.000	2.44	.121		
NS fluent reading	.64	.000	.50	.000	.59	.000	.90	.344		
NS early writing	.67	.000	.61	.000	.66	.000	3.62	.059		

Note: VIF- variance inflation factor, Sig-significance, NS-Northern Sotho, Eng-English.

The multicollinearity assumption assumes that the predictor variables[28] do not correlate too strongly (Field 2005, 170), and it is detected when the correlation coefficient *(r)* is above *.80* (Yoo, Mayberry, Bae, Singh, Peter and Lillard 2014, 10). The tolerance and variance inflation factor (VIF) statistics were used to assess multicollinearity (Hawking and Pendleton 1983, 497). A tolerance statistic value close to *0* suggests multicollinearity, whilst a value close to *1* suggests low or no multicollinearity (Gerbing 2014, 3). Most variables were within the VIF and tolerance acceptable ranges, which suggest the absence of multicollinearity among the

[28] In this case, examples of predictor variables are blending, sound matching, digit span, non-word repetition, RLN, RDN, RON and RCN.

variables. Taken together, the results obtained from the test of normality, Levene's test and from the multicollinearity analysis were deemed satisfactory, and they suggested that the data gathered at measuring point one of the study could be analysed using parametric statistical tests.

5.2.2. Construct validity and reliability

A Confirmatory Factor Analysis (CFA) was performed to determine the construct validity of variables. CFA is a structural equation modelling technique used to determine the goodness of fit between a hypothesised model and the sample data, and it is a powerful statistical tool for examining the nature of and relations among latent constructs (Jackson, Gillapsy and Purc-Stephenson 2009, 6). CFA was used in this study to establish the extent to which the measured variables are good indicators of the underlying latent variables. PA, PWM, RAN and literacy development (LD) represented the latent[29] variables in this study. The phonological processing (i.e. blending, sound matching, non-word repetition, digit span, RDN, RLN, RCN, RON) and literacy (i.e. letter knowledge, letter reading, word reading, fluent reading and early writing) tasks represented the indicator[30] variables. The factor loadings for each latent and indicator variable are presented in Figure 5. 1 below.

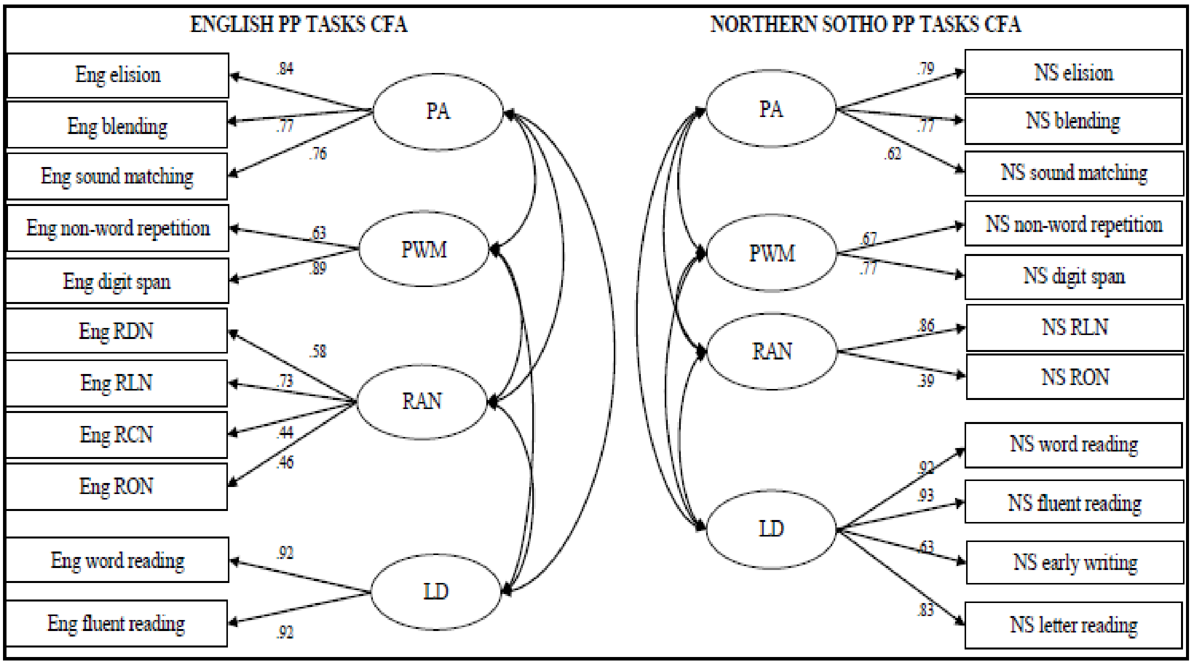


Figure 5.1 Confirmatory Factor Analysis results for English and Northern Sotho

The English variables indicate a good fit between the model and the observed data (*chi-square = 33.4; degrees of freedom (df) = 29, Normed Fit Index (NFI) = .93; Root Mean Square Error of Approximation (RMSEA) =.03, Comparative fit index (CFI) = .99, the Tucker-Lewis fit index (TLI) = .98, Incremental Fit Index (IFI) = .99*). On the other hand, Northern Sotho variables

[29] A latent variable is described as a hypothetical construct that cannot be directly measured (MacCallum and Austin 2000, 201).
[30] An indicator variable is a construct that can is directly observed (MacCallum and Austin 2000, 201).

indicate an acceptable fit[31] *(chi-square = 79.4; df = 38, RMSEA = .09, NFI = .86, CFI = .92, TLI = .86. IFI = .92, GFI = .90),* implying that these models can be retained for further analysis.

The findings in both LoLT groups indicated that blending and sound matching were significant indicators of PA ($p < .01$) latent variable. Non-word repetition and digit span variables were found to be significant indicators of PWM ($p<.01$). In addition, RON RCN RDN and RLN were significant indicators of RAN ($p < .01$). English (word and fluent reading) and Northern Sotho (word and fluent reading, blending) tasks had higher factor loadings > *.80*, indicating strong relationships between items and constructs. A factor loading for a variable is a measure of how much the variable contributes to the factor (Yong and Pearce 2013, 84). The closer a value is to *-1* or *+1,* the stronger the relationship and the closer to zero, the weaker the relationship between items and construct. The internal consistency of the tasks was measured using Cronbach's Alpha, and the results of all variables were above *.90*. The recommended value for Cronbach's Alpha is *.70* (Field 2013, 668). More information on the Cronbach's Alpha results was given in Chapter 3.

5.2.3 Descriptive statistics: Point 1

Preliminary analysis was conducted to provide descriptive statistics for all the phonological processing and literacy skills in this study. Descriptive statistics help to describe or summarise data in a meaningful way (Litoseliti 2010, 70). Descriptive statistics were also conducted to establish the learner performance differences between the Northern Sotho and English LoLT groups. Mean scores were obtained by calculating a raw score for each individual, and then calculating the mean raw score for each group. Table 5.3 displays the means, standard deviation (SD), minimum, maximum, range, skewness and kurtosis for all Northern Sotho and English measures, for the entire sample, as well as for the two LoLT groups.

Descriptive statistics for the entire sample revealed that Northern Sotho-English bilinguals performed below average for most of the English phonological and literacy tasks. In the Northern Sotho language, the children performed below average in most tasks except non-word repetition and early writing. Within-group statistics revealed that the English LoLT group had higher mean scores than the Northern Sotho LoLT group on English (blending, sound matching, RDN, RLN, RCN, fluent reading) and Northern Sotho (sound matching, blending, RLN, RON, early writing). The Northern Sotho LoLT group performed better than the English LoLT group on English (non-word repetition, digit span, word reading) and Northern Sotho (digit span, non-word repetition, letter knowledge, word reading, letter reading, fluent reading) tasks.

Overall, the descriptive statistics suggest that the two LoLT groups are more or less at the same level in terms of their performance at this stage, despite their different LoLTs. However, it is also apparent that the English LoLT group had an advantage in the English phonological and literacy tasks, whilst the Northern Sotho LoLT group performed slightly better in the Northern

[31] The CFI, IFI and GFI *(=.>90),* as well as the RMSEA of .09 values indicate that the model is an acceptable fit (Bentler and Bonnet 1980; Bentler 1990; MacCallum, Browne and Sugawara 1996, 132).

Sotho measures. The pattern shows some effects of the LoLT to a certain extent. Further analysis using a MANOVA was carried out to determine the significance of these observed differences. This multivariate analysis is presented in the following section. According to Baha (2016, 9) a descriptive analysis does not allow the researcher to go beyond the data that is given. Descriptive statistics alone cannot provide statistical evidence sufficient to answer the questions. Hence, inferential statistics were performed in order to establish the significance of group differences.

Table 5.3 Descriptive statistics for the groups and entire sample

NS & ENG TASKS	NS LoLT Group (N=69)						English LoLT Group (N=65)						Entire sample					
	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coefficient	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coefficient	M	SD	Min/Max	Range	Skewness coeffient	Kurtosis coefficient
Eng blending	7.3	4.3	0-19	19	1.22	1.12	7.5	3.6	0-17	17	.80	.86	7.4	4.0	0-19	19	1.02	.86
Eng sound matching	9.8	4.8	0-23	23	.25	.31	11.7	6.0	0-24	24	.23	-.17	10.7	5.5	0-24	24	.33	-.17
Eng digit span	13.5	2.3	9-19	10	.61	.01	13.5	2.1	9-18	9	.21	-.26	13.5	2.2	0-19	19	.45	-.26
Eng non-word repetition	15.3	2.6	7-22	15	-.68	2.52	12.8	4.6	0-19	10	-1.06	2.83	14.1	3.9	0-22	22	-1.40	2.83
Eng RDN	42.9	12.1	24-88	64	1.37	2.53	43.2	12.0	24-86	62	.97	1.92	43.1	12.0	24-88	64	2.70	8.88
Eng RLN	53.3	23.0	25-142	117	1.75	3.63	72.6	48.5	28-240	212	2.20	8.88	62.7	38.7	25-240	215	1.17	1.92
Eng RCN	53.7	17.6	32-110	78	1.30	1.25	56.2	23.7	23-180	157	2.57	9.50	54.9	20.7	23-180	157	2.27	9.50
Eng RON	63.5	20.7	35-155	120	1.53	4.33	59.8	13.8	34-101	67	.59	4.85	61.7	17.7	34-155	121	1.48	4.85
Eng regular word reading	5.4	3.03	0-21	21	2.67	11.1	5.02	4.1	0-29	29	3.24	17.5	5.21	3.6	0-29	29	3.08	16.4
Eng exceptional word reading	5.0	2.2	0-14	14	1.74	5.17	4.7	3.9	0-27	27	3.07	15.8	4.8	3.1	0-27	27	3.05	18.5
Eng non-word reading	4.5	2.04	0-12	12	.83	3.45	4.03	3.6	0-25	25	3.16	16.9	4.3	2.9	0-25	25	2.89	18.8
Eng word reading	14.8	6.8	0-45	45	2.08	7.63	13.7	11.1	0-81	81	3.58	21.6	14.3	2.9	0-81	81	3.41	21.6
Eng fluent reading	5.6	5.4	0-40	40	4.20	25.1	6.8	8.4	0-48	48	2.69	14.2	6.2	7.0	0-40	40	3.26	14.2
NS sound matching	4.13	2.8	0-10	10	.36	-.81	4.5	2.5	0-10	10	.06	-.84	4.3	2.7	0-10	10	.21	-.84
NS blending	7.20	2.9	0-15	15	1.35	1.67	7.3	3.2	0-15	15	.82	.98	7.3	3.04	0-15	15	1.05	.98
NS digit span	7.36	2.2	2-12	10	.14	-.42	7.1	2.1	2-11	9	-.14	-.52	7.2	2.2	2-12	10	.02	-.51
NS non-word repetition	14.3	2.6	7-20	13	-10	-.30	13.5	2.7	8-20	12	.01	-.21	13.9	2.7	7-20	13	-.05	-.21
NS RLN	62.7	32.9	24-187	163	2.18	4.99	66.7	35.2	31-195	164	2.29	5.09	64.7	33.9	24-195	171	2.22	5.09
NS RON	57.0	14.8	34-104	70	.81	.74	65.9	19.5	33-118	85	.40	.38	60.8	18.3	7-118	111	.50	.38
NS letter knowledge	11.1	1.6	8-15	7	.11	-.84	10.5	2.00	6-15	9	-.22	-.16	10.8	1.8	6-15	9	-.21	-.16
NS Di/Trigraphs	2.03	1.1	0-5	5	.226	.273	1.43	1.2	0-5	5	.429	-.426	1.7	1.2	0-5	5	.221	-.269
NS word reading	7.7	3.41	3-20	17	1.79	4.35	6.3	2.8	0-20	20	1.98	5.48	7.00	3.3	0-20	20	1.81	5.48
NS letter reading	20.0	5.8	7-42	35	1.07	3.01	18.7	8.4	1-55	54	1.04	4.71	7.2	7.2	1-55	54	.98	4.71
NS fluent reading	8.2	7.8	0-45	45	3.19	12.1	6.2	7.6	0-58	58	5.28	19.9	7.22	7.8	0-58	58	3.9	19.9
NS early writing	79.0	30.2	0-100	100	-1.14	.32	81.5	24.3	50-100	50	.56	-.07	80.2	27.4	0-100	100	-.98	-.07

Note: M-mean, SD-Standard deviation, Min-minimum, Max-maximum, NS-Northern Sotho, Eng-English

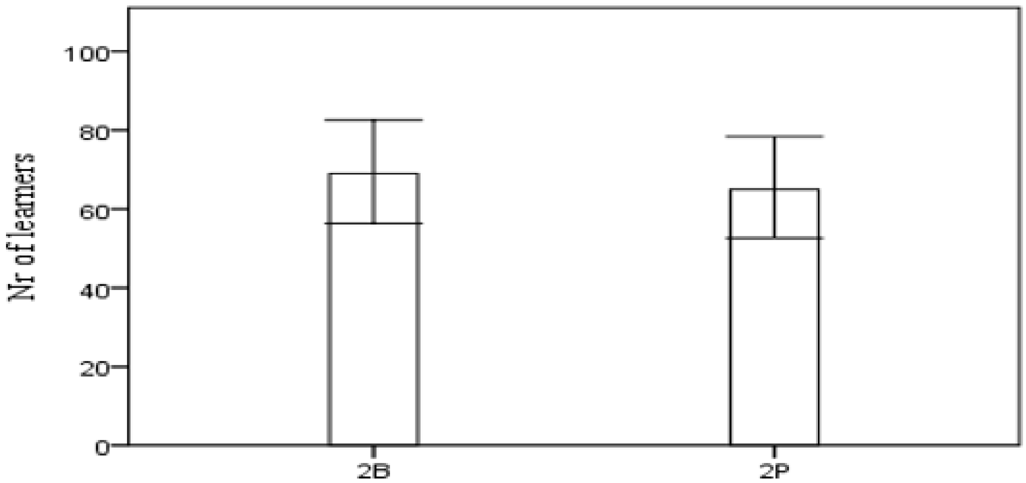
While obtaining the descriptive statistics, the researcher also checked for the normal distribution pattern of the data. This was done by checking skewness and kurtosis statistics. Findings from the entire sample revealed that the English tasks (blending, sound matching, digit span, RDN) and the Northern Sotho tasks (blending, sound matching, digit span, RON, letter reading) have acceptable values for normal distribution. English non-word repetition and Northern Sotho (non-word repetition, letter knowledge, early writing) tasks were negatively skewed. Findings based on the entire sample reveal that only the English non-word repetition is within the acceptable kurtosis range.

Within-group statistics revealed that in the Northern Sotho LoLT group, the English (blending, sound matching, digit span, RDN, RCN) and Northern Sotho (blending, sound matching, digit span, RON, letter knowledge, letter reading) tasks had acceptable skewness values. English non-word repetition and Northern Sotho (non-word repetition and early writing) measures were negatively skewed. With regards to kurtosis, English (i.e. non-word repetition, RDN) and

Northern Sotho letter reading indicate acceptable values in the Northern Sotho LoLT group. In the English LoLT group, English (blending, sound matching, digit span, RDN) and Northern Sotho (blending, sound matching, non-word repetition, RON, letter reading and early writing) had acceptable skewness values. English non-word repetition and Northern Sotho (digit span and letter knowledge) have negative skewed values. In terms of kurtosis, all Northern Sotho and English tasks fell out of the acceptable range.

5.2.4 Group differences in phonological processing and literacy: beginning of Grade 2

Error bars and Pearson chi-square analyses were performed to check the comparability of groups in terms of the number of learners in each group, and the results are shown in Figure 5.2, below:



Group (2B – NS LoLT group; 2P – Eng LoLT group)
Error Bars: 95% confidence interval
Figure 5.2 Error bars showing learner group differences

The analysis of group size (number of learners) between the two LoLT groups was done using SPSS graphical presentations at the 95% confidence level. The error bars show no significant differences between the English and Northern Sotho LoLT groups in terms of size. The Pearson Chi-square test also suggests no significant difference between the two LoLT groups, $\chi^2 (2, 134) = 134.000, p = .459$, in terms of size, suggesting that the groups are comparable.

A multivariate analysis of variance (MANOVA) was used to determine group differences in this study. MANOVA analyses are used to determine the differences between two or more independent groups (Finch 2016, 1; Grice and Iwasaki 2007, 199) on more than one continuous dependent variable (Tabachnick and Fidell 2007, 18). A MANOVA was used to establish group differences on the various phonological and literacy measures in both Northern Sotho and in English. According to Field (2013, 572) the MANOVA has very good statistical power to detect whether groups differ along a combination of variables. The English and Northern Sotho phonological processing and literacy variables (blending, sound matching, non-word repetition, digit span, RLN, RDN, RCN, RON, letter knowledge, letter reading, earl writing, word reading and fluent reading) were used as dependent variables. Group was used as a fixed factor. To determine the statistically significant mean differences (Field 2013, 597), Tukey's post hoc comparison procedure was used. Bonferroni corrections were applied. A confidence interval of 95% was used. Multicollinearity, homogeneity of variance and normality tests were conducted to determine the appropriateness of MANOVA analysis in this study. Although non-normality was assumed in some cases, MANOVAs are deemed as quite robust to violations of normality (Tabachnick and Fidell 2007, 260). Cohen's *d* analysis was used to determine the effect size of statistically significant variables ($p < .05$). The results of the MANOVA analysis are shown in Table 5.4 below.

Table 5.4 MANOVA and Cohen's d analyses results

English Tasks	F	Sig.	Cohen *d*'s analysis	Northern Sotho Tasks	F	Sig.	Cohen *d*'s analysis
Eng blending	.064	.801	NSS	NS blending	.029	.869	NSS
Eng sound matching	3.99	.048	.35	NS sound matching	.516	.474	NSS
Eng digit span	.015	.903	NSS	NS digit span	.462	.498	NSS
Eng non-word repetition	15.6	.000	.68	NS non-word repetition	3.72	.056	NSS
Eng RDN	.012	.913	NSS	NS RLN	.476	.004	.10
Eng RLN	8.80	.004	.40	NS RON	6.46	.012	.53
Eng RCN	.474	.492	NSS	NS letter knowledge	3.98	.048	.35
Eng RON	1.44	.233	NSS	NS letter reading	1.08	.301	NSS
Eng word reading	.501	.480	NSS	NS word reading	6.72	.011	.45
Eng fluent reading	.113	.289	NSS	NS fluent reading	2.24	.136	NSS
				NS early writing	.288	.592	NSS

*Note: NSS - not statistically significant, F - MANOVA test statistics value, Sig. - significance, NS - Northern Sotho, Eng - English. Significance: *p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

Generally, the MANOVA suggests no statistically significant differences between the LoLT groups in the majority of both the English and Northern Sotho tasks. Statistically significant differences between the LoLT groups were observed only on English measures: sound matching $(F(1, 132) = 3.99, p < .05;$ non-word repetition $(F(1, 132) = 15.6, p < .05$ and RLN $(F(1, 132) = 8.80, p < .05)$ and on the following Northern Sotho variables: RLN $(F(1, 132) = 0.48, p < .05)$; RON $(F(1, 132) = 6.46, p < .05)$; letter knowledge $(F(1, 132) = 3.98, p < .05)$ and word reading $(F(1, 132) = 6.72, p < .05)$. The English LoLT group ($M = 11.69, SD = 6.0$)[32] scored significantly better than the Northern Sotho LoLT group ($M = 9.81, SD = 4.8$) on English sound matching task, as well as on the English RLN task ($M = 72.60, SD = 48.5$ and $M = 53.32, SD = 22.9$). The Northern Sotho LoLT group ($M = 15.32, SD = 6.2$) performed significantly better than the English LoLT group ($M = 12.80, SD = 4.5$) on the English non-word repetition task. The researchers established no statistically significant group differences for other English literacy measures.

The English LoLT group ($M = 66.86, SD = 35.2$) scored significantly better than the Northern Sotho LoLT group ($M = 62.65, SD = 32.9$) on the Northern Sotho RLN task. The English LoLT group ($M = 64.91, SD = 20.8$) also scored significantly better than the Northern Sotho LoLT group ($M = 57.01, SD = 14.8$) on the Northern Sotho RON task. The Northern Sotho LoLT

[32] The means and descriptive statistics for English and Northern Sotho phonological and literacy tasks are reported in Table 5.3.

group (*M = 11.12, SD=1.6*) performed significantly better than the English LoLT group (*M=10.49, SD = 2.0*) on the Northern Sotho letter knowledge task. The Northern Sotho LoLT group (*M= 7.70, SD = 3.4*) also performed significantly better than the English LoLT group (*M=6.26, SD = 2.9*) on the Northern Sotho word reading task. Cohen's *d* suggested a large effect in English non-word repetition and Northern Sotho RON *(r > .50)*, a medium effect in English sound matching, English RLN, Northern Sotho letter knowledge and word reading tasks (*r > .30* but less than *.50*), and a small effect in Northern Sotho RLN *(r = .10)*. Overall the results suggested that each LoLT group can complete tasks in each of the two languages to some extent. Overall, the MANOVA analysis at Point 1 suggests that a strong effect of the LoLT is not yet very apparent at this point.

5.2.5 Relationships among variables: Point 1

Spearman's correlation analysis and path analysis were used to measure the relationship between phonological processing and literacy skills.

5.2.5.1 Spearman's correlation analysis

Correlation analysis was used in this study to determine the relationship between phonological processing and literacy variables in this study. Correlation is a measure of the linear relationship between variables (Field 2013, 107). Spearman's correlations analysis was considered in this study as a result of the non-normal distribution of some of the data. Correlation coefficients were calculated between phonological processing (sound matching, blending, non-word repetition, digit span, RCN, RLN, RDN, RON) and literacy variables (letter knowledge, letter reading, early writing, word reading and fluent reading), within and across languages.

Spearman's correlation was also conducted to ascertain the cross-linguistic pattern between phonological and literacy measures in Northern Sotho and English languages. The correlations are significant (2-tailed) at *p < .01* and *.05* level. The relationship between the two variables is determined by whether a change in one variable causes similar changes in the other variable. If there is a relationship between two variables, when one variable deviates from the mean, the other variable should deviate from the mean in the same or directly opposite way (Field 2013, 108). Table 5.5 below shows the correlation statistics between phonological processing and literacy abilities for the Northern Sotho and English LoLT groups. Correlations for the NS LoLT group are presented above the diagonal, whereas correlations for the English LoLT group is presented below the diagonal.

The statistics revealed that the strength of correlations ranged from very weak *r=-.00* to strong *r=.77*. Judging from Asuero, Sayago and Gonz´alez's (2006, 47) strength of correlation coefficient, the results suggest that the majority of variables within each LoLT group have weak or moderate correlations. Within-language statistics revealed that English PA (blending and sound matching) skills moderately correlated with English literacy (word reading and fluent reading) abilities in both the Northern Sotho and English LoLT groups. English digit span significantly correlated with English literacy skills in the English LoLT group. English non-word repetition significantly correlated with the English word and fluent reading skills in the Northern Sotho LoLT group. The correlation between PWM tasks and reading abilities proved to be weak. The relationships between English rapid naming and literacy skills ranged from weak to moderate (and were negative – i.e. the less time it took to complete the task, the higher the literacy scores).

Table 5.5 Spearman's correlations analysis for group samples

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1.Eng blending	–	.57**	.30*	.34**	-.30*	-.35**	-.42**	-.11	.47**	.56**	.44**	.33**	.15	.26*	-.34**	-.27*	.28*	.16	.40**	.30*	.24*
2.Eng sound matching	.49**	–	.40**	.35**	-.37**	-.43**	-.38**	-0,08	.51**	.56**	.44**	.51**	.46**	.34**	-.38**	-.34**	.57**	.26*	.53**	.46**	.46**
3.Eng digit span	.29*	.35**	–	.34**	-.25*	-.32**	-.25*	.16	.24	.16	.21	.19	.51**	.49**	-.09	-.24*	.35**	.00	.12	.07	.26*
4.Eng NWR	.31*	.19	.42**	–	-.17	-.311*	-.17	.09	.39**	.25*	.15	-.06	.21	.34**	-.14	-.27	.21	-.08	.25*	.10	.33**
5.Eng RLN	-.37**	-.43**	-.27*	-.21	–	.46**	.38**	.30*	-.44**	-.39**	-.15	-.11	-.04	-.15	.37**	.20	-.34**	-.24*	-.28*	-.16	-.31*
6.Eng RDN	-.30*	-.34**	-.16	-.10	.57**	–	.38**	.13	-.39**	-.40**	-.34**	-.27*	-.212	-.08	.37**	.46**	-.37**	-.25*	-.43**	-.36**	-.43**
7.Eng RCN	-.38**	-.39**	-.25*	-.25*	.72**	.61**	–	.44**	-.35**	-.39**	-.30*	-.09	-.06	-.11	.29*	.32**	-.26*	-.15	-0.211	-.18	-.04
8.Eng RON	-.17	-.15	-.13	-.20	.62**	.49**	.65**	–	-.16	-.25*	.05	.23	.28*	.22	-.15	.09	.11	.20	.03	-.00	.14
9.Eng word reading	.44**	.45**	.33**	.14	-.57**	-.53**	-.42**	-.40**	–	.77**	.40**	.38**	.11	.33**	-.25*	-.27*	.38**	.21	.56**	.41**	.41**
10.Eng fluent reading	.41**	.53**	.29*	.02	-.57**	-.50**	-.46**	-.27*	.71**	–	.40**	.33**	.09	.22	-.25*	-.29*	.31**	.16	.43**	.35**	.29*
11.NS blending	.45**	.46**	.16	.05	-.31*	-.21	-.19	-.13	.36**	.52**	–	.58**	.37**	.30*	-.45**	-.43**	.41**	.49**	.50**	.64**	.42**
12.NS sound matching	.26*	.36**	.35**	.20	-.24	-.23	-.39**	-.19	.22	.29*	.34**	–	.35**	.22	-.56**	-.34**	.54**	.50**	.44**	.58**	.42**
13. NS digit span	.25*	.38**	.42**	.24	-.24	-.08	-.24	-.16	.20	.30*	. 55**	. 50**	–	.44**	-.27*	-.24*	.33**	.14	.24	.30*	.28*
14.NS NWR	.40**	.18	.41**	.42**	-.31*	-.28*	-.29*	-.16	0,19	.27*	.32**	.39**	.44**	–	-.26*	-.04	.33**	.13	.26*	.26*	.19
15. NS RLN	-.22	-.28*	-.04	-.13	.31*	.19	.22	.30*	-.17	-.16	-.47**	-.22	-.46**	-.35**	–	.30*	-.44**	-.51**	-.39**	-.45**	-.32**
16.NS RON	-.19	-.26*	-.19	-.19	.08	.19	.25*	.18	-.13	-.19	-.34**	-.43**	-.51**	-.35**	.30*	–	-.32**	-22	-.30*	-.36**	-.17
17. NS letter knowledge	.39**	.58**	.30*	.06	-.38**	-.26*	-.24	-.15	.44**	.51**	.57**	.23	.48**	.42**	-.39**	-.23	–	.50**	.62**	.63**	.42**
18. NS letter reading	.47**	.58**	.27*	.08	-.49**	-.35**	-.41**	-.26*	.50**	.46**	.45**	.31*	.38**	.18	-.36**	-.20	.53**	–	.43**	.59**	.40**
19.NS word reading	.20	.30*	-.04	-.22	-.08	-.11	.00	-.03	.32**	.37**	.41**	.01	.24	.11	-.18	-.31*	.48**	.28*	–	.60**	.29*
20.NS fluent reading	.23	.30*	.09	-.18	-.26*	-.18	-.12	-15	.36**	.40**	.53**	.31*	.30*	.26*	-.24	-.32**	.35**	.34**	.62**	–	.41**
21. NS early writing	.09	.11	.08	.21	-.19	-.26*	-.19	-.13	.09	.21	.136	.09	.21	.12	-.21	-.13	.22	.34**	.36**	.35**	–

** Correlation significant at the 0.01 level (2 tailed): *Correlations significant at the 0.05 level (2 tailed).

Correlations for the NS (Group 1) children are reported above the diagonal and correlations for the English (Group 2) children are reported below the diagonal.

The significant correlations between Northern Sotho PA (blending and sound matching) and Northern Sotho literacy skills (letter knowledge, letter reading, early writing, word and fluent reading) ranged from weak to moderate in the English LoLT group. The correlations between Northern Sotho PWM (digit span and non-word repetition) and some literacy skills in Northern Sotho were significantly moderate in both LoLT groups. The correlations between Northern Sotho rapid naming and literacy skills were mostly significant (and negative). Regarding interrelations between phonological processing skills, the results revealed that the association between English phonological skills ranged from weak to strong in both LoLT groups. The association between phonological processing skills in Northern Sotho ranged from weak to moderate in both LoLT groups.

The cross-linguistic correlations between English PA variables (i.e. blending and sound matching) and Northern Sotho literacy skills were significant and ranged from weak to moderate in both LoLT groups. English digit span and non-word repetition weakly correlated with some literacy skills in Northern Sotho, in both LoLT groups. The correlations between English rapid naming skills and Northern Sotho literacy skills were mostly significant but negative in both LoLT groups. Northern Sotho PA skills had weak to moderate correlations with English word and fluent reading. The associations between Northern Sotho PWM and English literacy skills were non-significant in the English LoLT group. In the Northern Sotho LoLT group, Northern Sotho non-word repetition weakly correlated with English word reading. The associations between Northern Sotho rapid naming and English literacy skills were weak and non-significant in the English LoLT group. In the Northern Sotho LoLT group, most associations between Northern Sotho rapid naming and English literacy skills were significant but negative. Cross-linguistic relations between Northern Sotho and English phonological processing skills ranged from weak to moderate in both LoLT groups. Overall, the finding suggested evidence of within language and cross-linguistic correlations between Northern Sotho and English phonological processing and literacy variables.

5.2.5.2 Phonological processing variables as predictors of literacy

AMOS path analysis was used to establish the association between phonological processing and literacy skills in both Northern Sotho and English. Path analysis is a variation of the multiple regression analysis, which is useful for examining causal pathways among a set of variables (Stage, Carter and Nora 2004, 5; Jeon 2015, 1637). The path model allows the examination of more complicated relations among several dependent and independent variables (Streiner 2005, 116). Hence, it was deemed as an appropriate tool to determine the causal effects between several phonological and literacy variables in this study.

CFA was explored to determine the appropriateness of path analysis. The variables met the requirements for construct validity and reliability with high factor loadings >.80. Phonological processing skills (blending, sound matching, digit span, non-word repetition, RDN, RLN, RON, RCN) represented the independent variable, whilst literacy skills (letter knowledge, letter reading, word reading, fluent reading and early writing) were the dependent variables. Table 5.6 below shows the regression coefficient values for all the variables based on the entire sample. This is followed by the path models for English and Northern Sotho variables.

Regression analysis revealed that English blending significantly predicted English word reading (*β=.277, p=.002*) and fluent reading (*β=.337, p=.000*) abilities. English sound matching significantly predicted English word reading (*β=.209, p=.018*) and fluent reading (*β=.301, p=.000*) abilities. English RLN significantly predicted English word reading (*β=.219, p=.016*). Northern Sotho blending showed a significant relationship with Northern Sotho letter knowledge (*β=. 338, p=.000*) and letter reading (*β=.490, p=.000*), word reading (*β=. 544, p=.000*) and fluent reading (*β=.565, p=.000*). Northern Sotho non-word repetition significantly predicted Northern Sotho letter knowledge (*β=. 166, p=. 053*). Northern Sotho RLN had a significant relationship with Northern Sotho letter knowledge (*β=.161, p=.039*) and letter reading (*β=. 183, p=.024*). Northern Sotho RON showed a significant association with

Northern Sotho word reading (*β=.183, p=.017*). Northern Sotho digit span significantly predicted Northern Sotho fluent reading (*β=.-.199*, *p=.018*) ability.

Table 5.6 Regression coefficients for English and Northern Sotho variables

Variable	Direction	Variable	Unstandadised Estimates	Standardised Estimates	Standard error	C.R	P
Eng blending	→	Eng word reading	.638	.277	.203	3.14	.002
Eng blending	→	Eng fluent reading	.592	.337	.146	4.06	***
Eng sound matching	→	Eng word reading	.346	.209	.146	2.37	.018
Eng sound matching	→	Eng fluent reading	0,38	.301	.105	3.62	***
Eng digit span	→	Eng word reading	-0.16	-,039	.335	-.478	.633
Eng digit span	→	Eng fluent reading	-.074	-.024	.241	-.309	.757
Eng non-word repetition	→	Eng word reading	.063	.027	.181	.347	.729
Eng non-word repetition	→	Eng fluent reading	-.184	-.103	.13	-1.41	.157
Eng rapid digit naming	→	Eng word reading	.321	.065	.443	.724	.469
Eng rapid digit naming	→	Eng fluent reading	.126	.033	.318	.398	.691
Eng rapid letter naming	→	Eng word reading	.753	.219	.311	2.42	.016
Eng rapid letter naming	→	Eng fluent reading	.363	.139	.224	1.63	.104
Eng rapid object naming	→	Eng word reading	.326	.149	.172	1.89	.058
Eng rapid object naming	→	Eng fluent reading	.247	.086	.24	1.03	.303
Eng rapid colour naming	→	Eng word reading	-.104	-.036	.268	-.388	.698
Eng rapid colour naming	→	Eng fluent reading	-.067	-.03	.192	-.349	.727
NS blending	→	NS letter knowledge	.203	.338	.05	4.10	***
NS blending	→	NS letter reading	1.16	0,49	.202	5.75	***
NS blending	→	NS word reading	.585	.544	.089	6.59	***
NS blending	→	NS fluent reading	1.46	.565	.21	6.95	***
NS blending	→	NS early writing	1.33	.147	.887	1.49	.135
NS sound matching	→	NS letter knowledge	.034	.049	.057	.592	.554
NS sound matching	→	NS letter reading	.12	.045	.23	.523	.601
NS sound matching	→	NS word reading	-.096	-.078	.101	-.947	.344
NS sound matching	→	NS fluent reading	.279	.095	.24	1.17	.244
NS sound matching	→	NS early writing	1.82	.176	1.01	1.81	.073
NS digit span	→	NS letter knowledge	.081	.095	.072	1.12	.263
NS digit span	→	NS letter reading	-.066	-.02	.292	-.224	.823
NS digit span	→	NS word reading	-.208	-.138	.129	-1.62	.106
NS digit span	→	NS fluent reading	-.72	-.199	.304	-2.37	.018
NS digit span	→	NS early writing	1.25	.098	1.29	.972	.331
NS non-word repetition	→	NS letter knowledge	.113	.166	.053	2.13	.034
NS non-word repetition	→	NS letter reading	-.077	-.029	.216	-.355	.722
NS non-word repetition	→	NS word reading	.169	.139	.095	1.77	.076
NS non-word repetition	→	NS fluent reading	.361	.124	.225	1.61	.109
NS non-word repetition	→	NS early writing	-.442	-.043	.951	-.465	.642
NS rapid letter naming	→	NS letter knowledge	.117	.161	.057	2.06	.039
NS rapid letter naming	→	NS letter reading	.521	.183	.23	2.27	.024
NS rapid letter naming	→	NS word reading	.088	.068	.101	.87	.384
NS rapid letter naming	→	NS fluent reading	.09	.029	.239	.378	.705
NS rapid letter naming	→	NS early writing	.876	.081	1.01	.867	.386
NS rapid object naming	→	NS letter knowledge	.034	.062	.042	.806	.420
NS rapid object naming	→	NS letter reading	-.062	-.029	.171	-.362	.717
NS rapid object naming	→	NS word reading	.181	.183	.075	2.39	.017
NS rapid object naming	→	NS fluent reading	.156	.066	.178	.877	.380
NS rapid object naming	→	NS early writing	-.161	-.019	.753	-.214	.831

Note: *P value represents the significance of the regression test statistics, C.R-Critical Ratio, NS-Northern Sotho, Eng-English. Significance: *p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

Figure 5.3 and Figure 5.4 show AMOS path analyses for the English and Northern Sotho variables. The goodness of fit indices of the path analysis model for the English variables presented in Figure 5.3 were as follows: *(chi-square = 107, df = 1, p = .000, Normed Fit Index (NFI) = .782; RMSEA =.892, CFI = .757, IFI = .783).* Values for IFI, NFI and CFI range from *0* to *1* with recommending values greater than *0.90* indicating a good fit. There is a good fit if the RMSEA is less than *.05*, and there is adequate fit if RMSEA is less than *.08* (Hair et al. 2014, 237). The goodness of fit indices results for the Northern Sotho variables were as follows: *(chi-square = 159; df = 10, RMSEA = .335, NFI = .731, CFI = .722, TLI = -.528 IFI = .744).*

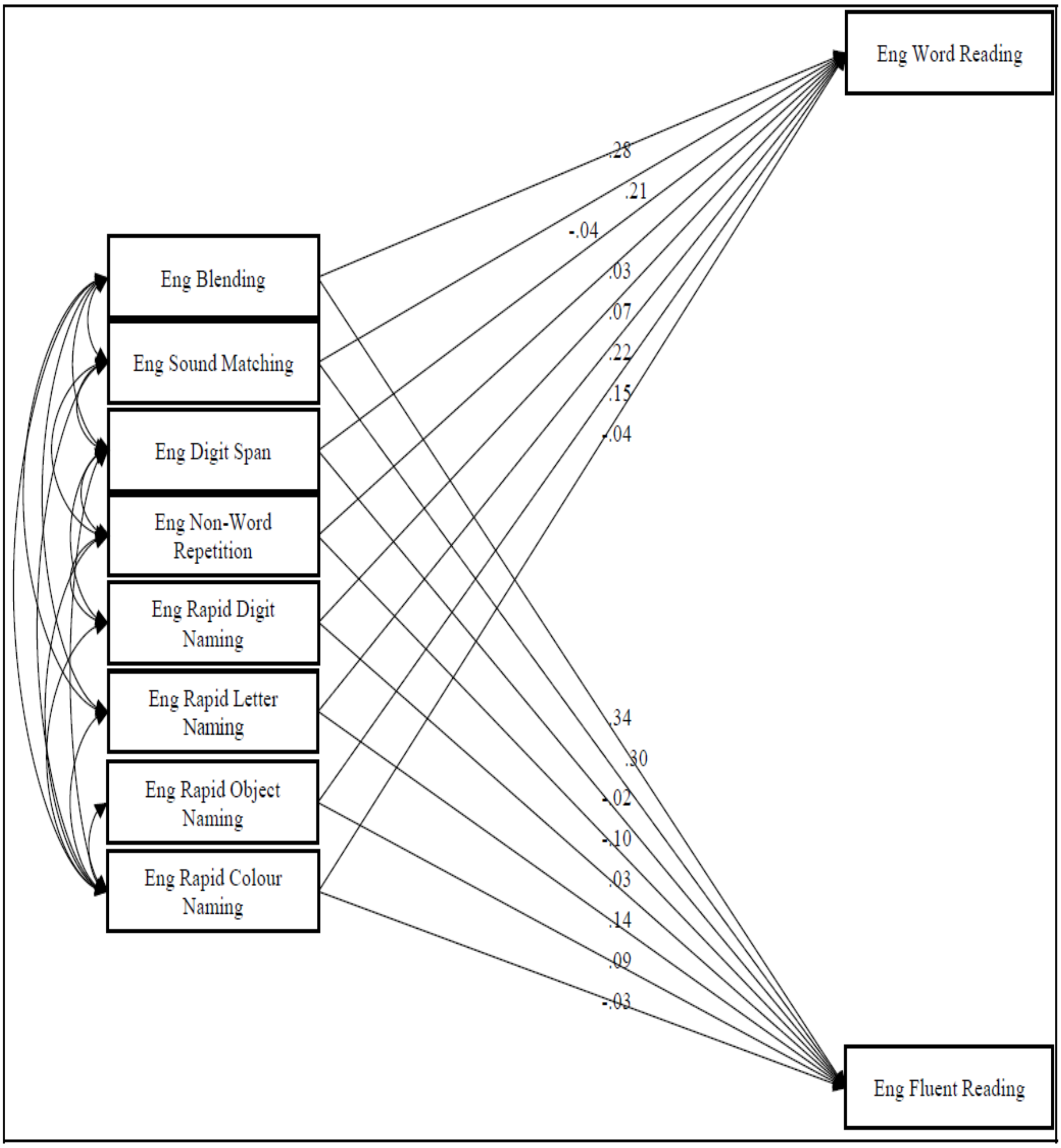


Figure 5.3 AMOS path analysis for English variables

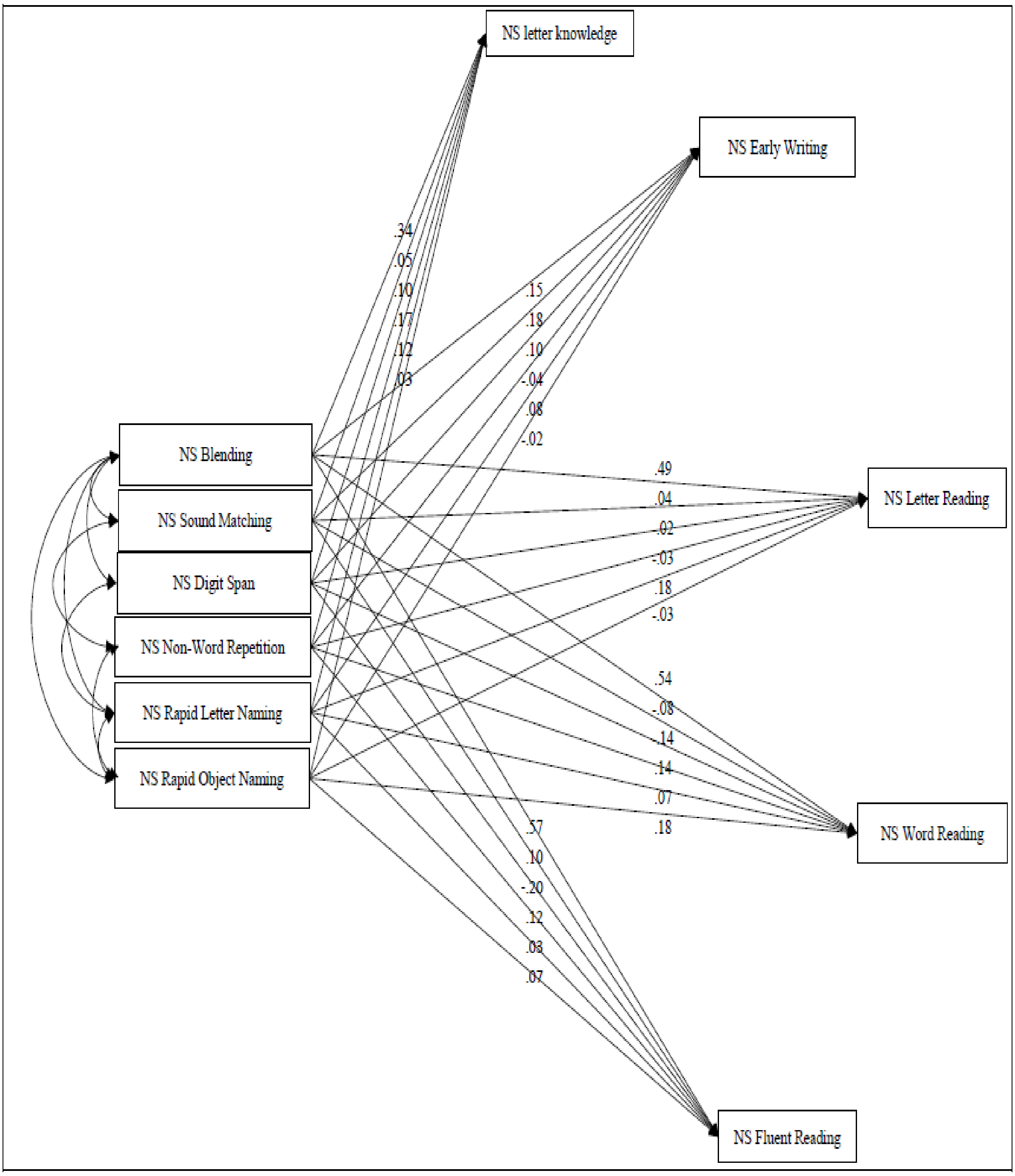


Figure 5.4 AMOS path analysis for Northern Sotho variables

The goodness of fit indices results for the two models indicate less than desirable models. This finding may be due to some floor effects[33]. Eliminating some outliers was not useful to improve the goodness of fit indices. However, the primary purpose of this study was not to design a model per se but to establish the predictive relations between phonological processing and literacy variables. The researcher was testing an already established model by Wagner and Torgesen (1984), and the goodness of fit indices could not be used to reject the null hypotheses of this study. Hence, further interpretation was carried out based on these two models. AMOS

[33] A floor effect occurs when the participants' scores cluster near the bottom (Garin 2014, 633).

path analysis was considered in this study due to its ability to accommodate and manage several amounts of variables at once. Path analysis was useful for establishing and explaining the pattern of prediction between phonological and literacy variables.

AMOS path analysis reveals that there is a significant causal relationship between English blending and English word and fluent reading abilities. English sound matching is causally related to English word reading and fluent reading abilities. English RLN is causally related to English word reading. Northern Sotho blending has a causal relationship with Northern Sotho letter knowledge, letter reading, word reading and fluent reading abilities. Northern Sotho non-word repetition is causally related to Northern Sotho letter knowledge. Northern Sotho RLN is causally related to Northern Sotho letter reading ability, while Northern Sotho RON is causally associated with Northern Sotho word reading skill. The path models results suggested a causal unidirectional effect between some phonological and literacy variables. Importantly, at this point, the causal findings between phonological and literacy are only preliminary and will be determined further at the second data measuring point.

5.3 Cross-linguistic transfer of skills: Point 1

Multiple regression analyses were conducted to determine the cross-linguistic transfer pattern of skills in Northern Sotho and English languages. Multiple regression is an extension of simple regression in which an outcome is predicted by a linear combination of two or more predictor variables and two or more outcome variables (Field 2013, 738). In other words, multiple regression allows the outcome of a dependent variable to be predicted from several predictor variables. Multiple regression analysis was used despite that some data were not normally distributed because it is quite robust in large sample sizes (Ghasemi and Zahediasl 2012, 486). Phonological processing variables (elision, blending, sound matching, non-word repetition, RLN, RDN, RON, RCN) were used as independent variables. Literacy skills (letter reading, word reading, fluent reading and early writing) were used as dependent variables.

5.3.1 Cross-linguistic predictors of Northern Sotho literacy

The aim in this part of the analysis was to determine the extent to which English phonological processing measures predicted literacy abilities in the Northern Sotho language. English phonological measures (blending, elision, sound matching, non-word repetition, digit span, RDN, RLN, RCN and RON) were used as independent variables. Northern Sotho literacy measures (letter knowledge, letter reading, word reading, fluent reading and early writing) were used as dependent variables. All the independent variables were entered into the model in a single step. Multiple regression analysis was conducted for the entire sample and for each LoLT group, to determine the cross-linguistic predictors of Northern Sotho literacy. Table 5.7 shows the cross-linguistic regression results for the whole group and each LoLT group.

Table 5.7 Multiple regression for cross-linguistic predictors of Northern Sotho

Variable	Northern Sotho LoLT group														
	NS letter knowledge			NS letter reading			NS word reading			NS fluent reading			NS early writing		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
Eng blanding	.05	.05	.12	.45	.20	.33*	.29	.10	.37*	.36	.24	.19	-.12	1.0	-.01
Eng sound matching	.16	.05	.48*	.24	.18	.20	.30	.08	.42*	.99	.22	.60*	1.9	.91	.31*
Eng digit span	.09	.08	.13	-.06	.33	-.02	-.23	.16	-16	-57	.39	-.16	-.42	1.6	-.03
Eng non-word repetition	-.04	.07	-.06	-.48	.29	-.21	.15	.14	.12	-.25	.34	-.08	.94	1.4	.08
Eng RLN	-.00	.01	-.03	-.03	.03	-.13	-.01	.02	-.08	-.02	.04	-.07	.02	.17	.17
Eng RDN	-.00	.02	-.02	-.06	.07	-12	.00	.03	-.00	.05	.08	.-07	-.96	.34	-.39*
Eng RCN	-.01	.01	-.07	.01	.04	.03	.01	.02	.04	.00	.05	.01*	.23	.21	.14
Eng RON	.02	.03	.07	.08	.12	.08	.02	.06	.04	-.04	.15	-.03	.34	.62	.07

Variable	English LoLT group														
	NS letter knowledge			NS letter reading			NS word reading			NS fluent reading			NS early writing		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
Eng blanding	.12	.07	.22	.57	.30	.25	.26	.11	.31*	.55	.30	.26	.50	.94	.08
Eng sound matching	.11	.04	.32*	.41	.19	.29*	.08	.07	.17	.18	.20	.14	-.03	.61	-.01
Eng digit span	.18	.11	.18	-.06	.50	-.02	-.26	.19	-.18	-.23	.51	-.06	1.9	1.5	.16
Eng non-word repetition	-.08	.05	-.19	-.30	.22	-.16	-12	.08	-18	-.24	.23	-.15	-2.1	.71	-.41*
Eng RLN	-.01	.01	-.24	-.03	.02	-.16	-.00	.01	-.07	-.02	.02	-.01	-.16	.07	-.31*
Eng RDN	-.01	.02	-.08	-.06	.10	-.08	-.05	.04	-.20	-.07	.10	-.10	-.21	.30	-.01
Eng RCN	.01	.01	.08	.02	.05	.03	.03	.02	.27	.06	.05	.19	.13	.15	.13
Eng RON	.01	.02	.04	-.08	.08	-.14	-.04	.03	-.20	-.14	.08	-.25	-.18	.25	-.10

Variable	Entire sample														
	NS letter knowledge			NS letter reading			NS word reading			NS fluent reading			NS early writing		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
Eng blanding	.09	.04	.20*	.44	.17	.24*	.30	.08	.37*	.53	.19	.27*	.23	.68	.03
Eng sound matching	.11	.03	.34*	.26	.12	.20*	.10	.06	.16	.34	.14	.24*	.75	.50	.15
Eng digit span	.11	.07	.13	-.15	.28	-.05	-.22	.13	-.15	-.38	.32	-.11	1.0	1.1	-.16
Eng non-word repetition	-.04	.04	-.07	-.23	.16	-.12	.02	.07	.03	-.07	.18	-.04	-.1.1	.63	-.16
Eng RLN	-.01	.01	-.22*	-.05	.02	-.26*	-.01	.01	-.12	-.02	.02	-.09	-.10	.07	-.14
Eng RDN	-.01	.01	-.03	-.06	.05	-.09	-.04	.03	-.16	-.05	.06	-.08	-.71	.22	-.31*
Eng RCN	.00	.01	.02	-.01	.03	-.03	.02	.01	.11	.03	.04	.07	.18	.13	.14
Eng RON	.05	.03	.13	.04	.03	.09	.01	.01	.03	-.01	.01	-.03	.11	.13	.07

Note: SE-Standard error, B-unstandardised regression coefficient, Beta-standardised regression coefficient value.
*Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

Cross-linguistic multiple regression statistics for the entire sample revealed that English blending and sound matching significantly predicted and accounted for 38%, 30% and 21% of the variance in Northern Sotho letter knowledge, letter reading and fluent reading, respectively. English blending accounted for 29% of the variance in word reading. The relationship between RLN and letter knowledge and letter reading was significant and negative. The association between English RDN and Northern Sotho early writing was also negative.

Within-group cross-linguistic regression statistics for the Northern Sotho LoLT revealed that English blending accounted for 26% of the variance in Northern Sotho letter reading. English blending and sound matching explained 50% of the variance in word reading. English sound matching accounted for 31%, 44% and 41% of the variance in Northern Sotho early writing, fluent reading and letter knowledge, respectively. The association between English RCN and Northern Sotho fluent reading was significantly negatively. In the English LoLT group, English blending explained 27% of the variance in Northern Sotho word reading. English sound matching explained 42% and 34% of the variance in letter knowledge and letter reading, respectively. English non-word repetition and English RLN significantly predicted Northern Sotho early writing but negatively. The pattern based on the entire sample and within-group results suggest that English PA skills (blending and sound matching) were unique predictors of Northern Sotho literacy skills.

5.3.2 Cross-linguistic predictors of English literacy

Multiple regression analysis was conducted to determine the Northern Sotho phonological processing predictors of literacy abilities in the English language. Northern Sotho phonological measures (blending, sound matching, non-word repetition, digit span, RLN and RON) were used as independent variables. English literacy (word reading, fluent reading) measures were utilised as dependent variables. All the independent variables were entered into the model in a single step. Table 5.8 shows the cross-linguistic regression results for the whole group and each LoLT group.

Table 5.8 Multiple regression for the cross-linguistics predictor of English literacy

Variables	Northern Sotho LoLT group						English LoLT group						Entire sample					
	Eng word reading			Eng fluent reading			Eng word reading			Eng fluent reading			Eng word reading			Eng fluent reading		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
NS blending	.87	.30	.38*	.52	.19	.38*	2.1	.49	.60*	1.4	.37	.51*	1.5	.27	.51*	1.2	.21	.52*
NS sound matching	.49	.32	.20	.16	.20	.11	.25	.60	.06	.51	.45	.15	.25	.32	.07	.28	.24	.11
NS digit span	-.99	.34	-.32*	-.09	.23	-.05	-1.2	.79	-.24	-.20	.59	-.05	-.88	.39	-.21*	-.43	.29	-.13
NS non-word repetition	.73	.29	.29*	.36	.18	.23	-.03	.55	-.01	-.01	.41	-.00	.40	.30	.12	.23	.22	.09
NS RLN	-.01	.02	-.06	.00	.01	.03	.04	.04	.09	.01	.03	.04	.02	.09	.02	.01	.07	.01
NS RON	-.04	.05	-.09	-.03	.03	-.11	-.04	-.08	-.07	-.02	.06	-.03	.14	.04	.28	.14	.21	.05

*Note: SE - Standard error, B - unstandardised regression coefficient value, Beta - standardised regression coefficient value, NS - Northern Sotho, Eng - English, Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

The results for the entire sample revealed that Northern Sotho blending significantly predicted and explained 28% and 31% of the variance in English word and fluent reading, respectively. The relationship between digit span and English word reading was significant but negative. Within-group statistics revealed that in the Northern Sotho LoLT group, Northern Sotho blending and non-word repetition accounted for 41% of the variance in English word reading. English blending explained 35% of the variance in fluent reading. The relationship between Northern Sotho digit span and English word reading was significant but negative. In the English LoLT group, Northern Sotho blending explained 27% and 30% of the variance in English word and fluent reading abilities, respectively. Overall the cross-linguistic pattern suggested that Northern Sotho PA and PWM are unique predictors of English literacy skills.

5.4. Results phonological processing and literacy: measuring point two

The data presented in this section was gathered from 131 Grade 2 (*mean age: 7.9; SD: 0.2*) Northern Sotho-English bilinguals, in the third term of the school year (August-October 2019). The learners who participated at measuring point two of the study were the same learners that participated at the first measuring point. The participants were, as explained previously, classified into two instructional groups depending on the LoLT. Phonological processing skills were assessed using sound matching, blending, elision, non-word repetition, digit span, object, colour, letter and digit naming tasks. Literacy skill was assessed using letter reading, word reading, fluent reading and early writing tasks[34]. MANOVA and Cohen's *d* analysis were performed to determine group differences. Spearman's correlations, multiple regression and AMOS path analysis, were used to establish the statistical significance of the relationship between phonological and literacy variables.

5.4.1. Parametric assumption analysis

Preliminary parametric assumption analysis was performed to determine an appropriate statistical model for data analysis (Garson 2012, 8). Three tests which include the Shapiro-Wilk test of normality, multicollinearity and homogeneity of variance, were used for parametric testing, and the results are given in Table 5.9 below.

The normality assumption was assessed using the Shapiro-Wilk test ($p > .05$). The Shapiro-Wilk test results based on the entire sample revealed that most variables in English languages violated the normality assumptions. Normality was met for Northern Sotho non-word repetition, digit span and RON. In the Northern Sotho LoLT group, the Northern Sotho tasks (sound matching and non-word repetition) achieved normality. In the English LoLT group, normality was achieved for English digit span and Northern Sotho (non-word repetition, letter reading) tasks. Although some variables violated normality, the sample size of ($n = 131$) can be considered large enough for the parametric test results to be robust (Pallant 2007, 179; Garson 2012, 17).

[34] Refer to chapter 4 for more information on phonological processing and literacy development tasks.

Table 5.9 Test of normality, homogeneity of variance and multicollinearity

English and Northern Sotho tasks	NS LoLT Group		English LoLT Group		Entire Sample		Homogeneity of variance		Collinearity statistics	
	Shapiro-Wilk test p.value	Sig.	Shapiro-Wilk test p.value	Sig.	Shapiro-Wilk test p.value	Sig.	P value	Sig	Tolerance	VIF
Eng blending	.85	.000	.94	.005	.91	.000	8.4	.005	.390	2.56
Eng elision	.96	.033	.96	.043	.94	.000	16.8	.000	.367	2.75
Eng sound matching	.96	.037	.94	.002	.96	.000	8.4	.421	.457	2.19
Eng digit span	.94	.004	.97	.197	.97	.002	1.4	.238	.583	1.17
Eng non-word repetition	.92	.000	.90	.000	92	.000	.002	.967	.581	1.72
Eng RLN	.93	.001	.91	.000	.92	.000	.067	.796	.604	1.66
Eng RDN	.94	.002	.85	.000	.89	.000	5.4	.022	.690	1.45
Eng RCN	.96	.024	.89	.000	.94	.000	2.3	.134	.589	1.70
Eng RON	.95	.012	.93	.003	.96	.001	.110	.741	.616	1.62
Eng word reading	.89	.000	.91	.000	.91	.000	.154	.695		
Eng fluent reading	.85	.000	.90	.000	.87	.000	.196	.164		
NS blending	.90	.000	.90	.000	.90	.000	.285	.595	.563	1.78
NS elision	.90	.000	.84	.000	.96	.033	.221	.639	.536	1.87
NS sound matching	.97	.061	.96	.031	.97	.013	.210	.150	.645	1.55
NS digit span	.96	.032	.95	.007	.97	.110	.295	.238	.684	1.46
NS non-word repetition	.97	.088	.97	.162	.98	.874	.352	.967	.683	1.46
NS RON	.96	.047	.93	.001	.95	.464	.497	.923	.848	1.18
NS RLN	.89	.000	.90	.000	.90	.000	.169	.682	.717	1.40
NS letter reading	.93	.001	.99	.972	.97	.006	.471	.494		
NS word reading	.85	.000	.95	.007	.92	.000	30.2	.000		
NS fluent reading	.86	.000	.93	.002	.91	.000	18.3	.000		
NS early writing	.66	.000	.83	.000	.78	.000	.134	.715		

Note: VIF- variance inflation factor, Sig-significance, NS-Northern Sotho, Eng-English.

The homogeneity of variance assumption was measured using Levene's test (*p >.05*). The majority of variables met this assumption except for the English (blending, elision, RDN) and Northern Sotho (word and fluent reading) tasks. Multicollinearity was assessed using the tolerance[35] and VIF (acceptable range between .1 and .10) statistics. The results indicate that all the variables were within the acceptable VIF range. However, regarding tolerance statistics, most variables except English blending and English elision fell outside the acceptable range. These findings suggested the possibility of multicollinearity amongst predictor variables.

5.4.2. Construct validity and reliability

A CFA was repeated at the second measuring point to determine the construct validity of variables, to ensure that the various measures remained reliably indicators of the various latent variables. PA, PWM, RAN and LD represented the latent[36] variables in this study. The phonological processing measures (i.e. elision, blending, sound matching, non-word repetition,

[35] Value close to 0 show multicollinearity and values close to 1 suggest low or no multicollinearity (Gerbing 2014, 3).

[36] A latent variable is described as a hypothetical construct that cannot be directly measured (MacCallum and Austin 2000, 201).

digit span, RDN, RLN, RCN, RON) and literacy measures (i.e. letter reading, word reading, fluent reading and early writing) represented the indicator[37] variables. The factor loadings for each latent and indicator variable are presented in Figure 5. 5 below.

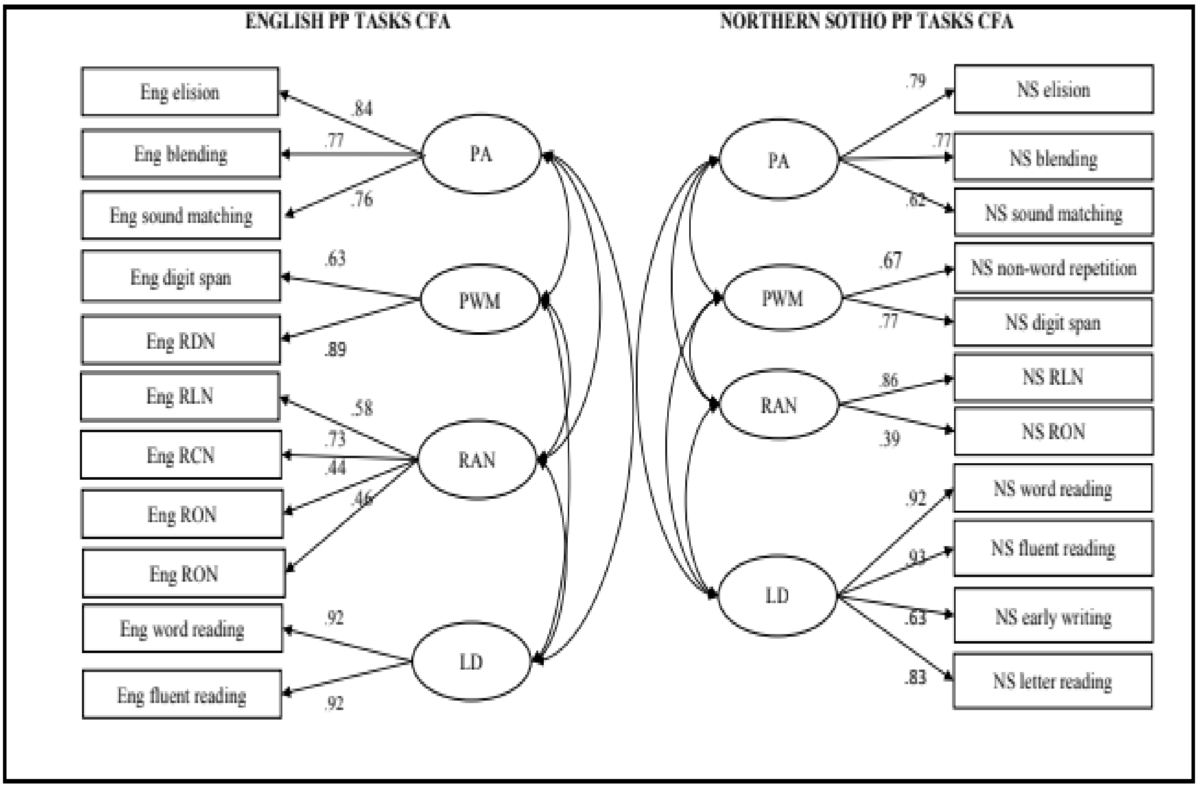


Figure 5.5 Confirmatory Factor Analysis results for English and Northern Sotho

The CFA models for the English and Northern Sotho variables indicate a good fit between the model and the observed data (*chi-square = 33.4, degrees of freedom (df) = 29, RMSEA =.07, NFI = .84; CFI = .93, RFI=.78, TLI = .90, IFI = .93*). This implies that these models can be retained for further analysis. The findings in both LoLT groups indicate that elision, blending and sound matching were significant indicators of the PA latent variable ($p < .01$). Non-word repetition and digit span variables were found to be significant indicators of PWM ($p<.01$). RON RCN RDN and RLN were significant indicators of RAN ($p < .01$). English (elision, RDN, word reading, fluent reading) and Northern Sotho (RLN, word reading, fluent reading, letter reading) tasks had higher factor loadings > *.80*, indicating strong relationships between items and constructs. The internal consistency of the tasks was measured using Cronbach's Alpha, and the results of all variables were above *.90*. More information on the Cronbach's Alpha results was given in Chapter 3.

5.4.3 Descriptive statistics: Point 2

As in the first measuring point, the researcher first obtained descriptive statistics for all the phonological and literacy measures, in order to form an overview of the data. Table 5.10 displays the descriptive statistics for all the phonological and literacy measures for the entire sample and each LoLT group. Descriptive statistics for the entire sample revealed that learners

[37] An indicator variable is a construct that can is directly observed (MacCallum and Austin 2000, 201).

performed above average for English (i.e. non-word repetition, word reading) and Northern Sotho (i.e. sound matching, blending, non-word repetition, word reading) tasks. However, they performed below average in most tasks such as English (blending, elision, sound matching, non-word repetition) and Northern Sotho (elision, digit span, letter reading) tasks. The within-group descriptive results revealed that the Northern Sotho LoLT group obtained higher mean scores for some English (RLN, RDN, RCN, RON) and for some Northern Sotho (sound matching, blending, elision, digit span, non-word repetition, RLN and early writing) tasks. The English LoLT group obtained higher mean scores for English (blending, elision, sound matching, non-word repetition, digit span, word reading and fluent reading) and for some Northern Sotho (RON, word reading, letter reading, fluent reading) tasks. However, in many cases, there were only very slight differences in terms of task performance, and it is unlikely that these differences are significant.

While obtaining descriptive statistics, the researcher also checked the distribution of the data. Skewness (acceptable value range between *-1 and +1*) and kurtosis (acceptable value is *3*) tests were used to check for the distribution pattern of the data. Findings from the entire sample revealed that English (blending, RLN, RON, RDN, RCN, digit span, word reading, fluent reading) Northern Sotho (blending, elision, RLN, RON, word reading, letter reading, fluent reading) tasks were within the acceptable skewness range. Some English (sound matching, non-word repetition) and Northern Sotho (sound matching, non-word repetition, digit span, early writing) tasks were negatively skewed. In terms of kurtosis, the tasks once again did not meet the acceptable kurtosis range.

Within-group statistics revealed that in the Northern Sotho LoLT group, most of the English measures (blending, elision, sound matching, digit span, non-word repletion, RLN, RCN, RDN, RON word and fluent reading) and Northern Sotho measures (blending, elision, digit span, RLN, RON, letter reading, early writing, word and fluent reading) have acceptable skewness ranges. However, no tasks obtained an acceptable kurtosis range.

In the English LoLT group, most English (elision, digit span, RLN, RDN, RON, RCN, word reading, fluent reading) and Northern Sotho (blending, elision, RLN, RON, word reading, letter reading, fluent reading) variables had acceptable skewness ranges. Some variables such as English (sound matching, non-word repetition) and Northern Sotho (sound matching, digit span and non-word repetition) were negatively skewed. In terms of kurtosis results, most tasks failed to meet the acceptable range.

Table 5.10 Descriptive statistics for the groups and entire sample

English and Northern Sotho tasks	NS LoLT Group (N=68)						English LoLT Group (N=63)						Entire sample					
	M	SD	Min/Max	Range	Skewness ceofficient	Kurtosis coefficient	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coeffient	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coefficient
Eng blending	6.5	4.6	0-21	21	1.42	1.82	9.4	5.5	0-21	21	.379	-.977	7.9	5.3	0-21	21	.833	-.259
Eng syllable blending	5.0	2.1	0-8	8	-.663	-.239	7.5	5.8	0-8	8	-1.32	1.63	5.4	2.0	0-8	8	-.937	.290
English phoneme blending	1.5	3.9	0-13	13	2.31	4.07	3.7	4.4	0-14	14	.54	-.925	2.5	4.1	0-14	14	1.34	.321
Eng elision	7.8	4.2	0-22	22	.610	1.17	11.5	6.8	0-30	30	.621	-.014	9.6	5.9	0-30	30	.955	1.07
Eng syllable elision	6.3	2.5	0-9	9	-1.10	.749	6.9	2.3	0-9	9	-1.17	.938	6.6	2.4	0-9	9	-1.12	.794
Eng phoneme elision	1.5	2.4	0-13	13	2.30	6.09	4.6	5.2	0-21	21	1.28	1.17	3.0	4.3	0-21	21	1.89	3.65
Eng sound matching	13.1	6.5	2-26	24	.213	.926	15.7	7.5	2-26	24	-.305	-1.12	14.3	7.1	2-26	24	-.007	-.1.13
Eng digit span	14.0	2.3	10-19	9	.446	-.557	14.4	2.5	9-21	12	.142	-.447	14.2	2.4	9-21	12	.298	-.523
Eng non-word repetition	12.3	5.2	0-22	22	-.909	.763	13.4	4.9	1-22	21	-.936	.112	12.8	5.1	0-22	22	-.909	.438
Eng RDN	35.7	9.7	20-61	41	.850	.482	35.6	14.4	19-25	6	1.50	1.99	36.1	12.2	19-85	66	1.43	.546
Eng RLN	48.6	17.1	21-97	64	.882	.161	46.6	16.7	24-103	79	1.14	1.20	47.4	16.9	21-103	82	.988	.546
Eng RCN	47.7	13.7	23-86	63	.696	.418	42.6	11.6	25-76	50	1.21	1.19	45.2	12.9	23-86	63	.923	.624
Eng RON	51.6	14.7	4-93	89	.248	1.85	47.8	13.9	25-89	64	.803	.179	49.8	14.4	4-93	89	.495	.897
Eng regular word reading	10.3	7.1	1-26	25	.708	-.777	11.2	7.8	1.29	28	.779	-.329	10.8	7.5	1-29	28	.753	-.489
Eng exceptional word reading	10.0	6.6	1-27	26	.789	-.373	10.7	7.8	1.28	27	.755	-.507	10.4	7.3	1-28	27	.782	-.408
Eng non-word reading	9.5	6.6	1-28	27	1.09	.486	9.2	6.6	0-28	28	1.32	1.45	9.4	6.6	0-28	28	1.19	.847
Eng word reading	29.5	19.8	3-79	76	.836	-.290	31.2	21.6	3-85	82	.889	-.052	30.3	20.7	3-85	82	.867	-.147
Eng fluent reading	18.5	17.1	2-63	61	.967	-.273	24.0	19.3	1-67	66	.696	-.699	23.4	18.0	3-67	64	.743	-.659
NS sound matching	7.01	3.0	0-12	12	-.250	-.427	5.67	2.8	0-10	10	-.206	-.725	6.4	3.0	0-12	12	-.155	-.542
NS blending	8.0	4.3	0-15	15	.289	-.964	7.9	4.6	0-17	17	.215	-.990	8.0	4.5	0-9	9	.245	-.978
NS syllable blending	5.2	1.5	0-11	11	-2.36	5.34	5.2	1.8	0-6	6	-2.26	3.32	5.2	1.6	0-6	6	-2.23	4.03
NS phoneme blending	2.2	3.5	0-9	9	.730	-1.21	2.7	3.6	0-9	9	.727	-.138	2.8	3.6	0-9	9	.717	-1.29
NS elision	4.9	4.7	0-18	18	1.01	.351	4.6	5.0	0-18	18	1.09	.173	4.7	4.8	0-18	18	1.03	.192
NS syllable elision	4.2	3.4	0-11	11	.356	-1.26	5.1	11.2	0-11	11	6.71	49.9	4.0	3.5	0-11	11	.448	-1.17
NS phoneme elision	0.7	1.1	0-9	9	3.11	10.2	0.75	1.98	0-8	8	2.66	6.03	.73	1.9	0-9	9	2.83	7.54
NS digit span	7.9	2.0	4-12	8	.143	-627	7.0	1.89	0-11	11	-.647	2.08	7.4	2.0	0-12	12	-.135	.707
NS non-word repetition	15.2	2.4	10-20	10	-.090	-.760	14.9	2.82	7-20	13	-.108	-.141	15.5	2.6	7-20	13	-.120	-.313
NS RLN	46.5	21.9	19-106	87	1.11	.482	46.0	20.2	22-106	84	1.10	.714	46.2	21.0	19-106	87	1.09	.538
NS RON	54.2	15.1	25-90	65	.502	-1.00	58.6	17.7	32-117	85	1.14	1.86	56.3	16.5	25-117	92	.925	1.40
NS word reading	10.1	7.4	0-20	20	.109	-1.70	11.3	5.1	0-20	20	.277	-.840	10.7	6.4	0-20	20	.055	-1.34
NS letter reading	30.8	13.9	7-65	58	.838	.032	32.6	12.7	2-65	63	.189	-.079	31.7	13.3	2-65	63	.542	-.142
NS fluent reading	19.2	19.2	0-71	71	.874	-.364	20.7	12.1	1-60	59	.975	.963	19.1	16.1	0-71	71	.955	.303
NS early writing	3.7	2.0	0-5	5	.291	-.677	2.22	1.9	0-5	5	1.93	-1.67	3.0	2.1	0-5	5	-.412	-1.57

M – mean; SD – standard deviation; Min – minimum; Max – maximum; NS – Northern Sotho; Eng – English.

5.4.4 Group differences in phonological and literacy variables at the end of Grade 2

A MANOVA analysis was used to establish group differences for the English and Northern Sotho variables. Phonological and literacy measures (blending, elision, sound matching, non-word repetition, digit span, RDN, RLN, RCN, letter reading, early writing, word and fluent reading) were used as dependent variables while group depicted the fixed factor. Cohen's *d* analysis was used to determine the effect size of statistically significant variables ($p < .05$). Table 5.11 shows the MANOVA and Cohen's *d* results for the English and Northern Sotho variables.

Table 5.11 MANOVA and Cohen's *d* analyses results

English tasks	F	Sig	Cohen d's analysis	Northern Sotho tasks	F	Sig	Cohen d's analysis
Englis blending	11.2	.001	.58	NS blending	.032	.859	NSS
Eng elision	14.0	.000	.66	NS elision	.136	.713	NSS
Eng sound matching	4.71	.032	.37	NS sound matching	7.03	.009	.46
Eng digit span	.904	.343	NSS	NS digit span	7.09	.009	.46
Eng non-word repetion	1.68	.197	NSS	NS non-word repetition	.243	.623	NSS
Eng RLN	.333	.565	NSS	NS RLN	.021	.886	NSS
Eng RDN	.148	.701	NSS	NS RON	2.38	.125	NSS
Eng RCN	5.31	.023	.40	NS letter reading	.621	.432	NSS
Eng RON	2.26	.135	NSS	NS word reading	1.09	.298	NSS
Eng word reading	.198	.657	NSS	NS fluent reading	.009	.925	NSS
Eng fluent reading	2.94	.088	NSS	NS ealy writing	17.1	.000	.73

*Note: NSS imply that the statistics in non-statistically significant, F-MANOVA test statistics value, Sig-significance, NS-Northern Sotho, Eng-English. Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

The MANOVA results suggest that there are statistically significant group differences between the LoLT groups on English elision *(F (1. 129) =14.0, p <05)*, English blending *(F (1.129) = 11.2, p<05)*, English sound matching *(F (1.129) = 4.71, p <05)*, English RCN *(F (1.129) =5.31, p <05)*, Northern Sotho sound matching *(F (1. 129) =7.03, p < .05).* Northern Sotho digit span *(F (1. 129) =7.09, p < .05)* and Northern Sotho early writing skills *(F (1. 129) =17.1, p <05).* The English LoLT group *(M= 11.5, SD = 6.8)* performed significantly better than the Northern Sotho LoLT group (*M=7.8, SD=4.2*)[38] on English elision and on English blending (*M=9.4, SD= 5.5* versus *M=6.5, SD= 4.6).* With regards to English measures, the English LoLT group *(M=15. 7, SD= 7.5)* also performed significantly better than the Northern Sotho LoLT group *(M=13.1, SD= 6.5)* on English sound matching. The Northern Sotho LoLT group *(M=47.7, SD= 13.7)* performed significantly better than the English LoLT group *(M=42.6, SD= 11.6)* on English RCN. With regards to the Northern Sotho measure, the Northern LoLT group *(M=7.1, SD= 3.0)* performed significantly better than the English LoLT group *(M=5.7, SD= 2.8)* on Northern Sotho sound matching and on Northern Sotho digit span (*M=7.9, SD= 2.0* versus *M=7.0, SD=1.9).* The Northern Sotho LoLT group *(M=3.7, SD= 2.0)* also

[38] The means and descriptive statistics for English and Northern Sotho phonological and literacy variables are depicted in Table 5.10.

performed significantly higher than the English LoLT group *(M=2.2, SD= 1.9)* on Northern Sotho early writing.

Cohen's *d* analysis suggested a large effect in English blending, English elision and Northern Sotho early writing *(r > .50)*, a medium effect in English sound matching, English RCN, Northern Sotho sound matching and Northern Sotho digit span, letter knowledge and word reading tasks (*r > .30* but less than *.50*). Compared to the first measuring point, there were more significant group differences, and the results suggest that the two LoLT groups, for the most part, performed better in the language in which they were taught. Thus, the influence of the medium of instruction seemed more apparent at this point.

5.4.5 Differences in syllable and phoneme awareness

A paired t-test was used to establish differences between syllable awareness and phoneme awareness. A paired t-test is a statistical procedure used to determine whether differences between means obtained from two groups in the same sample are statistically meaningful (Dornyei 2010, 215; Field 2013, 288). A paired t-test was conducted to determine differences in the mean scores calculated at the syllable and phoneme level of PA, based on the entire sample and within Northern Sotho and English LoLT groups. Syllable and phoneme awareness scores were extracted from the blending and elision tasks, since these tasks contained items at the syllable and phoneme level, respectively. English and Northern Sotho (syllable elision-phoneme elision and syllable blending - phoneme blending) measures were used as the paired variables. A confidence interval of 95% was used. Table 5.12 below shows the paired t-test analysis for English and Northern Sotho syllable and phoneme level measures based on the entire sample and each LoLT group.

Table 5.12 Paired t-test for syllable and phoneme awareness measures

English and Northern Sotho variables		NS LoLT group		English LoLT group		Entire sample		Paired differences							
											95% confidence interval of the difference				
		M	SD	M	SD	M	SD	Mean difference	SD	SE	Lower	Upper	t	df	Sig
Pair 1	Eng syllable elision	6.3	2.5	6.9	2.3	6.6	2.4	3.62	3.73	.326	2.97	4.26	11.11	130	.000
	Eng phoneme elision	1.5	2.5	4.6	5.2	3.0	4.3								
Pair 2	Eng syllable blending	5.0	2.1	5.8	1.8	5.4	2.0	2.82	3.57	.312	2.20	3.43	9.02	130	.000
	Eng phoneme blending	1.5	3.4	3.7	4.4	2.5	4.1								
Pair 1	NS syllable elision	4.2	3.5	5.1	11.2	4.6	8.1	3.89	7.96	.695	2.51	5.26	5.59	130	.000
	NS phoneme elision	.71	1.8	.75	2.0	.73	1.9								
Pair 2	NS syllable blending	5.2	1.5	5.2	1.8	5.2	1.6	2.35	3.35	.293	1.77	2.93	8.03	130	.000
	NS phoneme blending	2.9	3.5	2.7	3.6	2.8	3.6								

M-mean, SD-standard deviation, SE-standard error, T- t-test statistics value, df-degrees of freedom, NS-Northern Sotho, Eng-English, PAIR 1 and 2- syllable and phoneme level variables compared. Sig-significance. Sig. p <0.05.

The results revealed that there were significant statistical differences between syllable and phoneme awareness measures in both languages. The entire sample statistics showed that English syllable elision (*M=6.6, SD=2.4*)[39] was scored higher than English phoneme elision

[39] The means and descriptive statistics for English and Northern Sotho phonological and literacy variables are

(*M=3.0, SD=4.3*). The English syllable blending (*M=5.4, SD=2.0*) score was also significantly higher than the English phoneme blending score (*M=2.5, SD=4.1*). Northern Sotho syllable elision (*M=4.6, SD=8.1*) had a higher mean score than phoneme elision (*M=.73, SD=1.9*). Northern Sotho syllable blending *(M=5.2, SD=1.6*) proved easier than phoneme blending (*M=2.8, SD=3.6*).

Within-group statistics revealed that in the Northern Sotho LoLT group, English syllable elision (*M=6.3, SD=2.5*) was performed better than English phoneme elision (*M=1.5, SD=2.5*). Likewise, the score for English syllable blending (*M=5.0, SD=2.1*) was significantly higher than the score for English phoneme blending (*M=1.5, SD=3.4*). Northern Sotho syllable elision (*M=4.2, SD=3.5*) was scored higher than Northern Sotho phoneme elision (*M=.71, SD=1.8*) and Northern Sotho syllable blending (M*=5.2, SD=1.5*) was better than phoneme blending (*M=2.9, SD=3.5*).

In the English LoLT group, the participants performed significantly better in English syllable elision *(M=6.9, SD=2.3*) than in English phoneme elision (*M=4.6, SD=5.2*). English syllable blending (*M=5.8, SD=1.8*) had a significantly higher mean than English phoneme blending (*M=3.7, SD=4.4*). Likewise, Northern Sotho syllable elision (*M=5.1, SD=11.2*) was performed better than Northern Sotho phoneme elision (*M=.75, SD=2.0*). Northern Sotho syllable blending (*M=5.2, SD=1.8*) was scored better than phoneme blending (*M=2.7, SD=3.6*). The findings clearly indicate better syllable awareness than phoneme awareness in the entire sample, and in both LoLT groups, in both English and in Northern Sotho. The tasks which demanded syllabic awareness seemed less difficult for children in comparison to phoneme awareness tasks – notably, performance in phoneme awareness was very low, and all the learners had difficulty manipulating sound units at the phoneme level.

5.4.6 Relationships among variables: Point 2

Spearman's correlation analysis and path analysis was used to measure the relationship between phonological processing skills and literacy skills.

5.4.6.1 Spearman's correlation analysis

Spearman's correlations analysis was used to establish the associations between phonological and literacy variables. Spearman's correlations analysis was considered in this study because some of the data were not normally distributed. Table 5.13 below shows the Spearman correlations statistics between phonological processing and literacy abilities in the Northern Sotho and English LoLT groups. The correlations are significant (2-tailed) at $p < .01$ and *.05* level.

The r statistic revealed that the strength of correlations ranged from very weak (*r=-.02*) to strong (*r=.94*). For the English measures, the within-language correlations revealed significant

depicted in Table 5.10.

associations between English PA and literacy tasks, which ranged from moderate to strong in the English LoLT group. However, in the Northern Sotho LoLT group, the relationship ranged from weak to moderate. The correlations between English PWM and literacy skills were weak in both LoLT groups. The significant relations between rapid naming and literacy skills ranged from weak to moderate (and were negative in both LoLT groups).

Table 5.13 Spearman's correlations analysis for group sample

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1.Eng elision		.47**	.55**	.52**	.29*	-.43**	-.50**	-.27**	.21	.51**	.49**	.61**	.74**	.41**	.40**	.37**	-.50**	-.38**	.57**	.68**	.68**	.42**
2.Eng blending	.74**	-	.49**	.43**	.46**	-.27**	-.25**	-.13	-.22	.36**	.34**	.42**	.47**	.34**	.40**	.38**	-.24	-.07	.41**	.51**	.45**	.29**
3.Eng sound matching	.67**	.44**	-	.45**	.30*	-.36**	-.44**	-.28**	-.11	.61**	.55**	.47**	.49**	.59**	.35**	.38**	-.46**	-.22	.45**	.56**	.54**	.49**
4.Eng digit span	.31*	.31*	.29*	-	.55**	-.30	-.31*	-.10	-.34	.39**	.35**	.30*	.33**	.34**	.75**	.64**	-.30	-.14	.35**	.34**	.30*	.19
5.Eng NWR	.25	.40**	.36**	.70**	-	-.18	-.05	-.20	-.19	.08	.02	.14	.18	.18	.53**	.46**	-.10	-.14	.05	.09	.06	.02
6.Eng RDN	-.36**	-.17*	-.54**	-.13	-.28*	-	.55**	.42**	.18	-.37**	-.32**	-.48**	-.35	-.19	-.12	-.09	.53**	.39**	-.47**	-.39**	-.40**	-.35**
7.Eng RLN	-.55**	-.34**	-.63**	-.15	-.23	-.61**	-	.17	.22	-.61**	-.56**	-.38**	-.39**	-.23	-.19	-.21	.73**	.25**	-.57**	-.57**	-.57**	-.47**
8.Eng RCN	-.31*	-.24	-.39**	.11	-.03	.29*	.39**	-	.38**	-.12	-.05	-.20	-.19	-.19	-.09	-.09	.35**	.38**	-.20	-.22	-.25	-.24*
9.Eng RON	-.34**	-.31*	-.38**	.03	-.13	.27*	.45**	.80**	-	-.35**	-.32**	-.06	-.09	-.32**	-.16	-.29*	.32**	.11	-.37**	-.21	-.23	-.25*
10..Eng word reading	.80**	.63**	.59**	.19	.16	-.42**	-.63**	-.38**	-.44**	-	.94**	.54**	.44**	.60**	.23	.42**	-.62**	-.23	.61**	.76**	.71**	.54**
11.Eng fluent reading	.77**	.55**	.67**	.14	.12	-.50**	-.69**	-.44**	-.48**	.89**	-	.49**	.40**	.59**	.20	.38**	-.57**	-.19	.61**	.78**	.67**	.51**
12.NS blending	.77**	.57**	.58**	.11	.06	-.38**	-.54**	-.27*	-.26*	.67**	.68**	-	.63**	.43**	.26*	.28*	-.39**	-.26*	.46**	.61**	.53**	.41**
13. NS elision	.69**	.60**	.67**	.27*	.20	-.30**	-.50**	-.28*	-.23	.59**	.63**	.65**	-	.46**	.32**	.26*	-.43**	-.45**	.50**	.60**	.67**	.50**
14.NS sound matching	.70**	.48**	.59**	.36**	.32*	-.26	-.48**	-.21	-.32*	.51**	.52**	.59**	.59**	-	.27*	.36**	-.36**	-.23	.42**	.54**	.49**	.43**
15. NS digit span	.16	.12	.24	.57**	.40**	-.16	-.11	.05	.08	.09	.05	.06	.31*	.19	-	.58**	-.14	-.13	.24*	.30*	.26*	.14
16..NS NWR	.23	.27*	.22	.47**	.37**	-.17	-.14	-.10	-.12	.13	.17	.29*	.31*	.36**	.50**	-	-.16	-.03	.28*	.36*	.28*	.29*
17. NS RLN	-.53**	-.40**	-.48**	-.04	-.16	.49**	.57**	.52**	.43**	-.61**	-.66**	-.54**	-.51**	-.34**	-.12	-.17	-	.37**	-.65**	-.68**	-.69**	-.68**
18.NS RON	-.08	-.02	-.27*	.09	.03	.33**	.20	.32*	.24	-.25*	-.30*	-.12	-.21	-.07	-.02	.05	.37**	-	-.26**	-.35**	-.36**	-.23
19. NS letter reading	.48**	.30**	.53**	.08	.06	-.52**	-.62**	-.33**	-.38**	.60**	.64**	.55**	.46**	.36**	.03	.08	-.71**	-.36**	-	.78**	.79**	.58**
20..NS word reading	.68**	.46**	.57**	.15	.11	-.52**	-.62**	-.26**	-.31**	.68**	.70**	.67**	.58**	.48**	.13	.15	-.63**	-.32	.81**	-	.94**	.68**
21..NS fluent reading	.69**	.47**	.65**	.07	.08	-.51**	-.69**	-.40**	-.42**	.70**	.80**	.69**	.68**	.47**	.07	.18	-.69**	-.32**	.79**	.86**	-	.65**
22. NS early writing	.72**	.53**	.64**	.23*	.22	.42**	-.60**	-.24	-.28	.66**	.65**	.67**	.63**	.57**	.26*	.23	-.55**	-.26**	.57**	.78**	.67**	-

Note - Correlations for the Northern Sotho LoLT groups are reported above the diagonal and correlations for the English LoLT group are below the diagonal. The correlations are significant (2-tailed) at p < .01 and .05 level).

Within language correlations in Northern Sotho results revealed that correlations between PA and literacy skills in Northern Sotho ranged from weak to moderate in both LoLT groups. The significant correlations between PWM and literacy measures in Northern Sotho were weak in both LoLT groups. While PWM (digit span) correlated with one literacy skill (early writing) in the English LoLT group, PWM (digit span and non-word repetition) significantly correlated with several literacy variables in the Northern Sotho LoLT group. The relations between rapid naming and literacy skills in the Northern Sotho language were mostly significant (and negative), in both LoLT groups.

Cross-linguistic correlations revealed that the associations between English PA and Northern Sotho literacy variables ranged from weak to strong in both LoLT groups. Correlations between English PWM (digit span) and Northern Sotho literacy skills were weak in both LoLT groups. The correlations between English rapid naming and Northern Sotho literacy skills were mostly significant and negative. Cross-linguistic correlations between Northern Sotho PA and English literacy variables were moderate. Northern Sotho PWM and English literacy skills had weak correlations in both LoLT groups. The relations between Northern Sotho rapid naming and English literacy were significant (and negative).

5.4.6.2 Phonological processing variables as predictors of literacy

AMOS path analysis was once again conducted to establish the predictive value of phonological processing skills with regards to literacy variables in Northern Sotho and in English. The phonological processing measures (elision, blending, sound matching, non-word repetition, RLN, RDN, RON, RCN) were used as independent variables. Literacy measures (letter reading, word reading, fluent reading and early writing) were used as the dependent variables. Table 5.14 below shows the regression coefficients for the phonological processing and the literacy variables.

Table 5.14 Regression coefficients for English variables

Variable	Direction	Variable	Unstandadised Estimates	Standardised Estimates	Standard error	C.R	P
Eng elision	→	Eng word reading	1.20	.386	.281	4.27	***
Eng elision	→	Eng fluent reading	1.36	.384	.337	4.04	***
Eng syllable elision	→	Eng word reading	.148	.188	.061	2.44	.015
Eng syllable elision	→	Eng fluent reading	.151	.218	.054	2.82	.005
Eng phoneme elision	→	Eng word reading	.509	.422	.123	4.14	***
Eng phoneme elision	→	Eng fluent reading	.460	.434	.109	4.24	***
Eng blending	→	Eng word reading	.523	.132	.361	1.45	.147
Eng blending	→	Eng fluent reading	.245	.070	.302	.810	.418
Eng syllable blending	→	Eng word reading	.037	.044	.063	.598	.550
Eng syllable blending	→	Eng fluent reading	.000	.001	.055	.007	.994
Eng phoneme blending	→	Eng word reading	.169	.131	.134	1.27	.205
Eng phoneme blending	→	Eng fluent reading	.125	.111	.118	1.06	.289
Eng sound matching	→	Eng word reading	.608	.207	.250	2.43	.015
Eng sound matching	→	Eng fluent reading	.732	.283	.209	3.50	***
Eng digit span	→	Eng word reading	.076	.004	1.54	.049	.961
Eng digit span	→	Eng fluent reading	.994	.055	1.29	.770	.441
Eng non-word repetition	→	Eng word reading	2.26	.110	1.46	1.55	.122
Eng non-word repetition	→	Eng fluent reading	2.34	.129	1.22	1.91	.056
Eng rapid digit naming	→	Eng word reading	.235	.024	.778	.302	.763
Eng rapid digit naming	→	Eng fluent reading	.735	.085	.650	1.13	.258
Eng rapid letter naming	→	Eng word reading	1.55	.151	.828	1.87	.062
Eng rapid letter naming	→	Eng fluent reading	1.46	.162	.692	2.11	.035
Eng rapid object naming	→	Eng word reading	1.08	.150	.551	1.96	.050
Eng rapid object naming	→	Eng fluent reading	1.13	.178	.460	2.45	.014
Eng rapid colour naming	→	Eng word reading	.239	.148	.129	1.86	.064
Eng rapid colour naming	→	Eng fluent reading	.268	.189	.107	2.50	.013

Note: *P-value represents the significance of the regression test statistics, C.R-Critical Ratio, NS-Northern Sotho, Eng-English. Significance:* p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

The regression analysis results indicated that English elision significantly predicted English word reading (β=.386, p=000) and fluent reading (β =.384, p=000) abilities. English sound matching significantly predicted English word reading (β =.207, p=.015) and fluent reading (β =.283, p=.000). English RLN significantly predicted English fluent reading (β =.162, p=.035). English RON significantly predicted English word reading (β =.150, p=.050) and fluent reading (β =.178, p=.014). English RCN significantly predicted English fluent reading (β =.189, p=.013). The findings suggested that PA and rapid naming are unique predictors of literacy development in the English language. Table 5.15 below shows the regression results for the Northern Sotho phonological processing and literacy variables.

Table 5.15 Regression coefficients for Northern Sotho variables

Variable	Direction	Variable	Unstandadised Estimates	Standardised Estimates	Standard error	C.R	P
NS elision	→	NS letter reading	.785	.285	.242	3.24	.001
NS elision	→	NS word reading	.283	.214	.103	2.74	.006
NS elision	→	NS fluent reading	1.28	.383	.261	4.90	***
NS elision	→	NS early writing	.076	.175	.037	2.05	.040
NS syllable elision	→	NS letter reading	.123	.075	.126	.972	.331
NS syllable elision	→	NS word reading	.093	.118	.055	1.69	.091
NS syllable elision	→	NS fluent reading	.111	.056	.139	.798	.425
NS syllable elision	→	NS early writing	.026	.103	.020	1.30	.195
NS phoneme elision	→	NS letter reading	2.35	.330	.559	4.19	***
NS phoneme elision	→	NS word reading	.687	.202	.243	2.83	.005
NS phoneme elision	→	NS fluent reading	3.12	.362	.616	5.06	***
NS phoneme elision	→	NS early writing	.125	.112	.091	1.38	.168
NS blending	→	NS letter reading	.260	.087	.263	.989	.323
NS blending	→	NS word reading	.417	.291	.112	3.72	***
NS blending	→	NS fluent reading	.515	.142	.284	1.81	.070
NS blending	→	NS early writing	.054	.114	.040	1.33	.183
NS syllable blending	→	NS letter reading	1.16	.142	.630	1.85	.065
NS syllable blending	→	NS word reading	.600	.153	.274	2.19	.028
NS syllable blending	→	NS fluent reading	1.07	.108	.694	1.54	.124
NS syllable blending	→	NS early writing	.296	.231	.102	2.90	.004
NS phoneme blending	→	NS letter reading	.858	.230	.318	2.69	.007
NS phoneme blending	→	NS word reading	.761	.425	.138	5.50	***
NS phoneme blending	→	NS fluent reading	1.57	.348	.351	4.48	***
NS phoneme blending	→	NS early writing	.165	.282	.052	3.20	.001
NS sound matching	→	NS letter reading	.372	.083	.355	1.05	.294
NS sound matching	→	NS word reading	.266	.124	.151	1.76	.079
NS sound matching	→	NS fluent reading	.580	.107	.383	1.52	.130
NS sound matching	→	NS early writing	.170	.242	.054	3.13	.002
NS digit span	→	NS letter reading	-.343	-.026	1.02	-.337	.736
NS digit span	→	NS word reading	-.134	-.021	.433	-.309	.757
NS digit span	→	NS fluent reading	-.304	-.019	1.10	-.277	.781
NS digit span	→	NS early writing	.234	.114	.155	1.51	.131
NS non-word repetition	→	NS letter reading	.240	.018	1.03	.233	.816
NS non-word repetition	→	NS word reading	.124	.020	.439	.281	.778
NS non-word repetition	→	NS fluent reading	-.007	.000	1.11	-.007	.995
NS non-word repetition	→	NS early writing	-.048	-.023	.157	-.306	.759
NS rapid letter naming	→	NS letter reading	2.23	.414	.395	5.64	***
NS rapid letter naming	→	NS word reading	.866	.335	.169	5.13	***
NS rapid letter naming	→	NS fluent reading	2.22	.341	.426	5.22	***
NS rapid letter naming	→	NS early writing	.300	.355	.060	4.97	***
NS rapid object naming	→	NS letter reading	-.016	-.004	.287	-.054	.957
NS rapid object naming	→	NS word reading	.078	.039	.123	.637	.524
NS rapid object naming	→	NS fluent reading	.073	.015	.310	.236	.814
NS rapid object naming	→	NS early writing	-.010	.355	.044	-.222	.824

Note: *P value represents the significance of the regression test statistics, C.R-Critical Ratio, NS-Northern Sotho, Eng-English. Significance: *p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

The regression results for Northern Sotho indicated that Northern Sotho elision significantly predicted Northern Sotho letter reading (β =.285 p=.001), word reading (β =.214 p=.006), fluent reading (β =.383, p=.000) and early writing (β =.175 p=.040) skills. Northern Sotho blending predicted Northern Sotho word reading (β =.291, p=.000). Northern Sotho sound matching predicted Northern Sotho early writing (β =.242 p=.002). Northern Sotho RLN significantly predicted Northern Sotho letter reading (β =.414, p=.000), word reading (β =.335, p=.000), fluent reading *(β* =.341, p=.000) and early writing *(β* =.355, p=.000). The findings suggested that PA and RAN skills were unique predictors of literacy skills in the Northern Sotho language.

Figure 5.6 and 5.7 below show AMOS path analysis models for English and Northern Sotho variables. The goodness of fit indices for the English variables were as follows *(chi-square = 84.44, df = 1, p = .000, Goodness of Fit Index (GFI) =.933; Normed Fit Index (NFI) = .884; RMSEA =.792, CFI = .876, IFI = .886.* The GFI, NFI, CFI and IFI has desirable magnitudes *(>80).* The goodness of fit indices results for the Northern Sotho variables were as follows *(chi-square = 169.5, df = 6, p = .000, NFI = .788; RMSEA =.453, CFI = .780, IFI = .794.* Although the two models represent a less than desirable fit, possibly due to some floor effects, further interpretation was carried out. More information regarding the choice of the AMOS path analysis was given in section 5.2.5.2.

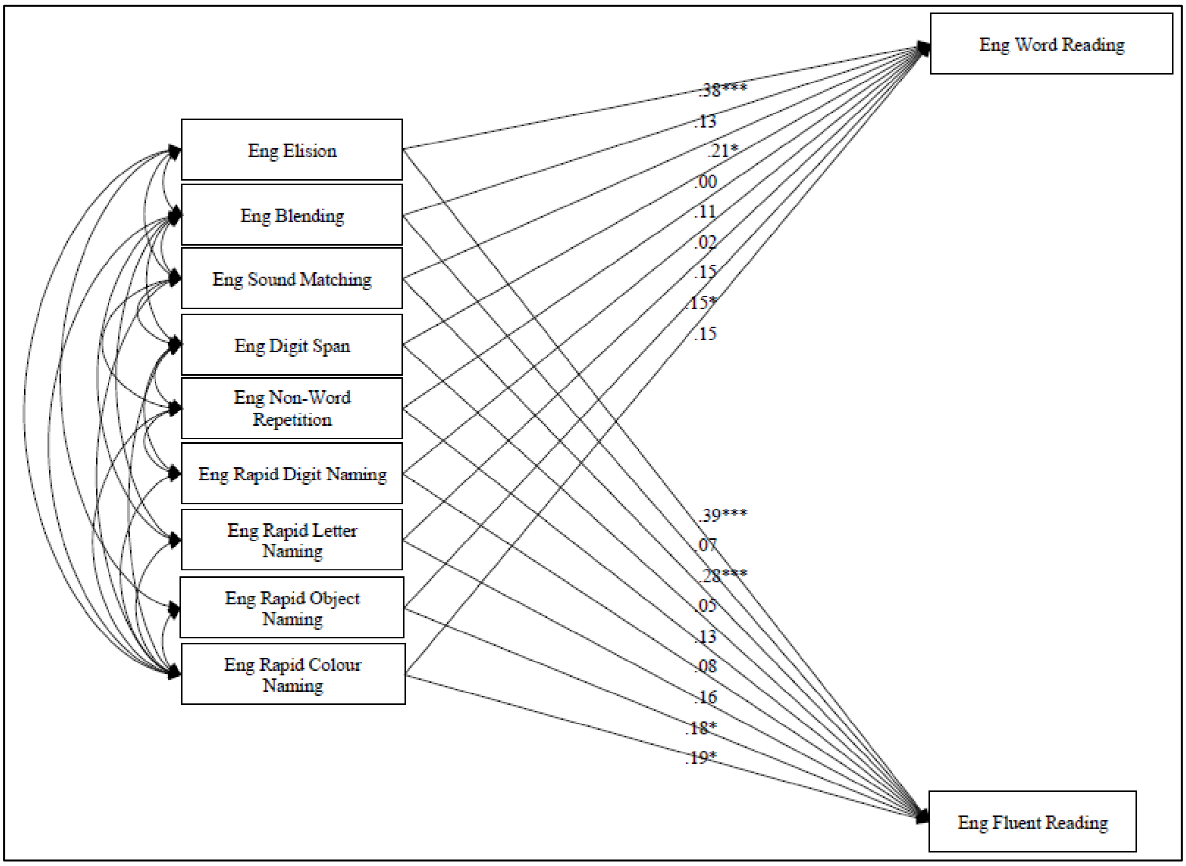


Figure 5.6 AMOS path analysis for English variables

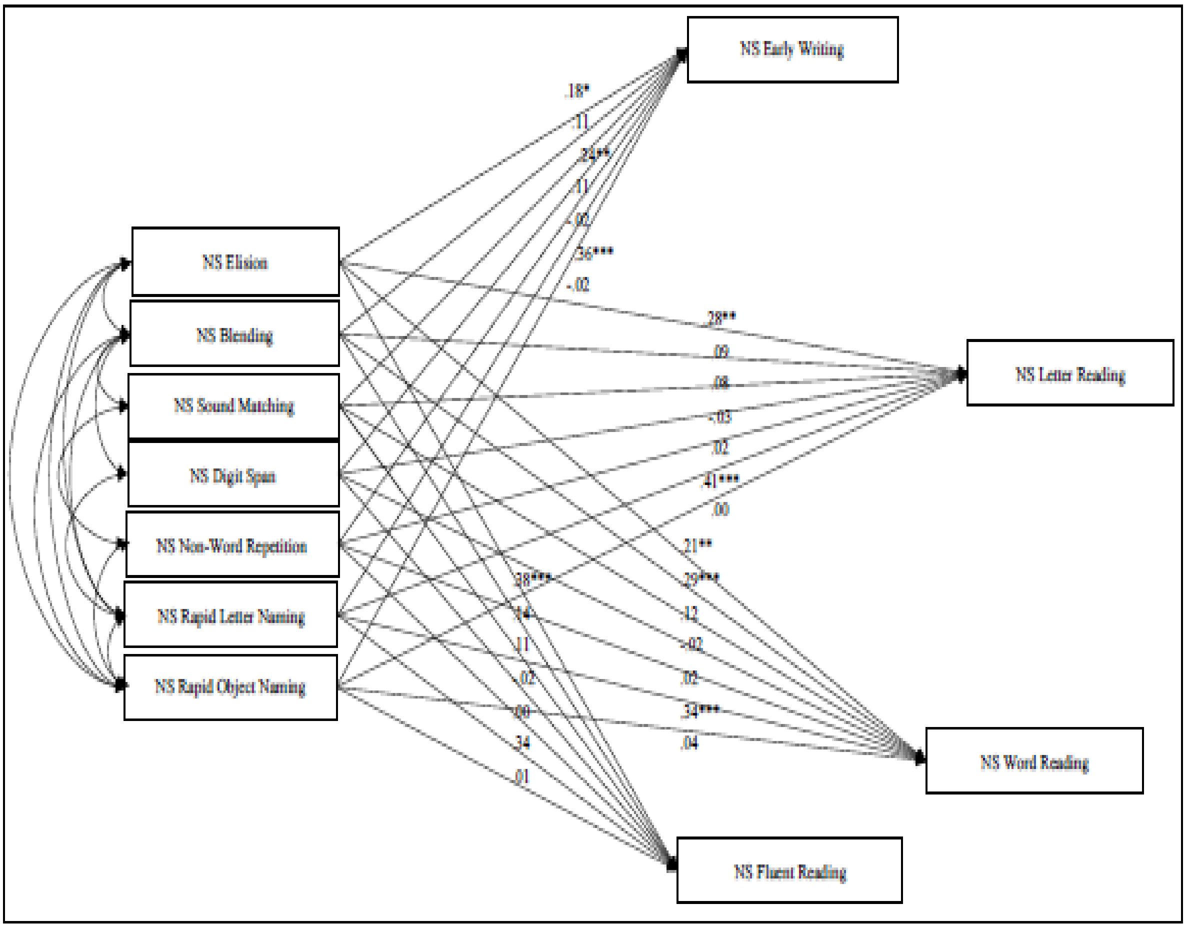


Figure 5.7 AMOS path analysis for Northern Sotho variables

The path models above depict the unidirectional causal relationships between phonological and literacy skills in Northern Sotho and English languages. The English path analysis model revealed that both English sound matching and English elision were significant predictors of English word and fluent reading. With regards to English RAN skills, RLN and RCN significantly predicted English fluent reading. English RON had causal relationships with both English word reading and English fluent reading.

Regarding Northern Sotho, the model showed that Northern Sotho elision was a significant predictor of several Northern Sotho literacy (letter reading, word reading, fluent reading and early writing) skills. Northern Sotho blending was only causally associated with Northern Sotho word reading. Northern Sotho sound matching significantly predicted early writing. With regards to Northern Sotho RAN measures, RLN was causally related to several Northern Sotho (letter reading, word reading, fluent reading and early writing) skills. These findings suggested that PA and RAN skills, in particular, are pre-requisite skills for literacy development in Northern Sotho and in English in the present sample. Importantly, the findings at Point 2 reinforce the findings of Point 1, that PA and RAN skills are foundational skills in learning to read, and serves as a first confirmation that these skills play a longitudinal role in literacy development.

5.4.6.3 Relationship between phoneme awareness, syllable awareness and literacy

AMOS path analysis was used to establish the relationship between PA (syllable elision, syllable blending, phoneme elision, phoneme blending) and literacy skills (letter reading, word reading, fluent reading and early writing). PA skills were used as independent variables whilst literacy skills represented the dependent variables. Path analysis examined the relationships between syllable and phoneme awareness and literacy development in English and Northern Sotho languages[40]. The regression results revealed that English syllable elision significantly predicted English word reading *(β =.188, p=.015)* and fluent reading *(β =.218 p=.005)*. English phoneme elision significantly predicted English word reading *(β =.422, p=.000)* and fluent reading *(β =.434, p=.000)*. In terms of task type, the elision task predicted literacy skills better than the blending task in the English language. Phoneme awareness predicted literacy better than syllable awareness skills in English. Northern Sotho phoneme elision significantly predicted Northern Sotho letter *(β =.330 p=.000)*, word reading (*β* =.202 p=.005) and fluent reading *(β =.362, p=.000)*. Northern Sotho syllable blending predicted Northern Sotho word reading (*β =.153, p=.028*) and early writing *(β =.231, p=.004)*. Northern Sotho phoneme blending predicted Northern Sotho letter reading *(β =.330, p=.000*), word reading *(β =.202, p=.005*), fluent reading *(β =.348 p=.000)* and early writing *(β =.282, p=.001)*. In terms of task type in Northern Sotho, blending was a better predictor of Northern Sotho literacy skills as compared to elision. Phoneme awareness predicted literacy skills better than syllable awareness. Fig 5.8 below shows a path analysis model for syllable and phoneme awareness measures of PA and literacy measures.

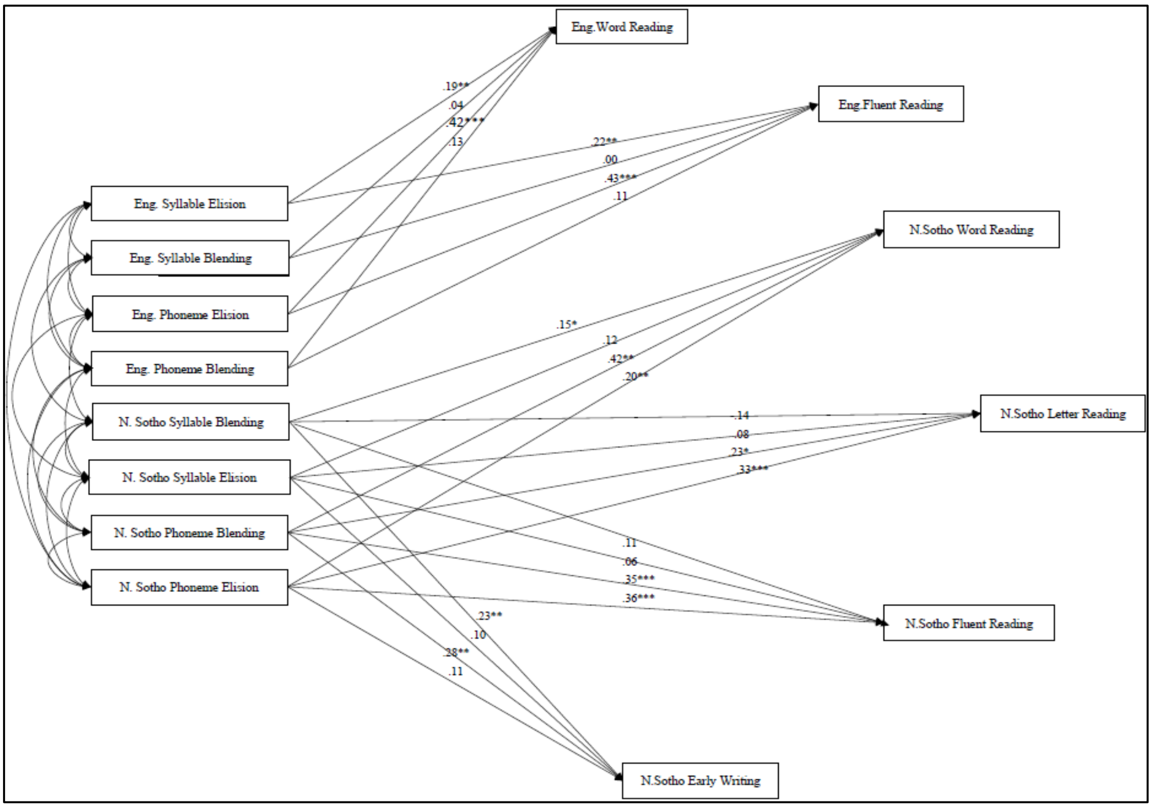


Figure 5.8 AMOS Path analysis for PA syllable and phoneme awareness measures

40 Refer to Table 5.13 (above) for the correlation analysis and Table 5.14 and 5.15 above for regression coefficient values.

The goodness of fit indices for the model were as follows: *chi-square = 471.74, df =39, p = .000, RMSEA =.453, CFI = .624, NFI = .620, IFI = .640*. The rationale for selecting the path analysis was given in section 5.2.5.2 of this chapter. The researcher used the model primarily to establish and explain the prediction pattern between PA and literacy skills. The PA model depicts a unidirectional pathway between PA and literacy skills in Northern Sotho and English abilities. Further interpretation based on this model suggested a causal relationship between English syllable elision and English literacy abilities. English phoneme elision is causally associated with English word reading and fluent reading abilities. With regards to Northern Sotho, a causal relationship was observed between Northern Sotho syllable blending and Northern Sotho word reading and early writing. Northern Sotho phoneme blending was a significant predictor of Northern Sotho early writing, letter reading, word reading and fluent reading abilities. Northern Sotho phoneme elision was causally related to Northern Sotho letter reading, word reading and fluent reading abilities.

5.5 Cross-linguistic transfer of skills in Northern Sotho and English: Point 2

Multiple regression analyses were used to assess the cross-linguistic predictors of literacy in Northern Sotho and English languages. Normality, multicollinearity and homogeneity of variance tests were performed to ascertain the appropriateness of multiple regression analysis. Multiple regression analysis was conducted to determine the extent to which phonological processing measures in each language predicted the literacy abilities of another language. Multiple regression analysis was conducted for the entire sample and for each LoLT group, to determine the cross-linguistic predictors of literacy in each language. Table 5.16 below shows the cross-linguistic regression results for the entire group and each LoLT group.

5.5.1 Cross-linguistic predictors of Northern Sotho literacy

Multiple regression was used to determine the cross-linguistic predictors of Northern Sotho literacy. English phonological processing variables (elision, blending, sound matching, non-word repetition, RLN, RDN, RON, RCN) were used as independent variables. Northern Sotho literacy skills (letter reading, word reading, fluent reading and early writing) were used as dependent variables. All the independent variables were entered into the model in a single step. The cross-linguistic regression results for the entire sample revealed that English elision explained 57% of the variance in Northern Sotho word reading. English blending explained 53% of the variance in Northern Sotho fluent reading. English sound matching explained 35% of the variance in Northern Sotho early writing. The relationship between English non-word repetition and rapid naming tasks and some literacy abilities in Northern Sotho (i.e. early writing, word reading, letter and fluent reading) was significant but negative.

Within-group statistics revealed that in the Northern Sotho LoLT group, English elision explained 58%, 57% and 67% of the variance in Northern Sotho letter, word and fluent reading abilities. English sound matching accounted for 41% of the variance Northern Sotho early writing. RLN significantly predicted early writing and fluent reading but negatively. In the English LoLT group, English elision explained 59% and 60% of the variance in Northern Sotho word and fluent reading, respectively.

Table 5.16 Multiple regression for cross-linguistic predictors of Northern Sotho literacy

Variable	Northern Sotho LoLT group												English LoLT group												Entire sample											
	NS letter reading			NS word reading			NS fluent reading			NS early writing			NS letter reading			NS word reading			NS fluent reading			NS early writing			NS letter reading			NS word reading			NS fluent reading			NS early writing		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
Eng blending	.46	.40	.16	.20	.21	.34*	.89	.48	.21	-.03	.07	-.07	.33	.36	.14	.10	.13	.11	.25	.31	.12	.05	.05	.13	.43	.26	.17	.22	.12	.18	.71	.31	.23*	.01	.05	.01
Eng elision	.87	.42	.27*	.59	.23	.12	1.7	.51	.37*	.05	.07	.10	.05	.33	.03	.33	.12	.44*	.58	.28	.33*	.08	.04	.29	.20	.24	.09	.25	.11	.23*	.40	.28	.15	.02	.04	.04
Eng sound matching	.11	.26	.08	.27	.14	.24	.56	.31	.19	.11	.04	.36*	.19	.27	.11	-.02	.10	-.03	.31	.23	.19	.07	.04	.26	.18	.18	.09	.12	.09	.13	.41	.21	.18	.08	.03	.27*
Eng digit span	.66	.73	.11	-.24	.39	-.08	-.43	.89	-.51	-.09	.13	-.11	.21	.68	.04	-.03	.25	-.02	-.84	.57	-.18	-.01	.05	-.03	.68	.46	.12	.12	.22	.05	.22	.55	.03	.03	.08	.03
Eng non-word repetition	-.55	.29	-.20	-.13	.15	-.90	-.54	.35	-.15	-.03	.05	-.08	-.72	.37	-.28*	-.18	.13	-.17	-.25	.31	-.10	-.01	.05	-.03	-.68	.22	-.26*	-.22	.10	-.18*	-.70	.26	-.22*	-.04	-.04	-.11
Eng RLN	-.17	.09	-.22	-.09	.05	-.22	-.27	.11	-.24*	-.04	.02	-.36*	-.26	.10	-.34*	-.09	.04	-.24*	-.17	.09	-.23	-.03	.01	-.22	-.21	.07	-.27*	-.09	.03	-.25*	-.26	.08	-.27*	-.04	.01	-.30*
Eng RDN	-.26	.16	.08	-.09	.09	-.17	-.14	.20	-.07	-.02	.03	-.10	-.29	.11	-.33	-.08	.04	-.24*	-.10	.09	-.12	-.01	.01	-.05	-.28	.08	-.26*	-.08	.04	-.16*	-.16	.10	-.02	-.02	.02	-.13
Eng RCN	.04	.11	.38*	-.02	.06	-.03	-.05	.14	-.04	-.01	.02	-.04	-.01	.18	-.00	.01	.07	.02	-.02	.16	-.02	.01	.03	.08	.04	.08	.03	-.02	.04	-.03	-.02	.10	-.02	.01	.02	.06
Eng RON	-.16	.09	-.17	-.03	.05	-.05	-.08	.11	-.06	-.01	.02	-.04	-.03	.16	-.04	.02	.06	.014	-.05	.13	-.06	-.01	.02	-.04	-.14	.08	-.14	.00	.04	.00	-.06	.09	-.05	-.00	.01	-.01

*Note: SE- Standard error, B-unstandardised regression coefficient, Beta- standardised regression coefficient value. Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

The relationship between English rapid naming (RLN and RDN) and Northern Sotho literacy skills (letter and word reading) was significant and negative. The findings showed evidence of cross-linguistic transfer between English (L2) and Northern Sotho (L1) and suggested that English PA skills are unique predictors of Northern Sotho literacy skills.

5.5.2 Cross-linguistic predictors of English literacy

Multiple regression analysis was conducted to determine the Northern Sotho phonological processing predictors of English literacy abilities. Northern Sotho phonological measures (blending, elision, sound matching, non-word repetition, digit span, RLN and RON) were used as independent variables. English literacy (word reading, fluent reading) measures were utilised as dependent variables. All the independent variables were entered into the model in a single step. Table 5. 17 shows the cross-linguistic regression results for the whole group and for each LoLT group.

Table 5.17 Multiple regression for cross-linguistic predictors of English literacy

Variable	Northern Sotho LoLT group						English LoLT group						Entire sample					
	NS word reading			NS fleunt reading			NS word reading			NS fluent reading			NS word reading			NS fluent reading		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
NS blending	1.1	.51	.25*	.57	.50	.14	1.9	.67	.41*	1.2	.56	.28*	1.3	.41	.29*	.81	.38	.20*
NS elision	.11	.50	.03	-.08	.49	-.02	1.3	.55	.30*	1.4	.46	.37*	.78	.38	.18*	.81	.35	.21*
NS sound matching	1.8	.66	.28*	1.7	-.65	.31*	-.07	.96	-.01	.18	.81	.03	.91	.55	.13	.71	.51	.12
NS digit span	-.54	1.1	-.05	.41	1.0	.05	.14	1.3	.01	-.69	1.1	-.07	-.45	.79	-.04	-.71	.74	-.08
NS non-word repetition	1.9	.58	.23*	1.1	.84	.16	-.90	.90	-.12	-.41	.75	-.06	.48	.62	.06	.55	.58	.08
NS RLN	-.32	.09	-.35*	-.27	.08	-.35*	-.22	.13	-.20	-.26	.11	-.28*	-.30	.07	-.31*	-.30	.07	-.34*
NS RON	.03	.12	.02	.04	.12	.04	-.06	.13	-.05	-.05	.11	-.04	.15	.09	.01	.04	.08	.04

*Note: SE- Standard error, B-unstandardised regression coefficient, Beta- standardised regression coefficient value. Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

The results for the entire group revealed that Northern Sotho blending and elision explained 51% and 45% of the variance in English word and fluent reading, respectively. The relationship between Northern Sotho RLN and English literacy abilities was significant and negative. Within-group statistics for the Northern Sotho LoLT suggest that Northern Sotho blending, sound matching and non-word repetition accounted for 47% of the variance in English word reading. Northern Sotho sound matching explained 40% of the variance in English word fluent reading. The relationship between rapid naming and English literacy abilities was significant but negative. In the English LoLT group, Northern Sotho blending and elision explained 54% and 58% of the variance in English word and fluent reading. The relationship between Northern Sotho RLN and English fluent reading was significant and negative. The results showed evidence of cross-linguistic transfer from Northern Sotho (L1) to English (L2). The findings suggested that Northern Sotho PA and PWM skills were unique predictors of English literacy skills.

5.6 Conclusion

This chapter presented the findings for the first and second measuring points. The chapter presented data on group differences between the Northern Sotho and English LoLT groups, cross-linguistic relations between the two groups and the associations between phonological processing skills and literacy skills at the beginning of Grade 2 and at the end of Grade 2.

The data obtained at measuring point one and measuring point two confirm the role of phonological processing skills in literacy development in English and Northern Sotho, in this sample of Northern Sotho-English bilinguals. The finding also provided evidence of cross-linguistic transfer of phonological processing skills between Northern Sotho and English. Finally, the data also established some significant group differences between the NS and English LoLT groups in terms of phonological processing abilities, especially towards the end of Grade 2. The influence of the LoLT, which was already very clear for receptive vocabulary knowledge in the middle of Grade 2 (the English LoLT group outperformed the Northern Sotho LoLT group on the English vocabulary test), seemed to be less apparent at earlier stages of literacy instruction. Nevertheless, a clearer pattern, showing that learners performed better in tasks in their language of instruction, emerged at the second measuring point. This suggests that the effects of the LoLT on literacy development might only become apparent after about two years of literacy instruction. Before this point, learners in both LoLT groups performed very similar with regards to phonological processing and literacy skills, in both languages.

CHAPTER 6
RESULTS PART 2
DEVELOPMENTAL PATHS, GRADE 3 GROUP DIFFERENCES AND LONGITUDINAL RELATIONSHIPS BETWEEN PHONOLOGICAL PROCESSING AND LITERACY

Chapter 6 focuses on the developmental paths and longitudinal relationships between phonological processing skills and vocabulary skills, and literacy development. Since the same group of participants were assessed repeatedly (at two points) on several phonological processing (sound matching, blending, non-word repetition, digit span, RCN, RLN, RDN, RON) and literacy (letter reading, word reading, fluent reading, early writing) skills, it is possible to shed some light on the developmental trajectory of these skills. The developmental pathways of phonological processing and literacy skills are presented first, followed by the longitudinal relationship between the various predictor variables (phonological processing and vocabulary skills) and the outcome variables at the end of Grade 3 (reading comprehension and spelling).

6. 1 Descriptive statistics

Preliminary analysis was conducted to provide descriptive statistics for phonological and literacy variables at Point 1 and Point 2. Parametric testing for all the measures at Point 1 and Point 2 was also done, and the results were given in Chapter 5 (section 5.2.1). Descriptive statistics were done to establish the developmental growth of Northern Sotho-English bilingual children on various phonological processing and literacy measures from Point 1 (February Grade 2) to Point 2 (August/October Grade 3). Descriptive statistics were also performed to establish the differences in the developmental patterns in the two groups (NS LoLT and English LoLT) of Northern Sotho-English bilingual children. For ease of reference, Table 6.1 below repeats the mean and standard deviation obtained at Point 1 and Point 2 for the English variables, in the entire sample and in each LoLT group. English sound elision and English early writing is not included as these variables were measured only at Point 2.

The descriptive statistics results based on the entire sample revealed that there seemed to be some changes in the developmental pattern of English phonological and literacy skills from Point 1 to Point 2. English blending, sound matching, digit span, RDN, RLN, RON, RCN, word and fluent reading showed a progressive change from Point 1 to Point 2. English NWR showed a regressive change from Point 1 to Point 2. Within-group statistics for the NS LoLT group revealed that there was a progressive change in English sound matching, digit span, RDN, RLN, RCN, RON, word reading, fluent reading from Point 1 and Point 2. The learners in this group seemed to regress on English blending and NWR measures from Point 1 to 2. In the English LoLT group, the results indicated a progressive change in English blending, sound matching, non-word repetition digit span, RLN, RDN, RON, RCN, word reading and fluent reading.

Table 6.1 Descriptive statistics for English phonological and literacy skills at Point 1 and 2

Variable	Time	NS LoLT		Eng LOLT		Entire sample	
		M	SD	M	SD	M	SD
Eng blending	Point 1	7.4	4.3	7.6	3.7	7.5	4.0
Eng blending	Point 2	6.5	4.6	9.4	5.5	7.9	5.3
Eng sound matching	Point 1	9.8	4.9	11.7	6.2	10.7	5.6
Eng sound matching	Point 2	13.1	6.5	15.7	7.5	14.3	7.1
Eng digit span	Point 1	13.5	2.4	13.5	2.1	13.5	2.2
Eng digit span	Point 2	14.0	2.3	14.4	2.5	14.2	2.4
Eng non-word repetion	Point 1	15.4	2.4	13.2	4.2	14.3	3.5
Eng non-word repetion	Point 2	12.3	5.2	13.4	4.9	12.8	5.1
Eng RLN	Point 1	52.9	22.9	73.0	49.2	62.6	39.1
Eng RLN	Point 2	48.3	17.1	46.6	16.7	47.4	16.9
Eng RDN	Point 1	43.0	12.2	43.1	12.6	43.0	12.1
Eng RDN	Point 2	35.7	9.7	36.6	14.4	36.1	12.2
Eng RON	Point 1	62.1	17.5	59.7	14.0	61.0	15.9
Eng RON	Point 2	51.6	14.7	47.8	13.9	49.8	14.4
Eng RCN	Point 1	53.8	17.7	56.1	24.1	54.9	20.9
Eng RCN	Point 2	47.7	13.7	42.6	11.6	45.2	12.9
Eng word reading	Point 1	14.9	6.8	14.1	11.1	14.5	9.1
Eng word reading	Point 2	29.8	20.2	31.2	21.8	30.5	20.9
Eng fluent reading	Point 1	5.6	5.4	7.0	8.4	6.3	7.0
Eng fluent reading	Point 2	18.5	17.1	24.0	19.3	21.1	18.3

Note: M-mean, SD- standard deviation, Eng-English.

Overall, the descriptive statistics suggest that there were some changes over time with regards to the developmental growth of English phonological processing and literacy skills. Further inferential statistical analysis was conducted using a repeated-measures ANOVA to establish whether the observed effect of time was statistically significant (Section 6.2.2).

Table 6.2 gives the mean and standard deviation for the Northern Sotho variables in the entire sample and each LoLT group. NS sound elision is not included as this variable was measured only at Point 2.

Table 6.2 Descriptive statistics for Northern Sotho variables at Point 1 and 2

Variable	Time	NS LoLT		Eng LOLT		Entire sample	
		M	SD	M	SD	M	SD
NS blending	Point 1	7.2	2.9	7.3	3.2	7.3	3.0
NS blending	Point 2	8.0	4.3	7.9	4.6	8.0	4.5
NS sound matching	Point 1	4.1	2.8	4.5	2.5	4.3	2.7
NS sound matching	Point 2	7.01	3.0	5.7	2.8	6.4	3.0
NS digit span	Point 1	7.4	2.2	7.1	2.1	7.2	2.2
NS digit span	Point 2	7.9	2.0	7.0	1.89	7.4	2.0
NS non-word repetion	Point 1	14.3	2.6	13.5	2.7	13.9	2.7
NS non-word repetion	Point 2	15.2	2.4	14.9	2.82	15.5	2.6
NS RLN	Point 1	62.7	32.9	66.7	35.2	64.7	33.9
NS RLN	Point 2	46.5	21.9	46.0	20.2	46.2	21.0
NS RON	Point 1	57.0	14.8	65.9	19.5	60.8	18.3
NS RON	Point 2	54.2	15.1	58.6	17.7	56.3	16.5
NS word reading	Point 1	7.7	3.4	6.3	2.8	7.0	3.3
NS word reading	Point 2	10.1	7.4	11.3	5.1	10.7	6.4
NS letter reading	Point 1	20.0	5.8	18.7	8.4	19.4	7.1
NS letter reading	Point 2	30.8	13.9	32.6	12.7	31.7	13.3
NS fluent reading	Point 1	8.2	7.8	6.2	7.6	7.2	7.8
NS fluent reading	Point 2	19.2	19.2	20.7	12.1	19.1	16.1
NS early writing	Point 1	79.0	30.2	81.5	24.3	80.2	27.4
NS early writing	Point 2	72.9	40.1	44.1	38.7	59.1	41.9

Note: M-mean, SD- standard deviation, NS-Northern Sotho.

The patterns observed based on the entire sample suggested that there were also some developmental changes in Northern Sotho phonological and literacy skills from Point 1 to Point 2. Northern Sotho (sound matching, digit span, NWR, RLN, RON, word reading, letter reading, fluent reading) showed a progressive change from Point 1 to Point 2. The mean scores showed a regressive change in Northern Sotho blending and early writing skills. Within-group statistics for the NS LoLT group revealed that there was a progressive change in most Northern Sotho tasks except in the early writing skill. Statistics for the English LoLT group indicated that there was a progressive change in most Northern Sotho tasks except digit span and early writing skills. Further inferential statistical analysis was conducted using a repeated-measures ANOVA (section 6.2.3) to establish whether the time effect observed was statistically significant.

6.2 The effect of time

The researcher used a repeated-measures MANOVA to assess the effect of time on the developmental growth of phonological processing and literacy measures in Northern Sotho-English bilinguals. A repeated-measures ANOVA is a statistical tool in which subjects are measured more than once to determine whether a statistically significant change has occurred (Vogt and Johnson 2011, 401). Northern Sotho-English bilingual children were repeatedly assessed at two-time points on various phonological and literacy measures. The participants were subjected to two instructional (NS LoLT and English LoLT) conditions. The mean scores of the participants based on these repeated observations (Point 1 and 2) were compared to determine any statistically significant changes in the mean scores obtained on the phonological processing and literacy measures over two-time points. This was done for the entire group and for each LoLT group individually.

The type of tasks measured at Point 1 and Point 2 represented the within-subject factor in this study. Group (NS LoLT, English LoLT) was used as the between-subject factor. A 95% confidence interval was used. The Greenhouse-Geisser, as well as Huynh-Feldt corrections[41], were applied to the repeated-measures MANOVA models. Tukey's post hoc multiple comparison procedures were used to compare mean scores at Point 1 and Point 2. Bonferroni corrections[42] were applied.

6.2.1 Repeated-measures testing assumptions

Three testing assumptions are used for repeated-measures models: normality, independent observations and sphericity (Field 2013, 429). The normality assumption is not discussed here, given that these results have already been given in Chapter 5, and the same data set was used in this chapter. Although some variables violated the normality assumption, the sample size of 134 (Point 1) and 131 (Point 2) were considered large enough to assume normality in this study. Furthermore, the ANOVA is considered to be a robust statistical technique that can withstand violations of normality.

The independent observations assumption assume that observations in a data sample are independent of each other (Field 2013, 734). In a within-group analysis, this implies that measurement at one data point must not influence measurements at another. There are several ways of checking the data for independence, which include: interclass correlation, Durbin-Watson correlation and graphical methods (Garson 2012, 47). The Durbin-Watson correlations coefficient was used to assess the independence observation assumption in this study. According to Garson (2012, 47), the Durbin-Watson statistic must be between 1.5 and 2.5 for the independent observations assumption to be met. Durbin-Watson coefficient statistics for English variables at Point 1 and 2 ranged between 1.6 and 1.9, whilst the figures for Northern Sotho variables ranged between 1.5 and 1. 9. This implies that observations at Point 1 did not influence observations at Point 2 in this study. Hence, the independent observations assumption was met in this study.

The assumption of sphericity holds that the variations between experimental conditions are fairly similar or roughly equal (Field 2013, 428). Mauchly's test, the Greenhouse-Geisser test, and the Huynh-Feldt tests are used to assess the sphericity assumption. However, for the sphericity assumption to be a major issue, at least three conditions are needed (Field 2013,

[41] The *Greenhouse–Geisser (1959) and* Huynh-Feldt (1976) correction are repeated measures ANOVA corrections based upon the estimates of sphericity (Field 2013, 430).
[42] Bonferroni corrections is a correction applied to control for Type 1 error when multiple significance tests are carried out (Field 2013, 725).

429). This study has only two treatment conditions (NS LoLT and English LoLT) which mean that variances across the two conditions are assumed to be equal. Hence, sphericity was automatically assumed in this study. Taken together, the results obtained from the test of normality, independent observations and sphericity were deemed satisfactory, and they suggested that the data gathered at measuring Point 1 and Point 2 of the study could be analysed using repeated-measures ANOVA models.

6.2.2 Effect of time on English phonological processing and literacy growth

A repeated-measures ANOVA was conducted to determine any statistically significant changes in English phonological and literacy measures over time. English phonological processing and literacy tasks were entered into the model as the within-subject (repeated measure) variables. Group (NS LoLT, English LoLT) was entered as the between-subject factor. Table 6.3 below shows the results of the multivariate test associated with the model. Pillai's Trace was used to indicate the overall significance of time on English phonological and literacy variables.

Table 6.3 Time effect on English phonological and literacy measures

Effect		Value	F	Hypothesis df	Error df	Sig.
Time	Pillai's Trace	.973	208.786	19.000	111.000	.000
Time * Group	Pillai's Trace	.436	4.515	19.000	111.000	.000

Pillai's Trace showed that children significantly improved in the performance of learners on the English phonological processing and literacy variables from Point 1 to Point 2 *(Pillai's Trace =.973, (F (19.111) = 208.8, p = .000).* The interaction effect[43] of time/group was also statistically significant *(Pillai's Trace = .436, (F (19.111) = 4.52, p=.000)*. This implied that both the time (i.e. the time that the learners spent learning at school) as well as the LoLT group for each learner impacted the development of English phonological and literacy skills. Put differently, time significantly affected the developmental growth of English phonological and literacy variables.

Test of within-subject effects was performed following multivariate testing, to identify the specific variables where significant development occurred. Table 6.4 and Table 6.5 below indicate the statistics for within-subject effects and within-group pairwise comparisons for English phonological and literacy variables.

[43] Interaction effect refers to the combined effect of two or more predictor variables on an outcome (Field 2013, 734).

Table 6.4 Test of within-subject effects for English variables based on time effects

Source		Type III sum of squares	Hypothesis df	Error df	Mean square	F	Sig.
Eng blending	Sphericity assumed	15.1	1	129	15.1	1.9	.173
Eng sound matching	Sphericity assumed	866.2	1	129	866.2	58.8	.000
Eng digit span	Sphericity assumed	35.1	1	129	35.1	17.7	.000
Eng non-word repetition	Sphericity assumed	139.7	1	129	139.7	12.5	.000
Eng RLN	Sphericity assumed	15839.8	1	129	15839.8	31.0	.000
Eng RDN	Sphericity assumed	3107.7	1	129	3107.7	51.4	.000
Eng RCN	Sphericity assumed	6316.0	1	129	6316.0	32.0	.000
Eng RON	Sphericity assumed	8298.6	1	129	8298.6	41.3	.000
Eng word reading	Sphericity assumed	16765.1	1	129	16765.1	102.0	.000
Eng fluen treading	Sphericity assumed	14584.2	1	129	14584.2	112.7	.000

Eng-English, F-repeated-measures ANOVA statistic value, Sig-significance. Significance: p<0.05 (95% confidence interval).

Table 6.5 Within-group pairwise comparisons for English variables based on time effects

Variable	NS LoLT		English LoLT		Entire sample	
	Mean Difference	Sig.	Mean Difference	Sig.	Mean Difference	Sig.
Eng blending	-.868	.037	-1.87	.001	-.481	.173
Eng sound matching	-3.92	.000	-3.98	.000	3.6	.000
Eng digit span	.544	.011	-.921	.002	.732	.000
Eng non-word repetition	3.18	.000	-.254	.680	1.46	.001
Eng RLN	4.63	.094	29.5	.000	2.80	.000
Eng RDN	7.29	.000	6.49	.000	6.89	.000
Eng RCN	6.16	.008	13.5	.000	9.83	.000
Eng RON	10.5	.000	12.0	.000	11.3	.000
Eng word reading	-14.9	.000	-17.1	.000	16.0	.000
Eng fluent reading	-12.9	.000	-17.0	.000	14.9	.000

Eng-English, Sig-significance. Significance: p<0.05 (95% confidence interval).

The results of the test of within-subject effect indicated that time had no statistically significant effect on English blending in the entire sample. Pairwise comparisons revealed that the mean difference for English blending between Point 1 and 2 was not statistically significant. Within-group mean changes were, however, significant in both groups. Descriptive statistics on the

English blending measure showed that while the English LoLT seemed to progress, the NS LoLT group regressed significantly, and so the progression in the overall sample got suppressed. Children significantly improved in English sound matching *(F (1, 129) = 58.8, p=.000)*. Pairwise comparisons based on the entire sample revealed that the mean difference between Point 1 and 2 *(MD =3.6, p=.000)* was significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the English LoLT group progressed better than the NS LoLT group on the English sound matching task over time.

Test of within-subject effects indicated that time also had a statistically significant impact on English digit span performance *(F (1, 129) = 17.7, p=.000)*. Pairwise comparisons based on the entire sample revealed that the mean difference between Point 1 and 2 *(MD = .732, p=.000)* was significant. Within-group mean differences for Point 1 and 2 were significant in both LoLT groups. Descriptive statistics suggest that the English LoLT group made better progress than the NS LoLT group on the English digit span task over time. Time likewise had a statistically significant effect on English NWR performance *(F (1, 129) = 12.5, p=.000)*. Pairwise comparisons based on the entire sample revealed that the mean difference between Point 1 and 2 *(MD = 1.46, p=.001)* was significant. Within-group mean differences for Point 1 and 2 tests were significant for the NS LoLT group but non-significant for the English LoLT group. Descriptive statistics suggested that the English LoLT group progressed better than the NS LoLT group on the English NWR task. Time had a regressive effect on English NWR performance in the NS LoLT group.

Test of within-subject effects indicated that time had a statistically significant impact on all the English RAN measures. The average time taken to complete these tasks decreased, which is an indication that learners' ability to rapidly and automatically name stimuli improved. For English RLN, pairwise comparisons based on the entire sample revealed that the mean difference between Point 1 and 2 *(MD = 2.80, p=.000)* was statistically significant *(F (1, 129) = 31.0, p=.000)*. Within-group mean differences for Point 1 and 2 tests were non-significant for the NS LoLT group but significant for the English LoLT group. Descriptive statistics suggested that the English LoLT group progressed better than the NS LoLT group on the English RLN task. Time also had a statistically significant effect on English RDN performance *(F (1, 129) = 51.4, p=.000)*. Pairwise comparisons based on the entire sample revealed that the mean difference between Point 1 and 2 *(MD =6.89, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the English LoLT group progressed better than the NS LoLT group on English RDN.

Children significantly improved in English RCN performance *(F (1, 129) = 32.0, p=.000)* over time. Pairwise comparisons revealed that the mean difference between Point 1 and 2 *(MD =9.83, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the English LoLT group progressed better than the NS LoLT group on English RCN. Likewise, children significantly improved in English RON performance *(F (1, 129) = 41.3, p=.000)*. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD =11.3, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the English LoLT group progressed better than the NS LoLT group on English RON.

Test of within-subject effects indicated that time had a statistically significant impact on English word reading performance *(F (1, 129) = 102.0, p=.000)*. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD =16.0, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the English LoLT group made better progress than the NS LoLT group on English word reading. Time also had a statistically significant effect on English fluent reading performance *(F (1, 129) = 112.7, p=.000)*. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD =14.9, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the English LoLT group progressed better than the NS LoLT group on English fluent reading.

Overall, the results suggest that children significantly improved in the performance of most English phonological and literacy measures (English blending was the only measure not significantly affected by time). The developmental patterns of the English phonological and literacy variables are further illustrated through Figures 6.1 to 6.10 below, which show line-plots for the various English phonological and literacy variables. The plot graphs for the English phonological processing and literacy variables visually confirm the results of the repeated-measures analysis. The plots indicate that the entire sample progressed positively on most English measures, except on the English NWR task (and recall that the positive progression in English blending for the entire sample was not significant). The plots further show that both treatment groups made progressive changes from Point 1 and 2 on English sound matching, digit span, RLN, RDN, RCN, RON, word reading and fluent reading tasks. With the exception of RON, the English LoLT group progressed more on these measures than the NS LoLT group.

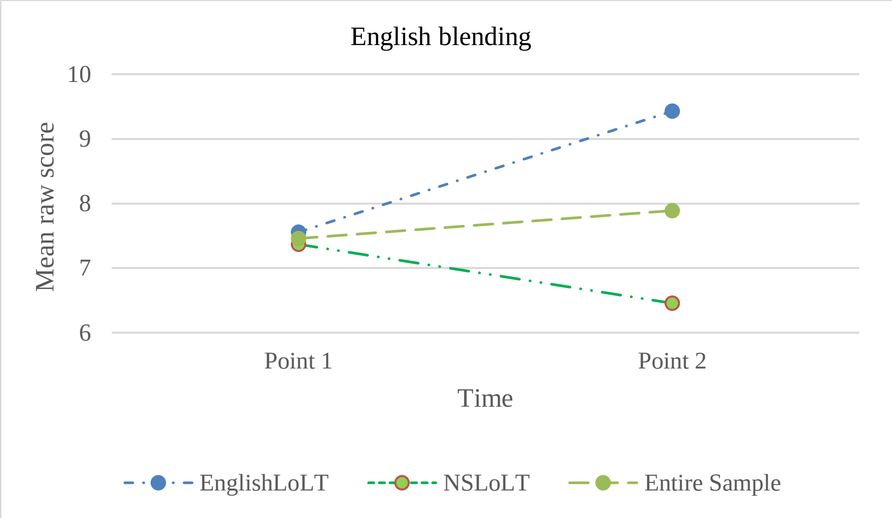


Figure 6.1 Development of English blending skill

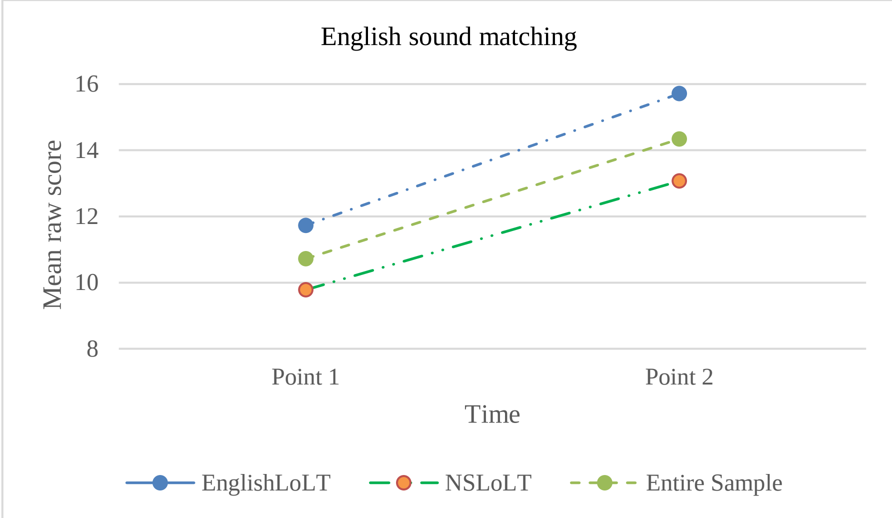


Figure 6.2 Development of English sound matching skill

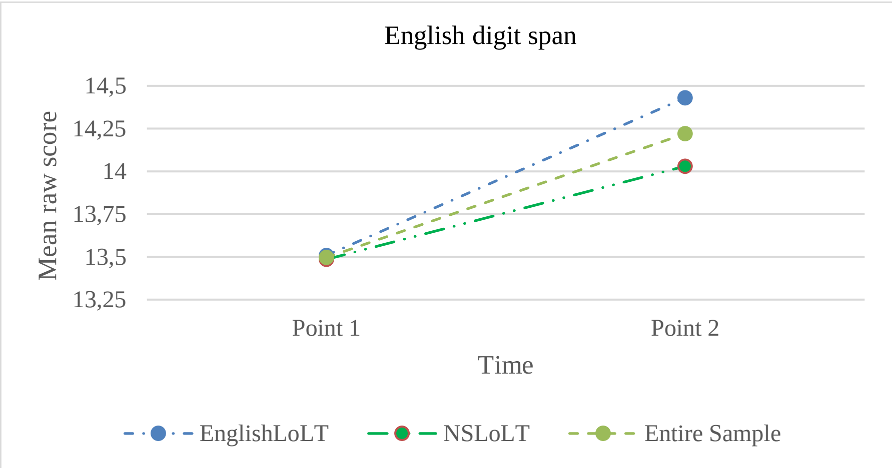


Figure 6.3 Development of English digit span skill

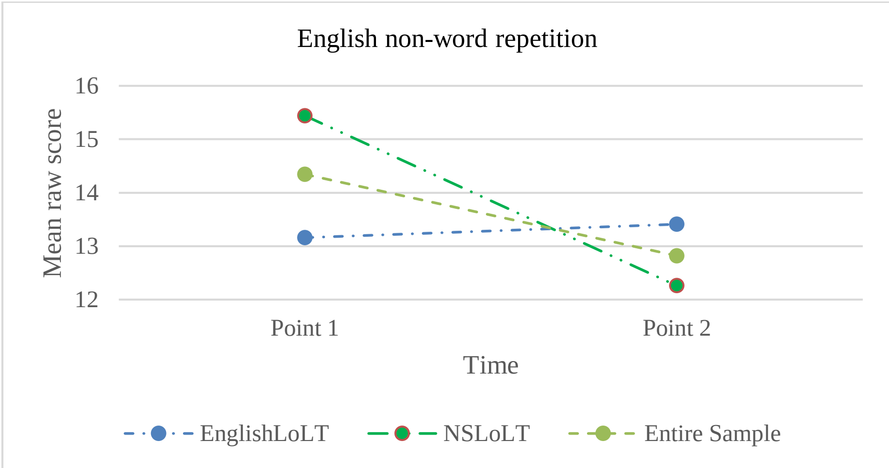


Figure 6.4 Development of English non-word repetition skill

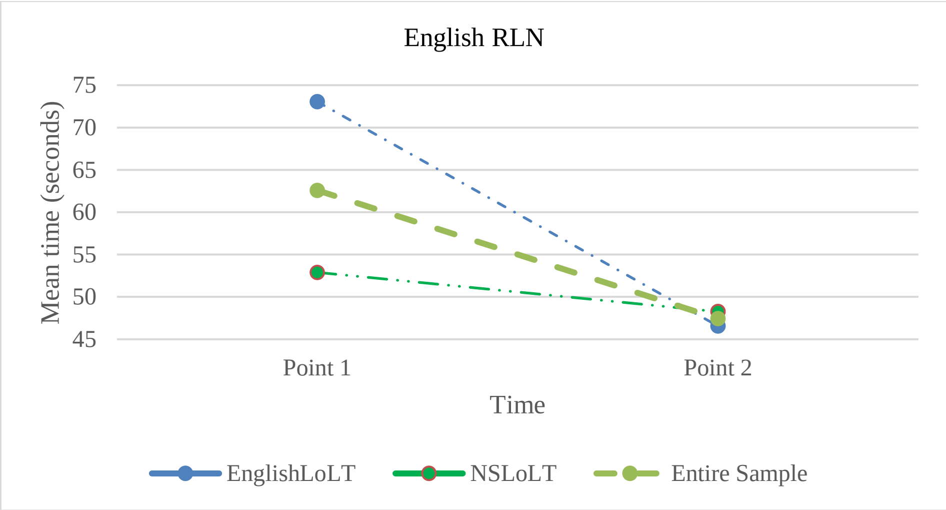


Figure 6.5 Development of English RLN skill

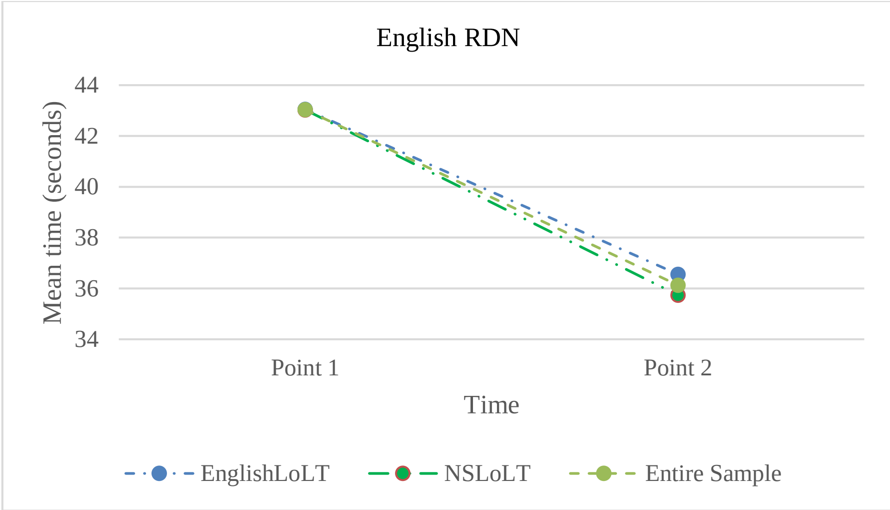


Figure 6.6 Development of English RDN skill

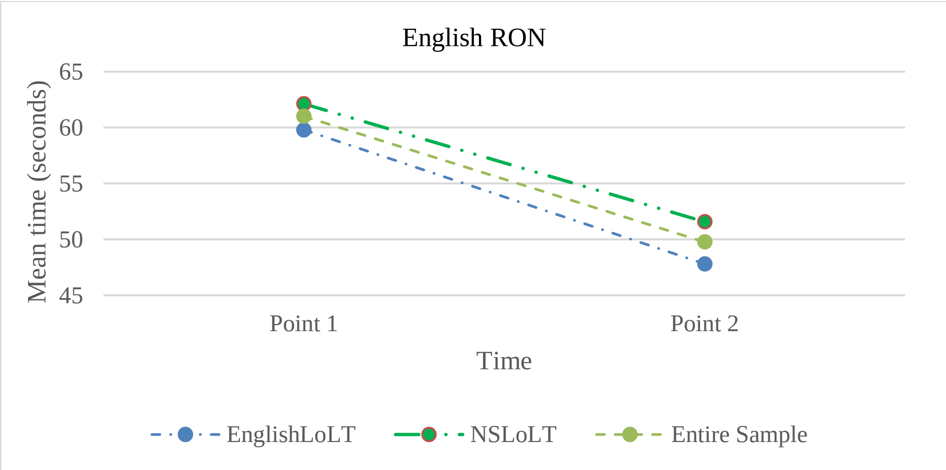


Figure 6.7 Development of English RON skill

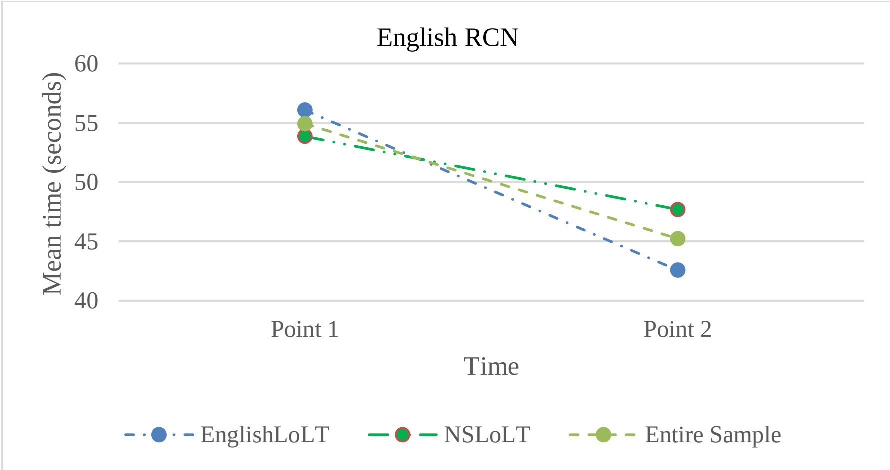


Figure 6.8 Development of English RCN skill

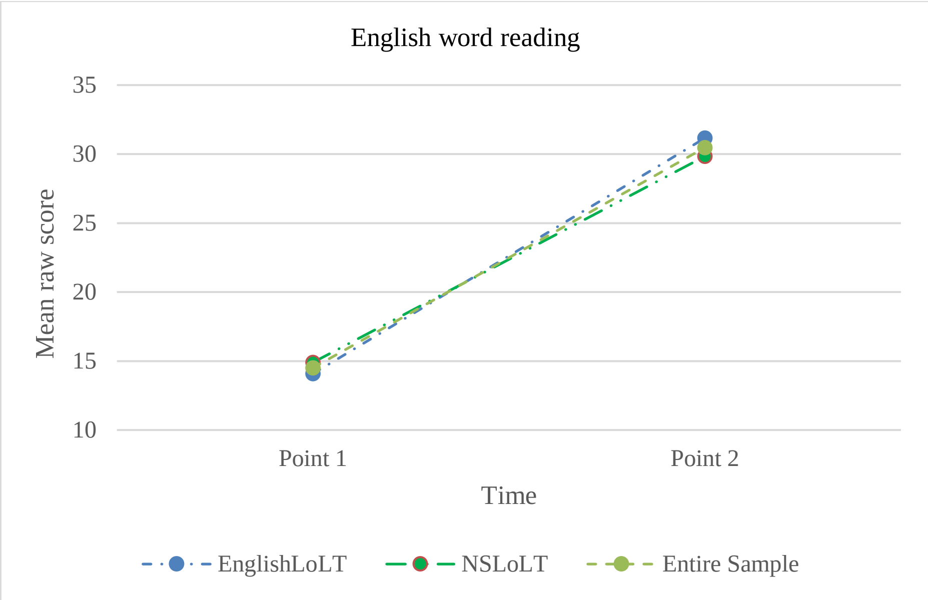


Figure 6.9 Development of English word reading skill

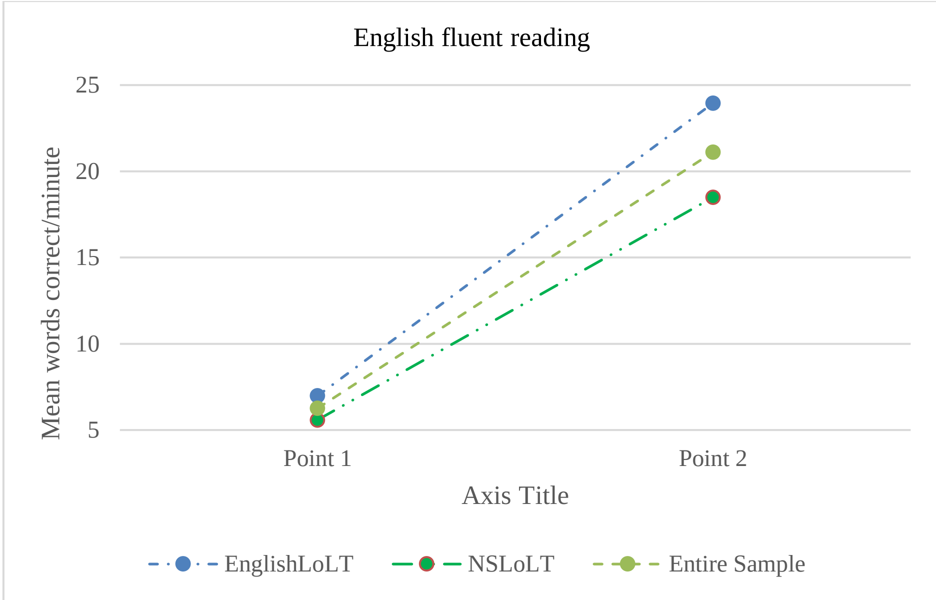


Figure 6.10 Development English fluent reading skill

6.2.3 Effect of time on Northern Sotho phonological processing and literacy growth

A repeated-measures MANOVA was conducted to determine any statistically significant changes in Northern Sotho phonological (blending, sound matching, digit span, NWR, RLN, RON) and literacy (letter reading, word reading, fluent reading, early writing) measures over time. Northern Sotho phonological and literacy tasks were entered into the model as the within-subject (repeated measure) variables. Group (NS LoLT, English LoLT) was entered as the between-subject factor. Table 6.6 below shows the results of the multivariate test associated with the model. Pillai's Trace was used to indicate the overall significance of time on Northern Sotho phonological and literacy variables.

Table 6.6 Time effect on Northern Sotho phonological and literacy measures

Effect		Value	F	Hypothesis df	Error df	Sig.
Time	Pillai's Trace	.987	437.995	19.000	111.000	.000
Time* Group	Pillai's Trace	.474	5.268	19.000	111.000	.000

Pillai's Trace showed that children significantly improved in the performance of learners on the Northern Sotho phonological processing and literacy variables *(Pillai's Trace =.987, (F (19.111) = 438.0, p = .000).* The interaction effect of time/group was statistically significant *(Pillai's Trace = .474, (F (19.111) = 5.27, p=.000).* This implied that both the time (i.e. the time that the learners spent learning at school) as well as the LoLT group for each learner impacted their Northern Sotho phonological and literacy development. Thus, children significantly improved in the developmental growth of Northern Sotho phonological and literacy variables from Point 1 to Point 2. Tests of within-subject effects were performed following multivariate testing, to ascertain which Northern Sotho skills specifically developed over time. Table 6.7 and Table 6.8 below indicate the statistics for within-subject effects and within-group pairwise comparisons for Northern Sotho phonological and literacy variables.

Table 6.7 Test of within-subject effects for Northern Sotho variables based on time effects

Source		Type III Sum of Squares	Hypothesis df	Error df	Mean Square	F	Sig.
NS blending	Sphericity assumed	36.1	1	129	36.1	5.8	.018
NS sound matching	Sphericity assumed	287.8	1	129	287.8	72.2	.000
NS digit span	Sphericity assumed	3.05	1	129	3.05	1.6	.209
NS non-word repetition	Sphericity assumed	91.4	1	129	91.4	22.3	.000
NS RLN	Sphericity assumed	23331.7	1	129	23331.7	47.6	.000
NS RON	Sphericity assumed	1834.1	1	129	1834.1	6.9	.010
NS word reading	Sphericity assumed	883.5	1	129	883.5	55.1	.000
NS fluent reading	Sphericity assumed	9231.4	1	129	9231.4	106.4	.000
NS letter reading	Sphericity assumed	9875.3	1	129	9875.3	143.2	.000
NS early writing	Sphericity assumed	29618.7	1	129	29618.7	34.7	.000

Note: NS-Northern Sotho, F-repeated-measures ANOVA statistic value, Sig-significance. Significance: p<0.05 (95% confidence interval).

Table 6.8 Within-group pairwise comparisons for Northern Sotho variables based on time

Variable	NS LoLT		Eng LoLT		Entire sample	
	Mean Difference	Sig.	Mean Difference	Sig.	Mean Difference	Sig.
NS blending	.912	.050	-.619	.194	-.743	.018
NS sound matching	-2.94	.000	-1.25	.001	2.10	.000
NS digit span	-.599	.018	.127	.620	.216	.209
NS non-word repetition	-.809	.011	-1.56	.000	1.2	.000
NS RLN	16.4	.000	21.3	.000	18.9	.000
NS RON	4.35	.027	6.21	.093	5.3	.010
NS word reading	-2.38	.003	-4.97	.000	3.7	.000
NS fluent reading	-11.0	.000	-12.8	.000	11.9	.000
NS letter reading	-10.8	.000	-13.8	.000	12.3	.000
NS early writing	5.74	.259	36.8	.000	21.3	.000

Note: NS-Northern Sotho, Sig-significance. Significance: p<0.05 (95% confidence interval).

Test of within-subject effects results indicated that children significantly improved in the Northern Sotho blending scores of learners *(F (1, 129) = 5.8, p=.018)*. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD =-.743 p=.018)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant for the NS LoLT group but non-significant for the English LoLT group. Descriptive statistics suggested that the NS LoLT group progressed better than the English LoLT group on Northern Sotho blending. Time also had a statistically significant effect on the development of Northern Sotho sound matching *(F (1, 129) =72.2, p=.000)*. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD =2.10, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the NS LoLT group progressed better than the English LoLT group on the Northern Sotho sound matching task.

Test of within-subject effects results indicated that time had no statistically significant effect on the development of Northern Sotho digit span. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 was not statistically significant. Within-group mean differences for Point 1 and 2 tests were significant for the NS LoLT group but non-significant for the English LoLT group. Descriptive statistics showed that while there seemed to be a progressive effect in the NS LoLT group, the English LoLT group regressed overtime on the Northern Sotho digit span task. With regards to Northern Sotho NWR, time also had a significant impact *(F (1, 129) =22.3, p=.000)* on performance. Pairwise comparisons revealed that the mean difference between Point 1 and 2 *(MD =1.2, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the NS LoLT group made better progress than the English LoLT group on the Northern Sotho NWR task.

Regarding RAN tasks in Northern Sotho, the test of within-subject effects showed that time had a statistically significant impact on the Northern Sotho RLN *(F (1, 129) =47.6, p=.000)* performance. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD = 18.9, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. The English LoLT group made better progress than the NS LoLT group on the Northern Sotho RLN task. Children significantly improved in Northern Sotho RON *(F (1, 129) =6.9, p=.010)* performance across time. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD = 5.3, p=.010)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant for the NS LoLT group and non-significant for the English LoLT. Descriptive statistics revealed that the NS LoLT group made better progress than the English LoLT group on the Northern Sotho RON task.

Regarding the literacy measures, the test of within-subject effects showed that children significantly improved in Northern Sotho word reading (*F (1, 129) =55.1, p=.000)* performance. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD = 3.7, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the English LoLT group progressed better than the NS LoLT on the Northern Sotho word reading task. Children significantly improved in the Northern Sotho fluent reading *(F (1, 129) =106.4, p=.000)* performance. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD = 11.9, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the NS LoLT group progressed better than the English LoLT group on the Northern Sotho fluent reading task.

Test of within-subject effects showed that children significantly improved in the Northern Sotho letter reading *(F (1, 129) =143.2, p=.000)*. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD =12.3, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were significant in both LoLT groups. Descriptive statistics suggested that the English LoLT group made better progress than the NS LoLT group on the Northern Sotho letter reading task. Time also had a statistically significant (but regressive) effect on the Northern Sotho early writing (*F (1, 129) =34.7.2, p=.000)* performance. Pairwise comparisons for the entire sample revealed that the mean difference between Point 1 and 2 *(MD =21.3, p=.000)* was statistically significant. Within-group mean differences for Point 1 and 2 tests were non-significant for the NS LoLT group but significant in the English LoLT group. Descriptive statistics suggested that both groups regressed overtime from Point 1 to Point 2 on Northern Sotho early writing performance (recall that the variable was measured with different tasks at the two points).

Overall, the findings suggest that time had a statistically significant and positive effect on the developmental patterns of most Northern Sotho phonological and literacy measures, with the exception of Northern Sotho digit span task and early writing. The developmental pattern of the Northern Sotho phonological and literacy variables was further illustrated through line-plot graphs. Figures 6.11 to 6.20 below show the plot graphs for various Northern Sotho phonological and literacy variables.

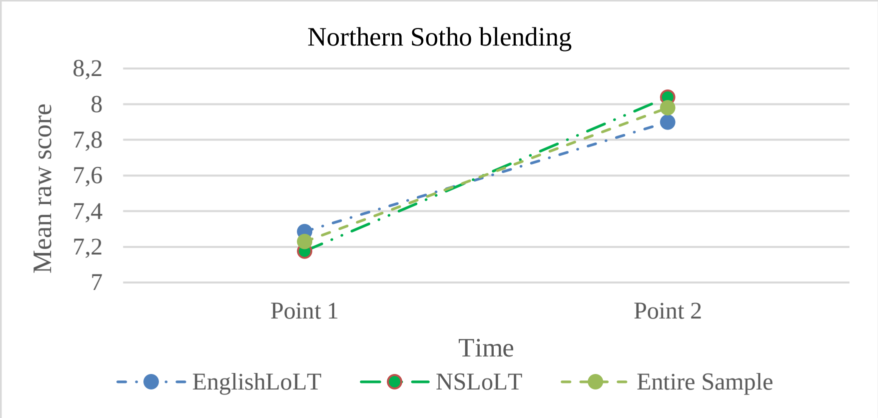


Figure 6.11 Development of Northern Sotho blending skill

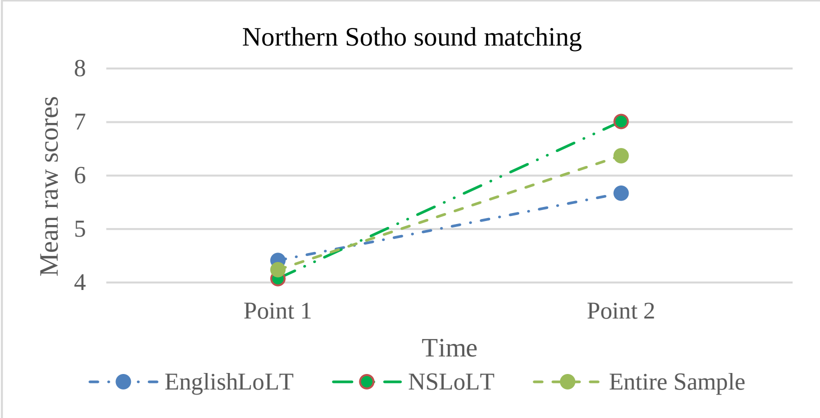


Figure 6.12 Development of Northern Sotho sound matching skill

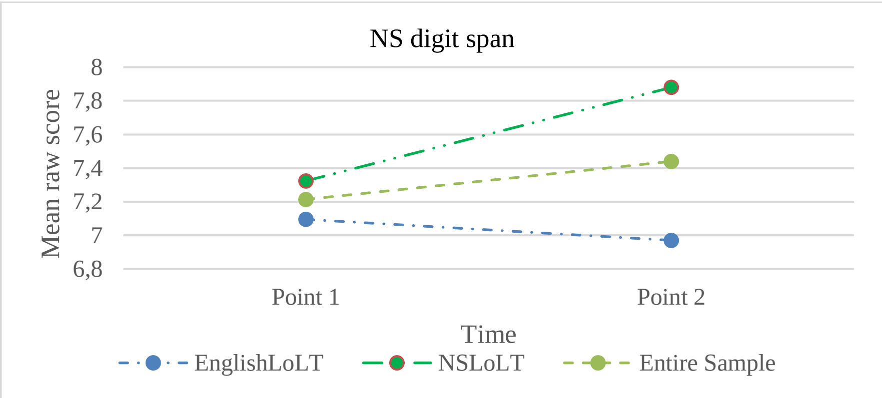


Figure 6.13 Development of Northern Sotho digit span skill

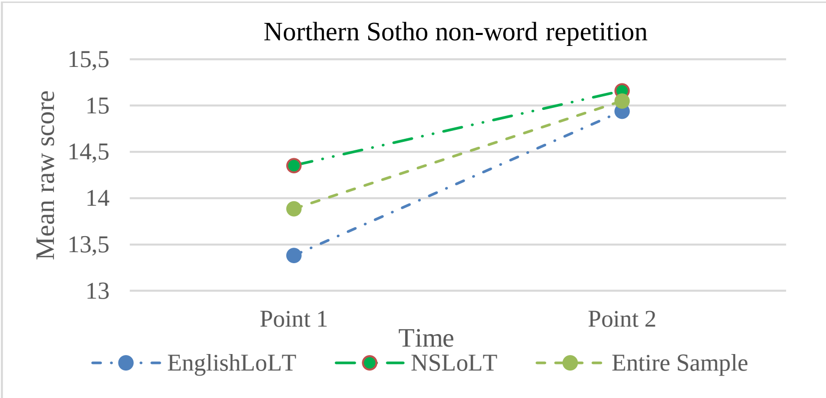


Figure 6.14 Development of Northern Sotho non-word repetition skill

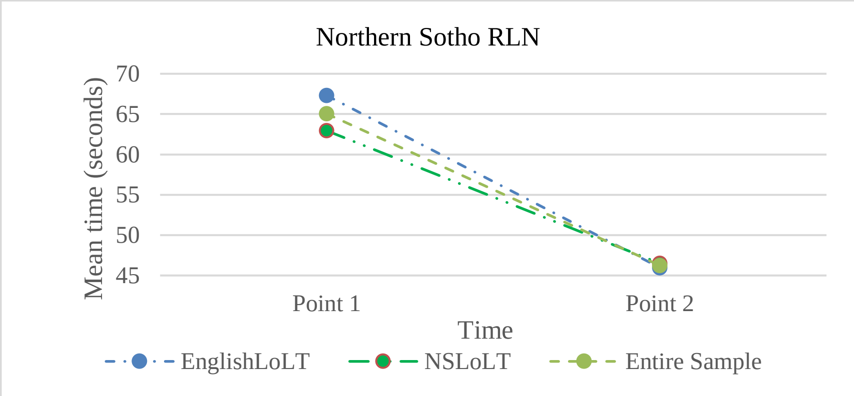


Figure 6.15 Development of Northern Sotho RLN skills

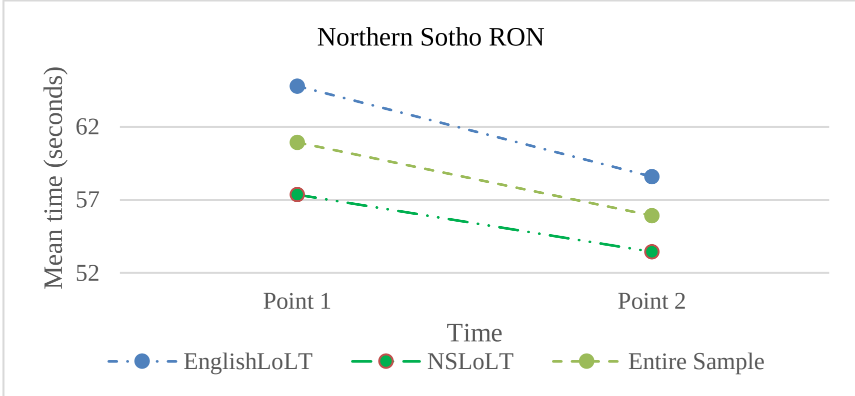


Figure 6.16 Development of Northern Sotho RON skill

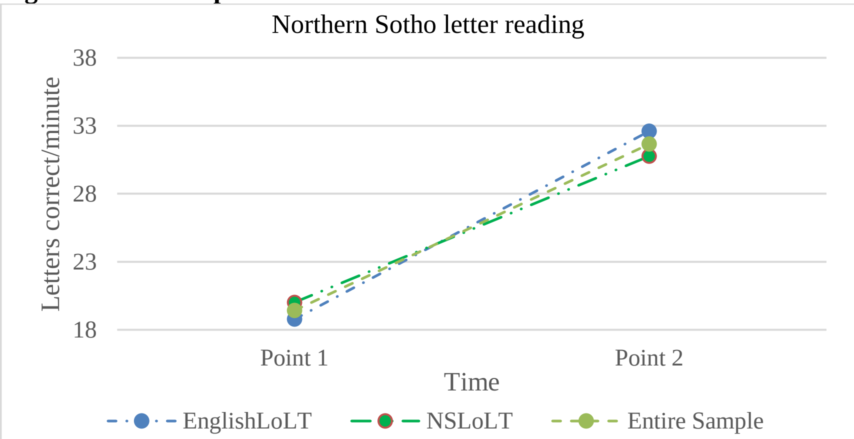


Figure 6.17 Development of Northern Sotho letter reading skill

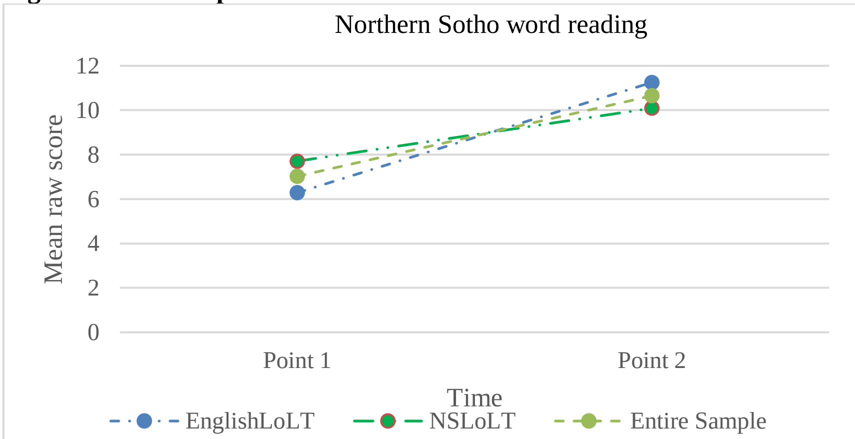


Figure 6.18 Development of Northern Sotho word reading skill

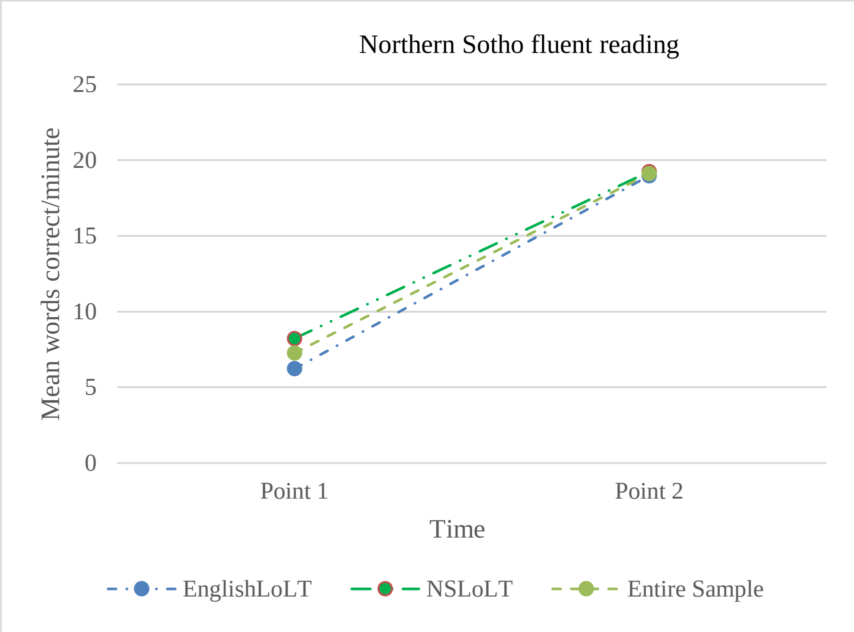


Figure 6.19 Development of Northern Sotho fluent reading skill

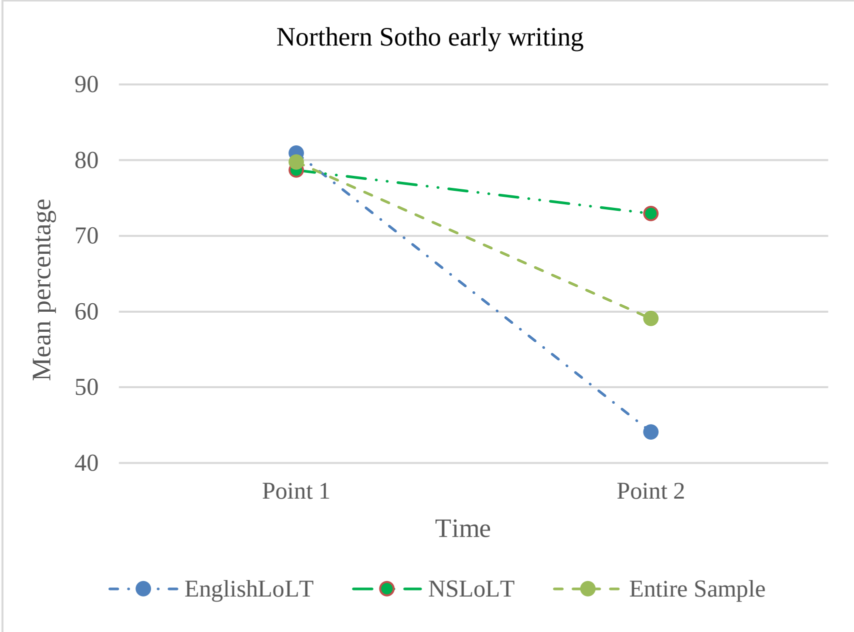


Figure 6.20 Development of Northern Sotho early writing skill

The plot graphs for the Northern Sotho phonological processing and literacy variables provide a visual representation of the results of the repeated-measures analysis. Plots illustrated that the entire sample made progress from Point 1 to 2 on most Northern Sotho measures except on digit span and early writing task (the Northern Sotho LoLT group demonstrated some progress on the Northern Sotho digit span task while the English LoLT group regressed and both groups regressed on the Northern Sotho early writing performance. Plots also illustrated that both NS LoLT and English LoLT groups made progressive changes on Northern Sotho blending, sound matching, NWR, RLN, RON, word reading, fluent reading and letter reading performance from Point 1 to Point 2.

6. 3 Results phonological processing and literacy: measuring point three

Data gathered from 106 Grade 3 Northern Sotho-English bilingual children were analysed for measuring Point 3 (end of Grade 3). Due to restrictions that resulted from the COVID-19 pandemic, only literacy development was assessed at Point 3 (November/ December 2020), using spelling and reading comprehension tasks. The same learners that participated at Point 1 and Point 2 were assessed at the end of 2020. At Point 3, the NS LoLT group consisted of 53 learners (Mean age 8.5 years; 46 girls), whereas the English LoLT group also consisted of 53 learners (Mean age 8.5 years; 33 girls). Twenty-eighty learners were not available for testing at Point 3. Although the researcher was not able to assess all the learners previously assessed at Point 1 and 2, the sample size was still acceptable to continue. Phonological processing measures (Point 1 and 2) and literacy measures (Point 3) were used to establish the longitudinal relationships between phonological processing and literacy performance. More information regarding these tasks was provided in Chapter 4. The data gathered at Point 3 was once again analysed using SPSS version 23.0 (IBM). Preliminary analysis was performed to determine the data's suitability for parametric testing, and to provide descriptive statistics for the sample. Group differences were assessed through MANOVA and Cohen's d analyses. Spearman's correlations and multiple regression were used for establishing longitudinal relations between variables.

6.3.1 Parametric assumptions

Preliminary analysis was conducted to determine the suitability of parametric analysis. Three tests which include the Shapiro-Wilk test of normality, homogeneity of variance and multicollinearity, were conducted for parametric testing, and the results are given in Table 6.9 below.

The Shapiro-Wilk test was used to assess the normality assumption. The normality assumption is achieved when the p-value is $p> .05$ (Das and Imon 2016, 1). The findings for the entire sample, and for each LoLT group revealed that the literacy data in both Northern Sotho and English were not normally distributed. The researcher also checked for normality of the data through skewness and kurtosis coefficient results. The skewness and kurtosis statistics are given in section 6.3.2 below. The findings for the entire sample revealed that all literacy tasks were within the acceptable skewness range. However, the literacy tasks did not meet the acceptable range for kurtosis. Within-group statistics for the NS LoLT group revealed that English (spelling, reading comprehension) and Northern Sotho reading comprehension have acceptable skewness values. Northern Sotho spelling was negatively skewed. Statistics for the English LoLT group revealed that all tasks achieved acceptable skewness values. However, all the tasks fell out of the kurtosis acceptable range in both LoLT groups. These findings suggested evidence of non-normality in some of the data samples.

Table 6.9 Test of normality, homogeneity of variance and multicollinearity

English and Northern Sotho tasks	NS LoLT Group		English LoLT Group		Entire Sample		Homogeneity of variance	
	Shapiro-Wilk test p.value	Sig.	Shapiro-Wilk test p.value	Sig.	Shapiro-Wilk test p.value	Sig.	P value	Sig
Eng spelling	.854	.000	.874	.000	.839	.000	46.3	.000
Eng reading comprehension	.863	.000	.934	.006	.902	.000	7.8	.006
NS spelling	.907	.001	.838	.000	.888	.000	.127	.722
NS reading comprehension	.931	.001	.931	.004	.929	.000	1.8	.189

Note: VIF- variance inflation factor, Sig-significance, NS-Northern Sotho, Eng-English. Significance: p>.05.

Levene's test was used to assess the homogeneity of variance assumption. Levene's test assumption is achieved when the p-value is non-significant (*p > .05*) (Field 2013, 98). The findings indicated that Northern Sotho spelling and reading comprehension measures achieved the homogeneity of variance assumption. This finding implies that variability in the mean scores for each LoLT group is approximately equal. English spelling and reading comprehension did not meet this assumption implying that variability in the scores for each LoLT group is not the same. Overall, with regards to the various parametric test assumptions, the results suggested a data set that was not as satisfactory as one would have preferred. However, MANOVA analyses have been found to be robust against violations of normality and homogeneity of variance (Stevens 2009, 249; Tabachnick and Fidell 2007, 260). Furthermore, regression models can also withstand violations of normality (Williams, Grajales and Kurkiewicz 2013, 3). Given this, and the adequate sample size (*n=106*), the researcher deemed further analysis using parametric analysis acceptable.

6.3.2 Descriptive statistics

Descriptive statistics were calculated to establish the performance of the entire sample on the spelling and reading comprehension tasks, and to establish differences between the NS LoLT and English LoLT groups. Recall that the spelling tests both counted out of 10, whereas the reading comprehension tests both counted out of 6. Table 6.10 displays the means, SD, minimum, maximum, range, skewness and kurtosis statistics for the Northern Sotho and English literacy tasks.

Table 6.10 Descriptive statistics for the Grade 3 sample

Variable	NS LoLT Group (N=53)						English LoLT Group (N=53)						Entire sample					
	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coefficient	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coefficient	M	SD	Min/Max	Range	Skewness coefficient	Kurtosis coefficient
Eng spelling	1.4	1.2	0-6	6	1.3	2.4	2.9	2.9	0-9	9	.569	-.943	1.4	1.2	0-9	9	1.3	.699
Eng reading comprehension	1.8	1.5	0-6	6	1.1	.742	2.7	1.9	0-7	7	.330	-.923	2.2	1.8	0-7	7	.711	-.399
NS spelling	4.7	3.2	0-10	10	-.236	-1.2	3.0	3.2	0-10	10	.799	-.691	3.8	3.3	0-10	10	.248	-1.4
NS reading comrehension	1.9	1.5	0.6	10	.534	-.279	2.2	1.3	0-6	6	.523	.451	2.0	1.4	0.6	6	.468	-.060

Note: NS=Northern Sotho, Eng-English, M-mean, SD-standard deviation.

Descriptive statistics for the entire sample revealed that the learners seemingly performed poorly on Northern Sotho and English literacy (spelling and reading comprehension) tasks. In the entire sample, the mean percentage for English spelling was 14% and 31% for reading comprehension. In the Northern Sotho language, the mean percentage for Northern Sotho spelling was 38%, while the men for Northern Sotho reading comprehension was 33%. Within-group statistics suggest that the English LoLT group performed better than the NS LoLT in English (spelling and reading comprehension) as well as in Northern Sotho reading comprehension. The NS LoLT group seemingly performed better than the English LoLT group in Northern Sotho spelling. Overall though, the preliminary results suggest that the two LoLT groups performed similarly. Inferential statistics were performed in order to establish the significance of the observed group differences.

6.3.3 Group differences

A MANOVA analysis was used to determine significant group differences in learners' literacy performance at Point 3, and Cohen's *d* was used to determine effect sizes of statistically significant differences. Literacy measures (spelling and reading comprehension) were entered as dependent variables while group was entered as the fixed factor. Tukey's post hoc comparison procedure was used, to which Bonferroni corrections were applied. A confidence interval of 95% was used. Table 6. 11 shows the MANOVA results for both Northern Sotho and English.

Table 6.11 MANOVA and Cohen's *d* analyses results

Northern Sotho and English Tasks	F	Sig.	Cohen *d* 's analysis
Eng spelling	11.9	.001	.67
Eng reading comprehension	7.7	.007	.53
NS spelling	8.1	.005	.53
NS reading comprehension	.942	.334	NSS

*Note: NSS imply that the statistics in non-statistically significant, F-MANOVA test statistics value, Sig-significance, NS-Northern Sotho, Eng-English. Significance: *p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

The results indicated that there were statistically significant differences between the LoLT groups on English (spelling, reading comprehension) and Northern Sotho spelling measures. The English LoLT group (*M =2.9, SD =2.9*)[44] scored significantly better than the NS LoLT group (*M =1.4, SD = 1.2*) on the English spelling task and on the English reading comprehension task (*M =2.7, SD =1.9* versus *M =1.8, SD = 1.5*). The NS LoLT group (*M =4.7, SD =3.2*) performed significantly better than the English LoLT group (*M =3.0, SD = 3.2*) on Northern Sotho spelling task. No significant difference was observed in Northern Sotho reading comprehension.

6.4 Longitudinal relations between variables

Correlations and regression analysis were used to determine the longitudinal relationships between phonological processing (Point 1 and 2) and literacy (Point 3) variables.

6.4.1 Correlations analysis

Correlation analysis was used in this study to determine the association between literacy measures in this study. Spearman's correlations analysis was considered in this study because some of the data were not normally distributed. Firstly, correlation coefficients were calculated to examine the associations between Point 3 literacy (spelling, reading comprehension). Secondly, Spearman's correlations were calculated between literacy variables at Point 1, 2 and 3 (letter knowledge, letter reading, early writing, word reading, fluent reading, spelling, reading comprehension), within and across languages. Spearman's correlation was also performed to ascertain the cross-linguistic pattern between literacy measures in Northern Sotho and English.

The findings revealed that the strength of correlations ranged from negatively weak $r=.10$ to very strong $r=.89$. Statistics for Point 3 literacy measures showed that English spelling moderately correlated with English reading comprehension in both LoLT groups. Northern Sotho spelling moderately correlated with Northern Sotho reading comprehension in both LoLT groups. Point 1 English literacy measures were weakly correlated with Point 3 measures, whereas Point 2 English literacy measures showed weak to strong correlations with Point 3 measures. The correlations between Point 1 and 3 Northern Sotho literacy skills were weak to strong. Point 2 and 3 Northern Sotho literacy skills were also weak to strong. Point 1 and Point 3 Northern Sotho and English literacy measures were weak to moderately correlated. Point 2 and Point 3 Northern Sotho and English literacy measures were weak to strongly correlated.

Table 6.12 below shows the results of Spearman correlation statistics between literacy abilities for the Northern Sotho and English LoLT groups. The correlations are significant (2-tailed) at the $p < .01$ (indicated by **) and *.05* (indicated by *) levels.

[44] The means and descriptive statistics for English and Northern Sotho phonological and literacy variables are depicted in Table 6.10.

Table 6.12 Spearman's correlations analysis for group samples

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Eng spelling point 3	-	.49**	.67**	.57**	.36**	.58**	.33*	.48**	.48**	.49**	.45**	.43**	.47**	.51**	.35*	.50**
2. Eng reading comprehension point 3	.59**	-	.33*	.53**	.23	.31*	.10	.27	.14	.20	.27*	.28*	.31*	.21	.36**	.15
3. NS spelling point 3	.82**	.59**	-	.61**	.40**	.73**	.46**	.72**	.45**	.78**	.50**	.70**	.51**	.73**	.57**	.70**
4. NS reading comprehension point 3	.33*	.48**	.34*	-	.42**	.51**	.41**	.51**	.39**	.52**	.31*	.54**	.34*	.50**	.42**	.49**
5. Eng word reading point 1	.42**	.61**	.39**	.33*	-	.48**	.77**	.44**	.56**	.40**	.21	.37**	.41**	.41**	.41**	.38**
6. Eng word reading point 2	.71**	.59**	.67**	.31*	.57**	-	.45**	.94**	.54**	.77**	.32**	.62**	.40**	.71**	.38**	.54**
7. Eng fluent reading point 1	.41**	.61**	.45**	.33*	.71**	.54**	-	.46**	.43**	.45**	.16	.33**	.35**	.41**	.29*	.41**
8. Eng fluent reading point 2	.76**	.67**	.70**	.38**	.58**	.89**	.61**	-	.48**	.73**	.27*	.61**	.35**	.67**	.39**	.51**
9. NS word reading point 1	.13	.38**	.20	.21	.32**	.37**	.37**	.33**	-	.51**	.43**	.49**	.60**	.52**	.29*	.46**
10. NS word reading point 2	.64**	.56**	.63**	.28*	.63**	.68**	.65**	.70**	.24	-	.48**	.78**	.52**	.94**	.51**	.68**
11. NS letter reading point 1	.49**	.49**	.39**	.11	.50**	.58**	.46**	.66**	.28*	.54**	-	.42**	.59**	.51**	.40**	.44**
12. NS letter reading point 2	.54**	.40**	.49**	.21	.56**	.60**	.52**	.64**	.14	.81**	.53**	-	.51**	.79**	.50**	.58**
13. NS fluent reading point 1	.25	.36**	.26	.14	.36**	.46**	.40**	.43**	.62**	.30*	.34**	.20	-	.62**	.41**	.51**
14. NS fluent reading point 2	.64**	.67**	.61**	.26	.65**	.70**	.63**	.80**	.28*	.86**	.65**	.79**	.32**	-	.49**	.65**
15. NS early writing point 1	.34*	.23	.25	.22	.09	.34**	.21	.35**	.36**	.29*	.34**	.20	.35**	.34**	-	.37**
16. NS early writing point 2	.60**	.57**	.67**	.36**	.56**	.66**	.52**	.65**	.14	.77**	.55**	.59**	.23	.67**	.37**	-

Note - Correlations for the NS LoLT groups are reported above the diagonal and correlations for the English LoLT group are below the diagonal. The correlations are significant (2-tailed) at $p < .01$ and .05 level.

Regression analysis was used to check which of the literacy measures at Point 1 and Point 2 best predicted the literacy measures at Point 3. Table 6.13 and Table 6.14 show the regression analyses for all literacy variables at various points. The results for English based on the entire sample revealed that English fluent reading at Point 2 significantly predicted and accounted for 40% and 35% in English spelling and reading comprehension, respectively.

Within-group statistics for the NS LoLT group revealed that English word reading and fluent reading at Point 2 significantly predicted and accounted for 52% of the variance in English spelling performance. Literacy measures at Point 1 did not predict English comprehension at Point 3 in this group. In the English LoLT group, English fluent reading at Point 2 significantly predicted and accounted for 54% of the variance in English spelling performance. English fluent reading at Point 2 significantly predicted and accounted for 46% of the variance in English reading performance.

Table 6.13 Multiple regression for English literacy variables

	NS LoLT group						English LoLT group						Entire sample					
	Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension		
Variable	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
Eng word reading point 1	.01	.03	.07	.06	.04	.27	-.02	.04	-.07	-.03	.04	-.18	-.02	.03	-.08	-.01	.03	-.06
Eng word reading point 2	.05	.01	.85*	.03	.02	.42	.04	.03	.31	-.00	.02	-.03	.02	.02	.19	-.00	.01	-.02
Eng fluent reading point 1	.06	.04	.28	-.01	.05	-.02	-.02	.06	-.07	.06	.05	.27	.06	.04	.19	.07	.04	.28
Eng fluent reading point 2	-.03	.02	-.43*	-.01	.02	-.07	.08	.03	.54*	.07	.07	.65*	.05	.02	.39*	.05	.02	.48*

*Note: SE- Standard error, B-unstandardised regression coefficient value, Beta- standardised regression coefficient value, Eng-English, Significance: *p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

Table 6.14 Multiple regression for Northern Sotho literacy

	NS LoLT group						English LoLT group						Entire sample					
	NS spelling			NS reading comprehension			NS spelling			NS reading comprehension			NS spelling			NS reading comprehension		
Variable	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
NS word reading point 1	-.02	.13	-.02	.02	.09	.04	.19	.20	.19	.12	.10	.30	.07	.11	.07	.01	.06	.02
NS word reading point 2	.14	.10	.31	'-.04	.07	-.18	.02	.17	.04	-.11	.09	-.45	.08	.08	.16	-.00	.04	-.02
NS fluent reading point 1	.03	.06	.08	.02	.04	.12	.02	.08	.05	-.01	.04	-.03	.03	.04	.08	.02	.03	.12
NS fluent reading point 2	.02	.04	.10	.03	.03	.39	.07	.06	.27	.02	.03	.02	.04	.03	.18	.03	.02	.31
NS letter reading point 1	.01	.07	.01	-.03	.05	-.09	-.10	.07	-.27	-.07	.03	-.50	-.04	.04	-.10	-.05	.02	.26*
NS letter reading point 2	.02	.07	.01	.02	.03	.20	-.00	.04	-.01	.01	.02	.15	.01	.03	.02	.01	.02	.11
NS early writing point 1	.02	.01	.19*	.01	.01	.13	.01	.02	.06	.01	.01	.21	.02	.01	.12	.01	.01	.16
NS early writing point 2	.02	.01	.30*	.01	.01	.19	.05	.02	.56*	.02	.01	.67*	.04	.01	.46*	.01	.00	.17

Note: SE- Standard error, B-unstandardised regression coefficient value, Beta- standardised regression coefficient value, NS-Northern Sotho. Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

Regression results for Northern Sotho based on the entire sample revealed that Northern Sotho early writing at Point 2 significantly predicted and accounted for 63% of the variance in Northern Sotho spelling. Northern Sotho letter reading at Point 1 significantly predicted and accounted for 28% of the variance in Northern Sotho reading comprehension. Within-group statistics for the NS LoLT group revealed that Northern Sotho early writing at Point 1 and Point 2 significantly predicted and accounted for 72% Northern Sotho spelling. In the English LoLT group, Northern Sotho early writing at Point 2 significantly predicted and accounted for 54% and 25% of the variance in Northern Sotho spelling and reading comprehension, respectively.

6.4.2 Longitudinal relationships between phonological processing and literacy measures

Multiple regression analysis was used to determine the longitudinal phonological predictors of literacy skills in Northern Sotho and English. The same procedure was used for all the regression models tested in this chapter. The phonological processing measures obtained at Point 1 and 2 (beginning and end of Grade 2) were used to determine the longitudinal predictors of literacy skills at Point 3 (end of Grade 3). Parametric testing for Point 1 and 2 variables was done to determine the appropriateness of regression analysis, and the results were presented in Chapter 5, section 5.2.1.

6.4.2.1 Longitudinal phonological processing predictors of English literacy

Multiple regression analysis was used to determine the longitudinal phonological predictors of English literacy skills. Point 1 and Point 2 phonological processing (blending, sound matching, elision, RLN, RCN and RON) measures were used as independent variables, while literacy skills (spelling, reading comprehension) were used as dependent variables. Note that not all phonological processing variables measured at Point 1 and 2 were selected as predictors of literacy at Point 3. The researcher selected the phonological processing variables which were the best predictors of English literacy at Point 1 and 2 to determine literacy predictions at Point 3. Thus, the phonological variables which predicted literacy either at Point 1 or 2 or at both measuring points were selected as independent variables for the current regression model. Hence, three phonological processing variables (digit span, NWR and RDN) were excluded since they failed to predict any English literacy abilities at Point 1 and 2. All the independent variables were entered into the model in a single step. Table 6.15 shows the regression results for the entire sample and each LoLT group.

The regression results for the entire sample revealed that English sound matching at Point 1 significantly predicted and accounted for 25% of the variance in English spelling performance. English elision and RLN at Point 2 significantly predicted and accounted for 47% of the variance in English spelling performance. English sound matching at Point 1 significantly predicted and accounted for 23% of the variance in English reading comprehension performance. English elision and RLN at Point 2 significantly predicted and accounted for 42% of the variance in English reading comprehension.

Table 6.15 Multiple regression for longitudinal phonological processing predictors of English literacy

Variable	NS LoLT group						English LoLT group						Entire sample					
	Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
Eng sound matching point 1	.10	.04	.39*	.05	.05	.16	.20	.07	.28*	.05	.05	.15	.17	.05	.38*	.09	.04	.28*
Eng sound matching point 2	.02	.04	.12	.04	.05	.18	.11	.07	.27	.05	.04	.20	.06	.04	.16	.03	.03	.10
Eng blending point 1	.10	.04	.34*	.05	.06	.14	.02	.12	.02	.14	.07	.26*	.05	.06	.08	.08	.05	.11
Eng blending point 2	.03	.05	.10	.02	.06	.06	.02	.08	.04	.02	.05	.06	.00	.05	.00	.02	.04	.05
Eng elision 2	.04	.05	.13	.02	.06	.07	.16	.07	.37*	.10	.05	.35*	.16	.04	40*	.09	.04	.31*
Eng RCN point 1	.02	.01	.31*	.00	.01	.03	-.01	.02	-.12	-.01	.01	-.15	.00	.01	.03	-.01	.01	-.05
Eng RCN point 2	-.01	.01	-.15	-.01	.02	-.07	-.01	.02	-.12	-.01	.03	-.07	-.01	.01	-.08	-.02	.01	-.13
Eng RLN point 1	-.00	.01	-.05	-.01	.01	-.13	-.01	.01	-.22	-.01	.01	-.13	-.01	.01	-.01	-.00	.01	-.07
Eng RLN point 2	-.03	.01	-.42*	-.02	.01	-.21	-.00	.05	-.02	-.05	.02	-.43*	-.03	.01	-.21*	-.03	.01	-.27
Eng RON point 1	-.02	.01	.23	.00	.01	.02	-.02	.03	-.08	-.00	.02	-.02	-.02	.01	-.13	-.00	.01	-.03
Eng RON point 2	-.01	.01	-.06	.01	.02	.10	.01	.04	.06	-.01	.02	-.44	.00	.02	.01	.00	.01	.02

*Note: SE- Standard error, B-unstandardised regression coefficient value, Beta- standardised regression coefficient value, Eng-English. Significance: *p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

Within-group regression statistics for the NS LoLT group revealed that English sound matching, blending and RCN tasks at Point 1 significantly predicted and accounted for 37% of the variance in English spelling performance. English RLN at Point 2 significantly predicted and accounted for 39% of the variance in English spelling performance. However, no phonological variable predicted English reading comprehension in the NS LoLT group.

Within-group statistics for the English LoLT group revealed that English sound matching at Point 1 significantly predicted and accounted for 28% of the variance in English spelling performance. English elision at Point 2 significantly predicted and accounted for 49% of the variance in English spelling performance. English blending at Point 1 significantly predicted and accounted for 37% of the variance in English reading comprehension performance. English elision and RLN at Point 2 significantly predicted and accounted for 53% of the variance in English reading comprehension performance.

Taken together, the findings suggest that some English PA (sound matching, blending and elision) and RAN (colour naming) skills were unique longitudinal predictors of English spelling abilities. PA was the strongest longitudinal predictor of English spelling as compared to RAN skills. English (sound matching, blending and elision) skills were also unique longitudinal predictors of English reading comprehension abilities. English elision was the strongest longitudinal predictor of English reading comprehension

6.4.2.2 Longitudinal phonological processing predictors of Northern Sotho literacy

Multiple regression analysis was used to determine the longitudinal phonological predictors of Northern Sotho literacy skills. Point 1 and Point 2 phonological processing (blending, sound matching, elision, digit span, RLN, RON) measures were used as independent variables. The selection criteria for phonological processing variables were based on the best predictors of literacy at Point 1 and 2. The phonological variables which predicted literacy either at Point 1 or 2 or at both measuring points were included as independent variables in this regression model. All the Northern Sotho phonological variables suited this criterion. Hence, no variable was excluded. Point 3 literacy (spelling, reading comprehension) measures were used as the dependent variables. All the independent variables were entered into the model in a single step. Table 6.16 shows the regression results for the entire sample and each group.

Regression statistics for the entire sample revealed that Northern Sotho blending and RLN at Point 1 significantly predicted and accounted for 28% of the variance in Northern Sotho spelling performance. Northern Sotho sound matching and RLN at Point 2 significantly predicted and accounted for 50% of the variance in Northern Sotho spelling. Northern Sotho elision, RLN and RON at Point 2 significantly predicted and accounted for 39% of the variance in Northern Sotho reading comprehension.

The within-group regression results for the NS LoLT group revealed that Northern Sotho RLN at Point 1 significantly predicted and accounted for 53% of the variance in Northern Sotho spelling. Northern Sotho sound matching and RLN at Point 2 significantly predicted and accounted for 68% of the variance in Northern Sotho spelling ability.

Table 6.16 Multiple regression for phonological processing predictors of Northern Sotho literacy

	NS LoLT						English LoLT						Entire sample					
	NS spelling			NS reading comprehension			NS spelling			NS reading comprehension			NS spelling			NS reading comprehension		
Variable	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
NS blending point 1.	.14	.15	.12	.02	.09	.03	.31	.16	.29*	.01	.07	.01	.21	.11	.18*	.02	.05	.04
NS blending point 2	.14	.08	.19	-.04	.05	-.10	.21	.14	.29	.03	.06	.11	.19	.07	.26	-.02	.04	-.06
NS sound matching point 1	.25	.15	.21	.10	.09	.19	.19	.22	.14	-.06	.09	-.12	.18	.13	.14	.05	.06	.09
NS sound matching point 2	.33	.12	.30*	.01	.07	.03	.20	.19	.17	.01	.08	.02	.36	.10	.31*	.01	.05	.02
NS elision point 2	-.03	.09	-.04	.03	.05	.11	.18	.11	.28	.07	.05	.28	.08	.06	.13	.05	.03	.20*
NS digit span point 1	.24	.17	.16	.02	.11	.03	-.28	.27	.19	.08	.12	.14	.02	.16	.01	.04	.08	.05
NS digit span point 2	.16	.19	.09	-.13	.12	-.16	-.07	.25	-.05	.13	.11	.20	.09	.15	.06	-.02	.08	-.02
NS NWR point 1	.23	.15	.18	.11	.09	.18	.17	.19	.14	.00	.08	.01	.21	.12	.17	.04	.06	.08
NS NWR point 2	.13	.14	.09	.25	.09	.40*	-.27	.17	-.22	-.14	.08	-.31	-.11	.12	-.09	.06	.06	.11
NS RLN point 1	-.03	.01	-.34*	-.01	.01	-.22	-.01	.02	-.09	-.00	.01	-.05	-.03	.01	-.23*	-.01	.01	-.19
NS RLN point 2	-.08	.01	-.55*	-.04	.01	-.56*	-.02	.02	-.15	-.01	.01	-.13	-.05	.01	-.33*	-.03	.01	-.41*
NS RON point 1	-.01	.03	-.03	.01	.02	.05	-.01	.03	-.03	-.00	.01	-.04	-.01	.02	-.04	.01	.01	.08
NS RON point 2	.03	.02	.12	.01	.01	.09	.01	.03	.07	.02	.01	.31*	.02	.02	.07	.02	.01	.19*

Note: SE- Standard error, B-unstandardised regression coefficient value, Beta- standardised regression coefficient value, NS-Northern Sotho. Significance: $p<0.05$; ** $p<0.01$; *** $p<0.001$ *(95% confidence interval).*

Northern Sotho NWR and RLN at Point 2 significantly predicted and accounted for 45% of the variance in Northern Sotho reading comprehension.

Regression statistics for the English LoLT group revealed that Northern Sotho blending at Point 1 significantly predicted and accounted for 16% of the variance in Northern Sotho spelling performance. Northern Sotho blending at Point 2 significantly predicted and explained 25% of the variance in Northern Sotho reading comprehension performance.

These findings suggested that PA skills (blending, sound matching) were unique longitudinal predictors of Northern Sotho spelling. Blending was the strongest predictor of Northern Sotho spelling, compared to sound matching. PA (elision, blending), PWM (NWR), and RAN (RON) skills were unique longitudinal phonological predictors of Northern Sotho reading comprehension. PA was the strongest predictor of Northern Sotho reading comprehension, followed by NWR and RAN.

6.5 Cross-linguistic transfer of skills

Multiple regression analyses were conducted to determine the longitudinal cross-linguistic transfer pattern of skills in Northern Sotho and English languages.

6.5.1 Cross-linguistic longitudinal predictors of Northern Sotho literacy

Multiple regression analysis was conducted to determine the longitudinal cross-linguistic predictors of Northern Sotho literacy. English phonological measures at Point 1 and 2 (blending, elision, sound matching, RCN, RLN and RON) were used as independent variables. Northern Sotho literacy (spelling, reading comprehension) measures at Point 3 were used as the dependent variables. Multiple regression was conducted for the entire sample and for each LoLT group, to determine the cross-linguistic predictors of Northern Sotho literacy. All the independent variables were entered into the model in a single step. Table 6.17 shows the cross-linguistic regression results for the entire group and each LoLT group.

Cross-linguistic regression results for the whole sample indicated that English sound matching and RLN at Point 1 significantly predicted and accounted for 26% of the variance in Northern Sotho spelling performance. English elision and RLN at Point 2 significantly predicted and accounted for 39% of the variance in Northern Sotho spelling performance. English sound matching at Point 1 significantly predicted and accounted for 18% of the variance in Northern Sotho reading comprehension performance. Regression results for the entire sample indicated that English sound matching at Point 2 significantly predicted and accounted for 36% of the variance in Northern Sotho reading comprehension performance.

Cross-linguistic statistics for the NS LoLT group revealed that English blending and English sound matching at Point 1 significantly predicted and accounted for 44% of the variance in Northern Sotho spelling performance. Northern Sotho RLN at Point 2 significantly predicted and accounted for 62% of the variance Northern Sotho spelling performance. Northern Sotho RLN at Point 2 significantly predicted and accounted for 41% of the variance in Northern Sotho reading comprehension performance.

Table 6.17 Multiple regression for longitudinal cross-linguistic predictors of Northern Sotho literacy

	NS LoLT						English LoLT						Entire sample					
	NS spelling			NS reading comprehension			NS spelling			NS reading comprehension			NS spelling			NS reading comprehension		
Variable	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
Eng blending point 1.	.20	.10	.26*	.07	.06	.19	.03	.13	.03	-.02	.05	-.07	.14	.09	.16	.03	.04	.08
Eng blending point 2	.01	.09	.02	.00	.01	.00	-.10	-.08	-.17	-.02	.04	-.08	-.04	.07	-.07	.00	.03	.01
Eng sound matching point 1	.32	.09	.48*	.09	.05	.27	.20	.09	.35*	.09	.04	.42*	.18	.06	.29*	.10	.03	.37*
Eng sound matching point 2	.10	.07	.20	.03	.04	.15	.02	.07	.05	.02	.04	.12	.06	.06	.12	.03	.03	.13
Eng elision point 2	.14	.09	.18	.01	.06	.01	.33	.08	.70*	.03	.04	.15	.16	.07	.29*	.01	.03	.03
Eng RLN point 1	-.01	.02	-.05	-.01	.01	-.17	-.01	.01	-.10	.00	.00	.13	-.02	.01	-.20*	.00	.00	.04
Eng RLN point 2	-.09	.02	-.47*	-.04	.01	-.51*	-.04	.03	-.23	-.01	.01	-.12	-.07	.02	-.39*	-.03	.01	-.36*
Eng RCN point 1	.01	.02	.08	.01	.01	.08	-.01	.02	-.11	.00	.01	-.01	-.01	.02	-.06	.00	.01	.02
Eng RCN point 2	-.03	.03	-.13	-.02	.02	-.18	.02	.05	.07	.01	.03	.05	.02	.03	.06	-.02	.01	.13
Eng RON point 1	.02	.03	.15	-.01	.01	-.12	-.00	.03	-.01	-.01	.01	-.20	.02	.03	.13	-.01	.01	-.15
Eng RON point 2	-.03	.02	-.11	.01	.01	.09	.02	.09	.04	-.02	.02	-.21	-.01	.02	-.02	.01	.01	.05

Note: SE- Standard error, B-unstandardised regression coefficient value, Beta- standardised regression coefficient value, NS-Northern Sotho, Eng-English. Significance: $p<0.05$; ** $p<0.01$; *** $p<0.001$ *(95% confidence interval).*

Cross-linguistic statistics for the English LoLT group revealed that English sound matching at Point 1 significantly predicted and accounted for 22% of the variance in Northern Sotho spelling performance. English elision at Point 2 significantly predicted and accounted for 54% of the variance in Northern Sotho spelling performance. English sound matching at Point 1 significantly predicted and accounted for 17% of the variance in Northern Sotho reading comprehension performance. Overall the finding suggested that English PA skills (elision, blending, sound matching) are unique long term predictors of Northern Sotho spelling and reading comprehension abilities. English sound matching was the strongest predictor of Northern Sotho spelling and reading comprehension.

6.5.2 Cross-linguistic longitudinal predictors of English literacy

Multiple regression analysis was conducted to determine the long term phonological predictors of English literacy. Northern Sotho phonological processing measures (blending, elision, sound matching, digit span, NWR, RLN and RON) at Point 1 and 2 were used as independent variables. English literacy (spelling, reading comprehension) measures at Point 3 were used as dependent variables. Multiple regression was conducted for the whole sample and for each LoLT group, to determine the cross-linguistic predictors of English literacy. All the independent variables were entered into the model in a single step. Table 6.18 shows the cross-linguistic regression results for the whole sample and each LoLT group.

Cross-linguistic results for the entire sample indicated that Northern Sotho sound matching and RLN at Point 1 significantly predicted and accounted for 19% of the variance in English spelling performance. Northern Sotho elision at Point 2 significantly predicted and accounted for 30% of the variance in English spelling performance. Northern Sotho NWR at Point 1 significantly predicted and accounted for 21% of the variance in English reading comprehension performance. Northern Sotho elision and Northern Sotho RON at Point 2 significantly predicted and accounted for 27% of the variance in English reading comprehension performance.

Cross-linguistic results for NS LoLT revealed that Northern Sotho blending and RLN at Point 1 significantly predicted and accounted for 19% of the variance in English spelling performance. Northern Sotho RLN at Point 2 significantly predicted and accounted for 39% of the variance in English spelling performance. No Northern Sotho phonological variables accounted for English reading comprehension.

Table 6.18 Multiple regression for cross-linguistic predictors of English literacy

Variable	NS LoLT						English LoLT						Entire sample					
	Eng spelling			Eng reading comprehension			Eng spelling			Engreading comprehension			Eng spelling			Eng reading comprehension		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
NS blending point 1	.20	.08	.25*	.11	.09	.22	.25	.14	.26	.10	.09	.15	.20	.08	.25*	.11	.06	.17
NS blending point 2	.03	.05	.10	-.06	.06	-.19	.21	.14	.29	-.02	.08	-.04	.12	.06	.22	-.01	-.04	-.01
NS sound matching point 1	.11	.10	.12	.05	.09	.10	.12	.19	.11	.22	.12	.27	.11	.10	.12	.13	.07	.20
NS sound matching point 2	.07	.06	.17	.10	.08	.21	.21	.19	.18	.22	.10	.30*	.08	.04	.05	.09	.07	.14
NS elision point 2	.03	.05	.13	.08	.06	.28	.18	.11	.28	.16	.06	.41*	.14	.06	.30*	.13	.05	.36*
NS digit span point 1	-.11	.12	-.10	-.11	.10	-.17	-.19	.23	-.14	-.23	.15	-.26	-.11	.12	.10	'-.15	.09	-.19
NS digit span point 2	.04	.10	.07	.01	.13	.02	-.07	.25	-.05	.04	.13	.04	-.16	.13	-.14	-.05	.10	-.06
NS NWR point 1	.09	.09	.10	.15	.09	.27	.19	.17	.18	.21	.11	.30*	.09	.09	.10	.17	.07	.25*
NS NWR point 2	.05	.07	.09	.10	.10	.17	-.27	.17	-.22	-.15	.09	-.21	-.08	.10	-.09	.02	.08	.02
NS RLN point 1	-.02	.01	-.22*	-.00	.01	-.08	-.02	.03	-.23	-.01	.01	-.18	-.02	.01	-.22*	-.01	.01	-.13
NS RLN point 2	-.02	.01	-.35*	-.01	.01	-.08	-.02	.02	-.13	-.03	.01	-.29	-.02	.01	-.16	-.02	.01	-.19
NS RON point 1	.02	.01	-.14	-.01	.02	-.08	.02	.02	.11	-.00	.01	-.03	.02	.01	.14	.00	.01	.10
NS RON point 2	.00	.01	.03	-.00	.01	-.01	.01	.03	.07	.04	.01	.31*	.00	.01	.02	.02	.01	.19*

*Note: SE- Standard error, B-unstandardised regression coefficient value, Beta- standardised regression coefficient value, NS-Northern Sotho, Eng-English. Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

Cross-linguistic statistics for the English LoLT group revealed that Northern Sotho NWR at Point 1 significantly predicted and accounted for 28% of the variance in English reading comprehension performance. Northern Sotho sound matching, elision, RLN and RON *at* Point 2 significantly predicted and accounted for 53% of the variance in English reading comprehension performance. No Northern Sotho phonological processing variables accounted for English spelling in this group. The findings suggested that Northern Sotho PA (blending, sound matching and elision) skills are unique longitudinal predictors of English spelling abilities. Northern Sotho blending was the strongest predictor of English spelling. Northern Sotho PA (sound matching, elision) and PWM (NWR) and RAN (RON) are were established as unique longitudinal phonological predictors of English reading comprehension. Northern Sotho PA was the strongest predictor of English reading comprehension.

6. 6 Receptive vocabulary and literacy skills

Correlations and regression analysis were performed to examine the associations between receptive vocabulary and literacy (spelling, reading comprehension) skills.

6.6. 1 Correlation between variables

Spearman rank-order correlation coefficients were calculated to determine the relationships between receptive vocabulary and literacy skills in both Northern Sotho and English languages. Spearman correlations were used because some of the data were non-normally distributed. Table 6. 19s below shows the correlations statistics for each LoLT group.

Table 6.19 Correlation analysis for vocabulary and literacy skills

Variable	1	2	3	4	5	6
1. Eng spelling	-	.49**	.67**	.57**	.41**	.13
2. Eng reading comprehension	.59**	-	.33*	.53**	.28	.29*
3. NS spelling	.82**	.59**	-	.61**	.33*	-.05
4. NS reading comprehension	.33*	.48**	.34*	-	.45**	.07
5. Eng receptive vocabulary	.58**	.67**	.58**	.40**	-	.33**
6. NS receptive vocabulary	.36**	.39**	.43**	.13	.45**	-

Note: Correlations for the NS LoLT groups are reported above the diagonal and correlations for the English LoLT group are below the diagonal. The correlations are significant (2-tailed) at p < .01 and .05 level).

The within-group statistics for the English LoLT group revealed that English vocabulary correlated moderately with English spelling but strongly correlated with English comprehension. Northern Sotho vocabulary moderately correlated with Northern Sotho spelling and weakly correlated with Northern Sotho comprehension. In the NS LoLT group, English vocabulary moderately correlated with English spelling and weakly correlated with English comprehension. The relations between Northern Sotho vocabulary and Northern Sotho spelling as well as reading comprehension was very weak in this group.

The cross-linguistic correlations between Northern Sotho vocabulary and English literacy skills were moderate in the English LoLT group. In the NS LoLT group, the correlations for the same variables were weak. The cross-linguistic correlations between English vocabulary and Northern Sotho literacy skills were moderate in the English LoLT group, but they ranged from weak to moderate in the Northern Sotho LoLT group.

6.6.2 Vocabulary predictors of literacy development

Simple regression analysis was conducted to examine the predictive pattern between vocabulary and literacy skills. Simple regression is a linear model in which one variable is predicted from a single predictor variable (Field 2013, 744). The receptive vocabulary skills were used as the independent variables and literacy (spelling, reading comprehension) skills as dependent variables. Simple regression was also conducted to determine the cross-linguistic relations between vocabulary and literacy skills in both Northern Sotho and English languages. English vocabulary was used as the independent variable and each Northern Sotho literacy (spelling, reading comprehension) skill as a dependent variable, to determine the cross-linguistic predictors of Northern Sotho literacy. Northern Sotho vocabulary was used as the independent variable and each English literacy (spelling, reading comprehension) skill as a dependent variable, to ascertain the cross-linguistic predictive power of NS vocabulary. All the independent variables were entered into the model in a single step. Tables 6.21 and 6.22 below show the within-language and cross-language simple regression results regarding receptive vocabulary and literacy skills for the entire sample and each LoLT group.

The within-language regression results for the entire sample revealed that English vocabulary significantly predicted and accounted for 22% and 44% of the variance in English spelling and reading comprehension, respectively. Northern Sotho vocabulary significantly predicted and explained 22% of the variance in Northern Sotho spelling performance. Findings in the NS LoLT group revealed that English vocabulary significantly predicted and accounted for 17% and 16% of the variance in English spelling and reading comprehension skills, respectively. However, Northern Sotho vocabulary did not predict any literacy skills in the NS LoLT group. In the English LoLT group, English vocabulary significantly predicted and accounted for 22% and 45% of the variance in English spelling and reading comprehension skills, respectively. Northern Sotho vocabulary significantly predicted and accounted for 22% of the variance in Northern Sotho spelling performance. Overall the results suggested that vocabulary is a good predictor of English (spelling, reading comprehension) and Northern Sotho (spelling) abilities.

Table 6.20 Simple regression for within-language vocabulary and literacy relationships

	NS LoLT group						English LoLT group						Entire sample					
	Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension		
Variable	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
1. Eng vocabulary	.04	.01	.41*	.04	.01	40*	.07	.02	.47*	.06	.01	.67*	.07	.02	.47*	.06	.01	.67*
	NS spelling			NS reading comprehension			NS spelling			NS reading comprehension			NS spelling			NS reading comprehension		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
2. NS vocabulary	-.01	.03	-.10	.01	.01	.11	.10	.03	.47*	.02	.01	.18	.10	.03	.47*	.02	.01	.18

Table 6.21 Simple regression for cross-linguistic relations between vocabulary and literacy

	NS LoLT group						English LoLT group						Entire sample					
	Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension		
Variable	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
1. NS vocabulary	.01	.01	.14	.03	.01	.32*	.01	.02	.39*	.06	.02	.44*	.04	.01	.24*	.04	.01	.35*
	NS spelling			NS reading comprehension			NS spelling			NS reading comprehension			NS spelling			NS reading comprehension		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
2. Eng vocabulary	.08	.03	.34*	.05	.01	47*	.08	.02	.49*	.02	.01	.36*	.03	.02	.19*	.03	.01	.38*

*Note: SE-Standard error, B-unstandardised regression coefficient value, Beta-standardised regression coefficient value, NS-Northern Sotho, Eng-English. Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

The cross-linguistic results for the entire group revealed that Northern Sotho vocabulary significantly predicted explained 6% and 12% of the variance in English spelling and reading comprehension, respectively. English vocabulary significantly predicted and explained 4% and 15% of the variance in Northern Sotho spelling and reading comprehension abilities, respectively. Statistics for the Northern Sotho LoLT group revealed that Northern Sotho vocabulary significantly predicted and explained 10% of the variance in reading comprehension performance. English vocabulary significantly predicted and explained 11% and 23% of the variance in Northern Sotho spelling and reading comprehension, respectively.

Within-group statistics for the English LoLT group showed that Northern Sotho vocabulary significantly predicted and explained 14% and 19% of the variance in English spelling and reading comprehension abilities, respectively. English vocabulary significantly predicted and explained 24% and 13% of the variance in Northern Sotho spelling and reading comprehension abilities, respectively.

6.7 Best predictors of spelling and reading comprehension

Hierarchical multiple regression was conducted to establish the best predictors of Point 3 literacy skills. Hierarchical regression is a method of multiple regression in which the order in which the predictors are entered into the model is determined by the researcher based on previous research (Field 2013, 732). All the significant predictors from Point 1 and Point 2 (phonological processing, literacy measures and vocabulary), which were identified by running the separate regression models, were considered for analysis at this point. These significant predictors were used to predict literacy (spelling and reading comprehension) measures at Point 3.

6.7.1 Best predictors of English spelling and reading comprehension skills

To determine the best predictors of English literacy, Point 1 and Point 2 phonological processing skills (blending, sound matching, elision, RLN, RCN and RON), receptive vocabulary and literacy measures (word reading 2 and fluent reading 2) were used as independent variables. Spelling and reading comprehension at Point 3 were the outcome variables. English receptive vocabulary was entered in the first step of the model to control for the effect of oral language proficiency. Phonological processing measures (sound matching, blending, RLN, RCN) were added in the second step of the model. Literacy skills (word and fluent reading) were added in the third step of the model. Table 6.22 shows the regression analysis for English spelling and reading comprehension.

In the entire sample, English vocabulary in step 1 significantly predicted and explained 29% of the variance in English spelling. English elision (Point 2), RLN (Point 2) and vocabulary significantly predicted and explained 21% of the variance in English spelling in step 2. English elision at Point 2 and vocabulary significantly predicted and explained 4% of the variance in English spelling in step 3. English vocabulary in step 1 significantly predicted and explained 38% of the variance in English reading comprehension. English elision (Point 2), RLN (Point 2) and vocabulary significantly predicted and explained 13% of the variance in English reading comprehension in step 2. English vocabulary significantly predicted and explained 2% of the variance in English reading comprehension in step 3.

Within-group statistics for NS LoLT revealed that English vocabulary in step 1 significantly predicted and explained 17% of the variance in English spelling. English RLN at Point 2 significantly predicted and explained 35% of the variance in English spelling at step 2. English blending and RCN at Point 1 as well as RLN, English word and fluent reading at Point 2 significantly predicted and explained 11% of the variance in English spelling in step 3. English vocabulary in step 1 significantly predicted and explained 16% of the variance in English reading comprehension. English vocabulary significantly predicted and explained 9% of the variance in English reading comprehension in step 2. No variables accounted for English reading comprehension in this group in step 3.

In the English LoLT group, English vocabulary at step 1 significantly predicted and explained 22% of the variance in English spelling. English elision at Point 2 significantly predicted and explained 26% of the variance in English spelling at step 2. No variables predicted English spelling at Point 3. English vocabulary in step 1 significantly predicted and explained 44% of the variance in English reading comprehension. English elision and vocabulary at Point 2 significantly predicted and explained 16% of the variance in English reading comprehension at step 2. English vocabulary significantly predicted and explained 3% of the variance in English reading comprehension in step 3.

Overall, English PA skills (elision, blending), vocabulary, RCN and word reading emerged as the best predictors of English spelling. English elision was the strongest predictor of English spelling. In terms of the English reading comprehension skill, English elision and vocabulary were both strong predictors, with vocabulary being the strongest predictor.

Table 6.22 Hierarchical multiple regression analysis for best predictors of English literacy

Variable	NS LoLT						English LoLT						Entire sample					
	Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension			Eng spelling			Eng reading comprehension		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
(Constant)	.18	.43		.30	.56		-.99	1.1		-1.0	.63		2.0	1.1		-.19	.34	
Eng vocabulary	.04	.01	.41*	.04	.01	.40*	.07	.02	47*	.06	.01	.67*	.06	.01	.53*	.05	.01	.61*
(Constant)	-.34	.97		.86	1.5		3.2	2.1		1.4	1.3		1.0	1.1		1.3	.81	
Eng vocabulary	.02	.01	.22	.03	.01	.28*	.02	.02	.13	.03	.01	.34*	.03	.01	.24*	.03	.01	.38*
Eng blending point 1	.04	.07	.23	.01	.06	.04	-.11	.10	-.13	.03	.06	.05	-.04	.05	-.07	.01	.04	.02
Eng sound matching point 1	.06	.03	.24	.01	.05	.04	-.03	.07	-.05	-.01	.04	-.03	.03	.04	.06	-.00	.03	-.01
Eng elision point 2	.02	.04	.09	.04	.05	.13	.20	.07	.48*	.04	.04	.28*	.15	.04	.38*	.07	.03	.23*
Eng RLN point 2	-.02	.01	-.30*	-.02	.01	-.20	-.04	.03	-.28	-.03	.02	-.23	-.03	.01	-.22*	-.02	.01	-.21*
Eng RCN point 1	.01	.01	.21	.00	.01	.02	-.01	.02	-.07	-.01	.01	-.10		.01	-.03	-.01	.01	-.07
(Constant)	-.93	.90		.22	1.5		1.3	2.0		.68	1.3		-.02	1.1		.84	.86	
Eng vocabulary	.02	.01	.18	.03	.02	.26	.02	.02	.13	.03	.01		.03	.01	.25*	.03	.01	.38*
Eng blending point 1	.08	.04	.27*	.01	.06	.01	-.12	.10	-.15	.04	.06	.07	-.07	.05	-.12	-.00	.04	-.00
Eng sound matching point 1	.03	.03	.13	.00	.05	.00	-.01	.07	-.03	.00	.04	-.00	.03	.04	.07	.00	.03	.01
Eng elision point 2	.01	.03	.04	.02	.06	.06	.08	.08	.18	.06	.05	.20	.09	.04	.23*	.04	.03	.15
Eng RLN point 2	-.01	.02	-.24*	-.01	.01	-.13	-.02	.02	-.14	-.02	.02	-.14	-.02	.01	-.13	-.15	.01	-.15
Eng RCN point 1	.02	.01	.26*	.04	.01	.06	-.00	.01	-.03	-.14	.01	-.09	.01	.01	.00	-.01	.01	-.06
Eng word reading point 2	.05	.01	.81*	.03	.02	.39	.03	.03	.20	-.02	.02	-.16	.02	.02	.15	.00	.01	.01
Eng fluent reading point 2	-.04	.02	-.65	-.01	.03	-.15	.03	.03	.32	.04	.02	.36	.02	.02	.17	.02	.02	.18

*Note: SE- Standard error, B-unstandardised regression coefficient value, Beta- standardised regression coefficient value, Eng-English. Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

6.7.2 Best predictors of Northern Sotho spelling and reading comprehension

To determine the best predictors of Northern Sotho literacy, Point 1 and Point 2 phonological processing measures (blending, sound matching, elision, digit span, RLN, RON), receptive vocabulary and literacy measures (letter reading, early writing) were used as independent variables. Spelling and reading comprehension at Point 3 were the outcome variables. Northern Sotho vocabulary was entered in the first step of the model to control for the effect of oral language proficiency. Phonological processing measures (sound matching, blending, elision RLN, RON) measures were added in the second step of the model. Literacy skills (letter reading 1, early writing 1, early writing 2) were added in the third step of the model. Table 6.23 shows the regression analysis for Northern Sotho spelling and reading comprehension.

Regression results for the entire sample revealed that Northern Sotho vocabulary significantly predicted and explained 4% of the variance in Northern Sotho spelling in step 1. Northern Sotho sound matching and RLN at Point 2 significantly predicted and explained 43% of the variance in Northern Sotho spelling in step 2. Northern Sotho early writing at Point 2 significantly predicted and explained 11% of the variance in Northern Sotho spelling in step 3. Northern Sotho vocabulary did not predict Northern reading comprehension at step 1. Northern Sotho elision, RON and RLN at Point 2 significantly predicted and explained 24% of the variance in Northern Sotho reading comprehension in step 2. RON and RLN at Point 2 significantly predicted and explained 2% of the variance in Northern Sotho reading comprehension in step 3.

Within-group statistics for the NS LoLT group revealed that Northern Sotho vocabulary did not predict Northern Sotho spelling in step 1. Northern Sotho RLN at Point 2 significantly predicted and explained 68% of the variance in Northern Sotho spelling in step 2. Northern Sotho sound matching (Point 2), RLN (Point 2), early writing (Point 1), and vocabulary significantly predicted and explained 8% of the variance in Northern Sotho spelling in step 3. Northern Sotho vocabulary did not predict Northern Sotho reading comprehension at step 1. Northern Sotho non-word repetition (Point 2) and RLN (Point 2) significantly predicted and explained 40% of the variance in Northern Sotho reading comprehension in step 2. Northern Sotho non-word repetition and RLN at Point 2 significantly predicted and 6% of the variance in Northern Sotho reading comprehension in step 3.

Table 6.23 Hierarchical multiple regression analysis for best predictors of Northern Sotho literacy

Variable	NS LoLT						English LoLT						Entire sample					
	NS spelling			NS reading comprehension			NS spelling			NS reading comprehension			NS spelling			NS reading comprehension		
	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta	B	SE	Beta
(Constant)	5.4	1.8		1.2	.86		-3.2	1.7		1.4	.74		1.2	1.3		1.4	.57	
NS vocabulary	-.01	.03	-.06	.01	.01	.11	.10	.03	46*	.01	.01	.16	.04	.02	.21*	.01	.01	.12
(Constant)	2.4	2.6		-.60	1.7		.65	3.5		2.8	1.6		3.1	2.3		1.7	1.1	
NS vocabulary	-.03	.01	-.18	.01	.01	.06	.06	.03	.27*	.00	.01	.00	.01	.02	.05	.00	.01	.04
NS blending point 1	.19	.15	.17	.01	.10	.02	-.04	.16	-.04	-.09	.07	-.22	-.03	.12	-.02	-.08	.06	-.17
NS sound matching point 2	.25	.13	.22	.00	.08	.01	.34	.16	.29*	.04	.07	.09	.37	.10	.32*	-.01	.05	-.02
NS elision point 2	.04	.10	.07	-.00	.07	-.01	.19	.10	.29	.11	.04	.45*	.14	.08	.22*	-.08	.04	.27*
NS non-word repetition 2	.20	.12	.16	.20	.08	.32*	-.23	.15	-.20	-.09	.07	-.19	-.09	.10	-.07	.04	.05	.07
NS RLN point 1	-.01	.01	-.11	.00	.01	-.02	-.01	.02	-.05	-.00	.01	-.02	-.01	.01	-.09	-.00	.01	-.07
NS RLN point 2	-.07	.02	-.51*	-.04	.01	-.54*	-.02	.02	-.13	-.01	.01	-.18	-.05	.01	-.32*	-.02	.01	-.37*
NS RON point 2	.03	.02	.15	.01	.01	.11	.02	.02	.10	.02	.01	.28	.03	.02	.12	.02	.01	.22*
(Constant)	-.59	2.7		-1.8	1.9		-.72	3.4		2.1	1.7		-.68	2.2		1.1	1.2	
NS vocabulary	-.04	.02	-.22*	.01	.01	.07	.06	.03	.26*	.00	.01	.01	.00	.02	.28	.00	.01	.02
NS blending point 1	.14	.14	.13	-.05	.10	-.09	.01	.17	.01	-.03	.08	-.07	.01	.11	.01	-.06	.06	-.12
NS sound matching point 2	.25	.12	.23*	.02	.08	.03	.09	.17	.07	-.05	.08	-.10	.19	.10	.17	-.03	.06	-.06
NS elision point 2	-.01	.09	-.01	-.03	.07	-.08	.05	.10	.07	.08	.05	.32	.06	.07	.08	.06	.04	.23
NS non-word repetition 2	.15	.11	.12	.18	.08	.28*	-.23	.14	-.19	-.08	.07	-.19	-.09	.10	-.07	.04	.05	.08
NS RLN point 1	.00	.01	.03	-.00	.01	-.09	-.01	.01	.11	-.00	.01	-.03	-.01	.01	-.04	-.00	.01	-.04
NS RLN point 2	-.07	.02	-.47*	-.04	.01	-.62*	-.00	.02	-.00	-.01	.01	-.15	-.02	.02	-.13	-.02	.01	-.33*
NS RON point 2	.02	.02	.10	.01	.01	.11	.03	.02	.15	.03	.01	.34*	.02	.02	.10	.02	.01	.21*
NS letter reading point 1	.04	.06	.07	.06	.04	.23	-.01	.06	-.03	-.04	.03	-.27	.02	.04	.06	-.01	.02	-.08
NS early writing point 1	.04	.01	.29*	.01	.01	.18	.01	.02	.05	.01	.01	.18	.02	.01	.14	.01	.01	.15
NS early writing point 2	.01	.01	.08	-.00	.01	-.10	.05	.01	.55*	.01	.01	.39	.03	.01	.42*	.00	.00	.10

*Note: SE- Standard error, B-unstandardised regression coefficient value, Beta- standardised regression coefficient value, NS-Northern Sotho. Significance: p<0.05; **p<0.01; ***p<0.001 (95% confidence interval).*

Within-group statistics for the English LoLT group showed that Northern Sotho vocabulary significantly predicted and explained 22% of the variance in Northern Sotho spelling in step 1. Northern Sotho sound matching at Point 2 and vocabulary significantly predicted and 24% of the variance in Northern Sotho spelling in step 2. Northern Sotho vocabulary and early writing at Point 2 significantly predicted and explained 13% of the variance in Northern Sotho spelling in step 3. Northern Sotho vocabulary did not predict Northern Sotho reading comprehension in step 1. Northern Sotho elision at Point 2 significantly predicted and explained 23% of the variance in Northern Sotho reading comprehension in step 2. Northern Sotho RON at Point 2 significantly predicted and explained 8% of the variance in Northern Sotho reading comprehension in step 3.

Overall the results suggested that PA skills (sound matching, elision), vocabulary and early writing skills were the best predictors for Northern Sotho spelling. Northern Sotho sound matching emerged as the strongest predictor of Northern Sotho spelling. Northern Sotho elision, RON and non-word repetition were robust predictors of Northern Sotho reading comprehension, with Northern Sotho elision emerging as the strongest indicator of Northern Sotho reading comprehension.

6.8 Conclusion

This chapter presented the developmental paths of phonological processing and literacy measures from Point 1 to Point 2. The chapter also reflected on the longitudinal cross-linguistic transfer of skills from one language to another in the Northern Sotho-English bilingual sample. The chapter finally presented an analysis to determine the best longitudinal predictors of spelling and reading comprehension at the end of Grade 3. All the cognitive-linguistic skills (phonological processing and vocabulary) and all the literacy measures from Point 1 and Point 2, which were deemed to be significant predictors of literacy development, were entered in a hierarchical regression model, to identify the most robust and the strongest cognitive-linguistic predictors of Grade 3 literacy outcomes. The next chapter focuses on the discussion of the findings presented in Chapter 5 (Results part 1) and Chapter 6 (Results part 2).

CHAPTER 7
DISCUSSION OF FINDINGS AND CONCLUSION

This study examined the relationships between phonological processing and various aspects of literacy in Northern Sotho-English bilinguals. Two groups (Northern Sotho LoLT, English LoLT) participated in the study and were assessed on a range of phonological processing and literacy skills in English and Northern Sotho. Additionally, the study also established the impact of the LoLT on the development of specific language and literacy skills in the two groups. The researcher was interested in exploring eight research questions (the main question and seven related sub-questions), which were posed in Chapter 1, and which are repeated here for easy reference: (i) What is the nature of the association between phonological processing and various aspects of literacy (letter knowledge, letter reading, word recognition, fluent reading, reading comprehension, early writing and spelling) in Northern Sotho-English bilingual children? (ii) What is the relationship between PA, PWM and RAN abilities? (iii) How does linguistic grain size influence the relationship between PA and literacy abilities in Northern Sotho-English bilingual children? (iv) To what extent do Northern Sotho-English bilingual children positively transfer cognitive-linguistic skills from Northern Sotho to English literacy acquisition and vice versa? (v) What effect does the LoLT (Northern Sotho or English) have on the development of phonological processing and literacy abilities of Northern Sotho-English bilingual children? (vi) Is there a difference in the progression of literacy development between Northern Sotho-English bilingual children instructed in a transparent orthography (like Northern Sotho) and those instructed in an opaque orthography (like English)? (vii) What is the developmental pattern of phonological processing and literacy abilities in Northern Sotho-English bilingual children? (viii) To what extent does vocabulary knowledge predict literacy acquisition in Northern Sotho-English bilingual children?

This study was longitudinal, and data was collected at three measuring points (Point 1, 2 and 3). Grade 2 children were followed and tested on various phonological processing, vocabulary and literacy measures at the beginning (Point 1) and end (Point 2) of Grade 2, and the same children were assessed on reading comprehension and spelling at the end of Grade 3 (Point 3). Various tasks were utilised at different points to assess the phonological processing (sound matching, blending, digit span, non-word repetition as well as digit, object, colour and letter naming) and literacy (letter-sound knowledge, letter reading, word reading, fluent reading, reading comprehension, spelling, writing) skills of participants. Different statistical tools, which included MANOVAs, Pearson Chi-square tests, error bars, Cohen's *d* analyses, repeated-measures ANOVAs, Spearman's correlations, simple regression, multiple regression and AMOS path analysis, were used to analyse the data in this study.

This chapter provides a discussion of the findings based on the results presented in Chapter 5 and 6. Each research question will be addressed in turn, and this will be followed by a summary of key findings, a discussion of the limitations of the study, recommendations for future research, a reflection on the practical implications of the study and the conclusion.

7.1 Phonological predictors of literacy development

The main research question asked whether there is a causal association between phonological processing and literacy skills in Northern Sotho-English bilingual learners. Correlation, multiple regression and Amos path analysis results based on the entire group, and on each LoLT group were used to answer this question. It was hypothesised that phonological processing skills would predict the literacy development of Northern Sotho-English bilingual children. The findings in relation to this question are discussed with respect to the phonological processing model, and as such different components of the phonological processing model (PA, PWM and RAN) and different levels within each of these components are addresses separately (Wagner and Torgesen 1987).

7.1.1 PA and literacy development

Sound matching, blending, and elision measures were used to assess PA skills in this study. CFA confirmed that sound matching, blending and elision were strong indicators of both Northern Sotho and English PA as latent variables, with high factor loadings ranging from *.57* to *.84* based on Point 1 and 2 measuring points. Several studies have supported the notion that sound matching, blending and elision are valid tasks to assess PA (Anthony et al. 2003; Anthony and Lonigan 2004). CFA also confirmed the validity of the literacy skills (word reading, fluent reading, reading comprehension, letter reading, early writing and spelling) to measure Northern Sotho and English literacy with factor loading ranging from *.37* to *.96.* Spearman's correlations (Point 1 and 2) revealed that the associations between PA and literacy skills ranged from weak to strong in both Northern Sotho and English languages. In the remainder of this section, the predictive value of phonological processing skills will first be discussed in relation to word and fluent reading, in English and in Northern Sotho, and then in relation to other early literacy skills. At this point, the discussion will focus mostly on the entire sample (i.e. on results obtained from the collapsed data set). Differences in the LoLT groups regarding phonological processing and literacy development will be discussed in Section 7.5.

7.1.1.1 PA and literacy development in English

Path analysis at Point 1 revealed that English blending and sound matching significantly predicted English word and fluent reading skills. Previous research has also consistently shown that blending and sound matching skills lay the foundation for early literacy acquisition (Choi, Hatcher, Dulong-Langley, Liu1, Bray, Courville, O' Brien, and DeBiase 2017; Le Roux, Geertsema, Jordan and Prinsloo 2017; Wackerle-Hollman, Durán, Brunner, Palma, Kohlmeier and Rodriguez 2019). Sound matching and blending are considered basic PA skills, which develop before other complex skills such as elision and segmentation (Anthony et al. 2003, 470; Wagner et al. 1994, 85). The path analysis suggested that, in the present study, blending was a stronger predictor of English word and fluent reading abilities than sound matching. This finding is in line with previous studies, which also indicated that blending is a robust predictor of literacy abilities relative to other PA sub-skills (Elhassan et al. 2017; Gilliver, Cupples, Ching, Leigh and Gunnourie 2016; Hatcher and Hulme 1999; Yeong and Liow 2012; Wagner et al. 1997). For instance, Wagner et al. (1997) examined the relationship between PA (elision, blending, segmentation) and reading performance in a five-year longitudinal study with 216 children (kindergarten to grade 4) and found that blending was a strong predictor of word reading ability. Blending develops concurrently with print experiences during the early stages of literacy development (Cisero and Royer 1995, 276; LaFrance and Gottardo 2005, 560), and children are expected to have a good mastery of this skill by the end of first grade (Lane and Pullen 2004, 102).

In terms of cognitive demand, blending is thought to be easier than other PA skills (i.e. segmentation, elision), but the results here and in other studies suggest that it is one of the most critical PA skills needed for developing decoding and fluent reading (Anthony et al. 2006, 262; Paige, Rupley, Smith, Olinger, and Leslie 2018, 2; Wagner et al. 1994, 85). When children learn to decode, they have to identify the sounds of separate letters first before blending those letter sounds together (Lane and Pullen 2004, 107). The finding of this study thus emphasises the importance of developing this much-needed and critical skill for literacy success early on in literacy instruction. Descriptive statistics suggested that performance was higher on English sound matching than on blending, which confirmed studies indicating that sound matching is an easier task relative to blending (Manrique and Signorini 1998, 499). In terms of cognitive complexity, recognising words containing the same or different sounds is viewed as an easier task than manipulating sounds within a word (Anthony et al. 2003, 481).

Path analysis findings at Point 2 showed that English elision and sound matching significantly predicted English word and fluent reading skills. The impact of blending disappeared at Point 2 when elision (i.e. the ability to delete sounds or syllables from a word, and to reproduce the remaining sounds as a string) was included in the model. In other words, elision emerged as the strongest predictor of English word and fluent reading abilities relative to other PA skills at Point 2. Previous studies have also identified elision as a more robust predictor of reading than blending (Kroese, Hynd, Knight, Hiemenz and Hall 2000). Similarly to Point 1, children performed better in sound matching relative to elision and blending tasks.

Multiple regression findings at Point 3 revealed that English PA (sound matching, blending and elision) skills were unique longitudinal phonological predictors of English spelling and reading comprehension abilities. This finding implies that spelling and reading development relies on a foundation of common skills and processes (Caravolis et al. 2001, 50). Elision was the strongest longitudinal predictor of literacy abilities in English at Point 3. In line with previous research that revealed that phonological processing is necessary for sufficient spelling and reading comprehension acquisition (Geers and Hayes 2012; Kaefer 2012; Patterson 1992; Pollo et al. 2009; Ouellette and Sénéchal 2017; Van Orden 1987; Van Orden and Kloos 2005), the present study supports the obligatory phonological mediation hypothesis, which assumes that these literacy skills are phonologically mediated to some extent (at least in early Grades) (Barry 1994, 320; Coltheart et al. 1994, 917; Hannely and McDonnell 1997, 7; Tainturier and Rapp 2001, 265). After controlling for the effect of vocabulary in the hierarchical regression model, elision and blending emerged as the best phonological predictors of English spelling. The impact of sound matching on spelling became insignificant, while elision remained the strongest predictor of English spelling. Elision also emerged as the most robust longitudinal predictor of reading comprehension (although it was not the strongest) after accounting for vocabulary knowledge. Interestingly, elision consistently emerged as a robust predictor of English literacy skills from Grade 2 until the end of Grade 3. A good mastery of the elision task is assumed to be indicative of better developed PA, as it not only requires the identification of sound units, but also the ability to hold identified units in the PWM and to manipulate them (Elhassan et al. 2017, 7). Hence, it seems that the development of complex phonological processing skills (such as elision skills) must be nurtured in Northern Sotho-English bilingual children to attain success in English decoding and in fluent reading. When considering the results of the three measuring points together, it seems clear that easier PA skills, such as blending, are definitely important at the earliest stages of literacy development in this population. However, mastering more difficult PA skills, such as elision, becomes more important once children have mastered basic decoding skills, and is also a better predictor of English comprehension and spelling skills over a longer period of time.

7.1.1.2 PA and literacy development in Northern Sotho

Regarding Northern Sotho, AMOS path analysis at Point 1 revealed that Northern Sotho blending predicted various literacy skills (letter knowledge, letter reading, word reading, fluent reading) in Northern Sotho. The relationships between Northern Sotho blending and some of the literacy skills (word and fluent reading) were quite strong, compared to others. Contrary to the results obtained for English, descriptive statistics suggested that performance was better for Northern Sotho blending than for sound matching, which is consistent with studies indicating that, in some languages, blending might develop before initial and final sound matching abilities (Gilliver et al. 2016; Pufpaff 2009). This might have to do with the simple syllable structure of Northern Sotho, and the fact that syllable blending, in particular, was easier than sound matching (where individual phonemes have to be identified). In terms of cognitive complexity, however, sound matching is thought to be easier than blending (Anthony 2003, 470).

There were no significant relationships between Northern Sotho sound matching and any of the Northern Sotho literacy abilities at Point 1. Descriptive statistics indicated that performance on the Northern Sotho sound matching task was quite low, implying that the task might have been demanding for the learners. This was somewhat unexpected considering that sound matching is a manageable task acquired incidentally, as children master speech sounds and are exposed to songs and word games (Lane and Pullen 2004, 102; Manrique and Signorini 1998, 499). Children are expected to master this skill by the end of kindergarten (Lonigan et al. 2009, 345). The low performance on the Northern Sotho sound matching task might be explained as a linguistic effect (i.e. linked to the phonological structure of Northern Sotho), or alternatively, some task-related factors or a lack of adequate instruction in Northern Sotho letter-sound correspondences might have played a role here. The phonological characteristics of the spoken language may have a significant impact on phonological development in different languages (Ziegler and Goswami 2005, 8), such that some skills may develop later than expected in some languages. Northern Sotho is a syllable-timed language, and words consist mostly of simple CV syllables. Some scholars have suggested that the syllable, and not the phoneme is the smallest grain size instinctively available to children in such languages (Diemer et al. 2015; Probert 2019; Wilsenach 2019). It is plausible that the phonological structure of Northern Sotho cause children to be less aware of the individual phonemes that constitute syllables. Following this reasoning, phoneme awareness was probably not yet well-developed at Point 1 in this population, and thus children might have attempted to match the first/last syllable (instead of the first/last phoneme) in this task, which would explain their performance. Regarding the sound matching task, learners were required to identify and match the initial sounds of a target item (i.e. sound /*k*/ from a set of three alternatives like /*kefa*/, /*tonki*/ and /*puku*/ - presented auditorily), by pointing to the matching item in a picture book. Thus, learners needed adequate knowledge of the individual sounds within syllables in Northern Sotho to manipulate the task effectively. Teaching sound matching in Northern Sotho, like other languages, demands that instructors know letter-sound teaching strategies. However, in most cases, instructors usually lack an adequate understanding of the basic language structure (Earle and Sayeski 2017, 267), to provide effective instruction. This has also been reported in the South African context (Pretorius and Ribbens 2005, 145; Pretorius and Spaull 2016, 1449; Van Staden and Howie 2012, 95). To recap, the results at Point 1 suggested that blending was a stronger predictor of literacy compared to sound matching in Northern Sotho, and this pattern was similar to what was established for English in this population.

AMOS path analysis at Point 2 revealed that Northern Sotho PA skills (elision, blending, sound matching) significantly predicted some aspects of literacy development in Northern Sotho. Northern Sotho elision significantly predicted Northern Sotho letter, word and fluent reading as well as early writing skills. Northern Sotho blending predicted Northern Sotho word reading whilst sound matching predicted early writing abilities. The prediction pattern suggested that elision was a strong predictor of literacy abilities in Northern Sotho (as was the case in English) relative to other PA tasks. Descriptive statistics suggested that Northern Sotho blending once more proved to be easier than sound matching and elision. Multiple regression at Point 3 indicated that Northern Sotho blending and sound matching skills were unique longitudinal predictors of Northern Sotho spelling. Previous research also found a unique relationship between PA and spelling development (Martins and Silva 2006; Ouellette, Sénéchal and Haley 2013; Schaffler 2007). Blending was the strongest predictor of Northern Sotho spelling, followed by sound matching. This finding confirms earlier findings which indicated that blending makes a unique contribution to spelling (Puranik et al. 2011). Although elision failed to predict spelling, it emerged as a unique and robust predictor of Northern Sotho reading comprehension.

After controlling for the effect of vocabulary in the hierarchical regression model, elision continued to emerge as a significant predictor of Northern Sotho spelling, together with sound matching. Sound matching then became the most robust predictor of Northern Sotho spelling. Previous studies indicate that sound matching is a good predictor of spelling development (Ouellette and Sénéchal 2008). The impact of blending became insignificant after controlling for vocabulary knowledge. In the hierarchical regression model, Northern Sotho elision once again emerged as the strongest predictor of Northern Sotho reading comprehension, confirming studies which established that elision is a good predictor of reading comprehension (e.g. Elhassan 2017).

Taken together, the findings suggested that PA skills (blending, sound matching and elision) are significant predictors of early literacy acquisition in both Northern Sotho and in English. These findings are in line with several studies that have reported that PA abilities play a crucial role in early literacy acquisition in the lower grades (Anthony et al. 2008; Choi et al. 2017; Cockcroft and Alloway 2012; Diemer et al. 2015; Elhassan et al. 2017; Gilliver et al. 2016; Le Roux et al. 2017; Paige et al. 2018; Yeong and Liow 2012; Wackerle-Hollman et al. 2019). Path analyses and hierarchical regression analyses suggested that these relationships may be causal, confirming previous studies that have established cause-effect relations between PA and literacy (Burgess and Lonigan 1998; de Jong and van der Leij 2002). Early literacy acquisition requires young children to use phoneme-grapheme mapping rules to generate the necessary phonological codes (Coltheart et al. 1993, 589), and PA skills lay the foundation for this process to occur. However, many current educational policies and practices fall short of meeting learners' needs in this area (Earle and Sayeski 2017, 262). The mean scores of the Northern Sotho-English bilingual children on most PA tasks were low, suggesting the need for more effective instruction to enhance learners' skills.

Certain aspects of PA do not develop intuitively or naturally – rather, it may require deliberate teaching and repeated opportunities to practice (Phillips, Clancy-Menchetti and Lonigan 2008, 4). Effective phonics instruction is needed to help learners understand how to map the sounds of spoken language onto their corresponding letters (Gillon 2004, 21). Early literacy instruction in South African emphasises a combination of phonics (i.e. children are taught to say a letter and the sound that represents it) and whole language (i.e. children are instructed to read by recognising whole words) instruction (Morin 2020). According to Wilsenach (2019, 8), a systematic synthetic phonics approach would be better suited to the needs of South African learners than an analytic phonics approach. A synthetic phonics approach whereby children are made aware of letter-sound correspondences followed by blending instruction in a systematic approach (Ehri et al. 2001, 393; Wyse and Goswami 2008, 692) would be useful to develop PA skills adequately in the present population. This study’s findings highlight the importance of fostering children PA skills for later literacy achievement (Anthony and Francis 2005, 255). As reported in the literature (e.g. Kastamoniti, Tsattalios, Christodoulides and Zakopoulou 2018, 280), children with greater sensitivity to their language's sound structure progressed faster in literacy acquisition than children with less developed PA skills.

7.1.2 PWM and literacy development

Digit span and non-word repetition tasks assessed the PWM construct in this study. CFA indicated high factor loadings for non-word repetition and digit span, in both Northern Sotho and English, and as such, these tasks were judged to be reliable indicators of PWM. The factor loadings ranged from *.51* to *.89* based on data obtained on Point 1 and Point 2. Correlation analysis revealed that the connections between PWM and literacy skills ranged from weak to moderately strong in Northern Sotho and English languages.

AMOS path analysis results at Point 1 revealed that both the English and the Northern Sotho non-word repetition and digit span tasks were non-significant predictors of the English word and fluent reading skills in Grade 2 children. This finding is consistent with studies that found the associations between phonological storage tasks and early reading in normally developing children to be non-significant or very weak (de Jong and van der Leig 1999; LaPointe and Engle 1990; Swanson and Berninger 1996; Wimmer and Mayringer 2002). A possible explanation for this finding is that the children in the present study were quite young, and not yet cognitively matured. Some scholars have argued that PWM capacity develops with increasing age and cognitive complexity, and that it becomes more important to literacy with increasing age, e.g. when longer and/or more complex texts have to be decoded and when learners have to rely on short-term memory in order to understand what they are reading (Summers et al. 2010, 480). Hence, PWM may become more critical in the literacy development of Northern Sotho-English bilingual children in later grades. Children's performance on English non-word repetition and digit span tasks were low, suggesting that children faced some difficulties in handling these tasks. This may be attributed to task-related factors such as the length of non-words, as well as language factors such as unfamiliarity with test items (Gathercole and Baddeley 1990, 344; Gathercole et al. 1991, 349). It was not surprising that learners had difficulties manipulating long words (i.e. *Mesidospregoudegounjopnas* and *Tavowgoandozjounipelaukof*) with many syllables, in comparison to short words like *ral, nibe*, given their age. Regarding familiarity, non-words with a higher word-likeness (*zid, nibe, ballop*) are easier to repeat, as learners can draw on similarities with phonologically similar (familiar words such as *zip, nite* and *ballot,* respectively.

Path analysis at Point 1 further revealed that Northern Sotho non-word repetition significantly predicted Northern Sotho letter knowledge skill. A couple of previous studies have shown non-word repetition to be a good predictor of letter knowledge (de Jong and Olson 2004, Torppa et al. 2006). Phonological memory is assumed to make a critical contribution when relationships between letter groups and sounds are acquired (Garthercole and Baddeley 1990, 358). The children in both the NS LoLT and English LoLT groups performed well on the letter knowledge tasks. However, it was also noticeable that learners struggled in manipulating complex letter combinations in Northern Sotho. Northern Sotho has complex letter combinations characterised by diagraphs (e.g. *sk, hl,*) trigraphs (e.g. *kgw, pšh*), quadgraphs (e.g. *tšhw mpšh*) and pentagraphs (e.g. *ntšhw*). The learners seemed not well-accustomed to these letter combinations, as their performance deteriorated when requested to read these letter clusters.

The relationship between Northern Sotho digit span and Northern Sotho fluent reading was significant but negative, indicating that fluent reading performance decreased as digit span increased. There is no straightforward explanation for this finding, as there is no logical reason to assume that increased PWM would be associated with decreased reading fluency. Digit span is assumed to be a less sensitive measure of PWM capacity compared to non-word repetition (Garthercole 1999, 415). The children's performance on Northern Sotho PWM tasks was better for non-word repetition than digit span tasks (in the entire sample). It is possible that non-word repetition might be simpler than digit span because of its lower cognitive demands, unlike digit span, which benefits from higher-level strategic processes such as cumulative rehearsal (Gathercole and Baddeley 1993, 49). Previous studies have also reported digit span challenges in children. For example, Jukes and Grigorenko (2010) assessed the digit span abilities of

Wolof and Mandinka ethnic groups (579 participants with an age range of 14-19) in Gambia, and the findings revealed that digit span recall was poorer in the Wolof group relative to the Mandinka group. This was attributed to the increased word length found in the base-5 Wolof counting system. For example, the Wolof equivalent of three, one, eight (ñett, benn, juróom-ñett) takes longer to rehearse than the Mandinka equivalent of three, one, eight (saba, kiling, sey) (Jukes and Grigorenko 2010, 20). This implies that linguistic factors related to the counting system can influence digit span performance in children.

The path analysis models at Point 2 did not reveal any significant paths between PWM and literacy abilities in both Northern Sotho and in English. It is unclear why PWM failed to contribute to any of the literacy abilities at this point. Unlike at Point 1, whereby PWM made a significant contribution to some literacy aspects in the Northern Sotho language, it seems at this point that its influence disappeared. The finding suggested that Grade 2 learners were not relying on PWM skills for word reading or fluent reading processes. The diminished effect of PWM could perhaps be explained by the developmental models of reading, suggesting a gradual shift from reliance on the phonologically based procedures to other procedures (i.e. orthographic) in the children's learning process (Frith 1986, 69; Morton 1989, 43). The mean scores of children on most PWM tasks (except the Northern Sotho non-word repetition) were low, which could explain the lack of any significant pathways with literacy abilities. PWM has also been associated more with reading development in clinical populations (such as dyslexics), and it would seem that in a sample of typically developing children, this component of the phonological processing model is overshadowed by PA, at least in the earlier stages of literacy development, where the focus is on decoding rather than on comprehension.

Multiple regression at Point 3 revealed that non-word repetition was a significant longitudinal predictor of Northern Sotho reading comprehension. PWM is a necessary phonological process that helps readers recall the words they read and to understand the context of a written text (Kastamoniti et al. 2018, 281). The present finding is contrary to some findings, which indicate that the influence of PWM on reading comprehension was insignificant (Kibby and Cohen 2008, 525). Nevertheless, the earlier (preliminary) explanation in this section that PWM is more important in later literacy development, when learners have to remember what they are reading in order to understand a text, seems accurate. After controlling for the effect of vocabulary in the hierarchical regression model, non-word repetition still emerged as a good predictor of reading comprehension. This finding was evident only in the NS LoLT group. The group achieved a mean percentage score of *70%* and *75%* on non-word repetition tasks at Point 1 and 2, respectively and may have benefitted from enhanced language proficiency considering Northern Sotho is their LoLT.

Overall, the findings suggest that PWM skill is a significant predictor of some Northern Sotho literacy skills. However, contrary to previous studies (Gathercole and Pickering 2000; Gathercole et al. 1991; Kibby 2009; Krishnan et al. 2017; Nouwens et al. 2016; Yeong et al. 2014), the present study suggests that relationships between PWM and literacy skills were non-existent in the English language in this particular population. Age is a crucial factor in PWM performance (Gathercole et al. 1991, 365); hence the PWM-literacy relations in Northern

Sotho-English bilingual children could be expected to change at some point with increasing age and reading expertise. Based on reading theories, the involvement of cognitive processes underlying reading is likely to change with progress in reading competence (Araujo et al. 2014, 12). Thus, PWM-literacy relationships may change throughout the learners' literacy development course. Early literacy acquisition involves recognising graphemes as representative symbols of phonemes on a written level (Kastamoniti et al. 2018, 279). These graphemes are then stored temporarily in the PWM system, where they are initially converted into sounds sequence, which allows for the construction of words and their subsequent meaning (De Carvalho, de Kida, Capellini and de Avila 2014, 746). Although PWM did not significantly contribute to decoding and fluent reading in this study, the findings do emphasise the importance of developing PWM skills, as such skills are crucial in later literacy acquisition (i.e. in reading comprehension). In short, PWM in the present study was clearly not as indicative of progress in early literacy development as PA skills. Nevertheless, the role of PWM in later literacy acquisition cannot be denied, and this knowledge must be incorporated into the educational policies and practices of teaching and learning how to read, write and spell.

7.1.3 RAN and literacy development

Rapid digit, letter, colour and object naming tasks were used as measures of RAN. CFA factor loadings ranged from *.34* to *.68* in both Northern Sotho and in English, indicating that the measures loaded significantly onto RAN as a latent variable. Three of the measures had low factor loadings (English RON .37; Northern Sotho RLN .47; and Northern Sotho RON .34), which could have been caused by the difficulty level of these particular tasks. Correlations analysis indicated that correlations between rapid naming and literacy skills were significant and negative – this is to be expected as an increased ability in RAN would lead to a lower overall naming speed on each task. Thus, the correlation pattern that emerged was the lower the naming speed, the better the literacy skills of learners.

AMOS path analysis at Point 1 revealed that English RLN significantly predicted English word reading. This confirms studies indicating that alphanumeric tasks capture the underlying processes important for word reading better than non-alphanumeric tasks (Araujo et al. 2014; Lervag and Hulme 2009; Misra et al. 2004; Savage et al. 2008). There were no significant relationships between English RDN, RON, RCN and any literacy measures at Point 1. Some previous findings have also failed to establish any meaningful relationship between RAN and early literacy success (Blachman 1984; Schatschneider et al. 2004; Stringer et al. 2004). Some studies found evidence that the impact of RAN is more critical at the beginning of elementary school (de Jong and van der Leij 2002), while others argue that RAN may be more important after the fourth grade (Vaessen, Gerretsen and Blomert 2009). There might be several reasons why the majority of the English RAN tasks failed to predict English word and fluent reading. Possibly, the tasks were cognitively too demanding for the children. It is also possible that the learners have not fully acquired the English digits, objects and colours that served as test items. In other words, it is possible that lexical access to the RDN, RON and RCN test items were not yet automated, and that the items could not be retrieved from the lexical store in a rapid manner. As such, these tasks probably didn't measure the construct RAN reliably at Point 1. Previous findings in the same research context revealed that various English RLN, RDN and RON significantly impacted both word and fluent reading abilities in Northern Sotho-English learners (Makaure 2016); however, this study was conducted with learners at the end of Grade 3, and thus it seems age is an important factor when it comes to the role of RAN in reading in this population. The fact that RCN and RON failed to predict literacy partly support findings which indicate that alphanumeric RAN is more closely related to reading than non-alphanumeric RAN (Denckla and Cutting 1999; Maya, Katzir, Wolf and Poldrack 2004; Meyer et al. 1998; Stringer et al. 2004). For instance, Stringer et al. (2004) examined the relationship between RAN, reading and spelling abilities of 56 children (Grade 3 and 4) and found that colour naming showed no association with literacy abilities. Maya et al. (2004) contend that colour and object RAN are not predictive of reading performance in average readers after the first or second grade, but letter and digit naming tasks predict reading until at least the age of eighteen.

Path analysis at Point 2 revealed that various rapid naming skills significantly predicted aspects of literacy skills in English. English RON significantly predicted English word reading while English RLN, RON and RCN significantly predicted English fluent reading. The data obtained at Point 2 indicated that RAN variables predicted literacy skills better at this point than at Point 1, which suggested a developmental change in the RAN-reading relationship in Northern Sotho-English bilingual children. Some scholars suggest that the impact of RAN on reading becomes stronger as children progress in terms of reading proficiency (de Jong 2011, Parilla et al. 2004, Vaessen et al. 2009). Children who can rapidly name linguistic codes (i.e. letters, colours, digits, objects) are typically expected to read more accurately and fluently. Kail and Hail (1994, 950) explain that children with strong rapid naming skills automatically access name codes and are more likely to recognise their words faster, and as a consequence, they understand what they read better. The results here thus support the notion that automaticity is an age-related skill (Kail et al. 1999, 303), implying that children are likely to access codes more rapidly with increasing age. It seems clear that age may also be a mediating link between RAN and reading in Northern Sotho-English bilingual learners, as RAN only emerged as a reliable predictor of reading skills at the end of Grade 2. The path analysis at Point 2 further showed that colour and object naming jointly explained more of the total variance in reading abilities in English compared to letter naming. English object and colour naming jointly explained *52%* of the total variance in English word and fluent reading, whilst letter naming explained *16%* of the variance in English word and fluent reading. This suggested that non-alphanumeric RAN was a better predictor of reading than alphanumeric RAN (Cohen, Maya, Laganaro, and Zesinger 2018). As was the case at Point 1, path analysis established no predictive links between English RDN and literacy abilities.

The data analysis at Point 2 showed a unique effect of RAN on reading fluency. English RAN measures explained more of the variance in English reading fluency than in word reading; however, only the English LoLT group provided empirical support for the view that RAN is a good predictor of reading fluency. Previous findings have proven RAN's unique association with reading fluency (Georgiou et al. 2016; Kirby et al. 2010; Moll, Ramus, Bartling, Bruder, Kunze, Landerl 2014; Vander et al. 2018, 12); implying that reading fluency is highly dependent on the speed of lexical access (Vander Stappen and Van Reybroeck 2018, 12).

Children who can access stored phonological codes rapidly are likely to have better fluent abilities. Albuquerque (2017, 54) explains that RAN is critical for fluency due to the multicomponent and automatic nature of both (i.e. both involve the simultaneous, rapid and effortless use of various processes). While reading fluency requires accuracy and automaticity in sub-lexical and lexical processes, RAN requires the establishment of automatic connections between linguistic and perceptive processes (Norton and Wolf 2012, 447). Some have described RAN as a microcosm of reading fluency activities (Norton and Wolf 2012, 429). The need for automaticity in executing these tasks binds the RAN-reading relationship.

Previous studies indicate that RAN is a good predictor of spelling accuracy (Georgiou et al. 2012; Moll et al., 2009; Savage et al. 2005; Savage et al. 2008; Stainthorp et al. 2013; Torppa et al. 2012; Wimmer et al. 2000). Multiple regression results at Point 3 suggested that English RCN was a unique longitudinal phonological predictor of English spelling abilities. However, this finding was only evident in the NS LoLT group. After controlling for the effect of vocabulary in the hierarchical regression model, colour naming in the NS LoLT group still emerged as a reliable longitudinal RAN predictor of English spelling. This finding was contrary to some previous studies, which found that alphanumeric RAN is more related to spelling accuracy than non-alphanumeric RAN (Savage et al. 2008). Finally, at Point 3, the impact of RLN on English spelling and reading comprehension was significant (with a negative correlation coefficient), suggesting that as RLN scores increased (i.e. the slower learners performed the RLN task), scores on spelling and reading comprehension decreased. In other words, RLN abilities remained a reliable predictor of both literacy outcomes at the end of Grade 3. This finding was in line with previous studies that suggested that RLN is a significant predictor of literacy abilities across languages (Gilliver et al. 2016; Kirby et al. 2014). According to Maya et al. (2004, 254) letter naming is a better predictor of literacy skills because children usually automatise letters after Grade 1, which is contrary to non-alphanumeric naming, which possible never gets fully automatised.

Regarding Northern Sotho, path analysis results at Point 1 revealed that Northern Sotho RLN and RON significantly predicted early literacy success in Northern Sotho. Northern Sotho RLN significantly predicted Northern Sotho letter reading and letter knowledge skills. This finding indicates that children who access phonological codes for lexical items efficiently, also access letter names and their associated sounds easily (Anthony et al. 2008, 134). Neuhaus and Swank (2002, 172) argue that the main factor which underpins the association between letter naming and other letter related tasks is that both require the integration of verbal, visual and attentional systems. Northern Sotho RON also showed a significant relationship with Northern Sotho word reading, suggesting that object naming can predict reading performance in young readers. This finding is opposite to the pattern typically observed with average readers (Blachman 1984; Cornwall 1992; Maya et al. 2004).

Path analysis at Point 2 revealed that Northern Sotho RLN significantly contributed to different literacy aspects (letter reading, word reading, fluent reading and early writing) abilities in Northern Sotho. At this point, alphanumeric RAN seemed to be a better predictor of literacy abilities in Northern Sotho. An orthographic-based explanation supports a more significant association between literacy ability and alphanumeric RAN compared to non-alphanumeric RAN because letters and digits carry more orthographic information than objects and colours (Araújo et al. 2011, 225). RON, at this point, explained no significant variance in any of the Northern Sotho literacy abilities. It is important to note that even though the children seemed to know the object terms in Northern Sotho, they would often swap the Northern Sotho term with an equivalent English term (e.g. use *pig* instead of *kolobe)*. This may be due to a lack of productive use of the object naming terms in Northern Sotho. Lack of automaticity would result in slower processing of Northern Sotho objects, as children would sometimes try to correct themselves when realising their mistake. Subsequently, this leads to slower naming speed, which may explain the lack of any significant path between RON and literacy variables.

Multiple regression results at Point 3 suggested that Northern Sotho RON skills were unique longitudinal phonological predictors of Northern Sotho reading comprehension. After controlling for the effect of vocabulary in the hierarchical regression model, RON still emerged as the best rapid naming predictor of Northern Sotho reading comprehension. Several studies suggest non-alphanumeric RAN is more related to reading comprehension (Badian 1997; Sprugevica and Hoien 2004; van den Bos et al. 2008). For instance, Sprugevica and Hoien (2004) followed Latvian children from first to second grade to explore RAN-reading relationships, and the findings revealed that rapid naming was a unique predictor of reading comprehension. However, there is no clear conceptualisation that explains how the processes underlying naming speed affect reading comprehension (Park 2008, 43).

Overall, the findings indicate that RAN is a significant predictor of literacy development in both Northern Sotho and in English. RAN was related to different reading domains (i.e. letter knowledge, letter reading, word reading, fluent reading, reading comprehension) and spelling. However, the prediction pattern varied depending on the rapid naming task and literacy components assessed in different grades, and was influenced by the age of the learners. Path analysis and hierarchical regression analysis suggested that the relations were causal. This is in line with some studies that have shown significant effects of rapid naming on literacy acquisition (de Jong and van der Leij 1999; Diemer 2015; Fricke et al. 2016; Georgiou et al. 2008; Landerl et al. 2019; Landgref et al. 2012; Savage et al. 2005; Torppa et al. 2012). However, it is important to note that there is still no consensus about what cognitive processes underlie the relationship between RAN and literacy (Närhi et al. 2005; Torgesen et al. 1994), or whether RAN abilities could be improved via focused instruction.

7.2 Relationships between phonological processing skills

The first sub-question inquired what the nature of the relationship between PA, PWM and RAN abilities in Northern Sotho-English bilingual children is. Spearman's correlations analysis was used to answer this question[45]. The findings (Point 1 and 2) revealed that the correlations (within-language and cross-linguistic[46]) between different phonological processing abilities

[45] Refer to Table 5.13 and 6.12 in Chapter 5 for correlations analysis statistiics.
[46] The nature of cross-linguistic relationship between these variables is dicussed in section 7.4 of this chapter.

ranged from weak negative correlations (*r =.-02*) to strong correlations (*r = .80***) in both Northern Sotho and in English. The relationships between PA and PWM tasks were moderate in both Northern Sotho and English languages (Point 1 and 2), supporting research findings which established significant correlations between PA and PWM tasks (Brady 1986, 138; Gathercole et al. 2006, 17; Mann and Liberman 1984, 592; Milwidsky 2008; Wagner and Torgesen 1987, 206). For instance, Milwidsky (2008) assessed seventy-nine South African grade 1 children on PA and working memory. The findings revealed that there was a significant association between PA and working memory and that the depth of analysis of PA determined the level of demand made on working memory. However, in some cases, these relations were insignificant. For instance, English sound matching failed to correlate with English NWR in both LoLT groups suggesting that PA and PWM skills are independent skills to some extent. When correlations between RAN and other phonological skills (PA and PWM) were compared, the findings revealed that these relations were mostly significant but negative in both Northern Sotho and English languages. This resonates with findings which established significant relations between RAN and other phonological abilities (Kibby et al. 2014; Ramus 2014; Savage et al. 2007; Torgesen et al.1997; Vaessen et al. 2009), suggesting that they at least load on a common factor to some extent (Pennington et al. 2001, 707). However, in some cases, correlations between sub-components of the phonological processing model were insignificant. For instance, English PWM tasks and some of the RAN (RLN, RDN, RON) tasks failed to correlate in the English LoLT group at Point 1. Similarly, Northern Sotho digit span and Northern Sotho RAN (RLN and RON) tasks at Point 2 failed to correlate in both LoLT groups. This reverberates findings that failed to find any significant correlations between RAN and other phonological measures (Mann 1984; Mann and Ditunno 1990), supporting the view that RAN measures may tap on an independent skill that is not related to the phonological domain (Wolf and Bowers 1999, 415; Wolf et al. 2000, 387; Wolf et al. 2002, 43).

The findings revealed that phonological processing tasks that measure the same sub-construct were more associated with each other. The strength of these correlations differed depending on the type of tasks, language of task as well as the LoLT group involved. For instance, while English elision strongly correlated with English blending in the English LoLT group, the same variables correlated moderately in the NS LoLT group at Point 2. English digit span and non-word repetition correlated moderately in the NS LoLT group but quite strongly in the English LoLT group at Point 2. The stronger correlations favouring the English LoLT group suggest that the group was more likely to have developed the related tasks in parallel; this makes sense as their LoLT would give them an advantage in terms of the English tasks, compared to the Northern Sotho LoLT group. The significant correlations for tasks measuring the same sub-construct suggest that learners who performed better in any one of the tasks were likely to perform well in another. In some cases, the correlations were the same for both LoLT groups. For instance, Northern Sotho blending moderately correlated with sound matching, in both LoLT groups at Point 1. However, other correlations patterns were unique to one language group. An interesting finding that emerged indicated that RAN tasks which tap on the same processing mechanisms were strongly related to each other. For instance, English non-alphanumeric (RCN and RCN) tasks were strongly related to each other in the English LoLT group at Point 2. Overall, the association between RAN abilities ranged from moderately weak to strong in English and Northern Sotho language in both groups. These findings collectively indicate that the degree of performance in each of the tasks measuring the same construct resulted in some change in the performance of another. Significant correlations in each of the tasks representing the PA, PWM and RAN sub-constructs confirm the confirmatory factor analysis findings, which indicate that these tasks were indeed testing the intended constructs.

Overall the findings indicate that the relations between phonological processing abilities were significant in some cases but insignificant in others. These findings reiterate previous findings where researchers reported significant correlations between some closely related phonological processing measures, such as PA measures (Gathercole et al. 2006; Mann and Liberman 1984; Spring and Perry 1983; Torgesen and Houck 1980; Wagner and Torgesen 1987), whilst failing to establish any significant correlations between more distinct phonological processing measures (Alegria et al. 1982; Mann 1984; Mann and Ditunno 1990). This finding concurs with the conceptualisation that although the phonological abilities in Wagner's phonological processing model can be interrelated, different components of phonological processing (i.e. PA, PWM, RAN) are also independent to some extent (Mann 1984, 130; Sprugevica and Heien 2004, 115; Wagner and Torgesen 1987, 206).

7.3 PA and linguistic grain sizes

The second sub-question asked whether the relationship between PA and literacy is subject to linguistic grain sizes. A paired samples t-test and AMOS path analysis were used to answer this question. This question was only explored at Point 2, as elision (which formed part of the data analysis for this question) was measured only at this point. The findings are interpreted in light of the psycholinguistic grain size theory.

AMOS path analysis revealed that both syllable awareness and phoneme awareness predicted some literacy outcomes in Northern Sotho and in English. English syllable and phoneme elision were both significant predictors of English word and fluent reading. However, syllable and phoneme blending failed to predict any English literacy abilities. The mean percentage scores for syllable blending (*63%*) and phoneme blending (*12%*) suggested that learners performed better on syllable blending than on phoneme blending. Even so, learners' relatively strong syllable blending skills did not guarantee the successful attainment of English literacy skills. Children performed very poorly on the phoneme blending task, explaining why the task failed to impact English literacy tasks positively (i.e. a floor effect occurred). In Northern Sotho, phoneme elision significantly predicted Northern Sotho literacy (i.e. letter, word and fluent reading) skills. Northern Sotho syllable blending predicted Northern Sotho word reading and early writing skills. Northern Sotho phoneme blending predicted Northern Sotho letter reading, word reading, fluent reading and early writing. These findings support the idea that syllable and phoneme awareness are essential in learning to read, spell and write, as reported in the literature (Hoien, Lundberg, Stanovich and Bjaalid 1995; Mann and Dituno 1990; Muter, Hulme, Snowling and Stevenson 2004; Treiman and Zukowski 1996).

Regarding the strength of these predictors, path analysis findings showed that phoneme awareness was a better predictor of literacy abilities in Northern Sotho and in English. English phoneme elision significantly predicted English word and fluent reading with strong beta weights compared to those of syllable elision. Northern Sotho phoneme awareness tasks also explained the development of Northern Sotho literacy skills better than syllable awareness tasks. Northern Sotho phoneme elision significantly predicted Northern Sotho letter, word and fluent reading abilities. Northern Sotho phoneme blending predicted Northern Sotho letter, word and fluent reading as well as early writing abilities. However, Northern Sotho syllable blending only predicted Northern Sotho word reading and early writing skills. The statistical analysis implies that successful literacy acquisition is highly dependent on the learners' ability to manipulate linguistic units at the phoneme level. This finding supports recent studies that have proved that phoneme awareness is a critical determinant of early literacy development (Lervage and Hulme 2012; Wasserstein and Lipka 2019). Phoneme awareness involves the understanding that spoken words can be separated and manipulated as minimally contrastive sound units (e.g. *bone* into */b/-/o/-/n/*) (Ukrainetz, Nuspl, Wilkerson, Beddes 2011, 50) and is needed for children to recognise the alphabetic principle and to sound out printed words (Paige et al. 2018, 2). An individual with good phoneme awareness skills is expected to manipulate and isolate individual sounds within a word effectively.

In the Northern Sotho test battery, the phoneme manipulation tasks required learners, for instance, to identify the phonemic units in words like /*p-o-s-o*/ and /*m-e-n-o*/. The mean percentages for Northern Sotho phoneme blending and phoneme elision were low. This indicated that learners struggled to manipulate sound units at the phoneme level. The paired t-test results (entire sample and within-group) confirmed that Northern Sotho-English bilingual children were better at manipulating words at the syllable level than at the phoneme level in both Northern Sotho and in English. This result supports existing research studies (Anthony and Lonigan 2004; Castles and Coltheart 2004) that young children are intuitively more sensitive to syllables than to phonemes. Furthermore, this finding supports the notion that the syllable may be a more salient or easily accessed linguistic grain size in Northern Sotho. During the Northern Sotho phoneme manipulation tasks, it was observable that the learners often responded with a syllable alternative, instead of with a phoneme. For instance, when manipulating word-initial phonemes in the word *meno*, the learners would often delete the whole syllable /*me*/ instead of providing a correct phoneme response */m/*. This observation is similar to Legkoko and Winskel's (2008) observations in Setswana speaking Grade 2 learners and Wilsenach's (2019) observations in Northern Sotho Grade 3 learners.

The learners in this population clearly struggled to manipulated sounds at the phoneme level, in both their languages. This might be the result of teaching methodologies in South African classrooms, which emphasise syllable-oriented teaching practices (De Vos et al. 2014, 16; Probert 2019, 3). Agglutinative languages like Northern Sotho tend to have a stronger CV oriented phonological structure (Demuth 2007, 529; Endemann 1964, 6; Kgasago 2001, 13), which may explain why syllables are the major focus in the language teaching practices at the expense of phonemes. Northern Sotho is a syllabic language, and words like *sekolo* (school), *kolobe* (pig) or *bona* (see) are prominent. Hence, young children are more likely to develop an instinctual awareness of syllables, and it is plausible that learners will automatically utilise syllable strategies in literacy acquisition due to the phonological structure of Northern Sotho.

Trudell and Schroeder (2007, 9) reported that automatic syllable recognition skills are more valuable for Bantu readers than whole word memorization or other global strategies. For instance, long complex Northern Sotho words such as *bohlokwahlokwa* (very important), *dikanegelokopana* (in the story) and *malaokakanywa* (bill; draft act) are likely to be manipulated easily using a syllable approach rather than whole word memorisation.

The results revealed that the vast majority of Northern Sotho-English bilingual children only had access to one linguistic grain size (i.e. the syllable) to facilitate reading in both Northern Sotho and English. This finding failed to provide direct support for the psycholinguistic grain size theory (Ziegler and Goswami 2005), which proposes that in transparent orthographies, readers are aware of and rely on smaller units, such as letters/graphemes (which represent phonemes) while decoding, and still achieve high reading accuracy. In this study, though, it seemed that learners had to rely on their awareness of syllables while decoding. In contrast, the theory predicts that in more opaque orthographies, such as English, readers have to develop some reliance on larger units to ensure fast and accurate decoding. For instance, *talk* cannot be decoded correctly using grapheme-phoneme correspondences (which would lead to the pronunciation/tælk/), but can be read accurately based on the rime correspondence '*-alk*' /o: k/, as in *walk* and *stalk* (Schmalz, Robidoux, Castles, Coltheart and Marinus 2017, 1). Northern Sotho-English bilingual children were expected to access different linguistic grain sizes when acquiring literacy in Northern Sotho. This, however, did not seem to be the case. According to Ziegler and Goswami (2005, 13) the linguistic unit (i.e. phoneme, syllable or word) utilised by the teachers in different linguistic environments has major implications for literacy acquisition. As mentioned already, the evidence provided here suggests that explicit and effective instruction are needed to ensure that learners get accustomed to the phonemes that constitute Northern Sotho words. Awareness to this grain size is clearly important for successful literacy attainment in Northern Sotho, but does not develop automatically, probably because of the dominance of syllables (both in terms of the phonological structure and in terms of current educational practise). It has been reported by many scholars that formal literacy instruction is necessary for children to attain phoneme awareness (Bertelson et al. 1989, 239; Morais et al. 1986, 45). In contexts where this is a focus point in instruction, children are expected to count the phonemes in a word or syllable by the end of Grade 1 (Milwidsky 2008, 10).

The findings provided support for the developmental perspective of PA, which suggests that children demonstrate sensitivity to linguistic units at lower levels of complexity (e.g. words, syllables) before they are aware of higher-level linguistic units (e.g. phonemes) (Anthony et al. 2002, 84; Paige et al. 2018, 2). This developmental trajectory has been proven in South African Bantu languages: Northern Sotho (Wilsenach 2019), Setswana (Legkoko and Winskel 2008, Probert 2016), isiXhosa (Diemer et al. 2015; Probert 2016); other Bantu languages such as Swahili (Alcock et al. 2010) and also in different orthographies, for instance, English (Treiman and Zukowski 1991; Ziegler and Goswami 2005) and Hebrew (Wassersten and Lipka 2019). For instance, Wilsenach (2019) assessed the contribution of various levels of PA to reading (phoneme isolation, phoneme elision, syllable elision, word and fluent reading measures) in 60 Grade 3 Northern Sotho learners. The results revealed that Northern Sotho learners manipulated syllable-based tasks better than phonemes. Diemer et al. (2015) tested 31 Grade 4 (mean age: 10 years) IsiXhosa children on blending, segmentation and substitution tasks, consisting of a syllable and phoneme component and found that the children performed better in syllable than phoneme awareness tasks. Probert (2019, 11) established that syllables were the dominant linguistic grain size in IsiXhosa and Setswana. Overall, this study findings add to the existing data that provides support for syllable saliency in Southern African Bantu languages.

The present findings may provide support for the view that linguistic grain sizes per se may not be the most critical factor in literacy development. According to Anthony and Lonigan (2004, 53) and Hamilton (2007, 162) the performance differences that may appear related to the type of linguistic grain size may be a product of the task demands and age-related factors. Hence, it might not be essential to consider which linguistic unit the children are utilising at a particular point in time. Rather, as suggested by Anthony and Lonigan (2004, 53), it may be more critical to consider whether the phonological sensitivity measures are developmentally appropriate for a child at a particular point in time. Following this line of argumentation, it is possible that Northern Sotho-English bilingual children will eventually reach a cognitive level where they can access the different linguistic grain sizes in Northern Sotho. So far, no studies on this topic have been conducted with older Northern Sotho children, and as such, there is no way to predict whether children will develop phoneme sensitivity naturally. What is clear at this stage, is that this level of awareness can be facilitated by proper and intensive phoneme awareness instruction. Studies have shown that systematic phoneme focused training is effective and often yield positive related effects on literacy development in young children (Elbro and Petersen 2004; Hatcher and Hulme 1999; Málková and Caravolas 2016; Tangel and Blachman 1995; Troia et al. 1998). A targeted early phoneme-based instruction where Northern Sotho learners are directly taught, for instance, that the word *bana* consist of four-unit of sounds *b-a-n-a* could help ensure that the learners are sensitive to phonemes in the long run. Wilsenach (2019, 8) also suggested that using a synthetic phonics-based approach[47] could spearhead the development of phonemic awareness in Northern Sotho children. Northern Sotho, however, contains complex words like *setlogolwana* (great grand-child) and *dintlongkgethwa* (in the church), which might not be easily accessed through phoneme manipulation strategies. Thus, phoneme teaching strategies may need to be complemented with syllable and word-based teaching approaches (Johnston et al. 2012, 1382; Watson and Johnston 2005, 25) for adequate literacy success in the Northern Sotho language.

7.4 Cross-linguistic transfer of cognitive-linguistic and literacy skills

The third sub-question asked whether Northern Sotho-English bilingual children would transfer cognitive-linguistic skills from Northern Sotho to English literacy acquisition and vice versa. Correlations, as well as multiple regression results based on the entire group, and on each LoLT group, were used to answer this question. The study hypothesised that Northern Sotho-English bilingual children would positively transfer cognitive-linguistic skills across

[47] Synthetics phonics based approach proceeds from small linguistic units such as phonemes and onsets to larger linguistic units such as syllable, words and rhymes in literacy development (Moustafa and Maldonado-Colon 1998, 448).

languages to aid literacy development in each of their two languages. The findings in relation to this question are discussed with respect to the linguistic interdependence hypothesis, linguistic threshold hypothesis, script dependent hypothesis and the central processing hypothesis.

7.4.1 Cross-linguistic transfer of cognitive-linguistic skills

Correlations analysis based on Point 1 and 2 indicate evidence of cross-linguistic transfer of phonological processing skills between L2 and L2. The correlations between Northern Sotho PA and English PA were weak to moderate at Point 1, but they ranged from moderate to strong at Point 2. This finding suggested that learners in both groups were able to effectively transfer PA skills from their L1 to L2 regardless of the language of instruction used. This finding is in line with Wilsenach's (2020) findings, who found evidence of cross-linguistic transfer of PA skills in Grade 1 and 3 Northern Sotho-English bilingual children. An interesting pattern emerged on the elision tasks at Point 2, which indicated that the correlations between the two languages regarding that task were stronger for the NS LoLT group. This implies that learners in this group were effectively using their acquired L1 skills to inform their elision task performance in the L2. Cross-linguistic correlations between Northern Sotho digit span and English digit span tasks were moderate at Point 1. At Point 2, these interrelations remained moderate in the NS LoLT group but emerged stronger in the NS LoLT group. Correlations between Northern Sotho and English non-word repetition were weak in both LoLT groups at Point 1. At Point 2, these relations remained weak in the English LoLT group, but became moderate in the NS LoLT group. In terms of RAN, the findings indicated that Northern Sotho and English RLN weakly correlated at Point 1 in both LoLT groups. At Point 2, these relations were moderate in the English LoLT group, but they emerged stronger in the NS LoLT group.

Overall the findings provided support for research findings which established significant cross-linguistic correlations between phonological processing skills (Aquino 2012; Geva 2006; Lafrance and Gottardo 2005). This provides support for the central processing hypothesis, which assumes that cognitive-linguistic skills such as phonological processing abilities transfer across languages regardless of the phonological and orthographic differences between languages (Geva and Siegel 2000, 2). The findings also suggested that learners instructed in the L1 were more successful at transferring their L1 phonological skills to L2, which resonates with Wilsenach's (2020) findings. Learners in the NS LoLT group seemed to benefit from L1 instruction, in the sense that the cross-linguistic correlations in this group were often stronger. This implies that adequately developed L1 skills might go a long way to facilitate phonological processing skills and literacy skills in the L2.

7.4.2 Cross-linguistic relationships between cognitive-linguistic and literacy skills

Multiple regression (Point 1, 2 and 3) results based on the entire sample, and on each LoLT group indicated that English PA skills (blending, sound matching and elision) predicted Northern Sotho literacy skills. Cross-linguistic correlations (Point 1 and 2) revealed that the associations between English PA and Northern Sotho literacy variables ranged from weak to strong in both LoLT groups. The findings suggested that English PA is a unique predictor of Northern Sotho literacy skills. This would suggest that once children have understood that the word */mat/* contains three sounds /*m-a-t*/, they can use this knowledge to segment Northern Sotho words (e.g. /*bana/* into /*b-a-n-a*/), thereby strengthening their literacy skills in Northern Sotho. Interestingly, even though Northern Sotho does not have onset-rime patterns in the same way as English, most children were able to manipulate words such as /*e-ma*/ in a manner that resembles English onset-rime (i.e. blend individual sounds *t-oy* into *toy*) manipulation. This could mean that learners were using their onset-rime knowledge from their L2 to process their L1. A cross-linguistic transfer effect, in which PA skills in one language predict literacy skills in another language, has been observed between alphabetic languages in previous studies (Durgunoglu et al. 1993; Gottardo et al. 2001) and also (albeit not relevant here) between alphabetic and non-alphabetic languages such as English and Chinese (Chow et al. 2005, Gottardo et al. 2001). According to the script dependent hypothesis, language-specific factors such as orthographic depth may impose limitations on the transfer of skills involved in learning to read, spell and write in a different language (Geva 2006, 2; Geva and Siegel 2000, 17). Northern Sotho (transparent orthography) and English (opaque orthography) are orthographically different, which theoretically may deter the effective transfer of some abilities from one language to another. Regarding the cross-linguistic predictive nature of PA skills and literacy in this study, the script dependent hypothesis would also suggest that PA skills developed in a transparent orthography might not support literacy in a deep orthography. However, the evidence here defies the script dependent hypothesis and supports the idea that children can use PA skills cross-linguistically to support literacy development, regardless of the orthographic depth of the languages in which they learn to read.

Some L2 skills (PWM and RAN), however, did not positively influence L1 literacy, implying that these skills may be language-specific (Gottardo and Lafrance 2005; Keung and Ho 2009). Correlations (Point 1 and 2) between L2 PWM and RAN skill and L1 literacy skills were very weak in both LoLT groups. This might be explained by the fact that performance on test items used in PWM and RAN are more likely to be affected by a lack of knowledge of those items in a specific language. So, if a child does not know the digits well in both languages, the task will not correlate between languages, and is unlikely to support literacy cross-linguistically. This is in line with the linguistic threshold hypothesis, which suggests that if the children have not reached a threshold level in terms of certain L2 skills, these skills will not be transferable from the L1 to the L2 (and there will be insufficient knowledge in the L2 to support literacy in the L1).

Regarding the predictive nature of L1 phonological processing skills in relation to L2 literacy, the pattern was complex and varied depending on each data measuring point. Multiple regression (Point 1) revealed that Northern Sotho PA (blending) and PWM (non-word repetition) were unique predictors of English literacy skills. At point 2, Northern Sotho PA (blending, sound matching, elision) and PWM (non-word repetition) skills predicted English literacy skills. Northern Sotho PA (blending, sound matching and elision) skills predicted English spelling abilities at Point 3. Northern Sotho PA (sound matching, elision) and PWM (non-word repetition) and RAN (RON) predicted English reading comprehension at Point 3. Taken together, these findings suggested that L1 PA, PWM and RAN abilities were unique cross-linguistic predictors of L2 literacy acquisition. Correlations between L1 PA and L2 literacy skills ranged from weak to moderate at Point 1 but were moderate at Point 2. Cross-linguistic correlations between L1 PWM and L2 literacy skills were weak in both LoLT groups, while the relations between L1 rapid naming and L2 literacy were significant. Taken together, these results support previous studies that provided evidence for the cross-linguistic transfer of phonological processing and literacy skills from the L1 to the L2 (Geva and Siegel 2000; Gottardo 2002; Gottardo, Yan, Siegel and Wade-Woolley 2001). Furthermore, it seemed that, in this particular population, children were more able to rely on L1 phonological processing skills to support L2 literacy skills than vice versa, regardless of the LoLT.

The findings suggested that Northern Sotho PA was the strongest cross-linguistic predictor of English literacy. PA skills are assumed to develop faster in a transparent orthography than in a deep orthography (Trudell and Schroeder 2007, 5), facilitating the effective transfer of this skill from L1 to an L2 in the present context. For instance, learners can take advantage of their early development of syllable awareness in their L1 to strengthen their understanding of the underlying mechanics of English literacy (which also rely on syllable awareness, to some extent). There has been far less discussion concerning the transfer of PWM and RAN and how aspects of these skills set transfer from one language to another. According to the linguistic threshold hypothesis, however, L2 learners must reach a threshold level in L2 proficiency before they are able to transfer L1 skills and knowledge to L2 (Bernhardt and Kamil 1995, 17). Therefore, the learners' L2 needs to be adequately developed for them to actually benefit from L1 knowledge. Low levels of L2 linguistic proficiency may slow the development of phonological processing (particularly PA) and subsequent literacy abilities in L2 (Durgunuglu 2002, 194).

The cross-linguistic predictive nature of vocabulary (for the entire population and within each LoLTgroup) was also explored at Point 3. Literature suggests that vocabulary knowledge is typically associated with the literacy outcomes used at Point 3 (particularly with reading comprehension) (Laufer and Aviad-Levitzky 2017; Sénéchal, Ouellette and Rodney 2006; Sidek and Rahim 2015) and not so much with word decoding or letter reading. This motivated the researcher to examine these relations in the current sample. The findings suggested that English vocabulary skills were unique long term predictors of Northern Sotho spelling and reading comprehension. Similarly, Northern Sotho vocabulary skills uniquely predicted English spelling and reading comprehension skills. The findings suggest that vocabulary skills from one language can support literacy development in another language. Cross-linguistic correlations between vocabulary and literacy skills ranged from weak to moderate in both languages.

Correlations between L1 and L2 vocabulary were moderate in the English LoLT group but weak in the NS LoLT group. This means that children with better vocabulary skills in L1 were more likely to transfer the skill to inform L2 vocabulary knowledge. The findings confirmed various studies, which established that vocabulary knowledge is language-independent and is transferrable across languages (Dahl 2015; Koda 2008; Nagy, Garcıa, Durgunoglu, and Hancin-Bhatt 1993). For instance, Nagy et al. (1993), assessed 74 upper-elementary Spanish–English bilinguals and found a significant relationship between learners' vocabulary knowledge in Spanish and their English reading comprehension. Similarly, Koda (2008b) explored the effects of vocabulary knowledge (in 24 college learners) and found that L1 vocabulary knowledge (Japanese) enhanced overall reading proficiency in L2 *(*English*)*. Children can thus rely on their vocabulary strength in one language to aid language and literacy abilities in another language.

Overall, the findings provided evidence that cognitive-linguistic skills (phonological processing and vocabulary) could support literacy development cross-linguistically in Northern Sotho-English bilingual children. This means that, at least for some skills, once learners have acquired them, they may not have to be learned from scratch in the other language (Durgunuglu 2002, 192). According to Melby-Lervag and Lervag (2011, 129) once children have learned a general procedure (in one language) that words can be divided into smaller units (like phonemes), and that these units can be used to decode text, that knowledge should ease the process of learning to decode in another language. In the current study, this seemed to be particularly true for the relationship between L1 cognitive-linguistic skills and L2 literacy development, highlighting the importance of developing linguistic and literacy skills in a child's first language. The findings supported the linguistic interdependence hypothesis (Cummins 1991, 84; Cummins 2005, 4) and central processing hypothesis (Geva and Siegel 2000, 2). The interrelations between L1 and L2 may reflect a common underlying proficiency between Northern Sotho and English languages, in line with the interdependence hypothesis. From the central processing hypothesis's perspective, the findings suggested that orthographic differences between Northern Sotho and English are not a hindrance to the transference of skills between the two languages. Once learners identify similarities between the two languages, they can transfer this knowledge to any language.

Adequate exposure and instruction in each of the learners' languages is necessary to facilitate effective learning and literacy development. Ríos and Castillón (2018, 86) argue that if bilingual and biliterate learners are not nurtured, they are in danger of losing their literacy skills in their L1 and having many difficulties acquiring literacy in their L2. Some have suggested that the mere existence of similar language structures is not enough to promote transfer between L1 and L2, but that the children have to be made aware explicitly of those similarities (Genesse Geva, Dressler and Kamil 2006, 153). Direct instruction regarding similarities will help children to directly compare and recognise both language structures, which should support the effective cross-linguistic transfer of skills (Melby-Lervag and Lervag 2010, 130)

7.5 Group differences in phonological and literacy acquisition

The fourth sub-question asked whether there were any significant differences in phonological processing and literacy abilities of Northern Sotho-English bilingual children instructed in Northern Sotho and those instructed in English. The fifth sub-question asked whether Northern Sotho-English bilinguals progress faster in a transparent language like Northern Sotho than in a deep orthographic language like English. These questions will be answered concurrently in this section. MANOVA and Cohen's *d* analyses were used to answer the questions. The results are interpreted within the framework of the orthographic depth hypothesis.

MANOVA analyses (Point 1, 2 and 3) indicated a significant group (i.e. LoLT) effect on children's performance in phonological and literacy tasks in both Northern Sotho and in English. The results are consistent with the prediction that the two instructional groups would differ in terms of performance on various tasks, considering the phonological and orthographic dissimilarities between Northern Sotho and English and the fact that they received their literacy instruction in the foundation phase either in Northern Sotho or in English. MANOVA results at Point 1 revealed that the English LoLT group performed significantly better than the NS LoLT group on English sound matching and RLN tasks. Cohen's *d* indicated that the effect sizes were medium for the two tasks. Additionally, the MANOVA analysis revealed that the English LoLT group scored significantly higher than the NS LoLT group on the Northern Sotho RLN and Northern Sotho RON tasks. The effect sizes were small for RLN (*Cohen's d = .10)* and medium for RON (*Cohen's d = .53*). The NS LoLT group performed significantly better than the English LoLT group in the English non-word repetition task. The effect size revealed that the group difference in English non-word repetition (*Cohen's d = .68*) performance was large. Descriptive statistics suggested the NS LoLT achieved a mean percentage of *50%* whilst the English LoLT group achieved a mean percentage of *43%* on the English non-word repetition task. The non-word repetition task requires learners to repeat phonological items of increasing length (e.g. *meb, woogalamic*) that are phototactically possible but meaningless in that language (Gathercole et al. 1994, 103; Baddeley 2003, 832). In other words, a non-word is an unfamiliar word that lacks semantic meaning but is constructed following the phonological specifications of a particular language. The fact that the NS LoLT performed better seems like a random effect in this particular population, which cannot be explained logically. It is possible that, since the English LoLT group is exposed to a non-standard dialect of English (as is the NS LoLT group), their increased exposure to English would not help them much in non-word repetition after all (in which case no group will have a real advantage). It is also possible that the CTOPP non-word repetition task, when presented in an American accent (as presented in the standardised test kit), is not very reliable in the South African context, and that it will not discriminate between learners with varying levels of English PWM.

The MANOVA analysis established that there were no statistically significant group differences for any of the other English phonological processing and literacy tasks. It was expected that the English LoLT group would outperform the Northern Sotho LoLT group on English measures, considering that English is their medium of instruction. It was thus surprising to find that this group's advantage on the English measures was limited to the sound matching task. Regarding the development of phonological processing and literacy skills in English after one year of formal schooling, the results obtained at Point 1 (beginning of Grade 2), suggest that being instructed in English from the beginning of Grade 1 in this particular context did not lead to an advantage in English phonological processing or literacy skills.

The NS LoLT group scored significantly better than the English LoLT group on the Northern Sotho letter knowledge and Northern Sotho word reading tasks. Cohen's *d* indicated a medium effect size (*.35* and *.45* respectively) for both tasks. Descriptive statistics suggested that the NS LoLT group obtained a mean percentage of *73%* in letter knowledge and *40%* in word reading. In comparison, the English LoLT group achieved a mean percentage of *67%* on letter knowledge and *30%* on word reading. This suggests that the L1 instruction group was perhaps somewhat better prepared to decode text at the start of Grade 2 than the English LoLT group. Research has shown that letter knowledge is an essential foundation for reading, spelling, and writing (Hiebert Cioffi and Antonak 1984; McClelland and Rumelhart 1981; Muter et al. 2004; Schatschneider et al. 2004, 265; Treiman et al. 1998; Whitehurst and Lonigan 1998). A good score in letter knowledge shows that learners were starting Grade 2 with a good foundation in letter-sound knowledge. However, in terms of letter knowledge, it should be mentioned here that most learners (in both LoLT groups) had difficulties identifying and reading complex letter combinations such as *kg, kw tlw, thw,* and *tshw*. Notably, trigraphs (*thw, tlh, tšh*) and quadgraphs (tshw) were the most difficult for learners to manipulate. It might be that the task was asking too much of learners at the beginning of Grade 2; nevertheless, direct instruction targeting these complex letters may be needed in Northern Sotho to ensure that children can identify them quickly and can read fluently.

Overall, the findings at Point 1 indicated that, regardless of the language of instruction, the two groups of bilingual children in this study could complete tasks in both languages to some degree, but that performance tended to be somewhat weak. Factors like the type of task, language of a task, quality of instruction and age of the learners might have been at play in determining the two groups' performance on the various measures. Although the NS LoLT group performed better on some phonological processing and literacy tasks, the group did not demonstrate a huge advantage as a result of being schooled in their mother tongue. For instance, the group achieved a mean percentage of *40%* in the Northern Sotho word reading and *17%* in English word reading. Given the transparent nature of Northern Sotho orthography, and the fact that the Northern Sotho word reading task was designed to be easy (the longest words were 3 syllables words and consisted of a simple CVCV structure (e.g. *morena*)), an average score of *40%* on this task shows that many learners were still struggling with basic decoding after a year of literacy instruction in their mother tongue. In terms of reading fluency, the children were reading an average of 8.2 words correct per minute (wcpm) in Northern Sotho and 5.6 wcpm in English. Considering the threshold level established for African languages, that Northern Sotho children should be able to read at least 52-66 wcpm by the end of Grade 3 (Spaull et al. 2017, 17), the present results show that the NS LoLT learners are progressing slowly, and more or less at the same rate in both languages. Considering that this group's instructional language is Northern Sotho, the expectation was that L1 reading should surpass L2 reading on all counts in this group, but an effect was only found for word reading. As mentioned above, Northern-Sotho is a transparent language (De Schryver 2007, 24) with a simple phonological system (i.e. few vowels, simple syllabic structure) compared to English. Hence, learners are expected to make better progress if they take advantage of this simple phonological system. Theoretically, literacy acquisition progress should progress rapidly in orthographies where letter-sound relationships are highly regular (Seymour et al. 2003, 430; Wimmer and Goswami 1994, 91; Ziegler and Goswami 2005, 10). Research in African languages indicates that literacy acquisition is more likely to succeed if children are taught in a language already known to them, rather than a language they come across for the first time at school (Pretorius and Mampuru 2007). However, the data collected at Point 1 did not immediately suggest a robust mother tongue effect on learners’ scholastic development. This finding is in line with Wilsenach (2015), who compared early literacy skills in two groups of Northern Sotho learners (Northern Sotho LoLT vs English LoLT) at the end of Grade 1, and found no obvious scholastic advantages in the Northern Sotho LoLT group.

On the other hand, although the English LoLT group achieved better on some tasks, the group's performance does not show any absolute gains of being schooled in English either. For instance, the group obtained a mean percentage score of *30%* on Northern Sotho word reading and *16%* on English word recognition, suggesting that the learners were struggling with decoding in both languages. The group read an average of 6.2 wcpm in Northern Sotho and 6.8 wcpm in English, indicating that learners have not attained basic reading fluency in either of their languages at this point. Interestingly, the English LoLT group even performed slightly lower than the NS LoLT group on literacy measures in English. Regarding the established norms of reading for English, children should read 53 wcpm by the end of Grade 1 and at least 89 wcpm by the end of Grade 2 (Hasbrouck and Tindal 2006, 640). Hence, the reading rate in this group is also substantially below standard in both languages. The low reading levels in the English LoLT group could indicate that some other key factors (e.g. teacher instruction) (Chung et al. 2019), as well as the additional challenges posed by learning in an L2 (Le Roux et al. 2017, 8), may be prohibiting learners from attaining literacy success in both languages.

The MANOVA analysis at Point 2 suggested a clearer LoLT effect in both groups. At this point, both groups performed significantly better in phonological and literacy tasks when these were delivered in their LoLT. The English LoLT group performed significantly better in the English elision, blending and English sound matching tasks. The NS LoLT group performed better than the English LoLT group on English RCN, Northern Sotho sound matching, Northern Sotho digit span, and Northern Sotho early writing skills. Effect sizes ranging from *37% -77%* were observed for the group effect, and these differences were statistically significant ($p < .05$). The findings indicated that the children who received instruction in English were, on the whole, stronger in the English phonological processing and literacy tasks. Similarly, the children taught in Northern Sotho were better on Northern Sotho phonological processing and literacy tasks. Previous findings indicate that children in bilingual educational environments performed better on outcomes measured in their native language (Carlisle and Beeman. 2000, 331), but the results here are more indicative of a pattern where bilingual learners acquire better phonological processing and literacy skills in the language in which they receive literacy instruction. To summarise, the effects of language of instruction on the two LoLT groups became more apparent at the end of Grade 2. A similar, but cross-sectional study, in the same context (Makaure 2016), suggested that by the end of Grade 3, learners' performance on phonological processing and literacy also dependent on the LoLT, with English LoLT learners generally performing better on English measures, and Northern Sotho LoLT learners generally performing better on Northern Sotho measures. Given the additional evidence gathered here, it would seem then that this pattern is not apparent yet at the beginning of Grade 2, but emerges towards the end of Grade 2, and that it persists through the rest of the foundation phase.

Learners had made noticeable progress at Point 2. Statistics for the entire sample revealed that the children's mean percentage scores for English word reading was *33%,* and the children were now reading an average of 21.1 wcpm in English. In terms of Northern Sotho, word reading was now at a mean of *55%,* and learners were reading an average 19.1 wcpm. However, despite this progress, in both languages, reading levels were still not quite grade-appropriate for most reading tasks (given the threshold levels provided by Spaull et al. 2017), except perhaps for Northern Sotho word reading. It was also observable that some learners could still not read a single word correctly and relied on visual cues (pictures) to understand a text even in their L1. Northern Sotho tend to have longer word units such as *kgafetšakgafetša* (repeatedly), *modirišopeelano* (conditional mood), and *dintlongkgetwa* (to/in/at the church), which (in general) could explain the lower reading rate in that language. According to Seymour (2006, 457) word length is a crucial factor in shallow orthographies, where readers rely more on the phonological route, since it affects the word recognition time. Longer words are, therefore, likely to be read more slowly than short words (Acha, Laka and Perea 2009, 369). However, in this study, a grade-appropriate Northern Sotho reader was used, and very long words did not appear, which renders this explanation for poor fluent reading implausible at the Grade 2 level.

On the other hand, considering the disjunctive nature of the Northern Sotho orthography, word units can also be very short, with V or CV syllable structures (Spaull et al. 2017, 4). For instance, in Northern Sotho, in sentences such as *ke a ba rata* (I like them), four orthographic elements that constitute a single word category (i.e. verb) are split into separate orthographic entities (Anderson and Kotze 2006, 190; Taljard and Bosch 2006, 433). Hence, theoretically, it would also be possible for Northern Sotho readers to rely on whole-word parsing in accessing some Northern Sotho orthographic units. Due to the variations in word length units in Northern Sotho, educators should thus implement phoneme, syllable, and whole-word reading strategies to facilitate effective literacy development. A cumulative body of research supports a blended approach whereby a small unit approach (phonemes, syllable) is supplemented by a large unit (word) approach (Bornfreund 2012, 3; Juel 1996, 759).

Aspects of language proficiency could be key in explaining the low levels of reading in Northern Sotho-English bilingual children. A receptive vocabulary task was used to establish learners' oral language proficiency skills, and learners' performed better in Northern Sotho vocabulary than in English vocabulary. Theoretical models of skilled reading emphasise the importance of developing foundational oral language skills (Hoover and Gough 1990, 127). Hence, early instructional practices should focus on improving learners' general language skills to engage meaningfully in their overall learning. Additionally, Point 2 results (for the NS LoLT group) suggested that learning in the mother tongue had no additional benefits for English learning outcomes. Similarly, the English LoLT group acquiring literacy in an L2 seemed unable to develop L1 literacy skills based on the linguistic competence developed in their mother tongue before the onset of formal schooling. Theoretically, it is expected that efforts to develop literacy skills in L1 will translate and facilitate L2 literacy development and that bilingual children should benefit from native language scaffolding as they acquire literacy in an L2 (Ford 2005, 1). However, as pointed out previously, in the context of this study, the mother tongue seems to not be the main factor that determines successful literacy acquisition.

Multivariate analysis at Point 3 indicated that the English LoLT group scored significantly higher than the NS LoLT group on the English spelling and reading comprehension tasks. The NS LoLT group scored significantly higher than the English LoLT group on the Northern Sotho spelling task. The effect sizes were large (*.53* to *.67*). These findings clearly demonstrate that the two LoLT groups performed better in their medium of instruction. Descriptive statistics for the entire sample revealed that the learners performed poorly on Northern Sotho and English literacy (spelling and reading comprehension) tasks at the end of Grade 3. In terms of spelling, the learners achieved a mean percentage score of *14%* in English spelling and *38%* for Northern Sotho spelling. The better performance in Northern Sotho is consistent with studies that indicated that spelling development is relatively more accessible in transparent languages than in deeper orthographies, which often have more than one graphic possibility for the same phoneme (Borzone de Manrique and Signorini 1998; Moats 2005; Morin 2007). However, the finding is contrary to Soares De Soussa et al. (2010), who established that isiZulu-English bilingual children performed better in English spelling than isiZulu spelling tasks (though the LoLT in that study was English for all the participants). In terms of spelling development, it was noticeable that some learners showed signs of spelling difficulties. Some of the errors made by Northern Sotho-English bilingual children in English spelling included omission of letters (i.e. *strched* for *stretched*, *elepant* for *elephant*, *strem* for *stream*, *specil* for *special*), wrong sequencing of letters (i.e. *pne* instead of pen, *fihs* in place of *fish*, *borwn* in place of *brown*), the addition of unnecessary letters (i.e. *peni, fiesh, speciall*), phonetic over generalisations (i.e. *laf* instead of l*augh*; *speshal* instead of *special*), confusion with letters (i.e. diphthongs for example *streem* instead of *stream*) and incorrect letter formations.

Regarding Northern Sotho spelling, learners struggled with diagraphs and trigraphs such as *kg, hl, ng, tšw*. As was the case for English spelling, learners confused some letters. For instance, the digraph *kg* was confused with the simple letter *g*, resulting in *gona* instead of *kgona.* In cases that required learners to use *š* as in the word *mošemane,* learners used the normal letter *s.* Other common errors included the omission of letters (i.e. letter *e* in words like *taelo, e* in words like *sekolong, w* in *befetšwe),* wrong sequencing of letters (i.e. *lhapi* instead of *hlapi),* the addition of unnecessary letters *(i.e. emma* instead of *ema, tayelo* instead of *taelo)* and phonetic over generalisations *(i.e. mošimane* instead of *mošemane).* Hence, it seems clear that educators need to identify learners with spelling difficulties to help them effectively.

In terms of reading comprehension in both languages, the learners achieved a mean percentage of *33%* for Northern Sotho reading comprehension and *31%* for English reading comprehension, suggesting that performance was low. Even at this point, there is no evidence to suggest a mother tongue advantage on learners' performance at the end of Grade 3. The findings suggested that both LoLT groups still performed below-average in terms of literacy. Possibly, the learning constraints posed by the COVID-19 pandemic affected the learners' performance, as it was expected that learners would have made better progress by the end of Grade 3. It should be noted, though, that Makaure (2016) reported worrisome literacy levels in

Grade 3 English and Northern Sotho fluent reading too, when learning was not impeded by a pandemic. Makaure (2016, 175) indicated that Grade 3 Northern Sotho-English bilingual children were reading 41 wcpm in English and 29 wcpm in Northern Sotho, which suggested some reading difficulties. The spelling and reading comprehension tasks in this study were purposefully kept simple, and were aligned precisely with summative assessments that the respective schools conducted at the end of 2020. Given this, it seems that a persistent problem in attaining adequate literacy skills exists in this population, at least in this particular educational setting.

Taken together, the findings confirmed several other studies that have reported significant differences in different instruction groups in phonological and literacy tasks (Ben-Yehudah, Hirshorn, Simcox, Perfetti and Fiez 2019; Chung, Chen and Geva 2019; Le Roux et al. 2017; Probert 2019). For instance, Le Roux et al. (2017, 8) compared the performance of twelve English L1 and fifteen English L2 (Setswana L1 speaking) children (8 to 10 years) on PA and literacy tasks and found that the English L2 participants displayed significant challenges in phonological blending and segmentation tasks, compared to the English L1 children. Probert (2019, 11) compared the performance of 74 Grade 3 and 4 isiXhosa (conjunctive orthography) and Setswana (disjunctive orthography) learners on phonological and reading measures. Her study revealed that Setswana learners performed better on PA tasks than the isiXhosa learners. The present findings suggest that differences in orthographies can lead to differences in phonological and literacy acquisition across languages. This fits well within the orthographic depth hypothesis, which proposes that literacy development progresses differently for learners acquiring literacy skills in different orthographies (Frost 2006, 439), possibly as a result of fundamental differences in the nature of strategies that are employed in response to the different orthographies (Goswami 2010, 36).

7.6 The effect of time on phonological and literacy growth

The sixth sub-question inquired how phonological and literacy skills in Northern Sotho-English bilingual children developed over time. Repeated-measures ANOVAs and plot graphs were used to answer this question. The various phonological processing and literacy measures at Point 1 and Point 2 were included in the statistical model to examine the effect of time on the development of these skills.

Pillai’s Trace showed that children significantly improved in learners' performance on the Northern Sotho and English phonological processing and literacy variables from Point 1 to Point 2. Repeated-measures ANOVA statistics and the plot graphs indicated that the entire sample progressed positively on most English measures, except on the English non-word repetition task. Both instruction groups also progressed positively from Point 1 and 2 in English sound matching, digit span, RLN, RDN, RCN, RON, word reading, and fluent reading tasks. The English LoLT group progressed on the English blending and non-word repetition tasks, whilst the NS LoLT group regressed overtime on these two tasks. It is not clear why the learners in the NS LoLT group regressed on these tasks, one speculative explanation could be that there was a lack of systematic direct instruction targeting these tasks (particularly blending) over the six months period that passed from Point 1, but the researcher, unfortunately, has no way of determining whether this is was the case. The manipulation of the non-word repetition task does not really depend on direct instruction since the task is made up of non-words. However, learners need a lot of linguistics input in English to become familiar with the language structure of the target items to manipulate the task. Given the allocated time for English instruction in the NS LoLT group (2 to 3 hours per week), it might be that learners in this group do not have enough time to interact with the L2 in a manner that keeps them well abreast with all aspects of L2 learning. As mentioned before, the fact that the task was presented in an American accent (the standardised CD included in the CTOPP test-kit was used) might also mean that data obtained for this particular task was less reliable.

Regarding Northern Sotho performance, the repeated-measures ANOVA statistics and plot graphs illustrated that the entire sample progressed positively from Point 1 to 2 on most Northern Sotho measures, except in early writing. Both NS LoLT and English LoLT groups progressed in Northern Sotho blending, sound matching, non-word repetition, RLN, RON, word reading, fluent reading, and letter reading performance from Point 1 to Point 2. The Northern Sotho LoLT group progressed on the Northern Sotho digit span task, while the English LoLT group regressed. This finding could be explained by a lack of direct exposure to digits in Northern Sotho in the English LoLT group during the period from Point 1 to Point 2 (these learners would have received their numeracy instruction in English only). Northern Sotho digits tend to be complex since some contain more than one syllable (i.e. *tee, hlano, tharo, tshela, senyane*). Hence, consistent and direct instruction will be necessary to ensure that Northern Sotho learners, whose medium of instruction is not Northern Sotho, acquire digit names in Northern Sotho. From a cognitive perspective, consistent, guided instruction helps learners to effectively internalise information in their long-term memory (Kirschner, Sweller and Clark 2006, 77).

Both groups regressed on the Northern Sotho early writing task. This might be attributed to methodological issues. A name writing task was used at Point 1, whilst a word writing task was employed at Point 2. The differences in the early writing measuring instruments might have stimulated poor performance at Point 2. It was observable that, although most learners could manage to write their names, the majority of learners experienced difficulties in word writing. Knowing how to write a word is a complex process that goes beyond one's name (Puranik et al. 2012, 14) and is a reflection of increased sensitivity to the alphabetic principle (Puranik and Apel 2010, 46). Some learners had not made a meaningful transition from name writing to word writing at the end of Grade 2. The change in the name writing instrument was necessary at Point 2 to avoid ceiling effects, considering that the learners had a mean percentage of *80%* at Point 1. The fact that some learners struggled with word writing at Point 2 is a cause for concern, considering that the learners already had almost 18 months of literacy instruction. The word writing task required learners to identify a picture (of a car) and write the name in Northern Sotho (i.e. *koloi* or *mmotoro*) language. Some learners had difficulties identifying and writing the word, whilst some could identify the name but could not produce the written representation. Both language groups showed evidence of struggling in terms of word writing. However, the problem of determining the targeted object was more prominent in the English LoLT group, which may be due to limited literacy instruction in their L1.

Repeated-measures ANOVA revealed that the English LoLT group progressed better than the NS LoLT group on the English sound matching, digit span, non-word repetition, RDN, RCN, RLN, word reading and fluent reading) tasks over time. In terms of progress, the English LoLT group dominated most of the English tasks, suggesting that they were benefitting from instruction in English. The NS LoLT group progressed better than the English LoLT group on English RON. In terms of performance on the Northern Sotho measures, the NS LoLT group progressed better than the English LoLT group on several Northern Sotho measures, including blending, sound matching, non-word repetition, letter reading and fluent reading. The English LoLT group progressed better in Northern Sotho RLN, RON, word reading.

Overall, Northern Sotho-English bilingual children progressed positively in most phonological and literacy tasks in both languages, indicating that they were still developing the phonological processing skills needed to support literacy attainment. This also supports developmental models, which suggest that phonological processing changes and improves as literacy skills improve, and that these skills are in a reciprocal relationship with literacy skills. With increasing age and literacy expertise, children develop from having a mostly intuitive PA to having an awareness of more complex levels of PA (Booth et al. 1999, 4; Chace et al. 2005, 209; Perfetti and Hart 2002, 68; Stuart and Masterson 1992, 168; van Orden 1987, 181). However, though there were positive changes in many phonological and literacy abilities of Northern Sotho-English bilingual children from the beginning to the end of Grade 2, it should be noted that the children seemed to progress slowly. For instance, in tasks like English blending, learners achieved a mean score of *7.5* at Point 1 and *7.9* at Point 2. In the English digit span task, learners achieved a mean score of *13.5* at Point 1 and *14.2* at Point 2. The slow progress was also evident in Northern Sotho blending (i.e. mean score *7.3* and *8.0* at Point 1 and 2) and Northern Sotho digit span (i.e. mean score *7.2* and *7.4* at Point 1 and 2). The repeated-measures ANOVA indicated that this increase in the mean scores at Point 1 and 2 were statistically significant except for English blending, which shows that although increases seemed small, they were still significant. It is difficult to judge whether these increases are age-appropriate, since the CTOPP tasks are standardised for L1 English speakers, and cannot be applied in the current context, and since the Northern Sotho measures are not standardised. As such, the present researcher will not go beyond an observation that the leaners' seemed to progress somewhat slowly.

7.7 Vocabulary knowledge and literacy development

The seventh sub-question inquired what the association between vocabulary and literacy skills in Northern Sotho-English bilingual children are. Although the main focus in this study was on the relationship between phonological processing and literacy development, the researcher was interested in establishing to what extent vocabulary predicted later-developing literacy skills (spelling and reading comprehension) in Northern Sotho-English bilingual children after accounting for the influence of phonological processing. Simple regression analysis and hierarchical multiple regression analysis were used to answer this question.

Simple regression (entire sample) results revealed that English vocabulary explained*22%* of the variance in English spelling and *44%* of the variance in reading comprehension. Hierarchical regression also confirmed that vocabulary was the best predictor of English spelling and reading comprehension with strong beta weights. An enriched vocabulary thus is necessary for effective spelling and reading comprehension development. The prediction pattern suggested that English vocabulary knowledge was a better predictor of reading comprehension than of spelling. The importance of receptive vocabulary knowledge in determining reading comprehension success is well-established in the literature (Laufer and Aviad-Levitzky 2017; Sénéchal et al. 2006; Sidek and Rahim 2015). For instance, Sénéchal et al. (2006) explored the relations between early vocabulary and later reading skills in a longitudinal study and found that vocabulary in kindergarten explained unique variance in reading comprehension in Grades 3 and 4, even after controlling for the effects of other critical reading-related variables, including PA.

Simple regression (entire sample) results revealed that Northern Sotho vocabulary explained *22%* of the Northern Sotho spelling performance variance. However, vocabulary knowledge failed to predict Northern Sotho reading comprehension. It is not immediately clear why Northern Sotho vocabulary was not supportive of learners' Northern Sotho reading comprehension skills. Descriptive statistics suggested that learners' performed better in Northern Sotho vocabulary than in English vocabulary. Furthermore, the results revealed that the Northern Sotho-English bilingual children performed very low on the Northern Sotho and English vocabulary tasks. A direct comparison with the American population where the test was normed is, however, not possible, given that these learners do not speak English as an L1. Still, the results suggested that the learners' vocabulary levels are too low to facilitate academic learning. Northern Sotho reading comprehension in the sample was so poorly developed that no correlation existed between these variables, which could explain this counterintuitive finding. In other words, having a large(r) L1 vocabulary will not automatically lead to successful reading comprehension in the L1 – learners must still be able to decode text quickly, which ensures fluent reading.

Schmitt (2010, 67) suggested that vocabulary knowledge develops in an incremental nature, from zero knowledge to partial mastery and then to precise knowledge. Vocabulary knowledge increase with an increase in oral language exposure (Nelson and Stage 2007, 2). Thus, the larger and more sophisticated vocabulary knowledge becomes, the more it can support literacy practices. Hierarchical regression confirmed that vocabulary was the best longitudinal predictor of Northern Sotho spelling. To the researcher's knowledge, the impact of vocabulary knowledge on spelling development seems less investigated. Instead, vocabulary knowledge is shown to be related to other language domains such as grammar and phonology during language development and reading-related aspects (Gathercole and Baddeley 1993; Sénéchal et al. 2006). This might be attributed to the fact that definitions of vocabulary often encompass the spelling component as part and parcel of vocabulary knowledge (Haastrup and Henriksen 2000, 221). Haastrup and Henriksen (2000, 221) state that knowing a word include various kinds of linguistic knowledge ranging from pronunciation, spelling and morphology.

Findings in the NS LoLT group revealed that English vocabulary explained *17%* of the English spelling variance and *16%* of the variance in reading comprehension skills. However, Northern Sotho vocabulary did not predict any literacy skills in the NS LoLT group. In the English LoLT group, English vocabulary explained *22%* of the variance in English spelling and *45%* of the variance in reading comprehension skills. Northern Sotho vocabulary explained *22%* of the variance in Northern Sotho spelling performance. As was the case in the entire sample, Northern Sotho vocabulary was not supportive of Northern Sotho reading comprehension.

Overall the results suggested that vocabulary was a good predictor of English (spelling, reading comprehension) and Northern Sotho (spelling) abilities. This confirmed previous findings that have established an association between vocabulary knowledge and literacy abilities (Nelson and Stage 2007; Proctor et al. 2006; Wilsenach 2015). Wilsenach (2015) assessed receptive vocabulary size and early literacy skills (letter naming, knowledge of phoneme-grapheme correspondences and early writing) in emergent Northern Sotho-English bilingual children in Grade 1. The findings revealed that English receptive vocabulary significantly predicted all English literacy skills whilst Northern Sotho vocabulary predicted early writing and phoneme-grapheme correspondences. The present study's findings suggest that vocabulary knowledge (apart from phonological processing skill) is also a crucial component of literacy development in Northern Sotho-English bilingual children, but that good L1 vocabulary skills in itself will not guarantee reading development. Nevertheless, the findings emphasise the need for effective development of the learners' vocabulary skills to attain literacy success. Previous findings suggest that explicit vocabulary instruction methods improve learners' vocabulary knowledge and overall literacy abilities (Fukkin and deClopper 1998) – it is very likely that such explicit instruction is needed in the present research setting.

7.8 Summary of key findings

The relationship between cognitive-linguistic skills and literacy development

This study demonstrated that phonological processing skills are core contributors to early literacy success in Northern Sotho-English bilingual children. PA (blending, elision, sound matching) and RAN (RLN, RON RCN) consistently emerged as good predictors of English literacy skills from the beginning of Grade 2 to the end of Grade 3. Similarly, PA (blending, elision, sound matching), RAN (RLN, RON) and PWM (non-word repetition) consistently emerged as the good predictors of Northern Sotho literacy skills from the beginning of Grade 2 to the end of Grade 3. However, there were different relational patterns on the associations between phonological processing and literacy abilities. The type of task involved and the language assessed determined these relationships' predictive power at various points. Differences in the phonological and orthographic structures, as well as the LoLT of the learners, most likely contributed to these variations.

PA and RAN were the strongest predictors of literacy skills in both languages. PA and RAN are well established as having a major impact on literacy acquisition in alphabetic writing systems varying in orthographic consistency (Caravolas et al. 2012; Kirby et al. 2014, 5; Lonigan et al. 2009, 345; Vaessen and Blomert 2010; Ziegler et al. 2010a). The current findings also support studies indicating that RAN is a good second determinant of literacy development, accounting for a significant amount of variance in literacy abilities apart from PA (Manis et al.

2000; Parrila et al. 2004). Theoretically, this fits well within the conceptualisation of the double deficit theory, which ties RAN and PA components in explaining reading difficulties among children (Wolf and Bowers 1999). RAN is related to reading because skilled performance in both naming and reading depends, in part, on the rapid execution of the underlying processes (Kail et al. 1999). An alternative explanation is that processing speed may be an integral component of the RAN and literacy relationship (Kail and Hall 1994, 949; Georgiou et al. 2009, 531). Fast speed of processing implies that tasks are completed more rapidly, which is an integral component in time-allocated tasks.

The prediction pattern (Point 1, 2 and 3) of PA and RAN measures was consistent in both languages, indicating that PA and RAN taps a universal mechanism that is of similar relevance in learning to read, spell and write across alphabetic orthographies, irrespective of differences in their complexity (Landerl et al. 2019, 230). Only one language group (Northern Sotho LoLT) provided support for the role of PWM in literacy development, as shown by the results at Point 1 and 3. This predictive effect was noticeable between Northern Sotho non-word repetition and Northern Sotho letter knowledge as well as reading comprehension skills. It unclear why the non-word repetition failed to predict any other aspects of literacy in Northern Sotho, despite that learners seemingly performed better in the non-word repetition task. Previous research with Northern Sotho children also indicated that relations between PWM and literacy were non-significant (Wilsenach 2013) or very weak (Makaure 2016), but neither of these studies considered reading comprehension. The present findings implied that PWM is important in some aspects of literacy acquisition (it seems reading comprehension especially), but the effect was not as robust as for PA and RAN.

No support was found for the view that PWM is important for the development of early literacy abilities in English in this population. One possible explanation for the lack of a PWM contribution in literacy development is that this skill tends to be overshadowed by PA. Some have conceptualised PWM as a PA component rather than an independent phonological processing skill (Stanovich et al. 1984, 175). Other studies have linked PWM skills to vocabulary development rather than aspects of literacy skills (Bowey 2001, 441; de Abreu and Garthercole 2014, 11; Gathercole et al. 1991, 349), implying that the relationship between PWM and literacy may be secondary, mediated by a more direct link between PWM and vocabulary. This could also explain why PWM has a more reliable relationship with reading comprehension than with decoding. Another explanation is that the role of PWM skills in the literacy development of normally developing children has been overemphasized due to the significant relationship between poor PWM and reading in clinical populations such as children with developmental dyslexia and SLI (Claessen, Leitão, Kane and Williams 2013; Gathercole and Baddeley 1990; Ramus 2014). The present sample included, to the best of the researcher's knowledge, typically developing children. Finally, the result might be attributed to task-related factors. The English standardised tests used in this study might not be context-appropriate since they are designed for use in the L1 context; hence they can be difficult for learners in the L2 context. Thus, the finding that PWM did not predict English literacy development could have been caused by an interplay of several factors.

Overall, the present findings suggested that PA, RAN and vocabulary skills play a critical role in the development of literacy skills of children in the foundation phase. The causal link between PA and RAN and literacy outcomes resonates with the phonological processing model, which assumes that phonological processing is automatic and mandatory in literacy-related activities (Frost 1998, 76; Ham and Seidenberg 1999, 2). Children need adequate knowledge of the phonological structure of a language to ensure proper literacy acquisition. Studies indicated that children with sufficient phonological skills are more likely to have better-developed literacy skills (Wagner et al. 1997) than children with poor skills. These findings reiterate previous findings which provide evidence for phonological processing dominance in the development of various literacy skills of children at different levels (Antony and Lonigan 2004; Both-de Vries and Bus 2008; Castles and Coltheart 2004; Männel, Schaadt, Illner, van der Meer and Friederici 2017; Ozernov-Palchik, Wolf and Patel 2018, 355; Share 2004; Zhang and Roberts 2019). The findings (through path analysis, multiple regression and hierarchical regression) suggested that the relations between phonological processing and literacy skills were causal. This means that phonological processing skills are a pre-condition for effective literacy development in Northern Sotho-English bilingual children.

Importantly, the results revealed that phonological processing skills made an essential contribution to an array of literacy skills (letter knowledge, letter reading, early writing, word reading, fluent reading, reading comprehension, and spelling) assessed in Northern Sotho. Northern Sotho-English bilingual children can access the phonological route to decode, spell and write in their L1. Previous cross-sectional research with Northern Sotho-English bilingual children also established associations between phonological processing abilities and learning to read (Wilsenach 2013; 2019; Makaure 2016). This finding has also been confirmed in isiZulu (De Soussa and Broom 2011; De Soussa et al. 2010); isiXhosa (Diemer 2015), and Setswana (Lekgoko and Winskel 2008; Le Roux et al. 2016; Malda, Nel and van de Vijver 2014). Studies across many other African agglutinating languages, such as Herero (Vei and Everatt 2005) and Swahili (Alcock et al. 2010), support the notion that phonological skills are critical for literacy development. Thus, the present findings add to the existing knowledge of the role of phonological processing and literacy acquisition in African agglutinating languages. Learners in a shallow orthography depend more on phonological processing because of the direct and reliable phoneme-grapheme mappings (Katz and Frost 1992, 2; Mattingly 1992, 71). These findings emphasise the importance of appropriate early development of phonological processing in African languages, which will have a long-term, positive impact on literacy development.

Additionally, the findings established that apart from phonological processing, vocabulary skills explained unique variance in English (spelling, reading comprehension) and Northern Sotho (spelling) abilities. The finding builds on previous findings by Wilsenach (2015), who examined Northern-English bilingual children on similar receptive vocabulary measures. This finding emphasises the need for effective development of the learners' vocabulary for adequate literacy development. Hence, targeted vocabulary knowledge instruction, as explained in Wilsenach (2015, 7), is recommended, so that vocabulary development in both the L1 and L2 is stimulated in South African classrooms as early as possible. Although language development is expected to develop naturally (Astuti 2015, 397), direct and targeted instruction is also necessary for enhancing oral language skills (National Early Literacy Panel 2009, 33).

PA and linguistic grain sizes

The results indicated that Northern Sotho-English bilingual children were better at manipulating words at the syllable level relative to the phoneme level, indicating that the syllable may be a more salient grain size in Northern Sotho. The results suggested that children were probably using only one linguistic grain size to facilitate reading in both Northern Sotho and English languages, as phoneme awareness was very weak in both languages. The results provided support for the developmental perspective of PA, which suggests that large linguistic units are acquired first before smaller units (Paige et al. 2018, 2). Notably, phoneme awareness was a better predictor of literacy outcomes than syllable awareness in both languages. Thus, although awareness to this grain size did not develop automatically in the present sample (despite the simplistic phonological structure and the transparent orthography), an understanding that a word in Northern Sotho can be broken down to its constituent phonemes is crucial for successful decoding. Contrary to the psycholinguistic grain size theory, learners did not seem to use the smallest possible unit available. This highlights the importance of providing explicit instruction at the phoneme level, as young learners seem unable to break down syllables into phonemes automatically.

Transfer of cognitive-linguistic skills

The findings provided evidence of cross-linguistic transfer of cognitive-linguistic skills (phonological and vocabulary) in Northern Sotho-English bilingual children. This finding was bidirectional, implying that learners were using their L1 skills to enhance L2 skills development and vice versa. PA was the strongest cross-linguistic predictor of literacy skills across Northern Sotho and English languages. Interestingly, Northern Sotho skills (non-word repetition and RON) uniquely predicted literacy skills in the English language. These findings support the linguistic interdependence hypothesis and the central processing hypothesis, which emphasise the universal transfer of skills across languages despite the structural differences. Adequate development of each of the bilingual learners' languages is crucial so that learners can use acquired skills in each of their languages to aid literacy development in another.

Group differences in phonological processing and literacy performance of Northern Sotho-English bilingual children.

As predicted, there were performance differences between the two instructional groups on various phonological and literacy tasks at each of the measuring points. At Point 1, there were almost no significant differences, so it seemed as if the medium of instruction didn't really affect children's performance in the two languages. By Point 2, the English LoLT group performed better on English measures, and the NS group performed better on NS measures (for the most part), suggesting that only by the end of Grade 2, an effect appears for the LoLT. The results suggested that phonological and literacy acquisition in bilingual children takes place regardless of the LoLT used. Therefore, it may be irrelevant to consider whether the language of learning should be confined to either the L1 or an additional language (Ford 2005, 1). The critical goal should be to develop an academic language, to enable the learners to engage meaningfully with the content and subject matter across the curriculum at all stages of the learning process (Jordaan 2011, 79).

Literacy progress in the orthographically more transparent language

The findings at Point 1 indicated that irrespective of the LoLT, the two groups of Northern Sotho bilingual children were able to respond to tasks in both languages to some degree. Overall, the results suggested no significant mother tongue advantages in the development of cognitive-linguistic and literacy skills of learners. Theoretically, cognitive-linguistic skills develop faster in an orthographically more transparent language like Northern Sotho. This mother-tongue advantage should theoretically occur regardless of whether the instruction occurs in the mother tongue or an L2 (Seymour et al. 2003, 430; Ziegler and Goswami 2005, 10). Instructional factors may be a major factor for the lack of any significant advantages of mother-tongue instruction in the present context. According to Pretorius and Spaull (2016), much of the instructional practices in South African classrooms are borrowed from English teaching methodologies. This approach, however, may be ineffective as it disregards the language-specific aspects of African agglutinating languages. Effective instructional practices that consider the linguistic properties of the Northern language are needed for adequate literacy acquisition.

The developmental nature of phonological and literacy skills

Findings revealed that children's performance significantly improved in various phonological processing and literacy tasks in both languages. Overall, Northern Sotho-English bilingual children made progress on most phonological and literacy tasks in Northern Sotho and English languages. However, there were a few tasks in which their performance digressed overtime. Children were still relying on phonological processing skills to inform their literacy practices by the end of Grade 3. The findings support the developmental models which suggest that phonological processing changes with literacy skills such that it becomes more critical with increasing age and literacy expertise (Booth et al. 1999, 4; Chace et al. 2005, 209; Perfetti and Hart 2002, 68; Stuart and Masterson 1992, 168; van Orden 1987, 181).

7.9 Limitations and recommendations for future research

This study has made significant advances in understanding the critical phonological processing predictors of literacy development in Northern Sotho-English bilingual children. However, the study is not without limitations. Firstly, the study was limited to one research setting and data were obtained from only two schools; and given this, the results should not be generalised to other populations of learners. Secondly, due to constraints that resulted from the COVID-19 pandemic, it was impossible to conduct research in schools between April and November of 2020. For this reason, the researcher was unable to include phonological processing measures at Point 3 as originally intended, as it was impossible to conduct individual learner assessments. Instead, the researcher measured literacy outcomes that could be conducted in-class with groups of learners. This means that early phonological processing measures administered at the beginning of Grade 2 were utilised only to predict future literacy performance (spelling and reading comprehension) at the end of Grade 3. Although this design is not unique in longitudinal studies, the researcher was restricted in establishing the developmental nature of phonological processing from the beginning of Grade 2 to the end of Grade 3. This was critical in order to establish how the learners had progressed over a longer period of time on the phonological processing tasks in both Northern Sotho and English languages.

The researcher also acknowledges it would have been helpful to include Grade R and early Grade 1 learners as part of this study, in order to track the developmental progression of skills that are fundamental for literacy acquisition (e.g phoneme awareness). However, this was beyond the scope of this study and could not be implemented due to the time frame and limited resources. Future research efforts on phonological processing and literacy development could implement a longitudinal approach that follows students from grade R, across first, second grade, and possibly beyond. Some developmental views on phonological processing suggest that these skills are time-limited and are critical up to a particular stage (de Jong and van der Leij 1999; de Jong and van der Leij 2002, 51; Scarborough et al. 1998, 115; 450), after which other skills (i.e. orthographic processing) are crucial for literacy. Theories of learning to read typically posit a developmental change, from early reader's reliance on phonology to direct reliance on orthographic-semantic links (Frost 1998, 71). Some, however, argue that children do not stop processing phonology, but rather the nature of processing changes with skilled reading (Milledge and Blythe 2019, 1). Longitudinal research that goes beyond the second and third grade is, therefore, crucial to establish the nature of phonological processing skills in older Northern Sotho-English bilingual children. Previous studies that have examined the nature of this relationship in the Northern Sotho linguistic group have focused on the foundation phase (i.e. grade one to three) (Makaure 2016; Wilsenach 2013; 2016; 2019). Hence, future research must also capture the nature of this relationship beyond the foundation phase grades.

Another limitation concerns the cross-linguistic adaptability of measures. Although all efforts were made to create identical tests, cross-linguistic differences made this impossible for some measurements. For instance, some phonological measures (i.e. RCN and RDN) could not be adapted in Northern Sotho. The RDN task was unadaptable due to the complexity of the Northern Sotho digits. Adapting the CTOPP RDN task in Northern Sotho would make the task cognitively more demanding than the English counterpart, considering that the task requires rapid manipulation of items. The CTOPP RCN task was also not included in Northern Sotho, since it was evident from the pilot study that learners were not familiar with the colour codes in the Northern Sotho language. Additionally, although some English measures were adapted to Northern Sotho, it is unclear whether these measures were at the same cognitive demanding level as the English measures. Hence, cross-linguistic comparisons must be treated with caution. There is a need for standardised Northern Sotho assessments as well as context-appropriate English measures to make ideal cross-linguistic comparisons. The researcher also acknowledges that there was greater variability in the number of test items for some Northern Sotho and English tasks. For example, the CTOPP blending task for English had 33 items, while Northern Sotho had 15 items. Many items had to be included for the English CTOPP items, given the fact that the items were made in a standardised format. However, it was anticipated that many learners were unlikely to reach the ceiling on those test items (e.g. the range for English blending was 19 at Point 1 and 21 at Point 2). Hence in our development of Northern Sotho tasks, it was not deemed necessary to add many items. However, future researches must try and ensure uniformity in terms of the number of items included in a task, considering that this could have affected the comparability of results across the two languages.

The researcher acknowledges that there are other factors closely related to literacy development that could potentially explain some of the results presented here. These include socio-economic factors, home environment, classroom teaching style, and level of parental involvement. However, it was beyond the scope of this study to assess these potential contributing factors. Future research in this area should consider these aspects to establish their contribution to children's overall literacy-related success. This study also focused on PA development only at the syllable and phoneme level. It is recommended that future research should also consider employing additional measures (i.e. word, onset/rimes), to capture the development of PA at various levels in the Northern Sotho language. It would be worthwhile for future research to assess PA's development at various levels in Northern Sotho to examine the role that these linguistic units play in literacy development in Northern Sotho.

A final limitation in this study concerns the changing of early writing instruments between Point 1 and 2 measuring points. Although this was done in order to avoid ceiling effects on the name writing task, this affected the interpretation of data to a certain extent. Importantly, however, CFA at Point 1 and 2 confirmed that the two instruments were measuring the same construct, but it is necessary for future researchers to first assess the implications of introducing a new testing instrument in cases where participants have to be compared on performance at several points.

7.10 Practical implications of the study

This study focused on the associations between phonological processing and a wide spectrum of literacy skills (letter knowledge, letter reading, word reading, fluent reading, reading comprehension, early writing and spelling) in Northern Sotho-English bilingual children. This study is the first to explore the long-term phonological predictors of literacy in Northern Sotho-English bilingual children. Previous research on the associations between phonological processing and literacy skills in the Northern Sotho linguistic group were cross-sectional and focused only on the reading aspect of literacy. This study established that phonological processing skills are critical in explaining children’s varying performance in literacy abilities across different levels of development. This study replicates and extends existing research on the development of cognitive-linguistic skills in Northern Sotho children. The results of the current study build on previous cross-sectional studies (Wilsenach 2013, 2015, 2018; Makaure 2016) comparing Northern Sotho-English bilingual children on a battery of phonological and literacy measures.

The findings demonstrated that skills related to both PA, RAN and PWM are essential areas to consider when designing literacy methodology and instructional practices for all school-age children. As suggested by De Vos et al. (2014, 23) a detailed investigation of the cognitive-linguistic skills involved in literacy in African languages is key towards informing language-specific literacy pedagogies and developing appropriate resources for teaching and learning. Phonological processing (as well as vocabulary knowledge, amongst others) is one critical cognitive-linguistic component that needs to be understood towards establishing language-specific pedagogies.

The phonological processing model is a good foundation for understanding a range of cognitive-linguistic skills facilitating literacy development in Northern Sotho-English bilingual children. It is vital that language professionals develop comprehensive phonological processing assessment tools, consisting of standardised tasks for all the official languages taught in South Africa. The phonological assessment kit must stipulate the uniform assessment criteria for all the languages. Specifically, with regards to this study, there is a need to develop context-appropriate Northern Sotho teaching and learning methods that take into account the linguistic structures of the language. Northern Sotho, CAPS documents, for instance, are translated directly from English (i.e. following the English language specifications). Although this approach establishes some form of standardisation (Madiba 2013, 25), it is not necessarily the best way of teaching literacy, given the linguistic differences between the two languages (Probert 2019, 2). Therefore, appropriate teaching instructional material has to be developed, considering the language-specific aspects of Northern Sotho. Correcting and designing these teaching and learning methods according to Northern Sotho language specifications is the first step towards ensuring adequate literacy instruction.

The researcher recommends that the results of phonological processing skills as significant predictors of early literacy success, in this study and other studies, be implemented in the education policies and literacy instruction practices. The development of phonological processing skills (amongst other critical skills) must be the focal point in the school curriculum. Although this skill is assumed to develop naturally with language development (Bowey 1996, 76), targeted instruction is necessary for adequate growth. Teachable aspects of phonological processing (i.e. phoneme-grapheme links, syllable awareness, phoneme awareness, onset-rime awareness) must be directly and explicitly taught in the classrooms. PWM aspects can be stimulated by playing rhyming games, teaching paraphrasing, summarising and rehearsal techniques, as well as the use of concrete examples (Montgomery 2008, 228). Flashcard activities, poem recital, singing of short songs, quick word retrieval games (i.e. pictionary board games, charades) and timed passage readings can be employed to improve RAN (Nordman 2017,1). Classroom activities must be centred on establishing the phonological building blocks of literacy. The goal of stimulating these skills is to build a stable phonological system from which children can base their literacy (Ham and Seidenberg 1999, 2).

The phonological linkage hypothesis emphasises the importance of coupling explicit phonology teaching with phonics instruction for successful literacy acquisition (Hatcher, Hulme and Ellis 1994; Hatcher, Hulme and Snowling 2004). This instructional approach does not seem to be a reality in South African classrooms where the primary focus is on phonics instruction (DoE 2008a, 12-13; DoE 2008b, 8). Hatcher et al. (1994) argued that spending time concentrating on either component in isolation is less effective. Recent research has shown that teaching the essential building blocks of literacy (i.e. phonological processing skills) seems to be a neglected component in South African classrooms (Le Roux et al. 2017, 7). Northern Sotho learners, therefore, require adequate phonological training (i.e. apart from phonics training), which will stimulate sufficient literacy acquisition in both Northern Sotho and English languages.

Moreover, this study adds to the existing findings of Wilsenach (2019), supporting the developmental trajectory of phonological sensitivity skills from large to smaller linguistic units in Northern Sotho-English bilingual children. Hence, there is a need to emphasise the PA pillars (particularly phoneme awareness) of literacy development in South African classrooms. According to Probert (2019, 11) an understanding of literacy in the Southern Bantu languages should consider the linguistic processing units that underpin literacy acquisition in these languages. Phoneme awareness entails the ability to segment and combine linguistic units into words (Anthony et al. 2002, 67), and it is the most challenging level of PA. Yet, it is one of the strongest predictors of literacy (Hoien et al. 1995, 171). As such, this skill does not develop spontaneously, and explicit literacy instruction is necessary for its stimulation (Treiman and Zukowski 1996, 193). As previously emphasised by Wilsenach (2019, 8) phoneme focused instruction is required in the Northern Sotho linguistic group to ensure adequate literacy gains.

Similarly, an intensive syllable-based approach is likely to also support Northern Sotho literacy development language. According to Trudell and Schroeder (2007, 12) African agglutinating language tend to have unusually complex syllable structures, particularly in their onsets. This feature is also prominent in Northern Sotho on the word onset, *'hlw' (hlwago), 'mpšh' (mphše), 'ntshw'* (*ntshwarele*); word middle *'nny' (monnyane), 'tlw' (ditlwaelo), 'ntlh' (dintlha) 'tshw' (matshwenyego)*, and word-final *'nth' (anthe), ntšh (bantšhi), 'ntšw' (fentšwe)*. Although literacy instruction in the South African language classroom is syllable oriented (de Vos et al. 2014, 16) it seems such a practice is rote learning based where learners have to recite syllable strings like *kga, kge, kgi, kgo, kgu*. Learners need more direct, focused instruction that goes beyond syllable-based drills on how to manipulate these complex letter strings. For instance, Northern Sotho learners can be taught to understand complex strings such as '*ntšh'* in the context of other similar letter strings *'ntšw'* and '*ntšhw'.* This setting allows learners to understand different syllable constituencies. Additionally, syllable strings that appear word-initially, middle and final should be systematically targeted (Trudell and Schroeder 2007, 12). For instance, Northern Sotho syllables such as *'tša'* take these three positions as in *tšama* (walk)*, fetšago* (who/which complete)*, fetša* (finish, complete). Learners need to be made aware of the different word positions where each syllable occurs.

To restate, PA instruction should be made a core component of the curriculum, taking into cognisance the linguistic-specific differences of each language, for effective literacy acquisition and literacy methodologies should consider the phonological and orthographic differences between Northern Sotho and English in order to facilitate literacy development.

7.11 Conclusion

The issue of low literacy abilities is a major concern in Africa at large (UNESCO Institute of Statistics 2016) and in South Africa specifically. The current state of affairs is caused by an interplay of various factors, including cognitive-linguistic development, socio-economic status, environmental/educational and individual factors (Pretorius and Mampuru 2007). As such, many factors have to be taken into consideration in literacy acquisition. From a cognitive-linguistic perspective, literacy development is a complex process involving many cognitive and linguistic abilities (i.e. vocabulary, morphological, orthographical, syntactic, semantic and phonological) knowledge (Antilla 2013, 9; Awramiuk 2014, 114; Catts and Kamhi 1987, 67; Verhoeven et al. 2011, 388).

This study particularly emphasised the critical role of cognitive-linguistic skills, particularly phonological processing and vocabulary (to some extent) in literacy development. The role of phonological processing is assumed to be automatic and mandatory in literacy-related activities (Frost 1998, 76). The primary claim of the phonological model is that all writing systems are naturally phonological (Mattingly 1992, 11; Frost 1998, 89) and that children bring considerable knowledge of the phonological structure of a language to the literacy acquisition task (Ham and Seidenberg 1999, 2). Children with adequate phonological processing skills are assumed to have better-developed literacy skills. Many children experience difficulties in the early stages of literacy acquisition which become a barrier to learning (Lane, Pullen, Eisele and Jordan 2002, 101). Hence, teachers of the foundation phase must appreciate the importance of phonological skills and incorporate these skills into the teaching and learning activities to aid early literacy success. The most fundamental requirement in early literacy development is to develop a high level, organised brain system, which can effectively integrate various cognitive and linguistic processes critical for future literacy success (Kastamoniti et al. 2018, 281).

Importantly, the study identified the long-term phonological predictors of literacy development in the Northern Sotho language. This finding is an essential step towards establishing appropriate teaching methodologies in the Northern Sotho language. According to De Vos et al. (2014, 23) an understanding of the cognitive-linguistic skills involved in literacy development in African languages is vital for establishing language-specific literacy norms and developing appropriate literacy instructional material. Pretorius (2017) reiterates that the inappropriate application of literacy instructional practices in linguistic contexts for which they were not originally intended poses risks in literacy acquisition. The study also provides an insight into how the phonological and orthographic differences in Northern Sotho and English languages affect the developmental trajectory of literacy in the different languages. The implication is that language-specific phonological and orthographic features must be considered in literacy instructional practices. Education policymakers, curriculum developers and regulators need to ensure that recommendations from various studies are evaluated and put into effect.

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APPENDIX A: PARENT'S CONSENT FORM-NORTHERN SOTHO

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.............................2019

Motswadi/Mohlokomedi yo a rategago
Yunibesithi ya Afrika Borwa e tlile go šoma le baithuti ba Kereiti ya, 2 le 3 mo Sekolong sa Poraemari sa Pathogeng le Bathokwa go ithuta go gontši ka ga polelo le ka ga go bala ga bana ba bannyane. Ngwana wa gago le yena a ka no tšea karolo mo go protšeke ye. Mošomo wo o dirwago ke yunibesithi o ka se ke wa kweša ngwana wa gago bohloko eupša o tla huetša tšwelopele mo mošomong wa ngwana wa sekolo. Boitsebišo bja ngwana wa gago bo tla swarwa sephiri ge mošomo wo o tšwago mo protšekeng ye o ahlaahlwa mo foramong efe goba efe.

O kgopelwa go tlatša le go bušetša lengwalo le go morutiši wa ngwana wa gago.

Ke a leboga!
Ka tlhompho
Patricia Makaure
(Researcher)

Nna, motswadi/mohlokomedi wa____
(tlatša leina la ngwana mo sekgobeng se sa ka godimo)

Ka fao ke fa tokelo ya gore ngwana wa ka a ka tšea karolo mo go thuto ya UNISA.

____________________________ __________________________
Tshaeno ka Motswadi/Mohlokomedi Letšatšikgwedi

APPENDIX B: PARENT'S CONSENT FORM-ENGLISH

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Dear Parent/Caregiver
The University of South Africa will be working with Grade 2 and 3 learners in Bathokwa and Patogeng Primary School to learn more about language and literacy in young children. Your child can also participate in this project. The work done by the university will not harm your child and will not influence your child's progress in school. Your child's identity will be kept confidential if work from this project is discussed in any forum.
Please complete and return this letter to your child's teacher.
Thank you!

Kind regards
Patricia Makaure
(Researcher)

I, parent/caregiver of ____

(fill in child's name in above space)

hereby give permission that my child can participate in the UNISA study.

________________________________ ____________________________

Signature of Parent/Caregiver Date

APPENDIX C: LETTER TO THE PRINCIPALS

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Attention: School Principal

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN SCHOOL

My name is Patricia Makaure, and I am a PhD student at the University of South Africa. I wish to conduct research for my Doctoral thesis on the role of phonological processing skills (i.e. phonological awareness, phonological working memory and rapid automatised naming) in the early literacy development (i.e. letter knowledge, word recognition, fluent reading, reading comprehension, writing and spelling) of Northern Sotho-English bilingual children. The study is a longitudinal project and it will be conducted over a period of three years. In 2019, I want to focus on the grade 2 learners, and those same learners will then be assessed again in Grade 3 (2020). The assessments will always take place in the first and third term of the school year, and the participating learners will be assessed during two 30-minute sessions. The project will be carried out under the supervision of Professor Carien Wilsenach, of the University of South Africa.

I am hereby seeking your consent to conduct the research (data collection) at your school. I have provided you with a copy of my thesis research proposal, as well as copies of my ethical clearance letters, which contains more information about the study. If you require any further information, please do not hesitate to contact me at 082 796 5256, or **53669703@mylife.unisa.ac.za** or my supervisor Professor Carien Wilsenach at +27-12-429 6045, or **wilseac@unisa.ac.za**. Thank you for your time and consideration in this matter.

Yours sincerely,
Patricia Makaure
University of South Africa

APPENDIX D: UNISA ETHICAL APPROVAL CERTIFICATE

UNISA university of south africa

COLLEGE OF HUMAN SCIENCES RESEARCH ETHICS REVIEW COMMITTEE

17 September 2018

Dear Zvinaiye Patricia Makaure

NHREC Registration # : Rec-240816-052
CREC Reference # : 2018-CHS-0048
Name : Zvinaiye Patricia Makaure
Student #: 53869703

Decision:
Ethics Approval from 17 September 2018 to 16 September 2023

Researcher(s): Zvinaiye Patricia Makaure

Supervisor(s): Prof Carien Wilsenach

Department of Linguistics and Modern Languages

0124296045

The contribution of phonological processing skills to early literacy development in northern sotho-english bilingual children- a longitudinal investigation.

Qualifications: PhD (Linguistics)

Thank you for the application for research ethics clearance by the Unisa College of Human Sciences Research Ethics Committee for the above mentioned research. Ethics approval is granted for one year.

The ***low risk application*** was ***reviewed and* expedited** by the Chair of College of Human Sciences Research Ethics Committee on the 24 August 2018 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the Department of Psychology Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No field work activities may continue after the expiry date (**16 September 2023**). Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:
The reference number **2018-CHS-0048** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Signature :

Dr Suryakanthie Chetty
Deputy Chair : CREC
E-mail: chetts@unisa.ac.za
Tel: (012) 429-6267

Signature :

Professor A Phillips
Executive Dean : CHS
E-mail: Phillap@unisa.ac.za
Tel: (012) 429-6825

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APPENDIX E: DOE ETHICAL CLEARANCE CERTIFICATES

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE AMENDED RESEARCH APPROVAL LETTER

Date:	21 November 2018
Validity of Research Approval:	04 February 2019 – 30 September 2019 2018/25AA
Name of Researcher:	Makaure Z.P, Wilsenach C, Matlala M, Phahlamohlaka L.E
Address of Researcher:	82 The Image One
	Akkedis Street, Glen Marais
	Kempton Park, 1619
Telephone Number:	082 796 5256
Email address:	53669703@mylife.ac.za
Research Topic:	The contribution of phonological processing skills to early literacy development of Northern Sotho-English bilingual children– a longitudinal investigation.
Type of Degree:	PhD in Linguistics
Number and type of schools:	Two Primary Schools
District/s/HO	Tshwane South

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

21/11/2018

1

Making education a societal priority

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.

2. The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.
3. A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.
4. A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.
5. The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
6. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
7. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.
8. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
9. It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.
10. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
11. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
12. On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.
13. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.
14. Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

....

Mrs Gumani Enos Mukatuni
Acting CES: Education Research and Knowledge Management

DATE: 21/11/2018

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
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Website: www.education.gpg.gov.za

GAUTENG PROVINCE

Department: Education

REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE AMENDED RESEARCH APPROVAL LETTER

Date:	**16 October 2019**
Validity of Research Approval:	**10 February 2020 – 30 September 2020** **2018/25AAA**
Name of Researcher:	**Makaure Z. P**
Address of Researcher:	**82 The Image One, Akkedis Street**
	Glen Marais
	Kempton Park, 1619
Telephone Number:	**082 796 5256**
Email address:	**53669703@mylife.ac.za**
Research Topic:	**The contribution of phonological processing skills to early literacy development of Northern Sotho-English bilingual children– a longitudinal investigation.**
Type of qualification	**PhD in Linguistics**
Number and type of schools:	**Two Primary Schools**
District/s/HO	**Tshwane South**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

17/10/2019

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

1. Letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.
2. The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.
3. A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.
4. A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.
5. The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
6. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
7. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.
8. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
9. It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.
10. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
11. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
12. On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.
13. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.
14. Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

....

Mr Gumani Mukatuni
Acting CES: Education Research and Knowledge Management

DATE: 17/10/2019

Office of the Director: Education Research and Knowledge Management
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APPENDIX F: NORTHERN SOTHO TEST ITEMS

1. Northern Sotho sound matching task

Practice items

Item	Correct Response	Score
Ke seswantšho sefe seo leina la sona le thomago ka modumo wa /d/, bjalo ka dinku? dinta goba thapo?	dinta	
Ke seswantšho sefe seo leina la sona le thomago ka modumo wa /p/, bjalo ka pudi? kefa; nnete goba pane?	pane	

Test Items

	Item	Correct Response	Score
1	Ke lentšu lefe leo le thomago ka modumo wa go swana le katse? tonki; kefa goba puku?	kefa	
2	Ke lentšu lefe leo le thomago ka modumo wa go swana le pitša? maswi; ngaka goba pudi ?	pudi	
3	Ke lentšu lefe leo le thomago ka modumo wa go swana le sekolo? phênsêle ; leoto goba sekele?	sekele	
4	Ke lentšu lefe leo le thomago ka modumo wa go swana le letšatši? kolobe; lebati goba sesepe?	lebati	
5	Ke lentšu lefe leo le thomago ka modumo wa go swana le borokgo? malao; borôthô goba mokotla?	borôthô	
6	Ke lentšu lefe leo le felelago ka modumo wa go swana le kgomo? pane; tonki goba mollo?	mollo	
7	Ke lentšu lefe leo le felelago ka modumo wa go swana le ngaka? kefa; pitsi goba tonki?	kefa	
8	Ke lentšu lefe leo le felelago ka modumo wa go swana le kereke? kepisi ; selepe goba setulo?	selepe	
9	Ke lentšu lefe leo le felelago ka modumo wa go swana le mphaka? phênsêle; foroko goba tafola?	tafola	
10	Ke lentšu lefe leo le felelago ka modumo wa go swana le naledi? letamo; pampiri goba malao?	pampiri	

2. Northern Sotho blending task

Practice Items

Item	Word	Correct Response	Score
Na medumo ye e bopa lentšu lefe?	ba-na	bana	
Na medumo ye e bopa lentšu lefe?	ra-ta	rata	

Test Items

	Item	Word	Correct Response	Score
1	Na medumo ye e bopa lentšu lefe?	se-ko-lo	sekolo	
2	Na medumo ye e bopa lentšu lefe?	mo-se-se	mosese	
3	Na medumo ye e bopa lentšu lefe?	le-bo-ne	lebone	
4	Na medumo ye e bopa lentšu lefe?	di-ra	dira	
5	Na medumo ye e bopa lentšu lefe?	yo-na	yona	
6	Na medumo ye e bopa lentšu lefe?	ra-ta	rata	
7	Na medumo ye e bopa lentšu lefe?	p-o-s-o	poso	
8	Na medumo ye e bopa lentšu lefe?	s-e-n-a	sena	
9	Na medumo ye e bopa lentšu lefe?	m-e-n-o	meno	
10	Na medumo ye e bopa lentšu lefe?	l-a	la	
11	Na medumo ye e bopa lentšu lefe?	f-a	fa	
12	Na medumo ye e bopa lentšu lefe?	e-la	ela	
13	Na medumo ye e bopa lentšu lefe?	e-ta	eta	
14	Na medumo ye e bopa lentšu lefe?	i-ma	ima	
15	Na medumo ye e bopa lentšu lefe?	e-pa	epa	

3. Northern Sotho elision task

Derived from Wilsenach (2013) and Pretorius and Mampuru (2007).

Practice Items

Item			Correct response	Score
Say	bana	Now say it again but don't say /ba/	-na	

Test items

	Item			Score
1	Bolela lentšu le	Raga	Bjale le boeletše, efela she bolele /ra/	
2	Bolela lentšu le	Bolo	Bjale le boeletše, efela she bolele /lo/	
3	Bolela lentšu le	Bolelo	Bjale le boeletše, efela she bolele /bo/	
4	Bolela lentšu le	Gabotse	Bjale le boeletše, efela she bolele /ga/	
5	Bolela lentšu le	Morago	Bjale le boeletše, efela she bolele /go/	
6	Bolela lentšu le	Batswadi	Bjale le boeletše, efela she bolele /di/	
7	Bolela lentšu le	Borena	Bjale le boeletše, efela she bolele /na/	
8	Bolela lentšu le	Fetola	Bjale le boeletše, efela she bolele /la/	
9	Bolela lentšu le	Polelo	Bjale le boeletše, efela she bolele /le/	
10	Bolela lentšu le	Basadi	Bjale le boeletše, efela she bolele /sa/	
11	Bolela lentšu le	Garafo	Bjale le boeletše, efela she bolele /ra/	
12	Bolela lentšu le	Bana	Bjale le boeletše, efela she bolele /b/	
13	Bolela lentšu le	Wena	Bjale le boeletše, efela she bolele /w/	
14	Bolela lentšu le	Dira	Bjale le boeletše, efela she bolele /d/	
15	Bolela lentšu le	Yena	Bjale le boeletše, efela she bolele /y/	

16	Bolela lentšu le	Bona	Bjale le boeletše, efela she bolele /b/	
17	Bolela lentšu le	Bofe	Bjale le boeletše, efela she bolele /e/	
18	Bolela lentšu le	Gauta	Bjale le boeletše, efela she bolele /u/	
19	Bolela lentšu le	Taolo	Bjale le boeletše, efela she bolele /a/	
20	Bolela lentšu le	Seabe	Bjale le boeletše, efela she bolele /a/	

4. Northern Sotho digit span task

(Adapted from the CTOPP (Wagner, Torgesen and Rashotte's 1999)

Practice Items

Item			Score
šupa	pedi		
tee	hlano	tharo	

Test Items

Item								
1	tee	tshela						
2	šupa	pêdi						
3	seswai	nne						
4	hlano	pêdi	tee					
5	tshela	nne	seswai					
6	šupa	tharo	tshela					
7	hlano	tharo	tee	seswai				
8	tharo	šupa	nne	tee				
9	šupa	hlano	tshela	pêdi				
10	nne	tee	seswai	tharo	pêdi			
11	tshela	tharo	pêdi	hlano	seswai			
12	tee	pêdi	nne	seswai	tharo			
13	seswai	nne	tshela	šupa	tee	tharo		
14	tshela	tee	pêdi	seswai	nne	šupa		
15	nne	tharo	seswai	hlano	šupa	pêdi		
16	tharo	tee	pêdi	šupa	nne	hlano	tshela	
17	tee	pêdi	hlano	nne	tshela	tharo	seswai	
18	šupa	tee	nne	hlano	pêdi	seswai	tharo	
19	nne	tshela	tharo	hlano	seswai	pêdi	šupa	tee

20	seswai	šupa	nne	tee	pêdi	hlano	tharo	tshela
21	nne	pêdi	tharo	šupa	tee	seswai	tshela	hlano

5. Northern Sotho non-word repetition

(Derived from Wilsenach, 2013).

Practice Items

	Item	Score
1.	Talo	
2.	Nola	
3	Kalu	

Test Items

Two-syllable words	**Three-syllable words**	**Four-syllable words**	**Five-syllable words**	**Six-syllable words**	**Seven-syllable words**
Miša	Mibogo	Sêpokari	Nesodiwakô	Môgisirolêtha	Narulongwakhubasi
Tlapo	Pšagodi	Ntômbuwêka	Môrigatsedi	Kuratshifodiri	Nôrakulêswibisi
Tšhupeng	Tšhuphika	Hlatôyani	Bosithirangwê	Tshuphihlosakêlu	Bjaratsiphobatshwera

5. Northern Sotho letter naming

(*Derived from Early Grade Reading Study 2018*)

Example chart

o	l	a	e	t	b

Test Items

o	t	a	e	b	l	t	o	l
b	a	e	l	b	t	a	e	o
t	b	l	o	e	a	t	l	e
b	a	o	e	l	b	o	t	a

6. Northern Sotho rapid object naming

(*Adapted from Early Grade Reading Study 2018*)

Practice Items

Setulo	Kolobe	Tafola
Mpša	Puku	Lesedi

Test Items

Lesedi	Mpša	Tafola	Setulo	Kolobe	Puku	Mpša	Lesedi	Puku
Kolobe	Tafola	Setulo	Puku	Kolobe	Mpša	Tafole	Setulo	Lesedi
Mpša	Kolobe	Puku	Lesedi	Setulo	Tafola	Mpša	Puku	Setulo
Kolobe	Tafola	Lesedi	Setulo	Puku	Kolobe	Lesedi	Mpša	Puku

7. Northern Sotho letter knowledge task

B	K	o	P	g
F	m	I	U	E
ng	ts	kg	ngw	tlw

8. Letter/Sound reading

(*Adapted from Early Grade Reading Study 2018*)

Practice Items	b	M	s	F

Test Items

m	l	h	g	S	y	r	W	L	n
f	k	T	D	a	t	s	d	N	w
H	ng	o	U	ny	š	tl	kh	B	u
K	sw	J	ts	kg	G	R	ngw	e	rw
th	N	gw	l	ph	Y	F	nts	W	E
y	tš	A	ph	M	lw	O	tlw	ny	P
thw	oo	a	tlh	f	kw	tšh	u	A	t
W	kg	H	L	b	tl	ngw	m	nw	U
R	o	kw	aa	tšh	N	E	ng	p	m
G	K	B	D	tshw	y	b	n	R	tlh
e	M	W	tshw	r	nts	h	g	S	y

8. Northern Sotho word reading task

Practice Items	abo	yena	bina

Word reading test items

eta	efa	motho	batswadi
nne	seo	bina	thapelo
kga	bona	hlapa	bošego
gae	pitsi	fela	lebala
ntlo	rena	maswi	meetse

10. Northern Sotho text reading

The text was selected from a children‘s Northern Sotho grade two graded reader *Ngwana yo moswa*, and is published by New Readers Publishers (Brain and Rankin 2002).

11. Northern Sotho spelling test items

1. Ema	6. Sepela
2. Bana	7. Befetšwe
3. Hlapi	8. Sekolong
4. Taelo	9. Hlokomela
5. Kgona	10. Mošemane

12. Northern Sotho reading comprehension

Derived from DBE Annual National Assessments (2014)

Ditaelo: Bala kanegelo gomme o arabe dipotšišo tše di latelago

(Read this paragraph and answer the following questions).

"Ke nyorilwe," Tšhošwane ya bolelela godimo.

"O reng o sa nwe meetse kua nokeng?" gwa kuruetša Leeba le le kgauswi le mohlare kua sethokgweng. "Hlokomela o se wele ka gare."

Tšhošwane e ile ya kitimela nokeng go nwa meetse. Ka potlako go ile gwa tšubutla moya gomme wa wišetša Tšhošwane ka gare ga meetse.

"Thušang!" gwa goelela Tšhošwane. "Ke kgangwa ke meetse!" Leeba le ile la nagana ka pela gore le phološe Tšhošwane. Leeba le ile la roba kala ya mohlare. La fofela ka nokeng la lahlela kala ka meetseng. Tšhošwane ya namela kala ya tšwa ka meetseng e bolokegile.

Ka morago ga matšatši a mabedi Tšhošwane e ile ya bona motsomi a bea molaba wa go tanya Leeba. Tšhošwane e ile ya nagana ka pela gore e phološe Leeba, ya namela leotong la motsomi ya mo loma kokoilane.

"Ijoo!" gwa goelela motsomi. Leeba le rile go kwa gore motsomi o a goelela la fofela godimo ga mohlare go yo iphihla.

[E tsopotšwe go tšwa kanegelong ya nnete ya anegwa ke Ann McGovern]

Di*potšišo:*

1. Ngwala hlogo ya kanegelo

……………………………………………………………………………………

2. Ageletša tlhaka ye e lebanego le karabo ye e nepagetšego. Baanegwathwadi ba kanegelo ye ke ...

A Tšhošwane le Tlou.

B Tšhošwane le Legotlo.
C Tšhošwane le Leeba.
D Tšhošwane le Ngwana

3. Swaya (X) ka gare ga lepokisi le le nepagetšego. Tšhošwane le Leeba di be di dula kua ...

thabeng.	
sethokgweng.	
ntlong.	
sehlageng.	

4. Laetša tatelano ye e nepagetšego ya ditiragalo go tšwa kanegelong. Nomora mafoko 1-4 ka mapokising ka tatelano ya maleba.

"O reng o sa nwe meetse kua nokeng?"	
Leeba le fofetše ka meetseng la lahlela kala.	
"Thušang!" gwa goelela Tšhošwane. "Ke kgangwa ke meetse."	
"Ke nyorilwe," gwa bolela Tšhošwane.	

5. Ke ka lebaka la eng Tšhošwane e ile ya loma motsomi kokoilane?
Tšhošwane e lomile motsomi kokoilane gobane
....
....
6. Naa o nagana gore Tšhošwane le Leeba di bile bagwera? Lebaka? Ke nagana gore Tšhošwane le Leeba ……………..
……………………………………………………………………………………………..

12. Name writing task (Time 1)
The leaners were tasked to write their names and surnames on a piece of paper.

13. Word writing (Time 2)
Learners had to identify and name a picture. If they identify the picture correctly they were tasked to write the name down.

APPENDIX G: ENGLISH LITERACY TEST ITEMS

11. English text reading list

The English text was derived from children's grade 2 English reader entitled *Honeybee*: *The Beehive Scheme Book 2* and is published by Juta Gariep (Lawrence and Okonsi 2006).

12. English spelling test items

1. Pen	6. Stream
2. Fish	7. Stretched
3. Sound	8. Special
4.Laugh	9. Mountain
5. Brown	10. Elephant

12. English reading comprehension

Derived from DBE Annual National Assessments (2015)

Read the story and answer Questions 1-6

Mr and Mrs Shepherd lived on a farm with their children John and Jane. Mrs Shepherd and Jane baked fresh bread daily and cleaned the stables. The Smith, Sodo and Singh families liked to visit the Shepherd family. The children looked after chickens and ducks. Mr Shepherd kept cattle and sheep. One day the family was enjoying a picnic lunch of cheese, chips, and chops when a terrible accident happened. The tractor's brakes failed and it was running slowly down the hill. Mr Shepherd screamed out loud to warn the family. The tractor rolled into the dam. The family ran after it, also landing in the water. Mr Shepherd got the oxen to pull out the tractor. Everyone was happy that nobody was hurt.

1. Place a cross (x) in the box next to the correct answer. What is the best title (name) for the story?

The chicken farm	
The runaway tractor	
The sheep farm	
The children's picnic lunch	

2. Place a cross (x) in the box next to the correct answer. Who had two children?

Mr and Mrs Shepherd	
Mr and Mrs Singh	
Mr and Mrs Sodo	
Mr and Mrs Smith	

3. Complete the sentence. The Shepherd family lived on a ....

4. Show the correct order of events in the story. Number the sentences from 1-4 in the boxes.

The family had a picnic lunch.	
The Shepherd family lived on a farm.	
The oxen pulled the tractor out of the dam.	
The children looked after chickens and ducks.	

5. Place a cross (x) in the box next to the correct answer. Why did the tractor roll down the hill? The tractor rolled down the hill because …

The wheels were too small.	
The brakes were new.	
The brakes failed.	
The wheels were too big.	

6. Answer the following question
6.1 What do you like or dislike about the story
…………………………………………………………………………………….......................

6.2 Why do you like or dislike the story
…………………………………………………………………………………….....................