Phonological awareness and learning to read in Afrikaans: The role of working memory

A research project in fulfilment of the degree: MA Speech-Language Pathology

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"No one who achieves success does so without acknowledging the help of others. The wise and confident acknowledge this help with gratitude."

Alfred North Whitehead

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Plagiarism Declaration

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I, Marizel Scheepers, declare that this dissertation is my own original work. Where secondary material is used, this has been carefully acknowledged and references in accordance with the University of Pretoria's requirements.

I understand what plagiarism is and I am aware of the University of Pretoria's policy in this regard.

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This is to affirm that the manuscript

Phonological awareness and learning to read in Afrikaans: The role of working memory

By

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was edited by me with regard to language and style.

Elsie Naudé

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List of Abbreviations

DDT	**-**	Dyslexia Determination Test
HPSCA	**-**	South African Health Professions Council
ITPA	**-**	Illinois Test of Psycholinguistic Abilities
L1	**-**	First language
LoLT	**-**	Language of learning and teaching
OMRT	**-**	One Minute Reading Test
PA	-	Phonological awareness
PAT-2	**-**	Phonological Awareness Test-Second Edition
PhA	-	Phonemic awareness
SAJCE	**-**	South African Journal of Childhood Education
SD	**-**	Standard Deviation
TAPS-3	**-**	Test of Auditory Processing Skills: Third Edition
WM	**-**	Working memory

List of Appendices

Formatting

The American Psychological Association *(7th ed.)* referencing style was used.

Abstract

Background

Early literacy skills have a crucial influence on the reading abilities and overall academic success of a child during the school years. The development of phonological awareness skills starts in the pre-school years. While phonological awareness predicts later reading success, working memory is also vital in higher cognitive skills such as reading. Phoneme-grapheme association supports and improves the lexical representation of words in the memory. The phoneme-grapheme association rules in transparent orthographies are in general more predictable and more words can be accurately read at an early stage. Therefore, reading accuracy and fluency seem to develop more straightforwardly since the phoneme-grapheme association is less complicated. As yet, the researcher has come across no studies which explored the role of phonological awareness and working memory in Afrikaans with its transparent orthography.

Purpose

To explore and describe the role of working memory in the acquisition of phonological awareness skills and ultimately reading in Afrikaans, a language with a transparent orthography.

Method

A cross-sectional descriptive design with correlational components was used to obtain data from the participants, aged 7 years to 8 years 11 months. Thirty-five participants from five private schools with Afrikaans as language of learning and teaching (LoLT) were assessed.

Results

The participants employed phonetic decoding more than eidetic decoding. The word reading skills of the participants developed rapidly and exceeded regular expectations. An overall high reading rate was displayed by the participants, likely due to the transparent orthography of Afrikaans. A higher score for the reading comprehension test was obtained by participants who read the comprehension test fluently. Text reading fluency made a more significant contribution to the performance of the

participants on the reading comprehension test than word reading fluency. The number memory reversed subtest was more challenging than number memory forward. Shorter words were recalled more easily than longer words. It was less challenging for the participants to recall an eight- to ten-word sentence than to recall a list of words. Visual spatial memory had no significant relationship to the decoding or reading comprehension skills of the participants. The rhyming production subtest was more challenging than the rhyming discrimination subtest. The impact of syllable awareness skills on the word decoding skills of the participants was not significant. The segmenting and blending scores exceeded the expected performance of the participants. The correlation coefficient between reading comprehension and WM was not statistically significant. The relationship between WM and reading skills seems to be the same in both opaque and transparent orthographies. The correlations of PA and PhA skills with the word reading skills of the participants were moderate in strength. A fairly strong correlation between reading comprehension and PA as well as PhA skills was, however, observed.

Conclusion

The fairly strong statistically significant correlation between word reading skills and WM supports reading development in the early phases. The reasoning behind this deduction is that children who cannot hold and manipulate information in memory will find phoneme-grapheme association difficult.

Keywords: Afrikaans, phonological awareness, reading, transparent orthographies, working memory.

Chapter One: Introduction

"Research is formalized curiosity. It is poking and prying with a purpose."

Zora Neale Hurston

Chapter Aim: The purpose of the chapter is to review current literature pertaining to this research study. There is a dearth of knowledge regarding the phonological awareness skills and working memory of Afrikaans speaking children. Furthermore, the role of phonological awareness and working memory during the acquisition of early reading skills in a transparent orthography is not clearly delineated. Chapter One starts with an overview of information relevant to the research topic, followed by the problem statement.

1.1 Literature review

1.1.1 Phonological awareness (PA) and Phonemic Awareness (PhA) in reading

The development of the early literacy knowledge of a child during pre-school years has an essential influence on reading abilities during the school years (Korat et al., 2017). One of the main skill sets acquired during this development is phonological awareness (PA) (Li et al., 2019). PA, a metalinguistic skill, entails the awareness and manipulation of phonological segments of a spoken language (Lynch, 2016; Sinnadurai, 2018). The sensitivity of a child to the sound structure of a language is illustrated through the level of PA skills displayed (O'Brien et al., 2019). Attaining a high level of PA skills enables a child to acquire reading skills more easily and PA is regarded as a significant predictor for later reading success (Finlayson, 2017; Sinnadurai, 2018). PA development starts early with the less sophisticated skill of alliteration and/or rhyme detection, which may support how a child understands the way in which words are divided into sound units (Read & Regan, 2018).

The development of PA progresses to syllable awareness, which is a prerequisite for phoneme awareness and reading skills to develop (O'Brien et al., 2019; Mehta et al., 2018). PA development then continues on to the manipulation of abstract, smaller sound units of the syllable, such as onset and rime (O'Brien et al., 2019; Korat et al., 2017; Lynch, 2016). Onset-rime awareness is the ability to recognise that a solitary syllable consists of two units. The onset is any initial phoneme before the vowel, while

the rime is the vowel and remaining phonemes of the syllable (Zuriyatiaslina et al., 2018). The development of the ability to manipulate even smaller sections of a word continues until the child is able to manipulate single phonemes (Ehri, 2014).

Phonemic awareness (PhA), the ability to manipulate individual phonemes, is the last and most sophisticated sub-skill of PA to develop (Lynch, 2016; Kenner et al., 2017; Yeong & Rickard Liow, 2012). This sub-skill of PA entails the understanding that spoken words can be divided into individual initial, medial, and final phonemes, and that different words can be formed by combining these phonemes (Ehri, 2014). Segmenting words into phonemes as well as blending, deleting, and substituting phonemes in words are PhA skills (Lynch, 2016). Manipulating phonemes on this level by making connections between phonemes in spoken words and graphemes in written words, is essential when learning to read (O'Leary, 2017; Korat el al., 2017; Kenner et al., 2017). In this way phoneme-grapheme association is established, thus connecting speech to print (Korat et al., 2017). PhA skills are therefore highly predictive of skilled reading (Lynch, 2016; Kenner et al., 2017; Yeong & Rickard Liow, 2012).

1.1.2 Decoding and comprehension in effective reading

The process of learning to read progresses in phases along a continuum, starting from a pre-alphabetic phase, and then proceeding to a partial alphabetic phase, to an alphabetic phase in Grade 1, and finally the consolidated phase (Ehri, 2014; Schaars et al., 2017). Learning to become a skilful reader includes the development of decoding and reading comprehension skills (Chang, 2020; Schaars et al., 2019). The three key components of skilful oral reading are accuracy, rate, and fluency (Chang, 2020). Beginner readers are instructed to identify the orientation and shape of graphemes and associate these graphemes with the phonemes when decoding unfamiliar words (Pham & Hasson, 2014). A child is taught to read by applying specific *phonetic decoding strategies* when reading unfamiliar words and *eidetic decoding* to retrieve familiar words stored in the memory (also referred to as sight words) (Ehri, 2014; van Rijthoven et al., 2017; Stark, 2011).

The *decoding strategy* includes the ability to convert graphemes into a blend of syllabic components and searching for a familiar word in the memory that matches the syllabic components (Ehri, 2014; Schmalz et al., 2013). The *analogy strategy* includes the identification of the equivalent spelling of a familiar word and applying the

pronunciation of the familiar word stored in the memory to the matching phonemes in the unfamiliar word (Ehri, 2014; Par, 2020). The *prediction strategy* includes the ability to use initial phonemes and contextual clues to predict the meaning of the word. After the word is predicted, the pronunciation is linked to the graphemes in order to confirm that the pronunciation fits the phonemes (Ehri, 2014). Phonetic decoding strategies ultimately result in automatic word identification and fluency (Swain et al., 2013). Once a certain level of word reading proficiency has been acquired, word reading fluency will manifest in text reading fluency (Kim & Wagner, 2015). Fluent readers can use their cognitive resources for reading comprehension (Kim & Wagner, 2015; Swain et al., 2013).

Reading comprehension skills develop gradually once proficient decoding skills have been obtained (Schaars et al., 2019). Once the fundamental decoding skills have been acquired, children steadily learn to read more complex and longer orthographic structures containing multi-syllabic words and consonant clusters (Schaars et al., 2017; Kim & Wagner, 2015). Orthographic processing skills include the visual learning of word orthography, for example spelling patterns that describe word parts or specific words (Rakhlin et al., 2019). The orthography of a language has a remarkable effect on the development of these reading skills (Sinnadurai, 2018).

1.1.3 Orthography and orthographic mapping in reading

Orthographic skills are the ability to identify, manipulate, and analyse grapheme patterns (Rakhlin et al., 2019). Orthographic mapping is the development of phoneme-grapheme associations to connect the pronunciation, spelling, and meaning of the specific word and store these connected phonemes and graphemes in the memory (Li et al., 2016; Ehri, 2014; Strauber et al., 2020). The development of phoneme-grapheme association explains how a child learns to read words by sight, also termed eidetic decoding (Ehri, 2014; Stark, 2011). A sight word refers to any word a reader immediately recognises and unconsciously identifies (Strauber et al., 2020). When children make use of orthographic mapping, they do not use phonetic decoding strategies since the words are read directly from memory (Li et al., 2016; Ehri, 2014). PA and PhA skills, automatic phoneme-grapheme association, and accurately decoding a word by identifying its sound phoneme by phoneme are the skills that must be in place to enable orthographic mapping (Ehri, 2014). Readers start to apply

orthographic mapping in second and third grade (Rakhlin et al., 2019). As beginner readers develop more fluent reading skills, they read words spontaneously by means of orthographic processing which allows more effective visual storage of familiar and unfamiliar words into long term memory (Pham & Hasson, 2014). As a result, connections between the phoneme, grapheme, and semantic components become stronger (Schaars et al., 2017).

Alphabetic orthographies – or writing systems – are all based on the principles of phoneme-grapheme association (Vibulpatanavong & Evans, 2019). The different types of writing systems are described as being 'opaque' or 'transparent', depending on the ease with which the pronunciation of a word can be predicted from its spelling (De Sousa et al., 2011). Opaque orthographies present with unpredictable and inconsistent phoneme-grapheme association rules, where graphemes may represent a number of different phonemes in different words (De Sousa et al., 2011). In transparent orthographies, such as Dutch, German, Spanish, Finnish, and Afrikaans, the phoneme-grapheme association rules are consistent and graphemes generally symbolise only one phoneme (Tibi & Kirby, 2018).

Since transparent languages have more predictable phoneme-grapheme association rules, more words can generally be read correctly by sounding out the graphemes, or decoding the word (De Sousa et al., 2011). Decoding is the ability to convert graphemes into a blend of phonemes or syllabic elements (Ehri, 2014). Therefore, decoding skills as well as reading accuracy and fluency develop more easily in transparent orthographies since the phoneme-grapheme association is more straightforward (Tibi & Kirby, 2018; Vibulpatanavong & Evans, 2019). First graders usually master the alphabetic principle in transparent orthographies within six months of phonics-based reading instruction (Schaars et al., 2019). Orthographic knowledge of words is an effective foundation for reading fluency since it provides a mnemonic device that help children to keep the pronunciations in their memory (Korat et al., 2017). Beginner readers are also required to memorise arbitrary correspondences between abstract visual shapes (graphemes and words) and verbal codes (phonemes) (Toffalini et al., 2019). This visual-phonological association acquired is an example of cross-modal binding (Toffalini et al., 2019; Albano et al., 2016). Cross-modal binding refers to the integration of information originating from different sensory sources to

form integrated, complex representations that can be retained in memory (Toffalini et al., 2019; Albano et al., 2016).

1.1.4 Working memory in decoding

Baddeley and Hitch's (1974) longstanding theoretical framework suggests that working memory (WM) is a multicomponent system responsible for temporarily storing a limited amount of auditory and visual information while this information is being manipulated (Friedman et al., 2017; Pae & Servick, 2011). WM is used in higher cognitive skills such as reading, and is a central component of the executive function which allows children to process information and regulate attention in addition to helping them achieve cognitive-linguistic goals (Choi et al., 2019; Linnegar et al., 2014; Blankenship et al., 2015). WM provides a means for temporarily holding information in an accessible form to be used successfully (Kellogg et al., 2016). Children need to remember some information while processing other information as they work out complex tasks (Linnegar et al., 2014). The central executive, the phonological loop and visuospatial sketchpad (the two slave systems), as well as the episodic buffer are the components of WM (Kellogg et al., 2016; Demoulin & Kolinsky, 2016; Wixey & Eamoraphan, 2017).

The central executive is an attentional control system directly in contact with the phonological loop and visuospatial sketchpad (Argyropoulos et al., 2017). The central executive prioritises incoming information, recovers information from long term memory, and manages selective attention across sensory storage areas (Argyropoulos et al., 2017). Complex span tasks are used to measure the central executive, for example, remembering information and recalling it in reverse (Maehler et al., 2019). The phonological loop, visuospatial sketchpad, and episodic buffer are controlled by the central executive (Kellogg et al., 2016).

The phonological loop is assumed to consist of a temporary phonological store where auditory memory traces deteriorate over a period of a few seconds, if not recovered by articulatory rehearsal (Baddeley, 2000). This loop is responsible for temporarily storing and maintaining verbal information such as a digit, word, phrase, or a sentence in a phonological form (Afshar et al., 2017; Kellogg et al., 2016; Argyropoulos et al., 2017). The phonological loop is frequently associated with PA (De Weerdt et al., 2013). A number of previous studies identified the phonological loop as the primary

system for reading affected in children with reading debilities. These observations are based on storage and processing difficulties of linguistic information demonstrated by children with reading difficulties (Pham & Hasson, 2014). Successful word identification during reading requires children to link the visual form of a word and the corresponding pronunciation of the word (Wang et al., 2015).

The visuospatial sketchpad consists of two separate components, namely the visual and spatial components (Thomas et al., 2012). The two components maintain and process information with a visual or spatial element such as forms of graphemes (Afshar et al., 2017; Argyropoulos et al., 2017; Thomas et al., 2012). This component is involved in everyday reading tasks such as the maintenance of a stable representation of a page and its design. In addition, it supports tasks such as correct eye movement from the end of a line to the beginning of the next (Baddeley, 2003). The two slave systems, the phonological loop and the visuospatial sketchpad, are responsible for span tasks, such as memorising sequences of items followed by immediate recall of the items in the presented order (Baddeley, 2000; Fellman et al., 2020).

The final component of WM is the episodic buffer, a limited capacity system. The episodic buffer is a temporary multi-dimensional holding area that allows different components of WM to interact (Baddeley et al., 2011). The buffer is episodic since it holds episodes whereby information is integrated. Furthermore, the component is a buffer in the sense that it functions as an interface between a variety of systems, each with a different set of codes (Baddeley, 2000). The episodic buffer integrates verbal and visual information and connects these integrated episodes of verbal and visual information to multi-dimensional illustrations in the long-term memory (Wixey & Eamoraphan, 2017; Baddeley, 2012). Wang et al. (2015) described the link between word identification in typically developing children and their ability to form and maintain temporary bound auditory and visual information, a skill closely associated with the episodic buffer. Thus, WM promotes reading success since it supports the formulation of words and the capacity to maintain these words for comprehension (Blankenship et al., 2015).

WM is also involved in the decoding of single words during which the reader accesses and monitors speech-based information (Arrington et al., 2014; Gordon et al., 2020).

A child who is learning to read has to sequentially decode the graphemes into their spoken form, and store the various forms temporarily in the exact order until the last grapheme has been decoded. The final task is to combine the ordered phoneme sequence into a word (Demoulin & Kolinsky, 2016). Phoneme-grapheme association knowledge is, for this reason, essential to secure the connections in memory (Li et al., 2016).

Phoneme-grapheme association assists in the simplification of the phonemic elements in the phonological representation of a word and improves the quality of lexical representation in the memory (Li et al., 2016). PhA skills, mainly segmentation and blending skills, are required to make connections between the spelling and pronunciation of a word, and the preservation of these words in memory (Ehri, 2014). Poor WM capacity affects the ability to identify the association between the phoneme and grapheme, the first essential process for reading (Nevo & Breznitz, 2014). The ability to remember phonemes during the process of decoding will also be affected in children with poor WM abilities (Nevo & Breznitz, 2014). As a result, WM is one of the most significant predictors of the reading abilities of children and their subsequent academic success at school (Rowe et al., 2019; Giofrè et al., 2018; Demoulin & Kolinsky, 2016; Toffalini et al., 2019).

1.2 Rationale and problem statement

The development of proficient reading skills is a fundamental objective of school (Dessemontet & de Chambrier, 2015). The ability to read, and subsequently to learn through reading, becomes an essential part of how academically successful learners are (Finlayson, 2017). The process of reading includes the activation of orthographic, phonological, and semantic structures of words (van Rijthoven et al., 2017). Since PA and WM have constantly emerged in various reports as essential precursors to skilled reading, it is crucial to examine the development and roles of these competences. The influence of the orthography of the language being read should also be examined in conjunction with PA skills and WM. Many research projects have been undertaken on reading in a language with an opaque orthography, such as English. However, existing research on the role of WM and PA skills in Afrikaans is limited. Moreover, to the knowledge of the researcher, no similar research projects involving Afrikaans as a transparent orthography have been conducted. A more robust understanding of

phonological awareness and the role of working memory in learning to read in a transparent language such as Afrikaans is required and therefore research on this topic is warranted. The following research question is consequently posed: What role does WM play in the acquisition of phonological awareness skills and, ultimately, in learning to read in Afrikaans as a language with a transparent orthography?

Chapter Two: Method

"Research is an organized method of keeping you reasonably dissatisfied with what you have."

Charles Kettering

Chapter Aim: The purpose of Chapter Two is to provide comprehensive information on the research process. The chapter sets out to report on the pilot study that was conducted prior to the main study. This report is followed by clarification of the research aim, research objectives, design, ethical principles adhered to, participant selection procedures, and materials and apparatus used during the research study. Chapter Two concludes with descriptions of the data collection and analysis procedures, and how reliability and validity were ensured.

2.1 Pilot study

A pilot study refers to a small-scale version of the method and processes used during the main study (Leon et al., 2011). The purpose of the present pilot study was to evaluate the procedures and design of the main research study and to adapt the format of the study, if and where applicable. The estimated time spent on data collection and the fidelity of the main research study were also determined (Johanson & Brooks, 2010). Finally, the purpose was to determine whether the assessment materials measured all the skills and areas specified in the aim of the main research study appropriately and successfully (Johanson & Brooks, 2010).

2.1.1. Participant selection for the pilot study

The researcher selected ten participants from the schools that consented to participate in the main research study. This sample encompassed 10% of the main research study's sample size and constitutes a justifiable sample size to obtain preliminary data (Hertzog, 2008). The participant exclusion and inclusion criteria were the same as for the main research study (2.6.2).

2.1.2 Adaptations and recommendations made a posteriori

The researcher concluded that the design and processes were mostly appropriate, successful means to collect and analyse data for the main study. Subsequently, only

a few recommendations for adjustments were made regarding the assessment material and areas:

- PA was assessed during the pilot study. However, since rhyme and syllabification had been omitted, the design was adapted to include the *Phonological Awareness Test-Second Edition: Normative Update (PAT-2)* (Robertson & Salter, 2018) to assess rhyme and syllabification in the main study. Rhyme and syllabification had initially not been assessed since PhA (the last PA skill to develop) was identified as the most essential precursor for reading. However, the researcher wanted to assess all PA skills as they develop consecutively.
- Reading comprehension had not been included in the initial assessment protocol. Since learning to read encompasses both the development of decoding and reading comprehension skills (Chang, 2020; Schaars et al., 2019), a comprehension test was included in the main study.
- Lastly, to assess all the components of WM (Kellogg et al., 2016) the visual sequential memory subtest of the *Illinois Test of Psycholinguistic Abilities (ITPA)* (Kirk, McCarthy, & Kirk, 1982) was additionally included to assess the functions of the visuospatial sketchpad.

2.2 Main aim of the research study

The aim of this research study was to explore and describe the role of WM in the acquisition of phonological awareness skills and, ultimately, reading in the Afrikaans language with its transparent orthography.

2.3 Objectives

The objectives were:

- To describe the level of early decoding skills of Afrikaans first language (L1) learners in Grade 2;
- To describe the oral reading rate of Afrikaans (L1) learners in Grade 2;
- To describe the level of reading comprehension skills of Afrikaans (L1) learners in Grade 2;
- To describe the level of WM, PA, and PhA skills of Afrikaans (L1) learners in Grade 2; and

- To correlate the WM, PA and PhA skills of the participants with their early decoding skills.

2.4 Research design

A cross-sectional descriptive study with correlational components was conducted. A cross-sectional design assesses a single group of participants at one specific point in time (Neuman, 2014). This design allows the researcher to keep certain variables constant while the other variables are being tested (Salkind, 2010). A descriptive design identifies characteristics of observed aspects (Salkind, 2010). The correlational design was used to determine whether a relationship exist between variables and to describe the relationship (Christensen et al., 2015).

2.5 Ethical considerations

Ethics in research refers to the responsibility of the researcher to truthfully protect the dignity, rights and welfare of research participants (Gravetter & Forzano, 2018). Ethics furthermore warrants that research reports are truthful and accurate (Gravetter & Forzano, 2018). The current researcher obtained ethical clearance for the pilot study from the Departmental Ethics and Research Committee of the Department of Speech-Language Pathology and Audiology, University of Pretoria (Appendix A). Ethical clearance for the main study was granted by the Research and Ethics Committee of the Faculty of Humanities, University of Pretoria (HUM013/1219, Appendix B). Permission from the principals of the participating schools was also obtained to conduct research at the schools (Appendix C). Parental consent was obtained from each child participant's parent or caregiver, by means of a letter which informed them of the research project (Appendix D). A child assent form with a happy and sad face was provided to each participant. The participant indicated initial and continuous willingness to participate using the face card and written consent by writing their name (Appendix E). Where a possible challenge or barrier to learning was identified during the assessment procedures, the participant was referred to appropriate services to be assessed and assisted (Appendix F).

The following ethical principles governed the research process and authentic decisions made during the present research study (Gravetter & Forzano, 2018):

2.5.1 Beneficence: all actions taken were grounded in the best interests of the participants. The dignity of the participants was respected and their welfare promoted by explaining the research process to them and by using age appropriate language during the assessment procedures. Furthermore, the participants were encouraged to answer the questions to the best of their ability. Participants were able to indicate when they no longer wished to participate. None of the participants indicated unwillingness to participate at any stage of the data collection.

2.5.2 Non-maleficence: care was taken to ensure that the participants experienced no discomfort and attention was given in the event discomfort occurred. The participants were protected from any physical and psychological harm. The participants had a ten-minute comfort break halfway through the assessment. Participants who showed signs of discomfort were asked to indicate whether they still wished to continue with the assessment by pointing to the face card.

2.5.3 Honesty: information and results were reported in a truthful way without misrepresenting the procedures or misleading the participations (Leedy & Ormrod, 2016). The data was collected, analysed, and described without fabricating information.

Where concerning trends regarding development of speech-language and reading was noted, as also noted under the general ethical considerations section, a confidential referral letter was written informing the parent/guardian about the concern and referring the participant for an in-depth assessment (Appendix F).

All publications and resources that contributed to this research study were acknowledged and referenced according to the American Psychological Association (7th ed.) referencing style.

2.5.4 Confidentiality: all personal information obtained and all reporting on findings were kept confidential (Neuman, 2014). The participating schools and participants' names were not directly associated with information obtained as participant codes were assigned. No identifying information of the participating schools and participants was disclosed in the dissertation or article.

2.5.5 Data storage: in agreement with the University of Pretoria's research policy, data and results from this research study will be stored at the Department of Speech-Language Pathology and Audiology, in hard copy and electronic depositories, for a minimum of 15 years. Any identifying information of participants was excluded from the data files stores, by assigning participant codes.

2.6 Participants

2.6.1 Participation selection procedures

Afrikaans (L1) participants were selected from five private schools in Gauteng, South Africa, that had Afrikaans as LoLT. The private Afrikaans schools were selected based on their willingness to participate in the research study. The researcher attempted to match the schools and participants as closely as possible to regulate external influences. Once informed consent had been obtained from the principals, the consent of participants' parents as well as the participants' assent was obtained. The parent/guardian and teacher of each potential participant provided information to assist in the identification of participants that would possibly meet the inclusion criteria (Appendix G & H). In total, thirty-five typically developing Afrikaans L1 participants were purposively selected for this research study. Seventeen male and eighteen female participants were selected. All the participants were presumed to be from the same socio-economic background, since private schools with Afrikaans as LoLT typically serve middle to high income households. The selected private schools use the same curriculum, the Curriculum Assessment Policy Statement (CAPS). School fees also fall within the same range (Languille, 2016).

2.6.2 Inclusion and exclusion criteria

2.6.2.1 Age:

Participants between the ages of seven years and eight years eleven months were selected. The specified age range is the required range for a child to be in Grade 2 for the first time. The average age of the participants was seven years seven months with a standard deviation (SD) of 0,446. In Grade 2 basic decoding skills are expected to be mastered (Rakhlin et al., 2019). Participants older than 9 years or who had repeated Grade R or Grade 1 were excluded from the research study.

2.6.2.2 Home language:

Afrikaans is the first language and language of instruction of the participants.

2.6.2.3 Medium of instruction:

The participants were required to have attended Grade R and Grade 1, and still be attending Grade 2, in a school with Afrikaans as language of teaching.

2.6.2.4 Development

Participants with typical speech and language skills were selected. Language disorders can reduce the receptive vocabulary of a child. This reduction can, in turn, influence the ability of the child to comprehend or interpret questions and to formulate answers correctly (Preston & Edwards, 2010). Participants with neurological disorders such as attention deficit hyperactivity disorder (ADHD) and dyslexia were excluded from the study. Children with these neurological disorders demonstrate difficulties with decoding (Gray & Climie, 2016). Separate teacher and parent questionnaires were compiled to ensure exclusion of participants with neurological disorders and/or speech and language disorders (Appendix G & H). Inclusion and exclusion were thus determined based on reported status of these disorders. In the event that the teacher or parent/guardian was unaware of the characteristics or possible presence of a specific disorder presented by participant, a referral letter was written to the parent/guardian (Appendix F). The assessment results of these participants were discarded.

2.6.3 Setting

The participants were assessed at Afrikaans first language (L1) private schools in quiet rooms. The room had limited visual and auditory distractions.

2.7 Materials and apparatus

All administered assessment tools were standardised. However, not all materials were standardised for the Afrikaans population. Translated versions of the assessment materials, utilised successfully for a substantive period in South African practice, were used. The following standardised tools were employed:

2.7.1 Phonological Awareness Test-Second Edition: Normative Update (PAT-2) (Robertson & Salter, 2018)

The *PAT-2* (a translated, but not standardised Afrikaans version) measures awareness of spoken syllables and phonemes. The following subtests with the respective objectives were administered:

Rhyming Discrimination: To describe the ability of the participants to identify rhyming words.

Rhyming Production: To describe the ability of the participants to provide novel rhyming words with stimulus words.

Syllabification: To describe the ability of the participants to segment words into syllables.

2.7.2 Test of Auditory Processing Skills (TAPS-3) (Martin & Brownell, 2005)

The preliminary Afrikaans translation of the *TAPS-3* was used to assess the phonological awareness and WM skills of the participants.

The following subtests were administered to assess phonological awareness:

Phonological segmentation: To describe the ability of the participants to segment words into phonemes.

Phonological blending: To describe the ability of the participants to perceive different phonemes and to combine these phonemes to form words.

The components of WM were assessed with the following subtests and procedures:

Number, word, and sentence memory assessed the function of the phonological loop: The participant repeated sequences of numbers, words, and sentences of increasing length. The subtests were all discontinued after three consecutive recall errors were made by the participant.

Number memory reversed assessed the function of the central executive: The participant recalled sequences of numbers of increasing length, in reserve order. The subtest was discontinued after three consecutive recall errors were made by the participant.

2.7.3 The One-Minute Reading Test (OMRT) (Transvaal Education Department, 1987)

Reading speed of sight words was assessed using the *OMRT*. A reading age equivalent was determined by monosyllabic sight words read against time at an optimal speed. If the participants made use of phonetic decoding skills to read the word, the word was not considered to be part of the sight word vocabulary of the participant. The participants were expected to read one word per second without using strategies to decode the word. The participants' word reading fluency was also assessed using the *OMRT*.

2.7.4 Stark-Griffin Dyslexia Determination Test (DDT) (Stark, 2011)

The *DDT* is a standardised and validated test for Afrikaans and English, endorsed by the South African Health Professions Council (HPSCA). The test investigates phonetic and eidetic (sight word) decoding skills primarily to diagnose specific learning disorder (developmental dyslexia). Reading accuracy was observed using the *DDT*. The decoding subtest consisted of ten words. Firstly, the subtest was used to assess the eidetic decoding skills of the participants. The participant had to read each word within a time frame of two seconds. Each word that was read correctly within two seconds was considered to be part of the sight word vocabulary of the participant. This would mean that the participant had mastered eidetic decoding. Secondly, the subtest was used to assess the phonetic decoding skills of the participants. The participant had to read the same ten words. However, the participant had ten seconds to read each word. The words not previously read within two seconds that were now read correctly within ten seconds, were considered to be phonetically decoded words. This would mean that the participant had mastered phonetic decoding of longer and novel phonetically balanced and unbalanced words through appropriate word attack strategies.

2.7.5 Comprehension test (Department of Basic Education, 2019)

The reading comprehension of the participants was assessed using a reading passage from the Curriculum Assessment Policy Statement (CAPS) (Department of Basic Education, 2019). The selected reading passage was read by all the participants from the participating schools. The participants read the passage aloud and answered comprehension questions.

2.7.6 Illinois Test of Psycholinguistic Abilities (ITPA) (Kirk, McCarthy, & Kirk, 1982) The visuospatial sketchpad component of the WM is typically assessed using spatial span tests (Kessels et al., 2015). The visual sequential memory subtest of the ITPA was administered to assess the visuospatial sketchpad. This subtest assessed the ability of the participants to reproduce non-meaningful figures from memory. A sequence of figures was shown for five seconds; where after the participant was asked to place matching figures in the same order. The sequence of figures increased in length from two to eight figures. This subtest tends to induce fatigue and was therefore administered early during the assessment. The subtest was discontinued after two consecutively sequence errors as per ceiling rule.

2.8 Data collection and analysis procedures

2.8.1 Data collection

The participants were assessed using the tools described in Section 2.7. The assessments took place at the different schools in quiet rooms with limited visual and auditory distractions. The mean duration of the assessment procedures was 45.42 minutes; the standard deviation (SD) was 4,975. Data was captured on an Excel spreadsheet and each participant was assigned an alphanumerical code to ensure confidentiality. The data entered on the spreadsheet was thoroughly verified prior to statistical analysis.

2.8.2 Data analysis

The results obtained from the *OMRT* and *DDT* were analysed and compared. The levels of decoding of the participants were classified as either eidetic or phonetic skills, or a combination where were both applied equally. The *DDT* results were analysed to describe the reading accuracy of the participants. The PA, PhA, and WM skills of the participants were also described. These skills were specifically depicted to determine whether the abilities support reading success. The results obtained from the *OMRT* were used to portray the reading speed and sight word vocabulary of the participants.

Results obtained from the *TAPS-3* (Martin & Brownell, 2005) (PA, PhA, and WM) were analysed and correlated with the decoding skills (results obtained from the *OMRT* and *DDT*) of the participants. The correlations were executed by a statistician using the Statistical Package for Social Sciences, SPSS (version 26). The statistical analysis

supported the researcher in determining relationships or trends in the data obtained. The data was correlated to determine the degree of association between PA, PhA, WM, and decoding skills.

The correlation coefficient *r* hypothesises correlation or test linearity. The correlation coefficient is negative if one variable tends to increase as the other variable decreases. On the other hand, the correlation coefficient is positive if the two variables tend to increase together. Table 1 provides a scale for interpreting the correlation coefficients (Asuero et al., 2006; Akoglu, 2018)

Table 1: Interpretation of Spearman and Pearson correlation coefficients

Strength of Correlation	
Range	**Interpretation**
1	Perfect correlation
$0.8 \leq r \leq 1$	Very strong correlation
$0.6 \leq r \leq 0.8$	Moderate correlation
$0.3 \leq r \leq 0.6$	Fair correlation
$0 \leq r \leq 0.3$	Poor correlation
0	No correlation

2.9 Reliability

Reliability refers to the consistency of the assessment measurements. These figures were taken into account in order to ensure that nearby/identical results were obtained with repeated measurements under the same environmental conditions. Elements of error occurring with each individual measurement were kept as small as possible. The following aspects were taken into account to ensure reliability (Christensen et al., 2015) for the present study:

2.9.1 Environment error

Participants were assessed in similar environmental conditions with minimal visual and auditory distractions (distracting noises and interruptions). The lighting in the room was adequate, free from reflection from the pages of the reading material.

2.9.2 Participant changes

Participant behaviour, including inattention and fatigue, can change between measurements. For this reason, all assessments were completed on the same day for the particular participant. The participant had a 10-minute break halfway through the assessment in order to ensure that results were reliable and not influenced by possible weariness.

2.9.3 Researcher error

Possible human error was minimised as much as possible to ensure that it did not influence the measurement process. The subtests were administered non-systemically during each assessment to counter the effects fatigue might have on the researcher.

2.10 Validity

Validity is an indicator of comprehensiveness and thoroughness of the research. This indicator applies to the research design as well as the methods used. The results obtained during the data collection must represent the phenomenon being measured (Christensen et al., 2015). The following aspects were taken into account to ensure validity for the present study:

2.10.1 Face validity

The validity of the research study was ensured by using formal, standardised assessments recommended and used by other professionals. The standardised tests which were used were designed to evaluate the skills they were designed to measure (Leedy & Ormrod, 2016; Christensen et al., 2015). The translated tests have been successfully utilised in practice in the Afrikaans population for a number of years. The results can therefore be used for descriptive outcomes (Chrisholm & Wildeman, 2013).

2.10.2 Content validity

The assessment instruments reflected the different sections of the content area and the specific skills assessed were essential to that area (Christensen et al., 2015). The assessment tools were purposefully selected to answer to the aim of the research study. The *PAT-2* (Robertson & Salter, 2018), *TAPS-3* (Martin & Brownell, 2005), OMRT (Transvaal Education Department, 1987), *DDT* (Stark, 2011), comprehension

test (CAPS), and *ITPA* (Kirk et al., 1982) are all standardised and validated assessment tools.

Chapter Three: Article

"Research is creating new knowledge."

Neil Armstrong

Chapter Aim: The intent of Chapter Three is to introduce the journal selected for publication and the guidelines for articles submitted to this journal. This information is followed by the submitted article, as per the Departmental postgraduate format.

The South African Journal of Childhood Education (SAJCE) was established in 2011 and publishes original peer-reviewed research articles reporting on childhood development and learning, including the care and education of children from birth to 12 years. The SACJE is published at least once a year. The journal is Social Sciences Citation Index (ISI) accredited. Articles published by the SACJE are licensed under the Creative Commons Attribution 4.0 International license (CC BY 4.0). Manuscripts submitted to the SACJE should be typed in any standard font and font size with 1.5-line spacing. In total, the manuscript should not exceed 8000 words. The reference list should not exceed 60 references and the Harvard reference style must be used. No more than seven tables or figures must be provided. A structured abstract of up to 250 words must be provided covering background, aim, setting, method, results, and conclusion. The article should be structured according to these sections: introduction, research method and design, results, discussion, conclusion, acknowledgements, and references. The article was submitted to the SACJE for review (Appendix I).

Abstract

Background: Phonological awareness skills and working memory are universally regarded as crucial precursors to skilled reading. The orthography of the language being read influences the ease with which a child learns to read. A considerable amount of research has been undertaken on reading in languages with an opaque orthography. Research on the role of phonological skills and working memory in Afrikaans with its transparent orthography is, however, limited.

Aim: The aim of the study was to investigate and describe the role of working memory in the acquisition of phonological awareness and ultimately reading in Afrikaans.

Setting: The research study was conducted in private schools with Afrikaans as LoLT. The participants were Grade 2 Afrikaans first language speakers.

Method: A descriptive research design with correlational components was applied.

Results: Phonetic decoding was employed more than eidetic decoding. Word reading skills developed rapidly and exceeded the expectations in the first two quarters of the year. Participants who read the comprehension test fluently scored higher on the questions than those who did not read fluently. The correlation between WM and reading comprehension was not statistically significant. The statistically significant correlation between WM and word reading seems to be present in both transparent and opaque orthographies. The statistically significant correlation between PA and word reading was not found in other transparent orthographies. The correlation between PhA and word reading is the same in other orthographies.

Conclusion: The statistically significant correlation between WM and word reading indicates that WM supports reading development, since the ability to hold information in memory supports phoneme-grapheme associations.

Keywords: Afrikaans; beginning readers, decoding strategies; phonemic awareness; phonological awareness; transparent orthography; working memory.

Introduction

The development of proficient reading skills is a fundamental objective of school (Dessemontet & de Chambrier 2015). The ability to read, and subsequently to learn through reading, becomes a crucial part of how academically successful learners are (Finlayson 2017). Attaining a high level of phonological awareness (PA) skills enables a child to acquire reading skills more easily (Finlayson 2017). Learning to read requires the sequential decoding of the graphemes into their spoken form and temporarily storing the various forms in the exact order until the last grapheme has been decoded (Dessemontet & de Chambrier 2015). Adequate phoneme-grapheme association knowledge secures the connection in memory (Li et al. 2016). Phoneme-grapheme correspondence improves the quality of lexical representations in the memory (Li et al. 2016). Phonemic awareness (PhA) skills, primarily blending and segmentation, are

required to connect the pronunciation and spelling of a word and to preserve these words in the memory (Ehri 2014). Research suggests that working memory (WM) is one of the most important predictors of children's reading abilities and later academic success (Giofrè et al. 2018; Toffalini et al. 2019). Research on the role of PA skills and WM in Afrikaans is limited. Furthermore, to the researchers' knowledge, no comparable research project involving Afrikaans as a transparent orthography has been conducted. A more robust understanding of phonological awareness and the role of working memory in learning to read in Afrikaans will contribute to support programmes for young readers.

One of the main skills acknowledged as essential in early literacy development is PA (Korat et al. 2017; Li et al. 2019). A child's sensitivity to the sound structure of a language is illustrated through the level of PA skills displayed (Li et al. 2019). A child who attains a high level of PA skills acquires reading skills more easily. PA is therefore a significant predictor of later reading success (Finlayson 2017). Detection of rhyme and alliteration, the least sophisticated PA skill, develops first and may support a child's understanding of how words are divided into sound units (Read & Regan 2018). The development of PA continues to syllable awareness, a pre-requisite for phoneme awareness and ultimately reading skills to develop (Mehta et al. 2018). The next level of PA development concerns onset and rime (Korat et al. 2017; Lynch 2016; Zuriyatiaslina et al. 2018). The ability to manipulate even smaller sections of a word continues to develop until the child is able to manipulate single phonemes (Ehri, 2014). The final, most sophisticated sub-skill of PA to develop is phonemic awareness (PhA) (Lynch, 2016; Ehri 2014,). PhA skills entail segmenting words into phonemes as well as blending, deleting, and substituting phonemes (Lynch 2016). When a child learns to read, manipulating phonemes by making connections between phonemes in spoken words and graphemes in written words (establishing phoneme-grapheme association) is essential (Korat el al. 2017). Consequently, PhA skills are greatly predictive of skilled reading (Lynch 2016).

The development of decoding and reading comprehension skills are essential components of becoming a skilful reader (Schaars, Segers, & Verhoeven 2019). When decoding unfamiliar words, beginner readers are typically instructed to identify the shape and orientation of graphemes and associate them with the correct phonemes (Pham & Hasson 2014). A child is instructed to read by applying specific *phonetic*

decoding strategies when reading unfamiliar words (Ehri 2014; Stark 2011). Sight words stored in the memory are retrieved and read by using *eidetic decoding strategies* (Ehri 2014; Stark 2011). Once proficient decoding skills have been attained, reading comprehension skills start to develop gradually (Schaars, Segers, & Verhoeven 2019). A child steadily learns to read longer and more complex orthographic structures containing consonant clusters and multi-syllabic words once the fundamental decoding skills have been developed (Schaars, Segers, & Verhoeven 2017).

The orthography of a language has a significant effect on the development of reading skills (Rakhlin et al. 2019). A child learns to read sight words through orthographic mapping (Ehri 2014; Stark 2011). When a child makes use of orthographic mapping, phonetic decoding strategies are not used anymore for familiar words since the words are read immediately from memory (Li et al. 2016; Ehri 2014). PA and PhA skills, automatic phoneme-grapheme association, and accurate decoding of words by identifying the sounds phoneme by phoneme, all facilitate orthographic mapping (Ehri 2014). Readers apply orthographic mapping in second and third grade (Rakhlin et al. 2019). As beginner readers become more fluent, words are spontaneously read by means of orthographic processing which allows more effective visual storage of familiar and unfamiliar words into long term memory (Pham & Hasson 2014). As a result, the connections between the phoneme, grapheme, and semantic components become stronger (Schaars, Segers, & Verhoeven 2017).

Alphabetic orthographies – or writing systems – are all created on the principles of phoneme-grapheme association (Vibulpatanavong & Evans 2019). The orthography of a language is described as being either transparent or opaque (De Sousa, Greenop, & Jessica 2011). Opaque orthographies present with inconsistent and unpredictable phoneme-grapheme association rules, and graphemes may represent a number of different phonemes (De Sousa, Greenop, & Jessica 2011). In transparent orthographies the phoneme-grapheme association rules are reliable and graphemes mostly symbolise only one phoneme (Tibi & Kirby 2018; De Sousa, Greenop, & Jessica 2011). Since the phoneme-grapheme association is more straightforward in transparent orthographies, decoding skills as well as reading fluency and accuracy develop more easily (Tibi & Kirby 2018; Vibulpatanavong & Evans 2019).

An effective foundation for reading fluency is orthographic knowledge of words, since it provides a mnemonic device that helps children to keep the pronunciations in their memory (Korat et al. 2017). Beginner readers must be able to memorise arbitrary correspondences between abstract visual shapes (representations of phonemes and words) and verbal codes (Toffalini et al. 2019). This visual-phonological association is an example of cross-modal binding (Toffalini et al. 2019). Cross-modal binding is the integration of information from different sensory sources to form complex, integrated representations that can be retained in memory (Toffalini et al. 2019).

As children work out complex tasks, they need to remember some information while processing other information (Linnegar, Condy, & McKinney 2014). Working memory (WM) is used in higher cognitive skills such as reading (Linnegar, Condy, & McKinney 2014; Blankenship et al., 2015). The subsystems of WM are the central executive, the two slave systems - phonological loop and visuospatial sketchpad - and the episodic buffer (Kellogg et al. 2016).

The central executive prioritises incoming information, retrieves information from long term memory, and controls selective attention across sensory storage areas (Argyropoulos et al. 2017). The WM components are controlled by the central executive (Kellogg et al. 2016). The phonological loop is responsible for temporary storing and maintaining verbal information in a phonological form (Afshar et al. 2017; Kellogg et al. 2016; Argyropoulos et al. 2017). PA is normally associated with the phonological loop (De Weerdt, Desoete, & Roeyers 2013). A number of previous studies point to the phonological loop as the principal system affected in children with reading difficulties. This is founded on the difficulties they experience in processing and storing linguistic information (Pham & Hasson 2014). Children are required to link the visual form of a word and the corresponding pronunciation of the word in order to identify words successful during reading tasks (Wang et al. 2015).

The visuospatial sketchpad maintains and processes information with a visual or spatial element, for example forms of graphemes (Afshar et al. 2017; Argyropoulos et al. 2017). This component is involved in reading tasks such as the maintenance of a stable representation of the page and its design. Furthermore, it enables correct eye movement from the end of one line to the beginning of the next (Baddeley 2012). The episodic buffer, a multi-dimensional buffer, allows the different components of WM to

interact (Baddeley, Allen, & Hitch 2011). The episodic buffer integrates visual and verbal information and connects these integrated episodes to multi-dimensional illustrations in the long-term memory (Baddeley 2012). WM can therefore be understood to promote reading success as it supports the formulation of words as well as the capacity to maintain these words for comprehension (Blankenship et al. 2015). The present study aimed for a robust understanding of PA and the role of WM in learning to read in Afrikaans as a transparent language. The aim was to explore and describe the role of WM in the acquisition of phonological awareness skills and ultimately in reading Afrikaans. Subordinate objectives were to describe the Grade 2 Afrikaans L1 participants' level of decoding, oral reading rate, level of reading comprehension, WM, PA and PhA skills; and, finally, to correlate the latter aspects with the early decoding skills of the participants.

The following research question is posed: What role does WM play in the acquisition of phonological awareness skills and, ultimately, in learning to read Afrikaans, a language with a transparent orthography?

Method

Research design

A descriptive research design with correlational components was applied (Christensen, Johnson, & Turner 2015).

Study population and sampling strategy

Participation selection procedures

The participants and schools were selected based on their willingness to participate as well as convenience sampling (Christensen, Johnson, & Turner 2015). The research study included 35 Afrikaans (L1) male and female participants selected from five private schools in Gauteng, South Africa, with Afrikaans as LoLT. A total of 30 or more participants had to be selected for the statistical analysis using Statistical Package for Social Sciences, SPSS (version 26), to be applicable. The participants were assessed during the first and second quarters of the academic year. The average age of the participants was seven years and seven months with a standard deviation (SD) of 0.446. The researchers endeavoured to match the participants and private schools as closely as possible to control external influences. The selected private

schools and participants represented similar socio-economic backgrounds. The similar background was implicit due to the circumstance that private schools generally serve middle to high income households. Moreover, the private schools used the same LoLT and curriculum, and school fees are also within the same range (Languille 2016).

Exclusion and inclusion criteria

The participants selected for the research study were between the ages of seven years and eight years eleven months. This identified range is the required age for a child to be in Grade 2. Additionally, basic decoding skills are expected to be mastered in Grade 2 (Rakhlin et al. 2019). Participants who had repeated Grade R or Grade 1, and who were older than 9 years, were excluded from the research study. The home language of the participants as well as their language of instruction from Grade R onward is Afrikaans. Participants with reported speech, language, or neurological disorders such as attention deficit hyperactivity disorder, were excluded. In cases where the parent/guardian or teacher appeared to be unaware that a potential participant was exhibiting the characteristics of a possible disorder, the participant was excluded and referred for a formal assessment.

Setting

The participants were assessed in quiet rooms with limited auditory and visual distractions.

Data collection and analysis procedures

Data collection

The participants were assessed using the assessment tools described in the section on materials and apparatus. The data was captured on an Excel spreadsheet and a numeric code was assigned to the individual data of each participant to ensure confidentiality. Prior to the statistical analysis the data entered on the spreadsheet was verified thoroughly.

Data collection material and apparatus

The administered assessment tools were standardised. It must be noted, though, that not all the assessment tools were standardised for the Afrikaans population. However,

the translated versions have been employed successfully for a substantive period in South African practice, and were accepted as appropriate for the present study. The assessment tools were utilised to support the aim of the research study. The assessment tools used for obtaining the desired data were: The Phonological Awareness Test-Second Edition: Normative Update (PAT-2) (Robertson & Salter 2018); the Test of Auditory Processing Skills (TAPS-3) (Martin & Brownell 2005); The One-Minute Reading Test (OMRT) (Transvaal Education Department 1987); the Stark-Griffin Dyslexia Determination Test (DDT) (Stark 2011); the Illinois Test of Psycholinguistic Abilities (ITPA) (Kirk, McCarthy, & Kirk 1982); and a prescribed comprehension test from the Curriculum Assessment Policy Statement (CAPS) (Department of Basic Education 2019).

Reliability and validity

Possible elements of error within each individual measurement were kept as small possible. The following factors were taken into account to ensure that identical/nearby results were obtained (Christensen, Johnson, & Turner 2015): environment factors, participant changes, and research factors.

Face and content validity were accounted for to ensure thoroughness and comprehensiveness of the research and results obtained (Christensen, Johnson, & Turner 2015). The desired data was obtained through normal and standardised assessments recommended and used by other professionals. The assessment tools were purposefully selected to correspond to the aim of the research study.

Data analysis

The decoding skills of the participants were described and classified as phonetic or eidetic, or a combination where both decoding skills applied. The results attained from the OMRT and DDT were analysed and compared. Reading accuracy was described using the outcomes of the DDT. The speed and sight word vocabulary of the participants were described according to the OMRT results. PA, PhA, and WM skills were described in a detailed manner to determine whether the skills of the participants support their ability to read successfully. The TAPS-3 (assessing PA, PhA, and WM) results were analysed and correlated with the decoding skills of the participants. A statistician correlated the results using the Statistical Package for Social Sciences, SPSS (version 26). The data was analysed using the Spearman Correlations (Field

2018). The purpose was to determine the degree of association between PA, PhA, WM, and decoding skills.

Ethical considerations

Ethical considerations were taken into account to ensure the welfare and dignity of the participants. Ethical clearance was obtained from the Research and Ethics Committee of the Faculty of Humanities, University of Pretoria. Written permission was obtained from the principals of the private schools, allowing the research to be conducted on the schools' premises in quiet rooms with minimal visual and auditory distractions. The researchers obtained informed written consent from the parents or caregivers of each participant. Each participant provided child assent by selecting the correct illustration on the assent form (pointing to a happy or sad face). The participants also provided written assent by writing their names on the assent form. The confidentially of the participants was ensured by the use of numeric codes. The following ethical principles governed the research process and authentic decisions made throughout the research study: beneficence, non-maleficence, honesty, and confidentiality.

Results and discussion

Objective 1: Describing the early decoding skills of Grade 2 Afrikaans (L1) learners using the results of the DDT (Stark 2011)

The participants decoded 33.60% of the words phonetically and 25.20% of the words through eidetic decoding. This outcome signifies that phonetic strategies were still applied more often than eidetic strategies at this early stage of Grade 2. A study conducted with Vietnamese participants confirmed that word reading skills are mastered initially and quickly in transparent orthographies (Pham & Snow 2020). These results are consistent with those obtained by Suggate et al. (2014) who reported on German, which also has a transparent orthography. These authors reported that readers of German have an advantage in word reading skills compared to readers of English, which has an opaque orthography. In the initial phase of learning to read in Greek, which also has a transparent orthography, the participants similarly used phonetic decoding (Sarris 2020). A plausible explanation is that children learning to read a transparent orthography depend more on the phonological than the

morphological structure of the language (Sarris 2020). Phoneme-grapheme associations are fundamental processes to assist beginning readers to build up orthographic representations in their mental lexicons which will ultimately enable easy and quick eidetic decoding (Schmalz, Marinus, & Castles 2013). The participants in the current study decoded more words phonetically since the orthographic representations in their mental lexicons are still being constructed (Schmalz, Marinus, & Castles 2013). The latter view is supported by Rakhlin et al. (2019) who reported that all basic decoding skills are mastered by the end of Grade 2. Orthographic mapping for both transparent and opaque orthographies is activated through frequent reading as basic decoding skills develop, which will result in more complete word spelling being stored in the mental lexicons of the reader, thus building the sight word vocabulary (Li et al. 2016; Rakhlin et al. 2019). The participants in the current study decoded 58.80% words correctly and 22.63% words incorrectly, while 18.57% of the test stimuli were not read. The phoneme-grapheme associations were still accurate for most of the test stimuli although 22.63% of words were decoded incorrectly. The incorrectly decoded words were the longer stimuli, consisting of three to four syllables. These are words to which the participants also would have had little to no reading exposure. Steacy et al. (2020) concur that longer words are understandably more challenging to read initially, and require more exposure for mastery than shorter words. Pham and Snow's (2020) study of the transparent Vietnamese orthography confirmed that children learning to read languages with transparent orthographies master word reading skills quickly. Beginning readers of pointed Hebrew, which is considered a transparent orthography, also develop word reading accuracy fairly easily based on the direct phoneme-grapheme associations (Nevo et al. 2020). These findings provide a possible reason why most words were decoded correctly by the participants in the study in hand. Another plausible explanation is that when phoneme-grapheme associations are developed in transparent orthographies, reading acquisition becomes largely a process of orthographic learning and acquiring unitised word reading (Rakhlin et al. 2019). It is therefore reasonable to assume that the Afrikaans Grade 2 participants were, during the first two quarters of the academic year, still in the beginning phase of orthographic learning, since basic decoding skills were being mastered. The Afrikaans Grade 2 participants' eidetic decoding skills should improve with reading experience as more complete word spellings will be stored in the metal lexicons of readers (Rakhlin et al. 2019; Schaars, Segers, & Verhoeven 2017). This

seems to be the case for other transparent orthographies, where the early decoding skills seem to develop along similar lines to in Afrikaans. What makes reading development a challenging task nonetheless is the acquisition of words consisting of larger units, in order to ultimately become a fluent reader (Steacy et al. 2020).

Objective 2: Describing the oral reading rate of the Grade 2 Afrikaans (L1) learners using the results of the OMRT (Transvaal Education Department 1987).

The participants read on average 50.94 words per minute during the OMRT. The average reading age was 7 years 9 months. The standard deviation (SD) for the OMRT was 21.57. As mentioned in the section on participant selection procedures, the average age for the assessed participants was 7 years and 7 months, with a SD of 0.446. Children are expected to read between 33 and 68 sight word per minute by the end of Grade 2 (Transvaal Education Department 1987). These results indicate that the participants had already achieved or even exceeded the expectations in the first and second quarters of the academic year. The maximum score of 99 words was achieved by one participant (n=1; 2.86%) and the minimum of 11 words by two (n=2; 5.71%) participants. Although 13 (n=13; 37.14%) participants read fewer sight words than anticipated for their age, only six (n=6; 17.14%) participants read fewer than 33 words, the basal for Grade 2 participants. These results support the finding (Objective 1) that word reading skills develop rapidly in transparent orthographies (Pham & Snow 2020; Suggate et al. 2014). The findings are also supported by the fact that the participants were assessed at the beginning of the academic year.

In English, which has an opaque orthography, a low reading rate is often confused with low reading accuracy (Rakhlin et al. 2019). In transparent orthographies with consistent phoneme-grapheme associations, a low reading rate manifests itself as a reading rate disorder, characterised by accurate, but slow and effortful reading including failure to attain sight word reading (Rakhlin et al. 2019). The statement of Rakhlin et al. (2019) regarding Russian with its transparent orthography, is based on the predisposition of readers to use orthographically incorrect but phonological reasonable spelling. Similar results were obtained in the present study. As was to be expected, the participants with a low reading rate read the comprehension test (text reading fluency) slower than participants with a higher reading rate. In most cases the

words were still read accurately although the participants read slowly, with more effort. There were, however, five (n=5; 14.26%) participants who not only displayed a low reading rate but also decoded many of the words incorrectly. These five participants read fewer words than expected for their age and less than the expected basal for Grade 2 children during the OMRT. Furthermore, the five (n=5; 14.26%) also obtained poor scores of 9, 15, 16, 17, and 18 respectively for the segmenting subtest. The scores for the blending subtest were poor for three (n=3; 8.57%) of the five (n=5; 14.26%) participants, with scores of 12, 15, and 19. The latter is worth noting since the PhA skills, segmenting and blending, are strongly predictive of adequate reading skills. It is possible that the decoding skills of these participants are not as developed as those of the other participants. The sight word vocabulary of readers expands as their orthographic mapping skills improve, which will improve the oral reading rate of the readers (Ehri 2014). Likewise, this improved orthographic mapping and expanded sight word vocabulary can be an explanation as to why some participants read more sight words per minute and subsequently displayed a higher reading rate. A final explanation offered for the present overall higher reading rate of these participants compared to the expected outcomes set by the normative data of the OMRT, is the transparent orthography of Afrikaans. It can safely be stated that the average oral reading rate of these Grade 2 Afrikaans participants exceeded the expectations even in the first two quarters of the academic year. The rapid development of word reading skills in other transparent orthographies seem to be in agreement with the findings for Afrikaans.

Objective 3: A description of the reading comprehension skills of Afrikaans (L1) readers in Grade 2

The mean score for the reading comprehension test was 7.29 out of 10. The SD for the comprehension test was 1.90. The maximum score of ten was obtained by three (n=3; 8.57%) participants and the minimum score of two by only one (n=1; 2.86%) participant. It was subsequently noted that participants who read the comprehension test fluently, quickly, and accurately with proper expression (Swain, Leader-Janssen, & Conley 2013), obtained a higher score on the questions. Twenty participants (n=20; 57.14%) who read the comprehension test fluently scored seven or higher out of 10. A score of six was obtained by two (n=2; 5.71%) participants who read the

comprehension test fluently and only one (n=1; 2.86%) participant, also fluent, scored three. These results are consistent with results from other studies conducted in transparent orthographies (Kim, Park, & Wagner 2014; Nevo et al. 2020). The general conclusion is that, as readers develop fluency, cognitive resources can be focused on comprehension of the text and not on decoding words (Kim, Park, & Wagner 2014; Nevo et al., 2020). Three (n=3; 8.57%) of the five (n=5; 14.26%) participants with a low reading rate (mentioned in Objective 2) scored six on the comprehension test, which is higher than expected. The individual differences in word reading skill, which is a foundational component of reading comprehension (Kim, Park, & Wagner 2014), is a possible explanation. The text reading fluency of the participants made a greater contribution to their reading comprehension performance, however, than word reading fluency. This conclusion was made since participants who did not read the anticipated number of words for their age during the OMRT did not necessarily also underperform during the comprehension test. Eighteen (n=18; 51.71%) of the 22 participants (n=22; 62.86%) who read the expected number of words during the OMRT for their age equivalent scored seven or higher in the comprehension test. However, only three (n=3; 8.57%) participants who underperformed in the OMRT obtained five or lower for the comprehension test. Ten (n=10; 28.57%) participants who read fewer words during the OMRT compared to their age equivalent scored six or higher on the comprehension test. A plausible explanation is that the relationship of word reading fluency to reading comprehension weakens from the initial to the later phases of learning to read (Kim, Park, & Wagner 2014). The decline is due to the development of reading skills. This was reported by Kim, Park, and Wagner (2014) after research conducted with participants learning to read Korean, which has a transparent orthography. A similar study by Kim and Wagner (2015) found this outcome also for English, which has an opaque orthography. Text reading fluency becomes independently related to reading comprehension. Once a certain level of word reading proficiency has developed, text reading fluency becomes an additional influence on reading comprehension together with word reading fluency and listening comprehension (Kim & Wagner 2015). This can serve as a plausible reason for text reading fluency being more predictive of the reading comprehension performance of the participants than their word reading fluency. Peng et al. (2018) provide another explanation. From their meta-analysis these authors reported that it was less challenging for participants to read sentences than to read lists of words with no

semantic context. The semantic context enables participants to read the sentences faster and more fluently. However, research in Finnish, Greek, and Korean, all with transparent orthographies, indicated that listening comprehension becomes a stronger prediction of reading comprehension over time (Argyropoulos et al. 2017; Kim, Park, & Wagner 2014). The reading comprehension skills of the participants are in agreement with those found by other studies conducted in languages with transparent orthographies. The research generally indicates that, as fluency develops, cognitive resources can be focused on comprehension of the text rather than on decoding words. The weakening of the link between word reading fluency and reading comprehension skills seem to happen also in languages with opaque orthographies.

Objective 4: A description of WM, PA, and PhA skills of the Afrikaans (L1) Grade 2 learners

In line with the penultimate objective, Tables 1 and 2 and the subsequent narratives present the data describing the WM skills of the participants.

Table 1: Results of WM skills *(n=35)*

WM skills	Mean	Median	SD	Minimum score	Maximum score
Number memory forward	7.51	7	1.46	4	10
Number memory reversed	3.31	3	1.05	2	6
Word memory	8.51	8	1.77	5	11
Sentence memory	10.41	10	2.38	7	16
Visual spatial Memory	11.91	12	2.54	6	17

Number memory forward and reversed: Number memory forward is a measurement of the phonological loop's capacity while number memory reversed, where the data has to be manipulated, measures the central executive (Afshar et al. 2017; Giofrè et al. 2016). Number memory forward, a 'passive' task, involves a limited amount of

execute control (Giofrè et al. 2016). An 'active' task comprises of double requests and/or control for irrelevant data (Giofrè et al. 2016). Number memory reversed is a task considered to be distributed between passive and active. The number memory reversed task was more challenging since it required more executive control and manipulation. It is therefore predictable that the participants would find it difficult to remember and manipulate information simultaneously. The central executive system includes higher-level cognitive skills including attention, planning, and inhibition (Afshar et al. 2017). Thus, we propose that these higher cognitive skills are still developing in Afrikaans Grade 2 children.

Word memory: The outcomes in Table 1 for the word memory subtest indicate that the participants have a word memory span of four to five words on average. Shorter words, for example car, are generally recalled more easily than longer words, for example banana (Saint-Aubin et al, 2020). This is true for French, with an opaque orthography (Saint-Aubin et al. 2020), and also true for the present study in a transparent orthography.

Sentence memory: The mean score of the sentence memory subtest indicates that the participants were on average able to recall a sentence with eight to ten words. It is possible that the semantic connotations between words in sentences facilitate the process of remembering and recalling the sentence. The results are supported by Peng et al.'s (2018) meta-analysis reporting that participants find it less challenging to recall a sentence with eight to ten words compared to recalling single words. In Objective 3 similar finding were reported regarding the semantic context making the task less challenging for the participants.

Visual spatial memory: The participants were able to recall on average four to five visual spatial blocks, according to the mean score for this subtest. The visual spatial memory skills of the participants were not an indication of their decoding or reading comprehension skills. The participants who obtained the mean score or a higher score on the visual spatial subtest did not all read the expected number of words for their age in the OMRT and vice versa. Ten participants (n=10; 28.57%) scored lower than the mean for the visual spatial subtest although they read the estimated numbers of words for their age during the OMRT. These findings are consistent with those from a

study in English, which has an opaque orthography, where it was reported that the visual-spatial sketchpad delivers no significant contribution to reading fluency (Pham & Hasson 2014). A probable explanation is that since reading fluency requires responding under a timed condition, processing speed may contribute more to reading fluency than WM (Pham & Hasson 2014). This is in contrast, however, with the findings of De Weerdt, Desoete, and Roeyers (2013) regarding German, a language with a transparent orthography, that children with reading difficulties experience problems in all components of WM.

Higher cognitive skills of the central executive that facilitate more executive control and manipulation are still developing in Afrikaans Grade 2 children. The Afrikaans Grade 2 participants recalled shorter words more easily than longer words, which is consistent with other findings from languages with opaque orthographies. It is seemingly true for both orthographies that the semantic context makes it less challenging to recall sentences than words. When considering other transparent orthographies, the influence of the visual spatial sketchpad on reading fluency seems to differ in comparison with Afrikaans. However, the results in this study of the visual spatial sketchpad having no significant contribution to reading fluency is in agreement with findings from other opaque orthographies.

Table 3: Results of PA and PhA skills *(n=35)*

PA and PhA skills	Mean	Median	SD	Minimum score	Maximum score
Rhyme discrimination	8.51	9	1.62	4	10
Rhyme production	5.86	6	2.94	0	10
Syllabification	7.11	8	2.40	2	10
Phonological Segmentation	25.11	26	6.32	9	34
Phonological blending	27.06	28	5.18	12	34

Rhyming: The rhyme discrimination subtest was less challenging than the rhyme production subtest. A study involving English-speaking South African participants (Manten et al. 2020) also indicated that the production of rhyme words was challenging. Rhyme awareness did not make a significant contribution to the development of reading skills in the transparent orthography of Finnish (Suortti & Lipponen 2016). Children typically show awareness of syllables and rhymes, before they display sensitivity to phonemes (Duncan 2018). Our study therefore suggests that, although rhyming contributes to the development of PhA and ultimately phoneme-grapheme association, the individual roles of rhyme discrimination and production may be different for Afrikaans.

Syllabification: Syllable awareness is one of the earlier PA skills to develop (Mehta et al. 2018). Children reading languages with transparent orthographies generally have sufficient awareness of syllables (Güldenoğlu 2017). However, 12 participants (n=12; 34,29%) scored below the mean score of 7.11. Both Güldenoğlu (2017) and Müller, Richter, and Karageorgos (2020) reported that syllable awareness has a more significant impact on decoding words in a transparent orthography than in opaque orthographies. Thirteen participants (n=13; 37.14%) who obtained the mean score or higher read the expected number of words per minute during the OMRT. However, six participants (n=6; 17.14%) read the expected number of words during the OMRT, but obtained a score of six or lower in the syllabification subtest. Furthermore, 10 participants (n=10; 28.57%) obtained the mean score or higher for the syllabification subtest, but read fewer words than expected during the OMRT. Finally, only six participants (n=6; 17.14%) obtained less than the mean for the syllabification subtest and did not read the expected number of words during the OMRT. The present study's results are in contrast with those from Güldenoğlu (2017) and Müller, Richter, and Karageorgos (2020) since the syllable awareness of the participants did not have a significant impact on the word decoding skills of the Afrikaans participants.

Phonological segmentation and blending: The estimated expected scores for Grade 2 children in the segmentation subtest are between 24 and 30, and for the blending subtest between 16 and 21 (Martin & Brownell 2005). Thirteen (n=13; 37.14%) participants obtained a score below the estimated score for the segmentation subtest and three (n=3; 8.57%) participants for the blending subtest. Although the results on

both subtests exceeded normative data overall, the results indicated that the perception and blending of different phonemes were less challenging for the participants. Research in English has also reflected that phonological blending was more developed and less challenging than segmentation skills (Le Roux et al. 2017; Suortti & Lipponen 2016). Participants who scored the mean or above on the segmentation subtest read more words correctly during the OMRT. However, 12 (n=12; 34.26%) participants who read the anticipated number of words per minute did not obtained the mean score for the blending subtest. It can be concluded that blending is less challenging than segmenting in both transparent and opaque orthographies (Le Roux et al. 2017; Suortti & Lipponen 2016). In the current study, segmenting skills seemed to facilitate word reading development to a greater extent than blending skills. The latter argument is made since participants who obtained the mean score or higher for the segmenting subtest, read the expected number of words or more during the OMRT, but this was not true for the blending subtest.

When compared to findings from other languages with transparent orthographies, rhyming awareness did also not contribute significantly to the acquisition of reading skills in Afrikaans. The influence of syllable awareness on the reading skills of participants differs from that reported for other transparent orthographies. Finally, the results of the blending subtest, reflective of less challenge than the segmenting subtest, seem to be in agreement with findings from opaque orthographies.

Objective 5: Correlating WM, PA, and PhA skills with the early decoding skills of the Grade 2 learners

The concluding objective entailed the statistical correlations of the WM, PA, and PhA skills with early decoding skills to ultimately explore the role of WM in the development of PA skills. The correlations may depict possible WM relationships with reading in a language with transparent orthography, such as Afrikaans.

Table 4: WM skills correlated with early reading skills

		Spearman correlation
WM skills correlated with OMRT	Correlation coefficient	0.336
	p-value	0.049
	N	35
WM skills correlated with DDT	Correlation coefficient	0.350
	p-value	0.040
	N	35
WM skills correlated with reading comprehension	Correlation coefficient	0.220
	p-value	0.204
	N	35

N = number of participants.

The correlations between WM and the OMRT and DDT were both of fair strength with r 0.366 and 0.350 respectively. However, the correlation coefficient between WM and the reading comprehension test was not statistically significant. These results are consistent with those reported by Arrington et al. (2014) who state that WM is a cognitive correlate for reading, but not necessarily the strongest predictor of reading skills in English with its opaque orthography. The relation of WM to reading skills is therefore ostensibly the same in both orthographies. A plausible justification for this study's findings could be that WM demonstrated a weaker relation to text reading fluency than word list reading fluency (Peng et al. 2018). Additionally, an untimed reading comprehension passage may involve less WM skills than timed tasks, since the time limit constitutes a greater cognitive load (Peng et al. 2018). Lastly, the correlation of fair strength can be explained by Schaefer and Kotzé (2019), who point out that children will find it difficult to associate a phoneme with its corresponding grapheme if items cannot be held in memory (Schaefer & Kotzé 2019).

Table 5: PA skills correlated with reading skills

	Spearman correlation	
PA skills correlated with OMRT	Correlation coefficient	0.707
	p-value	0.000
	N	35
PA skills correlated with DDT	Correlation coefficient	0.752
	p-value	0.000
	N	35
PA skills correlated with reading comprehension	Correlation coefficient	0.567
	p-value	0.000
	N	35

N = number of participants.

The correlation coefficients were moderate in strength for correlations between PA skills and both the OMRT (r=0.707) and DDT (0.752). However, the correlation between PA and reading comprehension (r=0.567) was only fair in strength. The moderately strong correlations, albeit statistically significant, are in contrast with research reporting that PA does not predict reading skills for the transparent orthographies of Greek, Finnish, and Dutch (Suortti & Lipponen 2016; Landerl et al. 2019). A possible explanation may be that PA seems to be more significant during the earlier phases of reading development when phoneme-grapheme correspondences are still being learned (Tibi & Kirby 2018). Once children have mastered phoneme-grapheme association, the relation of PA to reading skills may be less powerful since phoneme-grapheme association is acquired more rapidly in transparent orthographies (Pfost et al. 2019). In German, which has a transparent orthography, reading accuracy is acquired earlier than in the opaque orthography of English (Pfost et al. 2019). The importance of early phonology increases with the complexity of the orthography (Landerl et al. 2019; Al Dahhan et al. 2016). However, PA may be equally important for children struggling to develop adequate reading skills in a transparent orthography (Pfost et al. 2019). In summary, PA may rather act as a co-requisite than a prerequisite

skill for developing typical reading skills in languages with a transparent orthography such as Afrikaans (Landerl et al. 2019; Suortti & Lipponen 2016).

Table 6: PhA skills correlated with the early reading skills

	Spearman correlation	
PhA skills correlated with OMRT	Correlation coefficient	0.653
	p-value	0.000
	N	35
PhA skills correlated with DDT	Correlation coefficient	0.763
	p-value	0.000
	N	35
PhA skills correlated with reading comprehension	Correlation coefficient	0.542
	p-value	0.00
	N	35

N = number of participants.

The correlation coefficients were moderate in strength for both the OMRT (r=0.653) and DDT (r=0.763) correlated with the PhA skills of the participants. The correlation between PhA skills and the performance of the participants in the reading comprehension test was only fair in strength (r=0.542). The correlations are statically significant since the p-value is < 0.05. The moderate correlations between PhA skills and the OMRT and DTT are in agreement with the results of Lynch's (2016) meta-analysis. This author reports that phoneme segmentation and blending skills are important constructs to develop optimal reading skills, especially in opaque orthographies. Furthermore, in Greek - a language with a transparent orthography - the early performance of children on PhA were related to their later reading skills (Pittas 2018). The moderately strong correlation found in the current study may be explained by the transparent orthography of Afrikaans. Transparent orthographies have a weaker association with PhA, because of the consistency between phonemes and graphemes (Pittas 2018). However, some researchers propose that deficits in PhA skills may be a consequence of reading difficulties rather than a cause (Rakhlin

et al. 2019). The average performance of participants on the segmenting and blending subtests was above the estimated scores for the age levels of the participants (as mentioned in Objective 4). Segmenting and blending skills may provide children learning to read in a transparent orthography such as Afrikaans with greater sensitivity to the phonological structures of a word, ultimately supporting their reading skills (Suortti & Lipponen 2016).

The relation of WM to reading skills seems to be the same for both transparent and opaque orthographies. The moderately strong correlations found between PA skills and word reading skills seem to differ from findings in other transparent orthographies. The moderately strong correlation between PhA skills and reading skills, on the other hand, are consistent with findings from other transparent orthographies.

Conclusion

Phonetic decoding was the primary decoding strategy used by the participants. The early decoding skills of the Grade 2 Afrikaans participants are similar to those found for other transparent orthographies. The rapidly growing word skills of the participants support their oral reading rate and these outcomes seem to be in agreement with other research in transparent orthographies. Likewise, the reading comprehension skills of the Afrikaans participants are similar those found in other transparent orthographies. The capacity of the phonological loop is greater than that of the executive control system. As such, the semantic context supports the recall of information. Another interesting aspect is that the relation of WM to word reading and reading fluency skills was non-significant. This finding differs from other results reported for both types of orthographies. Additionally, the rhyming skills of the participants had no relation to their reading skills, and this seem to be in agreement with the results from other orthographies. However, when considering other transparent orthographies, the influence of syllable awareness on word reading skills seems to differ from that found for Afrikaans. Moreover, the blending and segmenting skills of participants exceeded expectations and seem to be similar to those found for opaque orthographies.

Finally, the statistically fairly significant correlation between WM and word reading skills are seemingly the same for both types of orthographies. The correlations between PA and reading skills of the participants were statistically significant, but differ from those found for other transparent orthographies. The statistically moderately

significant relation of PhA to the word reading skills of the Afrikaans participants was similar to that found for other transparent orthographies.

Limitations and strengths: The research study was conducted on a small, but statistically adequate sample of 35 participants. The assessment of the WM, PA, PhA, and early reading skills was completed during the first two quarters of the academic year. The study included only participants in Grade 2 in private schools. However, in spite of these limitations, the study provided valuable new data on the WM, PA, PhA, and early reading skills of Afrikaans learners in Grade 2, and subsequently on the transparent orthography of this language. The credibility is influenced by the use of instruments translated to Afrikaans that are standardised for use in English.

Recommendations: The PA, PhA, WM, and reading skills of Grade 2 children should be assessed in the third and last quarters of the academic year to allow time for the expected skills to develop fully. The PA, PhA, WM, and early reading skills could also be assessed at the beginning of Grade R to identify difficulties experienced by individuals and to allow early intervention. The development of successful reading skills can be supported by early identification and intervention.

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Authors' contributions

M.S. carried out the assessments and wrote the manuscript with support and guidance from S.G. and M.L.R.

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Data availability statement

The data of this study are available upon request from the authors, M.S., S.G., and M.L.R., in accordance with ethical considerations.

Disclaimer

The conclusions and opinions expressed in this article are those of the authors.

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Chapter Four: Conclusion

"Life is the art of drawing sufficient conclusions from insufficient premises."
Samuel Butler

Chapter Aim: In Chapter Four an overview of the research study is provided. The clinical implications, study limitations, and recommendations for future research are also discussed. The chapter closes with a final concluding statement on the research study.

Overview of study

In the early stage of Grade 2, participants employed phonetic decoding strategies more than eidetic decoding strategies. A probable reason offered for this finding is that the mental lexicons of the participants are still being constructed, which predisposes them to favour said strategies. These Grade 2 Afrikaans participants were still in the process of mastering basic decoding skills in the first and second quarters of the academic year. Therefore, their early decoding skills seem to develop in agreement with those of children learning other transparent orthographies. According to literature reporting on these other transparent orthographies, the eidetic decoding skills of the Afrikaans participants should improve as more unitised words are stored in their mental lexicons. Moreover, as the sight word vocabularies of readers expand, their oral reading rate should also improve (Rakhlin et al., 2019; Ehri, 2014).

In the present study, participants with a low reading rate understandably completed the comprehension test more slowly than their peers with a high reading rate. This higher reading rate on the *OMRT* can possibly be attributed to an expanded sight word vocabulary and improved orthography mapping skills. The participants already achieved the expectations regarding their word reading skills in the first two quarters of the academic year. These findings are consistent with research results in other transparent orthographies (Pham & Snow 2020; Suggate et al. 2014) showing that word reading skills develop swiftly in transparent orthographies. As word reading skills and reading rate develop, reading fluency will ultimately be facilitated (Rakhlin et al. 2019). Subsequently, when readers become more fluent, cognitive resources can shift focus from word decoding to text comprehension.

This account of transfer is also reflected in the present study. The participants obtained a higher score for reading comprehension when the text was read fluently. When comparing the fluency of the *OMRT* word reading with that of the comprehension text reading, reading fluency made a more significant contribution to performance in the latter. Currently this seems to be a novel finding, as research in other transparent orthographies highlights listening comprehension as the most significant predictor of reading comprehension (Argyropoulos et al. 2017; Kim, Park, & Wagner 2014). Overall, however, Afrikaans reading comprehension skills seem to develop similarly to the way skills develop in these transparent orthographies. Reading comprehension skills are therefore ultimately supported by fluency, accuracy, and speed, which are all based on an immediate memory system (Argyropoulos et al., 2017).

Moving on to higher cognitive skills, it was proposed that specifically those skills involved in the number memory subtest are still developing in Grade 2 Afrikaans children. Consequently, the number memory forward subtest was less challenging than the number memory reversed subtest. The participants recalled shorter words with more ease than longer words. The latter finding was also true for French, an opaque orthography (Saint-Aubin et al., 2020). In addition, the participants found it less challenging to recall a sentence with eight to ten words than to recall single words. A reasonable explanation for this phenomenon is that the semantic context provided by the sentences may result in fewer memory and recall challenges (Peng et al., 2018). Lastly, visual spatial memory skills did not predict the decoding or reading comprehension skills of the participants (Pham & Hasson 2014).

With regard to PA, the production of rhyme words was more challenging for the participants than rhyme discrimination. Furthermore, there was no significant relationship between the syllable awareness skills of the participants and their word reading skills. These findings are in disagreement with research in other transparent orthographies. For the specific PhA skills of segmenting and blending, the scores exceeded the expectations for the age levels of the participants. Interestingly, the blending subtest was less challenging for the participants than its segmenting counterpart. This specific skill seems to be the less challenging one in both types of orthographies. At the same time, the more challenging segmenting skills appeared to facilitate word reading skills to a greater extent in Afrikaans readers.

Penultimately, the correlation between the word reading skills and WM of the participants proved to be fair in strength. However, WM did not yield a statistically significant correlation with reading comprehension skills. These results are in agreement with research stating that WM is not necessarily the strongest predictor of reading skills overall. The PA skills correlated moderately strongly with the word reading skills of the participants. The correlation between PA and reading comprehension was, however, only fair in strength. These novel findings were in contrast with research suggesting that PA does not predict reading skills in transparent orthographies (Suortti & Lipponen 2016; Landerl et al., 2019). It is argued that the relation of PA to reading skills is less powerful once phoneme-grapheme association has been mastered. PA skills may act as a co-requisite rather than a prerequisite skill for developing typical reading skills in a transparent orthography, such as Afrikaans. Another interesting outcome concerns the correlations between the word reading and PhA skills. These correlations were moderately strong. However, the correlation between PhA skills and the performance of the participants on the reading comprehension test was only fairly strong. The transparent orthography of Afrikaans may explain the moderate strength of the correlation between PhA skills and word reading skills. Transparent orthographies have a weaker relationship between reading skills and PhA because of the phoneme-grapheme consistency (Pittas, 2018). Since the segmenting and blending scores exceeded the anticipated scores, these skills may provide children with a greater sensitivity to the phonological structures of a word, and consequently aid in the facilitation of their reading skills (Suortti & Lipponen, 2016).

Finally, the following conclusive statements aim to answer the research question: What role does WM play in the acquisition of PA skills and, ultimately, in learning to read in Afrikaans as a language with a transparent orthography?

The fairly strong correlations between WM and word reading skills of Afrikaans participants are noteworthy. Children who are not able to retain items in memory will find it challenging to associate a phoneme with a corresponding grapheme. These phoneme-grapheme associations are generally fundamental to the development of typical and successful reading skills; and this is also true in the case of Afrikaans as a transparent orthography.

Clinical implications

Skills that facilitate the reading outcomes of Afrikaans Grade 2 children were delineated in this dissertation. The reading, WM, PA, and PhA skills of these participants were explored and described. Certain interesting and novel outcomes for Afrikaans as a transparent orthography were highlighted. In support of these findings, the research study advocates for the need to focus on skills that facilitate successful reading proficiency development in Afrikaans as a transparent orthography specifically. Moreover, the focus should be on improving these skills during intervention for children who are struggling to acquire adequate reading skills. This endeavour will ultimately support their academic performance and success. SLTs are encouraged to collaborate with teachers and parents to develop intervention and classroom instruction guidelines that will support the development of reading skills in Afrikaans. As a final point, the present findings regarding the Afrikaans Grade 2 participants' reading, WM, PA, and PhA skills should be shared with the educators of this population. Such collaboration may lead to the development of overarching strategies that can address reading challenges.

Study limitations and strengths

The research study has limitations that are acknowledged by the researcher. The study was conducted on a small sample size and in a limited geographical area. The study was also limited to Grade 2 participants only. Furthermore, the participants were recruited from private Afrikaans schools alone. Regardless of the limitations, valuable data was provided regarding the WM, PA, PhA, and early decoding skills of Afrikaans Grade 2 learners. The credibility is influenced by the use of instruments translated to Afrikaans that are standardised for use in English.

Recommendations for future research

The assessment of the various early literacy skills of these participants in the first quarter of their Grade R year should be considered. Early identification of challenges may ensure early supplemental intervention, so that the children who experience these challenges can catch up with their peers. Moreover, early identification may support these children in the development of successful reading skills during formal reading instruction. A final suggestion in this regard is that forthcoming research should aim to determine effective means of providing parents with additional home intervention

programmes to support children in developing the skills investigated in this dissertation.

Final comments

Adequate attention to the different factors related to successful reading and literacy skills is important to assist children to succeed academically. Supporting the reading skill development of all children including Afrikaans children in South Africa is an imperative goal in education. Such support may prevent early reading and literacy difficulties that will have a negative impact on the future academic environment of this population.

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Appendices

Appendix A: Pilot study ethical clearance

April 2019

Dear Researchers

Project:	Phonological awareness and learning to read in Afrikaans: The role of working memory
Researchers:	Marizel Scheepers (16015658)
Supervisors:	Dr M le Roux, Dr S Geertsema
Department:	Department of Speech- Language Pathology and Audiology

Thank you for the application submitted to the Research Committee of the Department of Speech- Language Pathology and Audiology, Faculty of Humanities.

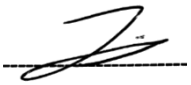
The approval is subject to the candidates abiding to the principles and parameters set out in the application.

We wish you success with the project.

Sincerely

Prof Lidia Pottas

Chair: Departmental Research Committee



Dr J van der Linde

ACTING HEAD: DEPARTMENT OF SPEECH- LANGUAGE PATHOLOGY & AUDIOLODY

University of Pretoria, Private Bag X20
Hatfield 0028, South Africa
Tel +27 (0)12 420 3614
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Email ...@up.ac.za
www.up.ac.za

Appendix B: Main study ethical clearance

12 February 2020

Dear Miss M Scheepers

Project Title:	Phonological awareness and learning to read in Afrikaans: The role of working memory
Researcher:	Miss M Scheepers
Supervisor:	Dr M Le Roux
Department:	Speech Language Path and Aud
Reference number:	16015658 (HUM013/1219)
Degree:	Masters

I have pleasure in informing you that the above application was **approved** by the Research Ethics Committee on 30 January 2020. Data collection may therefore commence.

Please note that this approval is based on the assumption that the research will be carried out along the lines laid out in the proposal. Should the actual research depart significantly from the proposed research, it will be necessary to apply for a new research approval and ethical clearance.

1. Permissions from the private Afrikaans schools are outstanding. The Committee notes that permission from one school was obtained but it did not bear a dated stamp. Since the names of the schools will be mentioned in the study, it is preferable that permission from the schools be on a school letterhead or bear a dated school stamp.
2. The letter to the schools' intimates that results could be shared with the parents/

We wish you success with the project.

Sincerely

Prof Maxi Schoeman
Deputy Dean: Postgraduate and Research Ethics
Faculty of Humanities
UNIVERSITY OF PRETORIA
email: PGHumanities@up.ac.za

Appendix C: Informed consent – Principal

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Humanities
Department of Speech-Language Pathology
and Audiology

Phonological awareness and learning to read in Afrikaans: The role of working memory

Dear Mr / Mrs,

Research: Reading in Afrikaans, Grade 2 learners

I, Marizel Scheepers, am a Master's student at the Department of Speech-Language Pathology, University of Pretoria. I am doing research on the role of working memory, phonological awareness, phonemic awareness and reading skills.

The aim of the research study is to define the role of working memory in phonological awareness skills, as well as to determine the specific influence working memory has on the reading process in Afrikaans. The research study is important because there is little research on Afrikaans children learning to read and the influence of working memory and phonological awareness skills on the process. Phonological awareness is one of the most important building blocks for a child to develop reading and spelling skills. Reading and spelling skills are essential for academic achievement.

I am a qualified speech-language therapist who will assess a child once. The assessment will take approximately 75 minutes and will be conducted at school, in a quiet room. I will start with the assessments in March 2020, on a weekly basis, to complete them as soon as possible. Children's parent / guardian will be notified in writing if any concerns have been identified during the assessment, which need further investigation.

Prior to the study, consent of the parent / guardian of each child will be requested. Assent of the specific children participating in the research study will also be obtained and the process explained to them.

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PRETORIA 0002
Republic of South Africa

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www.up.ac.za

During the assessment, each child has the right to indicate if they no longer wish to proceed with the assessment. All assessment results in this research study will be treated confidentially. Results will be published in such a way that the participants cannot be identified. Data will be stored at the University of Pretoria for 15 years.

I will discuss the results with you at the end of October 2020.

Your permission is requested to assess the Grade 2 learners in your school.

I am willing to arrange a meeting to provide more information.

Kind regards,

M.Scheepers

Marizel Scheepers

Dr Mia le Roux

Studieleier

Dr Salomé Geertsema

Studieleier

Prof Jeannie van der Linde

Hoof: Departement van Spraak-Taalpatologie en Oudiologie

Universiteit van Pretoria

INFORMED CONSENT: Principal

I hereby confirm that I was informed by the researcher, Marizel Scheepers, about the research process, as well as what will happen during the assessment of the learners. I received, read, and understood the information regarding the research study. I am aware that the results of the study, including the school's personal details, will be kept confidential. I may withdraw my consent at any time without any adverse consequences.

School:

Principal: Name and Surname_____

Signature _____

Date _____

School stamp

Appendix D: Informed consent – Parent / Guardian

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Department of Speech-Language Pathology
and Audiology

Dear Mrs / Mr

Permission to participate in a research study

I, Marizel Scheepers, am a Master's student at the Department of Speech-Langauge Pathology and Audiology, University of Pretoria. My research study is about Afrikaans children's reading skills. The purpose of my research study is to determine the components that contribute to successful reading skills. An example of working memory would be to sequentially remember words or numbers.

The research study is of importance since there is minimal research in children learning to read in Afrikaans as well as the influence of working memory and phonological skills on the process. Phonological awareness skills are the division of words into phonemes (sounds) and syllables, identification of rhyme and alliteration, use of phonemes and syllables to form words, and the deletion, addition, or replacement of phonemes in words. Working memory temporarily stores and manages information needed in order to successfully complete complex tasks, such as reading.

I am a qualified Speech-Language Therapist who will assess your child. Your child's phonological awareness skills, working memory, and reading skills will be assessed using standardised speech-language therapy assessment tools. The assessment will be approximately 75 minutes and will be conducted at your child's school.

All assessment results of your child in this research study will be confidential. Results will be published in such a way that the participants cannot be identified. If any concerns are identified during the research process, you will be informed.

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Your permission is required to allow your child to participate in this study.

Your possible assistance will be appreciated.

Kind regards,

M.Scheepers

Marizel Scheepers

Dr Mia le Roux

Supervisor

Dr Salomé Geertsema

Supervisor

Prof Jeannie van der Linde

Head of the Department of Speech-Language Pathology and Audiology

University of Pretoria

INFORMED CONSENT: PARENT / GUARDIAN

I hereby confirm that I was informed by the researcher, Marizel Scheepers, about the research process, as well as what will happen during the assessment of my child. I received, read, and understood the information regarding the research study. I am aware that the results of the study, including my child's personal details, will be kept confidential. I may withdraw my consent at any time without any adverse consequences.

Name and Surname of your Child _____

Date of Birth _____

Parent / Guardian Name and Surname _____

Parent / Guardian Signature _____

Date _____

Appendix E: Child assent

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Department of Speech-Language Pathology
and Audiology

Dear Grade 2,

My name is Marizel Scheepers and like you are learning in school, I learned to be a Speech Therapist. A Speech Therapist helps children who struggle to speak or understand what others are saying. For some children it is more difficult to read and because they struggle to read, they may struggle to do their homework, read a book, or write a test.

I want to find out why some children struggle to read. I need your help in order for me to help the children who struggle. I am going to ask you to answer a few questions for me, but you do not have to worry, it's not like a test in school.

Will you please me with this? If you want to help me, point to the smiley face. If you do not want to help me, please point to the sad face.

Name of child: _____

Researcher: *M.Scheepers*

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Appendix F: Referral letter

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Department of Speech-Language Pathology
and Audiology

Dear Parent / Guardian,

Thank you for your permission to let your child participate in the research study 'Phonological awareness and learning to read in Afrikaans: The role of working memory.

During the assessment it was noted that your child may need a more in depth assessment.

An assessment from the following practitioner is recommended for _____:

- ☐ Audiologist,
- ☐ Speech-language therapist,
- ☐ Occupational therapist,
- ☐ Educational psychologist,
- ☐ Other.

The reason for the more in depth assessment:

_____

_____

_____

_____

_____

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The following practitioners are possible options:

-

You are kindly encouraged to address this referral.

Kind regards,

M.Scheepers

Marizel Scheepers

Dr Mia le Roux

Supervisor

University of Pretoria

Dr Salomé Geertsema

Supervisor

Appendix G: Teacher questionnaire

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Department of Speech-Language Pathology
and Audiology

Teacher Questionnaire: Phonological awareness and learning to read in Afrikaans: The role working memory.

Student: _____

Questionnaire	✓	×	**Reasons**
• Does the learner perform academically average to above average?			
• Are there any fallouts regarding the learner's reading skills present?			
• Is a hearing impairment present?			
• Does the learner find it difficult to sit still in classroom compared to other leaners?			
• Does the learner find it difficult to attend to instructions or sustain his/her attention compared to other leaners?			
• Does the learner have any speech or language difficulties?			
• Did the learner repeat a school year?			
• Will the learner be 8 years in 2020?			

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Appendix H: Parent / Guardian questionnaire

Questionnaire: Phonological awareness and learning to read in Afrikaans: The role of working memory.

Dear Parent / Guardian

You are kindly requested to answer the questionnaire. All information in the document will be treated confidentially.

Your child's name and surname: _____

- What is your child's home language?

- Does your child experience any hearing problems? If yes, please describe.

- Does your child experience any visual problems? If yes, please describe.

- Does your child experience any learning- or reading problems? If yes, please describe.

- Does your child experience any difficulty to sit still when doing homework or other relevant task? If yes, please describe.

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- Does your child experience any difficulty to pay attention when doing homework or other relevant tasks? If yes, please describe.

- Does your child experience any difficulty saying a sound correctly or substituting one sound with another sound? If yes, please describe.

- Does your child experience any difficulty understanding communication or communicating to others? If yes, please describe.

- Has your child been assessed or received treatment for a health practitioner, for example educational psychologist, speech therapy, audiology, occupational therapy. If yes, please specify.

Thank you in advance for your assistance.

For more information, contact:

Marizel Scheepers:

zellie.scheepers@gmail.com

Kind regards,

M.Scheepers

Marizel Scheepers

Appendix I: Submission of article to South African Journal of Childhood Education

Gmail

Marizel Scheepers <zellie.scheepers@gmail.com>

SAJCE Submission 947 - Confirmation and acknowledgement of receipt

1 message

aosis@sajce.co.za <aosis@sajce.co.za> Tue, Oct 6, 2020 at 11:24 AM
Reply-To: AOSIS Publishing <submissions@sajce.co.za>
To: Marizel Scheepers <zellie.scheepers@gmail.com>

****
Ref. No.: 947
Manuscript title: Phonological awareness and learning to read in Afrikaans: The role of working memory
Journal: South African Journal of Childhood Education
****

Dear Marizel Scheepers

Your submission has been received by the journal and will now be processed in accordance with published timelines.

Processing time guidelines are available under the journal's 'About' section, however, please note that each submission is assessed on its individual merit and in certain circumstances processing times may differ.

You can check the status of your submission in three ways:
- Journal Website: login to your account at https://sajce.co.za/index.php/sajce/author/submission/947.
- Publisher Enquiry Service: telephone numbers are +27(0)219752602 and/or 0861000381.
- Publisher FAQ and Email Service: visit the Publisher FAQ and Email service at https://publishingsupport.aosis.co.za/index.php

You will receive additional emails from the journal as your submission passes through the phases of the editorial process.

Kind regards,
AOSIS Publishing
South African Journal of Childhood Education