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# A PROFILE OF SKILL DEFICITS IN GRADE 2 LEARNERS WITH DYSLEXIA

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## DECLARATION

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## DEFINITION OF TERMS

**Cape Metropole** – The area that extends from Khayelitsha and Muizenberg in the South, Belville in the North, Bridgetown in the West and Stellenbosch in the East (Delo, personal communication, March 9, 2004).

**DDH** – Double deficit hypothesis of Wolf and Bowers (1999), which purports that NS and PA are separate sources of dyslexia and are largely independent of one another.

**Dyslexia** – “A combination of abilities and difficulties which affect the learning processing in or more of reading, spelling and writing. Accompanying weaknesses may be identified in areas of speed of processing, short-term memory, sequencing, auditory and/or visual perception, spoken language and motor skill. It is particularly related to mastering written language, which may include alphabetic, numeric or musical notation” (British Dyslexia Association, 1994).

**Low socio-economic status** – For the purposes of this study, an income of less than R352.42 per adult equivalent per week was considered to constitute the low income and therefore low socio-economic group (May, 1998).

**LSEN** – Learners with Special Education Needs.

**PHAT** – Phonological Assessment Test (Robertson & Salter, 1997).

**PhAB** – Phonological Assessment Battery (Frederickson, Frith & Reason, 1997).

**Phonological Awareness (PA)** – Refers to “children’s appreciation of and ability to process and manipulate the speech sound segments of words” (Muter, 2003). PA is part of a larger construct in coding and retrieving verbal information known as phonological processing (Wagner & Torgesen, 1987).

**Phonological processing** – Includes the skills of PA, phonological code retrieval as well as phonological coding in working memory (Wagner, Torgesen, Laughon, Simmons & Rashotte, 1993).

**Piat – R – Peabody Individual Achievement Test – Revised** (Markwardt, 1989).

**Naming speed (NS)** – The processes underlying the rapid recognition and retrieval of visually presented linguistic stimuli (Wolff, Michel & Ovrut, 1990). “Naming speed is an end product of both lower level perceptual, attentional, articulatory and lexical retrieval processes and higher level cognitive processes, each of which require extremely rapid rates of processing “ (Wolf, Bowers & Biddle, p. 213).

**Orthographics processing** – Refers to the visual processing of letters and letter patterns into words (Wolf, 1993).

**Phoneme** – a phoneme is used to “mean a sound” (Hawkins, 1988, p. 3).

**SLT** – Speech and Language Therapist.

**SS** – Standard score. “The standard score is used to provide information about the relative standing of scores in units that have the same meaning throughout the whole range of values” (Robertson & Salter, 1997, p. 51). Standard scores have a mean of 100 and a standard deviation of 15 (Robertson & Salter, 1997).

**TAPS** – Test of Auditory perceptual Skills (Gardner, 1994).

**TOWRE** – Test of Word Reading Efficiency (Torgesen, Wagner & Rashotte, 1999).

## **ABSTRACT**

This paper applies the classification system of Wolf and Bowers (1999) to a group of twenty five (N = 25) Grade 2 learners with dyslexia aged between 7.9 - 9.7 years attending LSEN schools, matched for age, gender and socio-economic status to a control group of learners without dyslexia in the Cape Metropole. The study investigated whether naming speed (NS) and phonological awareness (PA) deficits occurred independently of one another in the sample and looked at the relationship between NS and PA using five measures of reading ability. A battery of NS, PA and reading tests was administered to the sample group. Descriptive statistics were employed to document the results and learners were categorised into subtypes of dyslexia according to the results of the NS and PA tests. Correlational statistics were employed to investigate the relationship between the variables, NS, PA and reading. A secondary aim of the study was to document the therapeutic approaches employed by Speech and Language Therapists with the sample population. The research is timely in South Africa where there is limited published research on the underlying deficits and intervention methods used by Speech and Language Therapists in children with dyslexia. The findings of the study provide evidence that NS deficits do occur independently of PA deficits and can be used to categorise subjects into subtypes of dyslexia. PA and NS had significantly different correlations with the five measures of reading ability. The clinical implications of this study may guide professionals in determining appropriate interventions in relation to the core deficits in children with dyslexia.

Key words: dyslexia, naming speed (NS), phonological awareness (PA), intervention

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# CHAPTER 1: INTRODUCTION

## 1.1. Background to the study

Reading is not a natural human skill. The brain is not pre-wired to read and there are no reading centres in the brain as there are language centres (Wolf & O'Brien, 2001). In fact, Ramus (2004) has likened reading to chess since it too is a recent cultural invention (about 5000 years old) that places considerable strain on the human cognitive system. Nicolson and Fawcett (1990) describe reading as 'an extraordinary cognitive accomplishment' (p. 160). Despite the enormous demands placed by reading on the cognitive system, most children who are taught to read learn to do so to a high level of proficiency and skill. However, those who do not ("dyslexics") pose major issues of social integration (Ramus, 2004).

Five to ten percent of school-aged children suffer from dyslexia (Habib, 2000 as cited in Habib et al., 2002), and it has been noted as one of the most common developmental disabilities (Nicolson, Fawcett, Moss, Nicolson, & Reason, 1999a). Although some children with dyslexia become competent readers, some children with dyslexia never reach the point at which they can read written text fluently. Temple (2002) acknowledges how these children struggle throughout school to gain access to the curriculum, a situation which is exacerbated in an unsupportive home or school environment. These children struggle to use written language to learn the content of school subjects and may experience failure at school despite their best efforts. Consequently, children with dyslexia may develop "serious problems with self-esteem" (Temple, 2002, p. 105).

Many failed readers are significantly at risk of becoming increasingly behaviourally disruptive or disturbed (Muter, 1996 as cited in Snowling & Stackhouse, 1996). Research has demonstrated a substantial link between early reading failure and later social adjustment problems and delinquent behaviour, at least into the adolescent years and in some instances beyond (Augur & Briggs, 1993). These authors have noted that dyslexics in the school system seldom find status either with their teachers or with their peers. They

end up friendless and solitary, their lack of self-confidence inhibiting their ability to make friends (Temple, 2002). The importance of identification and remediation of dyslexia is evident at the personal as well as the economic level. The difficulties experienced by the dyslexic child “and socio-economic consequences of the disorder are being increasingly emphasized” (Habib et al., 2002, p. 290).

In order to identify and treat dyslexia effectively, and therefore to reduce the negative social and academic development of these children, clinicians must be familiar with the underlying cause, or causes of the disorder. Temple (2002) states “to correct dyslexia effectively, we have to remove the actual cause of the dyslexic symptom” (p. 69). Rack, Snowling and Olson (1992) have stated that remedial (therapeutic) “instruction should be sensitive to the particular patterns of strengths and weaknesses exhibited by dyslexic readers” (p. 29). Characterising the underlying problem is an essential first stage for both theoretical and practical purposes. There are immediate diagnostic and treatment implications from such analysis (Rack & Snowling, 2000).

Ideally, reading disorders such as dyslexia should be identified and treated at the earliest possible sign of delay or disorder (Temple, 2002). Indeed the importance of early identification (and intervention) of reading failure, including dyslexia, has attracted increasing attention from teachers, psychologists, Speech and Language Therapists and the media over the last 10 years (Muter, 1996 as cited in Snowling & Stackhouse, 1996). Nicolson, Fawcett, Moss, Nicolson & Reason (1999) concluded from their study on the effectiveness and cost effectiveness of reading intervention that it is feasible to pick out children at risk of reading difficulties and to provide adaptive, cost-effective support. The identification of core underlying deficit(s) will influence diagnosis and treatment in the dyslexic population. Identifying the underlying cause, however, is no easy feat since there exists an ongoing debate in the literature concerning the causes, characteristics and classification of dyslexia.

In addition, the study of dyslexia, its causes and interventions has not received adequate attention in South Africa, where 28.4% of the adult population is illiterate (Ericsson,

2003). This is possibly due to the national focus on experiential causes (socio-economic and environmental) of illiteracy (Aziz et al., 1991; Gustafson & Samuelsson, 1999) rather than on constitutional factors that may cause illiteracy (Vellutino et al., 1997) in South Africa. However, while these experiential issues may be receiving national attention, constitutional factors causing reading difficulties should not be discarded. There is a need for systematic research on the subject of dyslexia, its causes and classification, in South Africa in order that one sub-section of the reading disabled population may be better understood. Research that investigates the underlying causes of dyslexia will assist in the development of appropriate interventions techniques that address these underlying deficits.

## **1.2. Purpose and significance of the study**

The purpose of this study was to determine whether deficits in naming speed (NS) and phonological awareness (PA) could be used to categorise learners into subtypes of dyslexia according to the theoretical framework of the Double Deficit Hypothesis (Wolf and Bowers, 1999). The purpose of this study was also to determine the relationship between NS and PA with five measures of reading. Furthermore, the study intended to document current intervention strategies employed by Speech and Language Therapists (SLTs) working with the Grade 2 learners with dyslexia in the sample.

This research is timely and important in South Africa where there is a shortage of published information on the South African dyslexic population. The International Institute for Educational Planning has stated that “the need for collecting data, evaluating the efficiency of existing programmes, undertaking a wide range of studies, exploring and fostering broad debate on these bases to guide educational policy decision making has become more acute than before” (Hite, 2001, p. 6). The data concerning the NS and PA deficits and their relationship with reading may inform diagnosis and intervention and provides preliminary data for larger studies in this area.

This study may have created awareness among those professionals working with the sample population. These data may provide preliminary data for further studies aimed at justifying an additional focus of diagnosis and intervention for children with dyslexia to enhance the efficiency of existing programmes.

## CHAPTER 2: LITERATURE REVIEW

### 2.1. Introduction

An extensive literature search was conducted to obtain research documents of appropriate quality and usefulness (Hite, 2001) on dyslexia and the underlying deficits of the dyslexic disorder. The term 'dyslexia' was adopted for this study as it specifies one of many learning disabilities. As noted by Greene (1996), "dyslexia is one of several distinct learning disabilities". It is possible that the term 'language-learning disability' could have sufficed for the purposes of this research. However, language learning disability encompasses receptive and expressive language disorders (National Institutes of Health, 1993), which (as will be noted later in the paper) do not necessarily form part of the description of dyslexia. Further 'reading disability' is a term that is synonymous with dyslexia (National Institutes of Health, 1993). For these reasons, the term 'dyslexia' was chosen for this study.

This literature was therefore found using keywords such as dyslexia, phonological awareness, phonological processing, naming speed, double deficit hypothesis, phonological deficit hypothesis, developmental reading disorders/delays, language disorders and reading. Papers in English were acquired and reviewed. References from the articles were used to lead to other sources of relevant titles. Government archives were accessed through the Government Publications Department. Finally, local resources were also used in the literature review process (Hite, 2001). Three experts in the field of reading disorders and dyslexia were consulted.

This literature review aims to provide an overview of the historical and contemporary perspectives of the classification of the underlying causes of dyslexia. Two of the major hypotheses will be presented and discussed. The main theoretical tenets of the phonological deficit hypothesis (PDH) will be presented followed by an outline of the rationale for the development of the DDH. These issues will offer a background to the

Discussion in which the findings of the present research will be analysed with respect to each hypothesis.

## **2.2. The phonological deficit hypothesis (PDH)**

Before 1979, the underlying cause of dyslexia was thought to be a visual perceptual deficit. Ascribing dyslexia to visual defects can be traced back to the 1930s (Spafford, Grosser, Donatelle, Squillace & Dana, 1995). This was a viable opinion based on the many reversal errors made in reading and spelling by dyslexic learners (e.g. saw for was). However, Vellutino (1979) (as cited in Nicolson & Fawcett, 1994a) undertook an extensive review of the evidence relating to this theory in a study that documented the deficits in children with dyslexia. Vellutino (1979) (as cited in Nicolson & Fawcett, 1994a) found that there was little evidence in favour of the visual processing deficit. However, this author identified a consistent relationship between reading disabilities and verbal processing deficits. From his study, he concluded that problems of language must, at least in part, be responsible for the reading deficits of dyslexic children. Subsequently, children with dyslexia have been found to have deficits in the areas of speech perception, speech production, reading, writing and object naming (Ramus, 2001), all of which have one element of language in common, that of phonological processing (Elbro, 1998; Ramus, 2001). This phonological deficit hypothesis (PDH) has become the main theoretical belief of most dyslexia researchers with a background in psychology (Cornwall, 1992; Nicolson & Fawcett, 1994a; Rack, Snowling & Olson, 1992; Snowling & Stackhouse, 1996; Wolf, Bowers & Biddle, 2000).

There has been an abundance of research into the PDH. It has been accepted that phonological processing skills play a major role in the acquisition of reading in an alphabetic script (Badian, Duffy, Als & McAnulty, 1991; Cornwall, 1992; Rack et al., 1992; Ramus, 2001; Wagner et al., 1993). The phonological deficit theory implies that dyslexia results from a specific, unitary impairment of phonological representations and processes (Ramus, 2001). These phonological processes include PA, phonological coding

in working memory and phonological code retrieval. A review of the research into these three areas will be presented below.

### **2.2.1. Phonological awareness**

The first body of research which has received much attention centres on the construct of PA (Wagner et al., 1993). This PDH view of dyslexia involves the idea that in order to learn an alphabetic writing system, the brain needs to map letters (graphemes) to the corresponding speech sounds (phonemes). Proponents of the PDH purport that children who are aware of the sound sequences that make up their (oral) language will be able to capitalize on this knowledge when learning the written sequences of their language (orthography) (Goswami, 1986 as cited in Wolf & Bowers, 1999). That is, children require explicit knowledge of the separate sounds (phonemes) before they can make direct connections between the phonemes and the graphemes (letters). This is a prerequisite for the development of the connections between spoken words and printed words for word recognition (Ehri, 1992 as cited in Snowling & Stackhouse, 1992) and reading. “For the majority of children, the phonological system is fully formed by the time they come to learn to read at school” (Snowling & Stackhouse, 1996, p. 5). These children can therefore begin to map sounds to letters and words due to their implicit knowledge of the sound sequences that make up their language. This awareness provides a foundation for the reading system, which can be thought of as “parasitic upon it” (Snowling & Stackhouse, 1992, p. 5). The PDH purports that dyslexic individuals have specific difficulty in representing and recalling the speech sounds. That is, they have a deficit in the skill of PA - hence their difficulty in mapping sounds to letters, and hence their reading difficulty (Ramus, 2001). There is therefore evidence that indicates that preliterate children, and those who are experiencing difficulty in acquiring the skill of reading, perform poorly on word games that require them to manipulate aspects of the sounds of words from memory (Byrne & Shea, 1979).

Numerous longitudinal studies have been conducted to examine the relationship between PA tasks administered to preschool children and their subsequent reading development.

These studies have concurred with the view that intact PA is necessary for the development of normal reading and that any deficits in preliterate PA skills result in reading difficulties at school-going age (Mann, 1986 as cited in Cornwall, 1992; McDougal, Hulme, Ellis & Monk 1994; Wagner & Torgesen, 1987; Wagner et al., 1993). Wagner and Torgesen (1987) as well as McDougal et al. (1994) have claimed that tests of PA are among the best predictors of children's progress in learning to read. Muter (2004) commented that PA tasks given to pre-school children could predict children who would develop later reading difficulties with 80 percent accuracy.

Before reviewing further evidence for the PDH, a synopsis of lexical access (Figure 1) is warranted to provide a framework within which to place phonological awareness and phonological code retrieval. The model of lexical access proposed by Ramus (2001) offers an outline of the phonological component of these skills. Ramus (2001) has developed an information-processing model of lexical access for words in memory, as well as printed words that centres on the mental lexicon. This model (Figure 1) presents the cognitive components that underlie most tasks used to argue for a PDH.

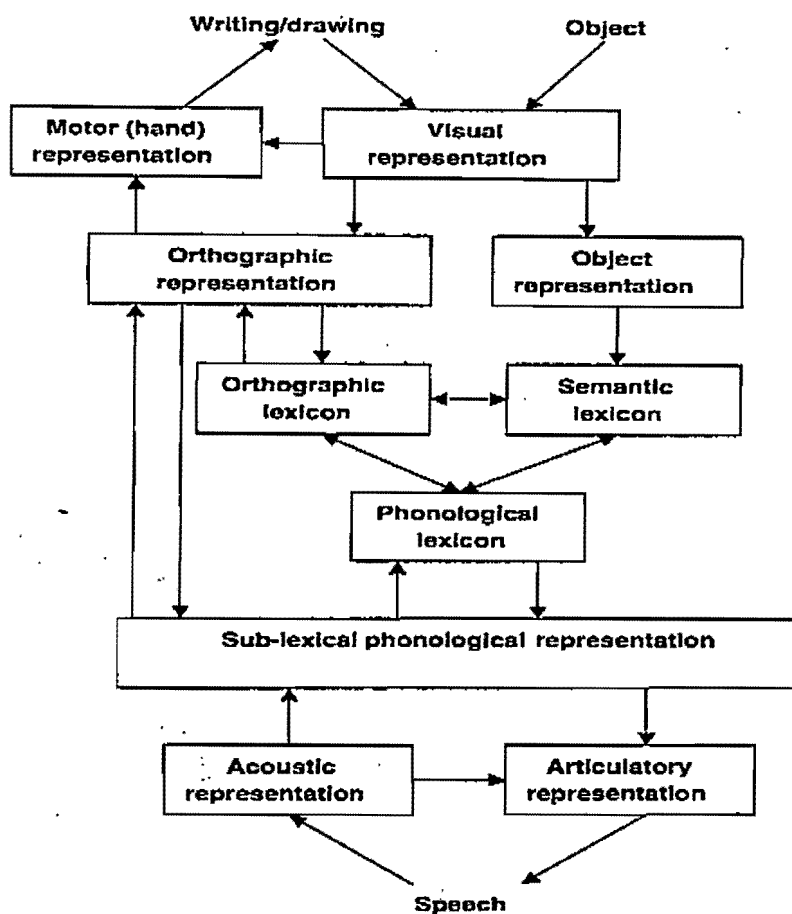


Figure 1

Model of lexical access (Ramus, 2001, p.4) (reprinted with permission)

The mental lexicon is divided into three parts: semantic lexicon, phonological lexicon and orthographic lexicon. The phonological lexicon is hypothesised to consist of two levels. The two levels may serve discrete purposes: the phonological lexicon is believed to contain a permanent storage of words and word forms (lexical access), whereas the sub-lexical level representation contains the short-term storage of phonological forms (Ramus, 2001). The explicit judgement and/or manipulations of phonemes is performed at this sub-lexical level of phonological representation. That is, PA tasks are performed at the sub-lexical phonological level and whole word retrieval is performed at the phonological lexicon level. Deficits at this level of lexical representation (sub-lexical level) suggest a phonological deficit in dyslexic children, who according to Stackhouse and Wells (1997) may not possess sufficient internalized knowledge of the structure of the different hierarchies of phonological representation.

### **2.2.2. Phonological code retrieval or lexical access**

The second body of research on phonological processing centres on the construct of “retrieval of phonological codes from a long term store” (Wagner et al., 1993, p. 85), in other words, accessing and retrieving phonological codes of words in the form of letters, word segments or whole words. Research has been conducted that has sought to realise that deficits at the phonological level (lexical and sub-lexical levels) underlie the difficulties children with dyslexia have with naming (retrieving words). The following section outlines two studies that demonstrate the phonological component of the naming difficulties experienced by children with dyslexia.

One of the tasks used to argue for the PDH has involved speech production or naming. Katz (1986) noted that children with reading disabilities have problems in naming objects. Children with dyslexia name fewer of a set of pictured objects than children without dyslexia. Katz (1986) aimed to determine whether the errors in naming that are so common in dyslexic children (Mattis, French & Rapin, 1975) were linked to the problems children with dyslexia had in performing certain tasks that require adequate phonological processing skills. Therefore, he conducted research to investigate whether poor readers had object-naming deficits as a result of phonological deficiencies in establishing complete, or distinct representations in long-term memory in order to provide evidence of a phonological deficit in dyslexic children.

Katz (1986) conducted two experiments to examine the hypothesis that phonological deficits contribute to the object-naming deficiencies in poor readers. In the first experiment, the author set out to elicit errors in naming by placing subjects under time pressure during a naming task. The children were asked to name line drawings of objects as quickly as possible. By stressing speed, it was expected that the subjects’ naming ability would be taxed. The instrument used was the Boston Naming Test (Kaplan, Goodglass & Weintraub, 1983 as cited in Katz, 1986), which is a confrontation naming task (placing pictures in front of the child, one at a time and asking him/her to say the

word for the picture). According to Ramus (2001) naming requires the detection of the appropriate word (or semantic level activation), the retrieval of their phonological form and the conversion to an articulatory command. The speech must be encoded in a 'speech-specific manner' which is a sub-lexical phonological representation (Ramus, 2001, p. 200).

Evidence that the failure to name objects correctly was due to phonological deficiencies was sought by analysing the erroneous responses and by analysing the characteristics of the object names that were produced incorrectly. The results indicated that many of the responses were incorrect, although phonetically similar to the target words, the "error word shared with the target words, the same stress pattern, the same number of syllables and several phonemes" (Katz, 1986, p. 236). Katz (1986) claimed that the phonological representations were not sufficiently detailed or not effectively processed. The higher error rate in the poor readers indicates immature and deficient phonological processing. Snowling, van Wagtenonk and Stafford (1988) replicated this study and added a semantic component. These authors found that "dyslexics are slower to lay down precise phonological specifications for spoken words they recognise and the meaning of which they know, than children of the same age" (p. 76).

In the second experiment, Katz (1986) compared the same children on their ability to make metalinguistic decisions based on the names of pictured objects. The children were tested on two metalinguistic tasks that had different kinds of phonological attributes. The tasks included rhyme tasks, which required them to decide whether two objects have rhyming names, and length tasks, which required them to decide whether two objects both have short names. Each task required that the necessary phonological attributes be adequately represented and that the subject have conscious access to these attributes. Although the poor readers performed as well as the good readers on rhyme tasks, they were unable to become explicitly aware of the length of the words that were held in memory. Ramus (2001) ascribes this to a deficit at the sub-lexical level of phonological representation. It required them to use their internal (phonological) representation to judge the length of each pair of test words. Poor readers could not judge the lengths of

words in long-term memory when they had to depend solely on the phonological representations stored in short-term memory (sub-lexical level).

Katz (1986) suggested that the poor readers failed on this task because they lacked explicit awareness of the units of the phonological representations which correspond to the units of spoken words. Therefore poor readers are less aware than good readers of the phonetic segments of spoken language (Liberman, Shankweiler, Fischer & Carter, 1974 as cited in Katz, 1986) and therefore make phonologically based errors in naming.

### **2.2.3. Phonological coding in working memory**

The third area of research which has given credence to the PDH concerns the phonological component in working memory. Wagner et al. (1993) have stated that phonological coding in working memory is the ability to code information in a sound-based representation system for effective on-line processing. Snowling (1998) (as cited in Muter, 2003) purports that tests of working memory may essentially be tapping the completeness or distinctness of the child's phonological representations. That is, various phonological processing tasks, including verbal working memory actually tap underlying phonological representations and it is the quality of these representations which affects the child's ability to hold phonological codes in memory. With words only vaguely represented at the phonological level, there is restriction in the number of verbal items that can be retained in memory (Muter, 2003).

With the knowledge that phonological deficits underlie the naming errors of children with dyslexia (Katz, 1986), Elbro (1998) aimed to establish a further possible cause of this accepted phonological processing deficit at the level of verbal short-term memory, and conducted research into the *distinctness* of phonological codes in memory. Elbro (1988) explains that problems in establishing distinct phonological representations in long-term memory may be a cause of the phonological processing deficits, including short-term memory deficits, found in children with dyslexia (Snowling et al., 1988). Within Ramus' (2001) model, this would be at the level of the phonological lexicon. In his work, Elbro

(1988) refers to *distinctness* as the magnitude of the difference between a representation and its neighbours. For example 'and' is more distinct than 'in' because 'in' is indistinguishable from the pronunciation of unstressed 'an' (p. 149). Phonological representations with many distinctive features are, on average, more distinct than representations with fewer distinctive features. The distinctness of a lexical representation is a determinant, among others, of the completeness and accuracy of the representation. Since speech production (naming) requires the finding of a lexical representation that matches a sub-lexical set of phonemes, low levels of distinctness impede access to sub-lexical phonological units (Ramus, 2001). Elbro (1998) goes on to suggest that it may be easier to get access to a phonological representation that is well specified and clearly separated from its neighbours than to a phonological representation that is incompletely separated from its neighbours.

Elbro (1998) tested this hypothesis by getting children with dyslexia to pronounce words clearly on hearing one part of the word at low levels of distinctness (e.g. 'codi' for crocodile). Distinctness was based on selected vowel segments. The distinctness of their productions differed significantly from a control group of children without dyslexia. The children with dyslexia made more errors due to words being represented with a low level of distinctness. This made it more likely that the words would be "mispronounced and confused with other similar sounding words" (Elbro, 1998, p. 152). This author suggests that low levels of phonological distinctness in children with dyslexia may be a cause of difficulties with phonological discrimination, picture naming, phonological short-term memory and phonological awareness. Therefore, Elbro (1998) has offered evidence that the phonological distinctness of words in memory may be impoverished in children with dyslexia, a deficit that may impair their ability to hold words in memory for ongoing processing.

Further evidence for phonological coding in working memory difficulties in children with dyslexia, has been provided in the form of non-word repetition tasks. Gathercole and Baddeley (1989) (as cited in Muter, 2003) adopted a non-word repetition task to assess children's phonological coding in working memory. In this task, children were asked to

listen to and repeat nonsense words (e.g. 'glistow). These authors performed a two-year longitudinal study in which they gave tests of non-word repetition and vocabulary knowledge one year apart. They determined that performance on a non-word repetition task predicted children's vocabulary one year later. These authors went on to hypothesise that non-word repetition may play a role in reading development. Muter and Snowling (1998) (as cited in Muter, 2003) confirmed this hypothesis by identifying a significant relationship between non-word repetition tasks at age five and six and reading accuracy at age nine. Marton and Schwartz (2003) concur with this hypothesis by stating that working memory plays an important role in learning to read.

#### **2.2.4. Overview of the PDH**

It can be noted that in conjunction with longitudinal studies on the predictive qualities of phonological processing on reading ability, the above findings provide strong evidence for a deficit at the level of phonological representation (lexical and sub-lexical levels of representation) (Ramus, 2001; Ramus, 2003) in children with dyslexia. In accordance with this hypothesis, the deficits in PA, naming (word retrieval) and verbal working memory that are so common in children with dyslexia, can be accounted for by their deficient phonological systems. As Wagner et al. (1994) have stated, phonological processing is believed to be causally related to the acquisition of beginning reading skills.

### 2.3. The double deficit hypothesis (DDH)

As alluded to earlier, although the PDH has received overwhelming support, it has not gone undisputed as the single underlying cause of reading failure in children with dyslexia. Despite the evidence of a unitary phonological difficulty (particularly PA deficits) in children with dyslexia (Plaza, 2003) there is also convincing evidence that the *rapid* retrieval of the spoken form of a visual stimulus is robustly related to reading skill and that dyslexic individuals have a deficit in this skill (Wolf, 1991). Therefore, the controversy surrounds what is termed 'phonological code retrieval' in the PDH. The argument that children with dyslexia are *slower* at naming tasks requiring precisely timed synchrony has led to the development of the Double Deficit Hypothesis (DDH) (Wolf & O'Brien, 2001).

The hypothesis that dyslexic children are slower at naming stemmed from the work of Geschwind (1975) (as cited in Wolf et al., 2000) who claimed that colour naming might predict reading since both tasks require the child to provide verbal responses for visual stimuli. Denckla (1972) (as cited in Wolf & Bowers, 1999) tested this theory and found that rapidity (in a serial rather than discrete trial format) rather than colour naming per se, correlated with reading performance. The importance of adopting the serial format in research on dyslexia and naming is made apparent by Blachman (1984) (as cited in Wolf & Bowers, 1999) who has suggested that the rapid serial naming format provides a better approximation of the requirements in reading than does the discrete trial tasks. Discrete trial tasks require the child to name visual stimuli that are presented one at a time. In contrast, the serial format requires children to name visual stimuli that are presented in a serial format. The best-known method of assessing NS is the rapid automatized naming (RAN) test developed by Denckla (1972) (as cited in Wolf & Bowers, 1999). The test requires the individual to name a visual array of 50 stimuli, consisting of five symbols from a given category (e.g. letters, digits, objects). Spring and Davis (1988) have noted that children with dyslexia are slower to perform this task than children without dyslexia.

Wolf and Bowers (1999) have described this NS difference in dyslexics as an information-processing deficit that may not be detected using tests of a discrete trial format. The performance of dyslexic children on these discrete trial format tasks (confrontation naming where the pictures are placed one at a time in front of the child) has been found to have little relationship with reading. Contrary to the findings of Katz (1986), Wolf (1986) argues that dyslexic children “do not differ at a basic level of rapid retrieval (discrete trial)” (p. 362) but that significant differences in naming are identified when the extra cognitive factors in continuous or serial retrieval are added, particularly for graphological symbols (digits and letters). Further, Spring and Davis (1988) provide an explanation of the difference in performance of dyslexic children on discrete trial and serial naming tasks stating that poor readers may have difficulty with simultaneous processing of information. That is, good readers are able to name the target item while processing information to the right of the target, while poor readers may be restricted to serial processing. Since automaticity is defined as “the ability to perform a task with so little attention that the performance of a simultaneous task is not impaired” (Spring & Davis, 1988, p. 317), it is clear that naming speed measured using the discrete trial format would be insufficient to measure automaticity necessary for fluent reading and comprehension (Katz & Shankweiler, 1985). Cross-sectional and longitudinal studies indicate that NS deficits characterise children with dyslexia from kindergarten (Wolf, Bally & Morris, 1986) through adulthood (Felton, Naylor & Wood, 1990 as cited in Wolf et al., 2001).

This rapidity difference in children with dyslexia has resulted in the re-conceptualisation of reading disabilities, integrating previous work on phonological deficits with research on naming speed deficits (Wolf et al., 2000). The importance or relevance of rapid naming in the study of the development of reading may seem an obscure one and the link between reading and NS will be explored in the following section.

### 2.3.1. Naming speed and reading

Wolf et al. (2000a) comment on the fact that serial naming of visual stimuli provides a simple approximation of the reading process. In both processes there exists a combination of rapid serial processing and integration of attentional, perceptual, contextual, lexical and motoric subprocesses (refer to Figure 2 on the model of rapid naming). The *automatisation* of the underlying processes in NS are believed to be prerequisite for the performance of other higher-level reading tasks such as comprehension. Tests of rapid naming measure this *automaticity* of the visual-verbal link, which provides an indication of the attentional capacity that is freed up and therefore available for higher level reading skills such as comprehension, or for acquiring the next level of skill in reading development (Bowers & Swanson, 1991). Clark (1988) (as cited in Cornwall, 1992) has proposed that rapid naming tasks reflect the ease with which a child can access the sound and meaning of a written word and is therefore important in the development of reading fluency and speed. Carver (1991) purports that NS offers a measure of “cognitive speed or thinking rate that can be compared to reading rate” (p. 33). Plaza (2003) suggests that NS is an adequate indicator of reading because of its emphasis on cross-modal skills (visual-verbal) rather than purely verbal skills, as in the PDH.

Wolf and Bowers (1999) offer a more in-depth account. Two hypotheses have been developed concerning the relationship between processes underlying NS and reading failure. The first is the domain-specific nature of NS. Within this hypothesis, NS is seen as an index of a specific deficit in the recognition of *orthographic* patterns. Although many researchers have downplayed the role of vision in reading (Spafford et al., 1995) the DDH has revisited, to some extent, the role of vision in the link between NS and reading, particularly the magnocellular system. Accordingly, the first hypothesis, the domain-specific hypothesis, proposed by Bowers and Wolf (1993) (as cited in Wolf & Bowers, 1999) asserts that the processes underlying slow visual naming speed contribute to reading failure by impeding the interaction and development of orthographic-phonemic links. Chase (1996) (as cited in Wolf & Bowers, 1999) provided an

explanation for this by suggesting that the impediments might begin at the visual perceptual level or the magnocellular level. On looking at visual stimuli such as letters, words or objects, the individual automatically analyses the constituent features. This requires the processing of low-spatial frequency components, which is the function of the magnocellular system. Anomalies in the magnocellular region (which have been identified in post-mortem and brain imaging studies) are believed to lead to deficits in the visual system which result in visual planning/visual attention deficits (Ramus, 2004). Rosen (1988) (as cited in Wolf & Bowers, 1999) argued that this would in turn affect the speed with which dyslexic individuals could process visual information. Similarly, the amalgamation of phonemes and orthographic patterns would be adversely affected with consequences for reading fluency. Wolf and Bowers (1999) purport that this processing speed can be indexed using RAN tasks, such as the tasks used in the present study. Overall, Wolf and Bowers (1999) suggest that within this hypothesis, slow retrieval of letter identities, at the level of the magnocellular system (NS deficit), could derail orthographic development and subsequently reading development.

It has been argued that the deficit in naming is limited to certain types of stimuli, and that results using these stimuli correlate more strongly with reading. For example, Katz and Shankweiler (1985) noted that there was no difference between impaired and normal readers in their naming times for colours, objects and animals, but that there was a significant difference between naming of letters and words for impaired and normal readers. They concluded from this study that naming deficits were limited to the orthographic (letters) domain. This finding was supported the following year by Wolf (1986) and extended to include digits. This author found that the deficit in naming in dyslexic children was found in naming of graphological symbols (digits and letters) rather than the non-graphological symbols (colours and objects). Furthermore, Wolf et al. (1986) found that continuous (serial) naming of digits *and* letters were effectively equal in predicting Grade 2 word recognition, and that both digit and letter naming were more robust than colour and picture naming.

The domain-general hypothesis considers NS as the “lexical midpoint in a cascading system of processing-speed effects” (Wolf & Bowers, 1999, p. 428). These authors acknowledge that within this hypothesis, slow retrieval of letter identities could be based on processing rate deficits in a variety of cognitive functions. Habib et al. (2002) have proposed that these different levels of impairment (above) all stem from a basic deficit involving temporal processing of stimuli by the brain. They suggest that dyslexic children are unable to process rapidly changing auditory or visual information at the rate of normal readers, thereby accounting for their deficit in NS. Further evidence for the domain-general deficits comes from findings at the motor level. Nicolson and Fawcett (1990) investigated balance ability in dyslexic and non-dyslexic children by requesting them to balance on a beam. These authors found no difference between the groups on this single balance task, but found significant group differences when dyslexic children were required to balance and perform another task such as counting. It is plausible to argue that these differences are due to “incomplete automatising of component sub skills leading to greater reliance on conscious processing resources thus impairing multi-task performance” (p. 176). This issue has already been touched on in previous sections. The dyslexic children’s performance on discrete trial format naming tasks did not differentiate dyslexic children. Rather, when the cognitive demands of serial processing are involved, dyslexic children emerge with a deficit in NS (Wolf, 1986). Wolf and Bowers (1999) suggest that whatever underlies the consistent perceptual and motoric timing deficits in children with dyslexia could also affect the speed of the lexical retrieval process. These authors use the above findings as evidence to support the domain-general hypothesis of NS. These two hypotheses have provided researchers with a framework within which intervention methods for NS deficits can be developed.

### **2.3.2. Rationale for separate categorisation of naming speed and phonological awareness**

Wolf and Bowers (1999) have stated that although there is “little disagreement concerning the behavioural evidence of naming-speed (NS) deficits in dyslexic readers” (p. 415), there are substantial differences in how these naming deficits should be categorised. Common practice is to subsume NS deficits under phonological processing deficits so that NS is seen as a manifestation of phonological processing difficulties (Plaza, 2003; Wolf & Bowers, 1999). The rationale for including NS under phonological processing is that NS involves retrieving and pronouncing words from the lexical or sub-lexical phonological system (Wise, 2001). However, Wolf and Bowers (1999) claim that NS deficits are not merely a manifestation of phonological processing deficits, but that they are a separate source of reading difficulties. The position of Wolf and Bowers (1999) diverges from the above-mentioned PDH in its differentiation of NS processes from phonological processes and in the implications for intervention and assessment. These authors present the following evidence in support of their hypothesis that NS and PA are not merely part of the same skill.

#### **2.3.2.1. Subtype distinctions**

One of the major findings by Wolf and Bowers (1999) in support of a separate deficit hypothesis, is their finding of distinct subgroups or subtypes of dyslexic learners. Wolf and Bowers (1999) purport that if a child presents with rate, or processing speed problems without PA problems, then this provides further evidence for the independence of the two sources of reading failure. To pursue evidence supporting these questions, Bowers (1995) (as cited in Wolf & Bowers, 1999) re-analysed a sample of readers between Kindergarten and Grade 4. This author used a 35-percentile cut-off on an auditory analysis task and digit-naming task. The results identified four subtypes of dyslexic readers (Table 1). In addition, Wolf (1997) reanalysed a sample using stricter cut-off criteria (one standard deviation below the mean) for a digit and letter NS and a

phonological nonsense word decoding test. These studies of whole classroom samples, which used different cut-off points and two different measures of phonological skill, both identified four subtypes of dyslexia. They identified NS, PA, double deficit and no-deficit subtypes of learners. The no-deficit subtype consisted of average readers. Lovett (1995) (as cited in Wolf & Bowers, 1999) replicated these findings with a clinically referred sample consisting of profoundly disabled readers. Lovett (1995) (as cited in Wolf & Bowers, 1999) found that 79 percent of her sample of dyslexic learners could be classified according to the double deficit criteria.

These studies identified that the phonological subtype had no identifiable deficit in NS performance but did have significant decrements in performance on phonological tasks (e.g. phoneme elision, phonological blending or both), word attack and comprehension. The NS deficit subtype had no identifiable deficit in phonological tasks but had difficulties in timed reading, fluency measures, and reading comprehension. The double-deficit subtype was characterized by deficits in both phonological and NS areas and in all aspects of reading (Table 1).

Table 1

Double Deficit Hypothesis Subtypes (Wolf & Bowers, 1999)

Subtype	Characteristics
Rate group	Intact phonological decoding, NS deficit and impaired comprehension
Phonological subtype	Intact NS, impaired phonological decoding
Double deficit	Naming speed, phonological decoding and severe comprehension deficits
Average group	No deficits, average reading

Lovett (1995) (as cited in Wolf & Bowers, 1999) noted that children with double-deficits presented with more severe reading difficulties than children with single-deficits.

Phonological deficit readers were more impaired than NS deficit readers on all word-identification accuracy measures and NS deficit readers were significantly more impaired than the phonological deficit readers on word-identification latencies or speed of word-identification. The existence of separate subtypes of dyslexia, and their influence of reading ability has been argued by Wolf and Bowers (1999) as a evidence that the two deficits occur independently of one another and should therefore be diagnosed and treated independently.

### **2.3.2.2. Data from diverse populations**

NS deficits have been demonstrated in impaired readers across several language systems; that is: German (Naslund & Schneider, 1991 as cited in Wolf & Bowers, 1999), Dutch (Van den Bos, 1998 as cited in Wolf & Bowers, 1999), Finnish (Korhonen, 1995) and Spanish (Novoa, 1988 as cited in Wolf & Bowers, 1999). Data from these language systems of varying degrees of regularity, have allowed researchers to separate the effects of NS and PA on reading. Therefore, researchers have aimed to investigate languages in which the phonological demands on young readers are reduced, as is the case in languages with a more regular orthography (such as German), to determine whether naming speed deficits appear as a stronger characteristic of dyslexic children. It was believed that readers with reduced phonological awareness abilities may master the less stringent demands for phoneme analysis and synthesis imposed by the more regular orthography, so that NS deficits would appear as the strongest diagnostic indicator of dyslexia (Wolf & Bowers, 1999). This hypothesis was supported by Wimmer (1993) who showed that young German dyslexic readers (Grade 2 - 4) had less severe deficits in phoneme segmentation tasks, scoring high in absolute terms, as well as recognition accuracy for words and pseudowords. However, these children had significant deficits in NS measures, with digit NS being the most predictive of dyslexia in German children. Wolf and Bowers (1999) interpreted this data as partial support for the DDH, since “when phonological analysis demands placed on young readers are reduced in language with a more regular orthography, the NS deficit appears as the dominant diagnostic indicator for at-risk readers” (p. 420).

### **2.3.2.3. Relationship between naming speed and phonological awareness**

The interrelationships between measures of NS and measures of PA are argued as a further finding in support of the DDH. Wolf and Bowers (1999) have stated that there are generally modest rather strong relationships between NS and broad phonological-based tasks. That is, PA tasks have weak correlations with NS tasks. In a study aimed at evaluating the presence of a general phonological factor in a reading-risk population, Felton and Brown (1990) found no significant correlation between NS and all measures of PA. Cornwall (1992) reported a modest relationship between NS and the measures of PA (phoneme deletion) in a reading-impaired population. Cornwall (1992) concluded “these abilities may represent unique aspects of the reading process, as opposed to an overall phonological ability” (p. 537). Wolf and Bowers (1999) interpret the findings as one indication of the difference in underlying requirements necessary for PA and NS. Further, cross-linguistic studies have been supportive, as noted by Wimmer (1993). Overall, the majority of findings across different languages, age groups and average and impaired readers is consistent with weak relationships between NS and PA.

#### **2.3.2.4. Independent contributions of naming speed and phonological awareness to reading**

Furthermore, there are independent contributions of both NS and PA to *different* measures of reading (Wolf & Bowers, 1999). Many studies have found differential contributions of NS and PA to specific aspects of reading. Bowers and Swanson (1991) reviewed studies in English, Dutch and German and suggested an independence of NS and PA in predicting word recognition performance. Different patterns in the relationships of NS and PA to the different reading sub skills has been argued by Wolf and Bowers (1999) as evidence of the hypothesized independence of NS from PA processes. Bowers and Newby-Clark (2002) state, “PA and NS contribute both unique and shared variance to many measures of reading” (p. 112). Bowers and Swanson (1991) found that PA tasks strongly predicted word and non-word identification as well as word attack (non-word reading), but not word and text reading speed. NS was independently related to word identification (accuracy and latency) in the study by Bowers and Swanson (1991). Cornwall (1992) found similar results to those of Bowers and Swanson (1991). PA added significantly to the variance in word attack (nonsense word reading) as well as reading comprehension. NS added significantly to the variance in word identification (sight word reading), prose passage speed and accuracy. Thus it is the unique variance associated with NS that suggests that another process, apart from PA, may be important for reading (Bowers & Newby-Clark, 2002).

Despite this evidence for unique contributions of NS to reading, Spring and Davis (1988) sought to identify the impact of digit naming deficits on three measures of reading in an earlier study. The three components of reading that were considered in this study were: the direct access mechanism by which words are recognized as a whole (sight word reading), the speech-recoding mechanism by which words are sounded out and reading comprehension. “It was assumed that irregular words (sight words) and nonsense words would be processed in different ways” (Spring & Davis, 1988, p. 322). However, there was no evidence from the results of the study to support this hypothesis. Digit NS was

reliably correlated with whole word reading and non-word reading and the difference between the correlation was not significant. Therefore, this study indicated that the digit NS test measured skills that were equally important to both word recognition routes. Furthermore, the results indicated that digit naming was reliably correlated with reading comprehension, although the correlation with comprehension was smaller ( $r = .23$ ) than the correlation between NS and word recognition accuracy. Spring and Davis (1988) contend that the relationship between NS and reading comprehension may be secondary to the ability of their subjects to recognise words in the comprehension test, rather than due to a direct connection between processing speed and comprehension. This was confirmed when the correlation between digit NS and comprehension was reduced to zero when word recognition was controlled. Therefore, it was apparent that the skill measured by digit NS was primarily important in word recognition.

#### **2.3.2.5. Processes underlying naming speed**

Wolf & O'Brien (2001) recognise that the underlying skills assessed in tasks of NS do require the activation of stored phonological representations to access and retrieve phonological labels for visual stimuli (such as 's'). However, in light of the contribution of many other processes involved in NS, these authors argue that NS is not reliant solely on phonological processing (Wolf et al., 2000a). Therefore, the rationale for differentiating NS from PA begins with an examination of the perceptual, cognitive and linguistic processes underlying the behavioural requirements of serial or continuous NS (Wolf & Bowers, 1999).

Wolf et al. (2000a) provide an overview of the complex cognitive structure and requirements of naming as well as the importance of timing within each of the subprocesses. Visual naming demands an array of attentional, perceptual, conceptual, memory, lexical and articulatory processes. Wolf and Bowers (1999) have developed a model of continuous letter naming (Figure 2), but stipulate that this model would also be relevant for other stimulus sets, particularly numbers. These authors purport that rapid

letter naming, as measured by the tasks in this study (taken from their example), requires the activation of attentional processes to the letter stimuli which in turn activate bihemispheric, visual processes responsible for feature detection, discrimination and pattern identification at multiple levels. This is followed by the integration of visual features with stored orthographic representations. Phonological processing then plays a role in the integration of visual information with stored phonological representations as well as access and retrieval of phonological codes. Finally, semantic and conceptual information is activated leading to motoric activation and ultimately articulation of the letter sound. The entire process is estimated to occur within 500 milliseconds (Wingfield, 1968 as cited in Wolf et al., 2000a).

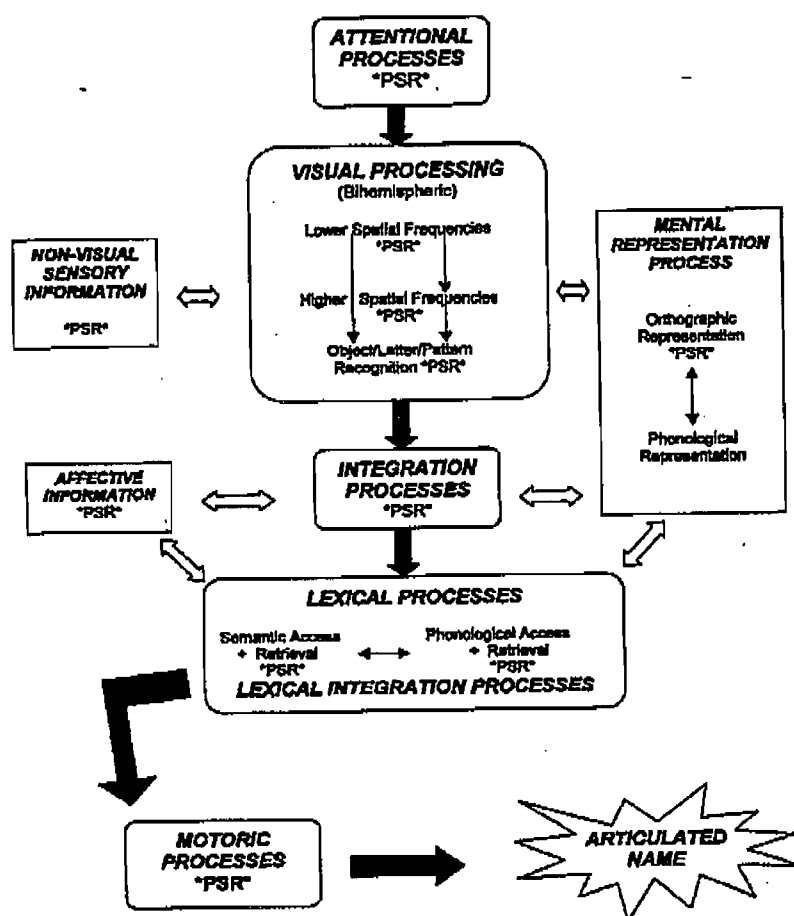


Figure 2

Model of visual naming for letters (Wolf & Bowers, 1999, p. 417). (PSR) = processing speed requirements (reprinted with permission).

The above model demonstrates the variety of processes involved in visual naming, the critical but confined role of phonological processing within naming and exhibits the extent of the processing speed requirements at each level as well as the correspondence between the components of naming and reading (Wolf & Bowers, 1999). The Figure above further underlies the motivation that NS is not part of the same phonological family as PA (Torgesen, Wagner, Rashotte, Burgess & Hecht 1997).

Therefore, within the DDH, the role of phonological processing in NS is seen as essential - activating stored phonological representations as well as access and retrieval of phonological labels. The role of phonological processes do not, however, constitute the only process involved in naming (Wolf & Bowers, 1999). In addition to the above-mentioned motivation, Wolf and Bowers (1999) point out that many other verbal tasks (such as semantic fluency and expressive vocabulary) require the same phonological processes yet are not classified as phonological tasks. They note how these tasks (semantic fluency and expressive vocabulary) are usually categorised according to the greater emphasis on other operations and are therefore categorised as semantic or language tasks. These authors therefore contend that since NS relies on an ensemble of lower level visual perceptual processes and higher-level cognitive and linguistic subprocesses that are not noted in PA tasks, NS warrants categorisation of its own, outside phonological processing.

### **2.3.3. Overview of the Double Deficit Hypothesis**

The processes underlying NS have a phonological component. Proponents of the DDH do not deny this fact, but argue that there is enough evidence to support separate categorisation of NS and PA for purposes of diagnosis and intervention in dyslexia theory and practice. NS incorporates cognitive skills beyond the level of phonological skill and there is evidence that the two skills occur independently of one another and have independent contributions to reading. The supporters of the DDH suggest that these are conclusive findings that support separate categorisation of NS and PA.

## 2.4. Concluding statements

The literature review identified one well-researched hypothesis of the underlying deficits in dyslexia, the PDH. Proponents of the PDH purported that a unitary phonological processing deficit accounts for the problems underlying reading such as PA, verbal short-term memory, word finding and naming in children with dyslexia. Within this hypothesis it is the phonological level skills that require attention in diagnosis, intervention and training of children with dyslexia (Muter, 2003).

As Wolf and Bowers (1999) noted, however, it is possible that phonological processing deficits are not the only underlying deficits in dyslexia. There are disadvantages in adopting this single phonological hypothesis to the study of reading disorders. These include the tendency to subsume other explanatory processes within the phonological domain (Wolf et al., 2002). An alternative to the PDH was presented in the literature and takes the form of the DDH of Wolf and Bowers (1999). These authors suggested that the processes underlying NS constitute a separate source of reading failure.

The literature offered some evidence for this separate categorisation, including evidence that the two deficits are weakly correlated with one another in children with dyslexia, occur independently in samples of learners with dyslexia and have independent contributions to reading. Furthermore, it was noted that although the processes involved in NS tap phonological skills, NS appears to rely on an array of differing cognitive skills outside the domain of phonological processing (Figure 2).

Wolf and Bowers (1999) contended that if current practice of placing NS deficits under the phonological domain is correct, then the vast majority of impaired readers are sufficiently served by the current emphasis on phonological-based skills in diagnosis and intervention. However, Wolf and Bowers (1999) noted that if NS and phonological processing are categorised as separate deficits (as proposed by the DDH), the current emphasis on phonological skills in assessment and intervention is no longer adequate.

The NS subtype would be classified as having phonological deficits and, therefore, given inappropriate intervention, or this subtype would be missed altogether. Readers with double deficits would receive treatment for only one deficit, with little attention given to their speed of processing, fluency and automaticity (Wolf, 1997).

It was stated that the existence of a second core deficit of dyslexia in processes indexed by NS, as hypothesized in the DDH, has significant implications for diagnosis, prediction and intervention (Deeney, Wolf & O'Rourke 2001; Wolf & Bowers, 1999, Wolf et al., 2002a) of learners with dyslexia. This applies to the South Africa context as well. Wolf and Bowers (1999) asserted that NS batteries should be added to all screening assessments in order to more comprehensively diagnose dyslexia. Furthermore, these authors suggested that classifying children into subtypes will assist in predicting their responses to instructional interventions and these subtype distinctions will assist in the development of more appropriate intervention strategies for the NS and double-deficit subtypes.

Considering the implications of the DDH on diagnosis, intervention and prediction in dyslexia, the present study is justified in South Africa. This study provided preliminary data that are necessary for more expensive and time-consuming studies aimed at identifying causal relationships between the variables of the DDH. Performing this study in South Africa at this time was crucial in creating awareness of the underlying skill deficits of learners with developmental dyslexia among those professionals dealing with the challenges of diagnosis and remediation of dyslexia in LSEN schools.

## **CHAPTER 3: METHODOLOGY**

### **3.1. Introduction**

The methodology will outline the main aims and objectives of this study as well as the research design chosen to meet these aims and objectives. A detailed account of the criteria and procedures used to select subjects (learners with dyslexia) and controls (learners without dyslexia) as well as a description of these learners will be presented. A description of the test battery and procedures for administering and scoring will serve to improve the repeatability of the study and are presented below. An outline of the non-standardised measures in this study (NS letters test and questionnaires to SLTs) will be offered. Validity and reliability issues will be introduced as well as Ethical guidelines of the study.

### **3.2. Main aims and objectives**

- 3.2.1. To determine whether a sample of South African Grade 2 learners with dyslexia, from LSEN schools, aged between 7.9 – 9.7 years, could be categorised in subtypes according to the presence or absence of phonological awareness (PA) and/or naming speed (NS) deficits.
  - 3.2.1.1. To examine and compare the performance of Grade 2 learners with and without dyslexia on assessments of PA and NS skills.
  - 3.2.1.2. To determine the frequency of subtypes of dyslexia in the sample of Grade 2 learners with dyslexia according to the classification of subtype system of Wolf and Bowers (1999).
- 3.2.2. To describe the relationship between NS and PA in Grade 2 learners with dyslexia who attend LSEN schools in the Cape Metropole.

3.2.2.1. To examine the extent to which PA and NS performances correlate in Grade 2 learners with dyslexia.

3.2.3. To explore the relationship between NS and PA with reading in Grade 2 learners with dyslexia.

3.2.3.1. To investigate the relationship between NS and PA with the following five measures of reading in Grade 2 learners with dyslexia.

- ✓ Words recognized as a whole (sight word reading)
- ✓ Words sounded out (non-word reading)
- ✓ Reading comprehension
- ✓ Sight word reading efficiency
- ✓ Non-word reading efficiency

3.2.4. To document the main therapeutic approaches used with Grade 2 learners with dyslexia.

### **3.3. Study Design**

Since various research designs differ in the quality of evidence they provide (Wallace, 1998), it was necessary to adopt a research design that was applicable to the study and would best serve to meet its aims. Therefore, a comparative research design with a descriptive component was employed as it served to meet the aims of the study. The subjects and controls were only assessed once so that associations between variables could be established (descriptive component) (Wallace, 1998). Descriptive statistics, such as means, standard deviations, standard scores and percentages, were used to examine subject (Grade 2 learners with dyslexia) and control (Grade 2 learners without dyslexia) group performances as well as subject and control group performance differences (Hite, 2001; Katzenellenbogen, Joubert & Abdool Karim, 1997). No variables in the study were manipulated. *The results from these assessments were used for the comparative component (Wallace, 1998).* This design was appropriate for the purposes of this study because it allowed the aims of the study to be met. The comparative design component served to include correlational statistics in order to determine whether there exists a significant relationship between the variables NS, PA and reading (Hite, 2001). In this way, the research design addressed the aims and objectives of the study.

Despite the attempts to ensure that the most appropriate research design was adopted, comparative and descriptive research designs have been criticised for being unable to provide information about the causal nature of the relationship between the variables (Sage, 2001).

### **3.4. Subjects and Controls**

The study population is defined as all English speaking Grade 2 learners with dyslexia between the ages 7.9 -9.7 years who lived in the Cape Town Metropole area and who attended English-medium LSEN schools at the time of the study. A total of fifty learners participated in the study. Twenty-five learners with dyslexia formed the subject group. Twenty-five learners without dyslexia from mainstream schools were selected as the

control group. Appendix O compares the subject group (learners with dyslexia) to the control group (learners without dyslexia). The sample size was calculated using the guidelines of Cohen (1977). Following these guidelines, the estimated  $r$ -value of 0.447 yields a 'd' value of 1.0. Using a significance level of  $p = 0.01$  a sample size of twenty-five thus returns sample power of 0.8 (80%).

The sample was selected from Grade 2 classes (7.9. - 9.7 years of age) since these learners had had adequate exposure to reading, digits, letters and phonological awareness tasks (blending and segmenting for example) for purposeful assessment of these skills (Stanovich & Cunningham, 1993). Older learners were not chosen for this study because Augur and Briggs (1993) noted that learners who struggle in reading for many years, may develop negative attitudes to reading which may influence their performance in assessment situations, particularly reading assessments. Therefore, older learners were not selected for this study because of the potential influence of negative attitude on reading assessment results (Markwardt, 1989).

### **3.4.1. Subject and control selection criteria**

The following criteria were adhered to during selection of the subject and control groups:

- Learners were between the ages 7.9 - 9.7 years.
- No known sensory deficit, which could possibly account for a reading difficulty (Nicolson & Fawcett, 1990). This information was stated on the case history form.
- Hearing was assessed by the researcher on the day of administration of the test battery and found to be within normal limits - below 25 decibels (Stach, 1998).

- No known neurological deficits (Nicolson & Fawcett, 1990; Wolf, 1986) since learners may present with acquired dyslexia rather than developmental dyslexia. This information was stated on the case history form.
- No known emotional problems (Nicolson & Fawcett, 1990; Wolf, 1986) that could account for a delay in reading ability. This information was stated on the case history form.
- The home language of each subject and control was English (Katz & Shankweiler, 1985). English was chosen for this study because the test instruments were standardised on English-speaking children. Furthermore, the researcher was fluent in English.
- Subjects and controls were recruited from middle to high socio-economic status (SES) homes (Cornwall, 1992) due to the documented negative effect of low SES on IQ (Siegel & Himel, 1998 as cited in Gustafson & Samuelsson, 1999) and general development (Wade & Tavis, 1993). SES was assessed using May's (1998) criteria. An income of less than R352.42 per adult equivalent per week was regarded as low SES. This information was stated on the case history form.

### **3.4.2. Specific selection criteria**

#### **3.4.2.1. Subjects**

In addition to the above, the following criteria were included for the subject group only:

- Reading age was 18 months or more below chronological age (Nicolson & Fawcett, 1994a). Initially, educators were requested to identify learners whose reading was low for age and for expected levels (Badian, 1997). This criteria was then formally assessed using the Piat - R (Volumes I and II).

- Verbal or performance IQ at or above 80 (Breier, Fletcher, Foorman, Klaas & Gray, 2003; Mattis et al., 1975). IQ scores were obtained from the records at each school (following informed consent).

### **3.4.2.2. Controls**

The following additional criteria were used for the selection of the control group:

- Reading level was average or age appropriate. Educators selected learners whose reading was not above or below the expected level for their age. This was formally assessed using the Piat - R (Volumes I and II) to ensure appropriate selection based on age appropriate reading.
- Control learners were not permitted to have been or to have attended Speech and Language Therapy at any time. This information was stated on the case history form.
- Control learners were performing well in areas outside written language. Although a full psychological assessment would have allowed for the inclusion of IQ scores in the analysis, the researcher's budget did not allow for the expense of full psychological evaluations for each of the control group learners. Therefore, it was assumed that a learner who was progressing at an age-expected level in areas other than written language (judged by the educators) had adequate intellectual abilities (Mattis et al., 1975).

## **3.5. Sampling**

### **3.5.1. General procedures**

Wallace (1998) states that the safest way to ensure the study is representative of the population is to perform simple random sampling. However, since no data base of learners with dyslexia is available in the Cape Metropole, this method was not possible for this study. It was therefore necessary to identify learners with dyslexia and randomly select from these. Cluster sampling was adopted for this purpose.

Information concerning the number of LSEN schools in the Cape Town Metropole was obtained from the WCED's (Western Cape Education Department) statistics department. The Cape Metropole extended from Khayelitsha and Muizenberg in the South to Bellville in the North, Bridgetown in the West and Stellenbosch in the East (Delo, personal communication, March 9, 2004). All LSEN schools that met the following criteria were included for possible selection:

- LSEN schools in the Cape Town Metropole were selected only if they admitted learners who had learning disabilities, without intellectual or sensory impairments, psychotic disorders or neurological damage (cerebral palsy, head injuries) (Nicolson, Fawcett & Dean, 2001).
- LSEN schools were selected only if they admitted learners from middle to high socio-economic status groups.
- Only single medium English schools were considered.

Three LSEN schools (schools A, B and C) in the Cape Town Metropole were found to fit these criteria. These schools were selected to take part in the study.

A method of cluster random sampling (Katzenellenbogen et al., 1997) was used in order to identify mainstream schools from which the control group was to be selected. Since the LSEN schools B and C were within close proximity of one another (700 m), it was considered acceptable to use one school from this area to serve as a source for the control group. Therefore, all schools within a one-kilometre radius of each LSEN school were considered for possible inclusion. However, the following criteria were adhered to:

- Schools were considered only if they admit learners from middle to high SES.
- Only single medium English schools were considered.

Following these criteria, three schools from the area around schools B and C were identified, and two schools around area A were identified. One school from each area was randomly selected. The selected school from area B and C did not agree to participate and therefore, another school out of the remaining two was randomly selected.

The sampling method chosen for this study may have been open to selection bias. Selection bias occurs when the sample is not representative of the population (Wallace, 1998). As will be noted later, learners attending mainstream schools who have not been diagnosed, or learners who attend private speech and language therapy have not been represented in this study. Furthermore, older and younger learners have not been represented in this study.

### **3.5.2. Subject and control selection procedures**

A letter requesting permission to perform the study at these three schools was sent to the Director of Education research, Western Cape Education Department (Appendix A). The letter of approval from the education department was then sent to the Head Teacher at each LSEN and mainstream school requesting permission to conduct the study at their school (Appendix B and D). The head teacher was informed of the nature of the study, its purpose and relevance, and what was to be required from the pupils and educators at the school. The head teacher was then requested to sign a letter granting permission for the researcher to perform the study at his/her school (Appendix C and E) before the researcher was able to enter the school. Following written permission from the head teacher, the Grade 2 educators at the schools were contacted by phone and a meeting was arranged.

During the meeting, the purpose and relevance of the study was discussed and the educators were provided with a letter (Appendix F and G) which outlined the purpose of the study as well as the subject selection criteria. The educators were requested to give each learner in their class a letter, consent form and case history form to take home to their parents (Appendix H, I, J, K, L). In this letter, the purpose and relevance of the study was outlined. Parents were informed that their child's participation was entirely voluntary, and if they refused to participate or withdrew their child from the study at any stage, there would be no prejudice to the quality of their child's subsequent clinical management, care or school programme.

Parents were requested to send the consent form back to the school within one week of receipt. The educators were requested to compile a list of names of all the learners who fit the selection criteria, which was collected at the educator's convenience. Following review of each learner's case history form, suitability was determined.

### **3.5.2.1. Subject selection procedures**

Apart from one parent who did not give consent, all identified LSEN learners' parents agreed to participate in the study. One of the learners was excluded from the study due to a history of emotional difficulties, as reported by the school and parents. Fifteen learners were found to fit the selection criteria from school A, nine learners from school B and one learner from school C. This resulted in twenty males and five females. Each candidate then underwent the full battery of assessment tests. Audiometric testing was performed on the same day (Breier et al., 2003). All learners were found to fit the reading selection requirements that were administered as part of the battery.

### **3.5.2.2. Control selection procedures**

Two learners from the list of names of suitable candidates obtained from the educators were excluded due to: 1) age limitations 2) the learner had attended Speech Therapy. Fifteen learners (nine males and six females) from school C and eighteen learners (10 males and eight females) from school D met the selection criteria. In order to match the control group with the subject group as closely as possible, the nineteen males were chosen and six females were randomly selected (computer generated) from the fourteen female candidates.

Each candidate then underwent the battery of assessment tests. After administration of the reading tests, the one learner who did not meet the reading requirements was excluded. This learner was replaced by randomly selecting from the remaining females from the control group learners. Please refer to the Discussion for more information on this issue.

### **3.6. Subject description**

A summary of the subject description is offered in Table M1 in Appendix M. Twenty males and five females with dyslexia took part in the study. The average age of the subject group was 8.65 years. All learners had hearing sensitivities of 25 decibels or better (Stach, 1998); English as their primary language (Breier et al., 2003); reading age at least eighteen months behind their chronological age (Nicolson & Fawcett, 1994); had no known sensory or emotional difficulties; no known neurological impairments; were in the middle to high socio economic group and had IQ scores above 80 (Breier et al., 2003; Mattis et al., 1975). Word finding (Renfrew Word Finding Scales) and receptive vocabulary (Peabody Picture Vocabulary Test) scores were obtained from tests performed by the resident SLTs at each LSEN school. Three learners were not receiving Speech Therapy due to their recent admission to the school. Five of the twenty-five learners were repeating their Grade 2 year. These learners were subjects number 12, 15, 17, 20 and 21.

### **3.7. Control Description**

A summary of the control group is offered in Table O1 in Appendix O. Nineteen males and six females took part in the study. The average age of the control group learners was 8.32 years. All learners had hearing sensitivities of 25 decibels or better (Stach, 1998); English as their primary language (Breier et al., 2003); reading level that was age appropriate; had no sensory or emotional difficulties; no neurological impairments and were in the middle to high socio economic group. None of the control learners had repeated Grade 2 or were attending/had attended Speech Therapy.

### **3.8. Apparatus for data collection**

A test battery (Table 2) was compiled to assess the lexical and sub-lexical components of reading, in the subject and control groups. The following information concerning the test battery will be provided below:

1. Table 2 will outline the test battery used in the present study
2. The rationale for the selection of each test will be offered
3. Each test will be described
4. The scoring guidelines for each test will be described

In addition to the above test battery, an informal questionnaire was given to SLTs at each LSEN school. This questionnaire will not be addressed as part of the test battery, but will be mentioned in a separate section.

### 3.8.1. The test battery

Table 2

Outline of the Test Battery Used On All Subject and Control Learners

Reading	Phonological processing	Naming Speed
Word recognition (Piat - R I)	Segmentation (PHAT)	Digits (PhAB)
Non-word reading test (PhAB)	Blending (PHAT)	Pictures (PhAB)
Reading comprehension (Piat - R II)	Isolation (PHAT)	Letters (non-standardised)
Sight word reading efficiency (TOWRE)	Deletion (PHAT)	
Non-word reading efficiency (TOWRE)	Verbal short term memory (TAPS number and word memory)	

Hite (2001) observes that in order to maximise the validity and reliability of research and its instruments, familiarity of the examiner with the test instruments is essential. For this reason, the researcher/examiner underwent thorough and systematic self-training of the tests. Tests were administered and scored a minimum of 15 times prior to the commencement of the study. Procedures for administration of each test followed the guidelines presented in the manual. This was adhered to throughout the administration of the test battery to the subject and control group of learners.

#### 3.8.1.1. Reading

As noted in Table 2, five tests of reading were administered to each learner in the subject and control group. The rationale for selection of these tests and a description of the tests is presented below.

### **3.8.1.1.1 Rationale for reading tests**

The tests used to assess reading in this study were chosen because of their widespread use in South Africa and because each test assesses one component of reading in accordance with the following rationale. Models of word recognition generally include two routes of access to words, or a dual-route model of reading (Castles & Coltheart, 1993). Spring and Davis (1988) use the terms 'direct-access' mechanisms and 'speech-recoding' mechanisms to refer to reading at the lexical and sub-lexical levels respectively. Although competent readers rely mostly on direct access or sight-word reading to read text fluently, speech-recoding, or phonemic decoding has been found to be of primary importance during early stages of learning to read (Wagner et al., 1999). Therefore, to be a skilled reader an individual requires access to both reading mechanisms (Castles & Coltheart, 1993).

The direct access route will be referred to as 'sight-word reading' throughout the following text. Sight-word reading was assessed using the Piat - R 'word recognition subtest'. The speech-recoding route will be referred to as non-word reading, which was assessed using the PhAB non-word reading test. However, in light of the DDH, and its emphasis on fluency and speed, this battery included a test of the efficiency of these skills (Torgesen et al., 1999). Thus the sight-word reading and non-word reading efficiency tests of the TOWRE were included in the battery. Lastly, since the ultimate goal of reading is "the construction of meaning from text" (Wagner et al., 1999, p. 2) it was essential to include a test of reading comprehension. Reading comprehension was assessed using the Piat - R reading comprehension subtest was administered.

### **3.8.1.1.2. Description of the reading tests**

➤ **Peabody Individual Achievement Test – Revised (Piat – R) (Markwardt, 1989)**

The initial pre-reading items of Volume I of the Piat - R assessed the learner's ability to recognise the sounds associated with letters. For example, the examiner requested the learner to identify the letter (from a set of four) that looked the same as the reference letter, or the examiner requested the learner to identify the letter that started with the same sound as a reference picture (e.g. g – goat). In the following items, the subjects' ability to read words aloud was assessed, by requesting the learner to read as many of a list of words as possible. Twelve words were presented on each page with four words in each horizontal line.

Volume II (reading comprehension) was administered. This subtest measured the learner's understanding of what was read. For each two-page item, the subject read a sentence silently, and on the next page chose one of the pictures (of four pictures) that best illustrated the sentence.

As a guideline, the basal was the lowest item of the highest five consecutive correct responses. The ceiling was the highest item of the lowest seven consecutive five errors. The starting point for the reading comprehension test was determined from the raw score on the reading recognition subtest. Reading comprehension was not administered if the subject's raw score on Reading Recognition was 18 or less.

When scoring Volume I, all acceptable pronunciations for the words are printed on the examiner plates, and follow the Webster's Ninth New Collegiate Dictionary (1984). Since the author suggests that all other pronunciations should be regarded as incorrect, this was adhered to throughout the scoring of the test for both the control and subject groups.

When recording responses for Volume II of the Piat – R, the number corresponding to the learner's choice of illustration was written on the response form. This was considered necessary for later reliability testing during re-recording of the tape-recorded sessions.

➤ **Phonological Assessment Battery (PhAB) (Frederickson et al., 1997)**

The Nonsense Word Decoding subtest of the PhAB was used to assess the learners' word recognition abilities using the speech-recoding mechanism by which words are sounded out (Spring & Davis, 1988). The test consisted of ten mono-syllabic words on Card 2 and ten bi-syllabic words on Card 3.

Acceptable pronunciations are provided in the manual of the PhAB. These guidelines were adhered to throughout the scoring of the PhAB assessment. A score of one was given for a correct pronunciation, and a score of nil for an incorrect pronunciation. The number of items read correctly was entered on the record form (Frederickson et al., 1997).

➤ **Test of Word Reading Efficiency (TOWRE) (Torgesen et al., 1999)**

Each subtest (non-word reading efficiency and sight-word reading efficiency) was presented on a separate piece of cardboard. The non-word reading test consisted of twenty-nine mono-syllabic words which included sixteen non-phonetically spelled words (e.g. *barp*), eighteen bi-syllabic words and five multi-syllabic words. Learners were given 45 seconds to read as many of the words as possible. The sight-word reading test consisted of forty-six mono-syllabic words and fifty-four multi-syllabic words. Learners were given 45 seconds to read as many of the sight words as possible.

Acceptable pronunciations of the words in the TOWRE are presented in the manual. These guidelines were strictly adhered to during scoring of the assessment. The learner's score for the non-words and real words, was the total number of words pronounced

correctly within 45 seconds. All the words read incorrectly or left out were marked with a line through them on the record sheet. The last word read correctly within 45 seconds was marked with a line underneath (Torgesen et al., 1999).

### **3.8.1.2. Phonological processing tests**

As noted in Table 2, five measures of phonological processing were assessed. The rationale for selection of the tests and a description of the tests is presented below.

#### **3.8.1.2.1. Rationale for phonological processing tests**

The importance of the concept of ‘phonological processing’ in theorising about reading acquisition is pertinent to the choice of tasks in the present study. There appears to be some confusion in the literature concerning the definition of the phonological tasks used to identify children with dyslexia. ‘Phonological awareness’ and ‘phonological processing’ appear to be used interchangeably. Wagner et al. (1993) provide clarification on the issue. These authors include tasks of PA, phonological coding in working memory *and* phonological code retrieval (naming speed) as measures of phonological processing. Consequently, PA is noted as one measure of phonological processing. Since phonological code retrieval, as conceptualised as a phonological task, is not consistent with the DDH, this task was excluded from the phonological measures in the present study.

With respect to phonological coding in working memory (verbal memory span), Muter (2003) states that “whether verbal memory span is an important indicator of reading skill, is not entirely clear” (p. 40). Furthermore, while the phonological system in the PDH consists of phonological coding in working memory, phonological code retrieval and PA (Wagner et al., 1993), PA has received much of the attention in reading acquisition research. “That there is a relationship between performance on PA tasks and reading ability is undisputed” (Castles & Coltheart, 2004, p. 79). Wagner et al. (1994) found from their study on verbal short-term memory and reading that verbal short-term memory does

not significantly predict reading skills after controlling for the level of the child's phonological skill. Plaza (2003) has commented that PA is a more potent predictor than other measures of phonological processing.

Although these are convincing arguments that verbal short-term memory is not a strong indicator of reading, this theory was tested, briefly, in the present study. In order to provide support for the inclusion of only PA measures in the present study and exclusion of the verbal short-term memory measures, the two skills were correlated with each other and verbal short-term memory was correlated with reading. Since none of these correlations reached significance at  $p < 0.1$ , only PA tasks were used in the present study as a measure of the learner's phonological skills. This is consistent with the DDH of Wolf and Bowers (1999) who use only PA tasks.

“Although PA is widely treated as a unitary construct, several theorists have noted that there are at least two different subprocesses involved in performing the various PA tasks that are regularly in use” (Castles & Coltheart, 2004, p. 86). These include phonological analysis - the ability to break words into their constituent sounds and phonological blending - the ability to combine isolated sounds to form words (Castles & Coltheart, 2004). The relevant issue for this study concerns the nature of the skills most related to reading acquisition. Castles and Coltheart (2004) undertook a review of the literature on this question and concluded, “there does not appear to be a strong argument for focusing on either phonological analysis or phonological synthesis skills” (p. 87).

Further guidance was offered by Wagner et al. (1993) who included both kinds of tasks in their study on the development of phonological processing abilities in young readers. Their analysis tasks included a) phoneme segmentation, b) phoneme elision c) sound isolation and d) sound categorisation. Their synthesis tasks included a) blending onset and rhyme, b) blending phonemes into words and c) blending phonemes into non-words. With respect to the present study, the sound categorisation test as used by Wagner et al. (1993) was excluded from the present study because of the influence of memory on this type of task (Bradley & Bryant, 1985 as cited in Wagner et al., 1993). In order to simplify

administration of the test so that all subtests were taken from the PHAT, the blending of onset and rhyme was replaced by a syllable-blending task from the PHAT and the blending of phonemes into non-words was excluded because the PHAT does not offer this subtest. However, in the reading assessment measure, the PhAB assesses non-word reading, which incorporates the skill of blending phonemes into non-words (Rack, Snowling & Olson, 1992). Lastly, the rhyming subtest of the PHAT was excluded. Castles and Coltheart (2004) noted from their recent extensive review of the literature “there is not a strong case to be made for rhyme awareness being a significant independent predictor of reading (and spelling) acquisition” (p. 90). Following from the above arguments, the tests of phonological processing used in this study are presented below.

#### **3.8.1.2.2. Description of phonological processing tests**

##### **➤ The Phonological Awareness Test (PHAT) (Robertson & Salter, 1997)**

Four subtests from the PHAT were chosen:

- A) Segmentation subtest: this subtest consisted of segmentation of sentences, syllables and phonemes. Segmentation of sentences required the learner to clap for each word in the sentence provided. The syllable segmentation test required the learner to clap for each syllable in the words provided. The phoneme segmentation test required the learner to say all the sounds in the words provided. There were ten test items for each segmentation task.
  
- B) Isolation subtest: these tasks assessed the learner’s ability to isolate initial, medial and final phonemes in words. The learner was provided with a word and then required to isolate either the initial, medial or final sound in the word. Again, there were ten items for each task.

- C) Deletion subtest: this test measured the learners' ability to manipulate root words, syllables and phonemes in words. The learner was asked to say a word, then say it again without one of its parts (delete a root word, syllable or phoneme). Ten items were tested for each task.
- D) Blending subtest: this subtest assessed the learner's ability to blend units of sound together to form words. These units of sound consisted of syllables and phonemes, with ten items tested for each task.

The learner's responses were recorded on the response form in order to assist with re-analysis for the purposes of reliability testing. A score of 1 was given for correct responses, a score of 0 for incorrect responses. There are no basals or ceilings in the PHAT. The PHAT provides possible correct responses on the test form. The authors state that clinical judgement may be used to determine whether a response is appropriate.

➤ **Test of Auditory Perceptual Skill - Lower Level (TAPS) (Gardner, 1994)**

The TAPS (numbers - forward) consists of numbers presented to the learner, beginning with two numbers and increasing by one after two sets of presentations. Learners were required to recite the numbers in the order in which they were presented. The word span test is similar in that it begins with two words and increases in the same manner as the digits, however, words do not have to be repeated in the exact order. The first twenty-eight words are one-syllable words after which there are two-syllable words.

Each digit in a set in which there was no error received a score of 1. The ceiling was reached when the learner repeated any of the series of numbers out of sequence or omitted or substituted numbers in any two consecutive sets of units (Gardner, 1994).

Each word in the set in which all words were recited received a score of 1. The ceiling was reached when the learner omitted or mispronounced any item in any two consecutive sets of words in a unit (Gardner, 1994).

### **3.8.1.3. Naming speed tests**

As noted in Table 2, three tests of NS were used in this study. The rationale for selection of the tests and a description of the tests is presented below.

#### **3.8.1.3.1. Rationale for naming speed tests**

Within the framework of the DDH, NS is considered a separate skill from phonological processing. Therefore, it was necessary to test NS as a separate skill. Digit NS was selected because of its suggested relevance to reading (Spring & Davis, 1988). Object NS was included because of the discrepancies in the literature concerning the type of NS test to use in detecting processing speed deficits. Denckla and Rudel (1976) found that object NS was the most difficult for the learners with dyslexia. However, since then Spring and Davis (1988) as well as Wolf et al. (1986) purport that it is graphological items such as digits and letters that are most robust in identifying automaticity deficits in learners with dyslexia. In order to investigate the possibility that NS letters and digits were more sensitive to the automaticity deficits of Grade 2 learners with dyslexia, the NS objects tests of the PhAB was included in the study.

In addition to the object and digit NS subtests from the PhAB an informal letter-naming test was included to provide a further measure for comparison of NS. The rationale for inclusion of this test is the possible importance of letter NS to reading (Katz & Shankweiler 1985; Wolf, 1986; Wolf & Bowers, 1999). Although Spring and Davis (1988) found a significant correlation between digit and letter NS it was essential to replicate these findings in the present sample. The digit NS test of the PhAB may be one of the most widely used test of NS in South Africa. The researcher could not locate a letter NS test. Therefore, since this digit NS test is widely used without the use of the letter NS, it was crucial to establish that the two tests correlate significantly with one another and with the same measures of reading so that the current use of only digit NS test is justified.

### **3.8.1.3.2. Description of the naming speed tests**

#### **➤ Phonological Assessment Battery (PhAB) (Frederickson et al., 1997)**

The Digit and Picture Naming Subtests of the PhAB. Digits consisted of the numbers 36814529 and objects consisted of line drawings of a hat, door, table, box and ball. Learners were then given the test items which required them to name a random sequence of fifty stimuli as fast as possible. The picture-naming test was administered first. Each of the digit and picture tests consisted of two A4 sheets of paper with the digits or pictures presented in different orders. That is, these test cards consisted of these stimuli repeated randomly over fifty presentations.

#### **➤ Non-standardised letter naming speed tests**

Five letters o, p, s, a, d were chosen for the present NS letters test from the example of Wolf and Bowers (1999). These were presented on the practice sheet after which the test items were presented. As with the digit and picture cards, two cards with fifty stimuli (letters) randomly ordered were presented to each learner. This random order was created using a computer. An example of the letter NS test is presented in Appendix R.

Recording of the learners' performance was conducted as follows (according to Frederickson et al., 1997): any item that was not named correctly (that is misnamed, omitted, inserted, or named in an incorrect sequence) was marked by striking through the item on the record sheet. If the learner corrected the errors, a tick was placed above the error. The lapsed time, to the nearest second, from the time the researcher said "Start" to the time the learner named the last digit, was recorded on a stopwatch. The time to complete the two digit and picture naming cards was added. Note was taken of learners who made more than three errors since Fredrickson et al. (1997) suggest that further investigation is warranted in these cases (for example eye sight or impulsivity) due to the very low numbers of children performing more than three errors in the standardisation

sample. None of the learners in the sample made more than three uncorrected errors. The above procedures were adhered to in the NS letters test.

### **3.9. Questionnaire to therapists (Appendix Q)**

A letter requesting permission to add a questionnaire to this study was sent to the UCT Ethics Department. This questionnaire was deemed necessary to assist in documenting the interventions used with the subject group. The impact of prior therapy/intervention on the results of the study may have influenced the outcome. It was important to determine/document the broad aims of therapy with these learners to provide further insight into their presenting profiles in terms of NS and PA. This information provided insight into the presenting deficits of the subjects by outlining the type and length of intervention they had received. Further, it served to give a broad indication of whether SLTs were addressing issues of fluency in their intervention efforts with the subject group. On receipt of approval, questionnaires to the therapists involved in treating the subject group were sent out at the beginning of the school year 2005. *The issues around prior intervention with the learners will be addressed in the Discussion.*

The questionnaire was an informal questionnaire that consisted of four questions. SLTs were required to write the main aims of their therapy with each learner. The researcher was not present during completion of the questionnaires.

### **3.10. Data analysis**

#### **3.10.1. General guidelines**

Data collection procedures remained constant for the control and the subject groups. All timed test were timed using a Sony stopwatch. A Sony Dictaphone was used to record each assessment and an AS 208 Intracoustics portable audiometre was used to assess learners' hearing.

Learners were assessed during morning sessions at their schools to reduce the effects of fatigue and to ensure a truly representative outcome (Naremore, Densmore & Harman, 1997). The range in time of assessment was between 7.45 am and 12.15pm. Each assessment lasted approximately 45 minutes with a 3-minute break.

Learners were seated across the table from the examiner in a quiet room (Frederickson et al., 1997) at each school. Standardised tests were administered and scored according to the guidelines set by the authors of the tests. Directions to subjects and controls were read verbatim. All practice items were presented to the learners in accordance with the guidelines set out in the test manuals. All tests allowed for general encouragement which was given intermittently to each learner according to the guidelines of the manual. The correct answers were not given in the test situation. A barrier, consisting of a small (unobtrusive) piece of cardboard between the learner and the examiner, was used to ensure the learner could not see the marking on the response sheet to use this as a cue to the correctness of the responses. All sessions were tape-recorded. Answers were recorded directly onto the test response forms in a manner that did not distract the learner.

### **3.11. Specific data analysis**

The following section has been outlined with reference to the aims and objectives of this paper since Hite (2001) states that “the data analyses should be consistent with the stated purpose of the study” (p. 69). Furthermore, it may ease interpretation of the data. The age of learners was excluded from the data analysis since age correlated significantly with most tests of the test battery (as shown in Table 16). Age has been associated with increased speed of processing (Kail & Hall, 1994) and may play a role in reading (Wolf & Bowers, 1999). Therefore, to reduce the effects of age on the results, age was excluded. In addition, verbal short-term memory was excluded from the data analysis because of its weak correlations with other measures of PA (Table 17) and its weak correlation with reading (Table 18). Plaza (2003) has stated that PA is more related to reading than verbal short-term memory. This statement was verified in this study (Table

17 and 18). Therefore, verbal short-term memory was excluded in order to allow for a more in-depth analysis of PA with the limits of the paper.

In keeping with the research design of the study, descriptive statistics were employed to address one of the main objectives. This was to determine whether a sample of Grade 2 learners with dyslexia between the ages 7.9 – 9.7 years could be divided into subtypes according to the presence or absence of NS or PA deficits. However, before this aim could be met, subjects and controls were compared on their performances on the test battery (NS, PA and reading) by contrasting mean standard scores and standard deviations for each group. This assisted in determining that the two groups differed with respect to their performance on each test. To ensure that the difference was significant, a 2-tailed t-test was performed. This procedure also added credence to the validity of the study, as will be addressed later.

Each learner in the subject group (learners with dyslexia) was categorised as having a single deficit in NS or PA or double deficit according to the classification of Wolf and Bowers (1999) (Table 1). The classification criteria of Deeney et al. (2001) was adopted for the purposes of this study. Learners were classified as having a core PA or NS deficit if their average standard scores were at or below one standard deviation below the mean. Learners were classified as having a double-deficit if the standard score of their PA and NS scores were at or below one standard deviation below the mean. Learners were classified as having 'neither-deficit' (in terms of PA and NS) if their NS and PA scores were within one standard deviation of the norm.

In order to critically evaluate the method used to classify learners, similar analyses were conducted using only phoneme-level PA tasks. A brief rationale for inclusion of the analysis of the data at the phoneme level will be presented below.

The relevant size of the phonological unit to assess PA skill has received much debate. "Considerable controversy has surrounded the question relative to the importance of small versus large phonological units" (Castles & Coltheart, 2004, p. 87). While Castles

and Coltheart (2004) note that syllabic awareness has little relationship with reading in the English language, the PHAT addresses syllable and phoneme levels. This test was standardised using syllable and phoneme levels on the age group used in the present study. Considering the Kuder-Richardson co-efficients of each task and each subtest in the PHAT by age, it was evident that the reliability of the syllable level tasks holds at the age levels used in the present study. These co-efficients report on the reliability based on item homogeneity (Robertson & Salter, 1997). The exception is the syllable blending task whose co-efficient reduced as age increased. In addition to the above motivation, Goswami and Bryant (1990) (as cited in Castles & Coltheart, 2004) have argued that an awareness of higher level speech units (syllables) assist learners in mapping sounds to words, a skill necessary to learn to read in an alphabetic script (Snowling & Stackhouse, 1997).

Therefore, because of the uncertainty in the literature, the syllabic-level was included in the present study in an attempt to attain high levels of validity. Furthermore, O'Carroll (2004) (personal communication February, 2004) recommended the use of phoneme level tasks in the present study. This issue will be revisited in the Discussion as the choice of tests appears to have significant implications for diagnosis and classification of subtypes of learners with dyslexia. The two methods of classification are presented separately in the results in order to highlight the differences in each. Thus, the frequency of each subtype, according to the level of PA used, will be presented so that the differences in frequency may be analysed. In order to obtain data for the analyses at the different levels of PA, the PHAT was administered. The PHAT provides scores at the phoneme and syllable levels, which allowed use of these scores for the purposes of this study.

In order to address the aim to determine the relationship between NS and PA as well as NS, PA and reading, the SAS statistical software package was used to calculate the correlational statistics. Pearson's Partial Correlation Co-efficient, which controlled for age, was used to identify a relationship between the variables NS and PA as well as the relationship between these two variables and reading. Pearsons' Correlations were appropriate for the present data because of the distribution of scores around the mean for

the control group (Underhill & Bradfield, 1994). Furthermore, Pearson's Partial Correlation Co-efficients (Cohen, 1977), which controlled for word recognition, were calculated for the correlation between NS and reading comprehension.

In order to identify the current therapeutic interventions used with the subject groups, the questionnaire to SLTs was analysed. Therapeutic aims were categorised into the following broad classes (as shown in the Results):

- PA
- Receptive language
- Expressive language
- Articulation
- Word finding
- Auditory memory

### **3.12. Validity**

The instrument validities have been presented in Appendices S to U. The following section will provide a succinct account of the overall validity of the study as well as outline the contemporary view of validity and its relevance to the present study.

#### **3.12.1. Overall validity**

Validity refers to the “usefulness and meaningfulness of the scores of a test” (Frederickson et al., 1997, p. 77). The following steps enhanced the validity of this research:

1. The inclusion of a control group, which helped to establish and maximize the measurement validity of the study and its measures. The Kolmogorov-Smirnov

test for normality was performed on the data from the control group to assess that the scores were taken from a normal distribution.

2. Individual tests have shown high standards of validity (Appendices S – U).
3. The sampling method used in the research design minimized sampling bias and therefore enhanced the validity of the study.
4. Stringent inclusion criteria were employed to reduce measurement bias (Katzenellenbogen et al., 1997).

### **3.12.2. Contemporary view of validity**

Contemporary issues of validity, such as the interaction between the examiner and the examinee (Hite, 2001) have attracted attention in recent reviews. The historical perspective noted validity as a “characteristic of the instrument or test itself” (Hite, 2001, p. 49) resulting in authors reporting on the content, criterion-related and construct validity of the test. These issues (instrument validity) were reported in the Appendices. However, contemporary opinions of validity regard it in a more holistic fashion taking into account the result of the interaction of the test, the test administrator, the conditions under which the test is administered, the ways in which the results are applied as well as the social and cultural impact of the study (Hite, 2001).

In order to maximise the validity of the study, using contemporary views “it is important to ensure that the learner is relaxed and receptive” (Frederickson et al., 1997, p. 5). This was achieved through general conversation lasting up to 5 minutes. During this conversation the researcher informed the learner, in language he/she understood, the purpose of the assessment and what was to be required from him/her. Following this conversation, the researcher obtained the learner's assent. This interaction put the learners at ease with the situation and allowed the learners to be comfortable and to respond in a natural and therefore valid manner. Furthermore, each test allowed for verbal

reinforcement throughout the administration of the tests. Although these guidelines were strictly adhered to, they did serve to further place the learners at ease once the initial conversation with the examiner had ended and formal testing had begun.

As mentioned previously, one motivation for conducting this research was to create an awareness of the independence of NS and PA deficits in determining the core deficits that may underlie dyslexia in the sample of learners in the Cape Town Metropole. Ultimately, this may result in more investigative research into relevant intervention methods for both subtypes, particularly the NS subtype. Overall there are believed to be positive consequences of using these tests, and in conjunction with the instrument validity, rationale of task selections, the tests are believed to be valid for this particular interpretation and use as well as for this sample of learners.

### **3.13. Reliability**

The instrument reliabilities have been presented in Appendices S to U. The following section will outline the overall reliability of the study.

Reliability can generally be defined as “the ability of the instrument used in research to consistently measure the characteristic being measured” (Hite, 2001, p. 45). To improve the reliability of the measures, all assessments were conducted according to the guidelines of the manuals of each test. Instructions to learners were read verbatim when stipulated in the manual of the test.

Inter-rater reliability was not an issue in the study as the data was collected, analysed and interpreted by one individual, the researcher. Intra-rater reliability is the degree of stability exhibited when the measurement is repeated under identical conditions by the same rater (Wallace, 1998). Intra-rater reliability was enhanced by strict adherence to the guidelines set out in the manuals of each test in order to reduce any bias through judgement differences (Cucchiaroni (1995). Additionally, intra-rater reliability was tested using re-analysis of the tape-recorded sessions two-weeks after initial administration.

### **3.14. Ethics**

#### **3.14.1. Consent**

Permission to perform the study was obtained from UCT's Research Ethics Committee as well as the Head of the Western Cape Education Department. The Head teachers/principals at each school were provided with an outline of the study and its aims before permission was requested for the researcher to use that school. The purpose of the study, its aims and potential benefits, were explained to the parents of the subjects and educators before a request was made for written consent. Parents of learners gave consent for their children to take part in the study on a voluntary basis. No attempt was made to coerce parents into participation. Parents provided consent for participation in writing and a copy was given to the researcher. Once parental consent was given, the researcher informed the child of his/her purpose in the study and sought verbal consent from him/her.

#### **3.14.2. Risk/ benefit**

Every effort was made in this study to reduce the risks to the learners. Learners were taken out of class at the convenience of the educator to ensure that they did not miss work that was judged to be important by the educator. This research may benefit professionals at the participating schools. The feedback sessions may raise awareness among professionals of NS deficits in learners with dyslexia.

#### **3.14.3. Confidentiality/anonymity**

All assessment results were kept confidential. Learners, principals and schools were assured of complete anonymity and are not identifiable in any way from the results of the study.

#### **3.14.4. Sensitive issues**

According to Kellaghan and Greaney (2001), assessments of learners are not only used to make educational policy decisions, but are also there to provide feedback to the learners. All results were made available to parents at their request. The parents of the learner in the control group who was identified as presenting with a deficit in reading were contacted (as stated in the letter to the parents). A meeting was set up with the researcher during which the results were discussed. The parents were referred to the nearest school clinic and were also referred to a private SLT.

#### **3.14.5. No harm**

While ethical standards were strictly adhered to throughout the procedures of the study it is important to address the impact of assessment on learners. The act of being singled out for an assessment can be a daunting process for a learner (Shanker & Ekwall, 1998). The impact of such a consequence was minimised in this study by initially ensuring that the learners felt at ease with the examiner. The examiner has been working with the age group 7.9 - 9.7 years for 6 years and has become accustomed to communicating with this age group. Furthermore, educators were requested to prime the learners about the assessment before the examiner began the data collection. They were asked to tell the learners that they would be helping the examiner by performing to the best of their ability during the assessment, which was termed 'games'. Secondly, any negative impact on the learners was reduced by making the assessment as 'fun' as possible and by avoiding any pressure to complete tasks. Learners were allowed to choose a sticker during the break in their assessment, as well as on completion of the assessment. Only positive reinforcement was given to the learners, with no negative reinforcement at any stage. Many of the learners requested to 'come back' to do another assessment.

#### **3.14.6. Withdrawal without prejudice**

Parents were assured that they may withdraw their child from the study at any stage, and there would be no prejudice to the quality of their child's school programme by educators or therapists in any way.

## **CHAPTER 4: RESULTS**

### **4.1. Introduction**

The results of the study are presented in accordance with the aims and objectives. Although there are no variables being manipulated, the learners with dyslexia are referred to as the subject group and the learners without dyslexia are referred to as the control group for ease of reference. Comparisons of the subject and control group on performance on the test battery was necessary to establish the appropriateness of the tests to the sample population. This allowed the results of the study to be interpreted with confidence (Hite, 2001). The learners with dyslexia (subjects) were categorised into subtypes according to the criteria of Deeney et al. (2001) as previously mentioned. The total PA and phoneme-level PA scores are presented in the Results as they highlight the difference in performance of each learner at each level of PA analysis. Correlational statistics are presented to investigate the relationship between NS, PA and reading. Data obtained from the questionnaires to the SLTs is documented so that the information may be used to discuss the issues of intervention in the subject group.

### **4.2. Comparison of the subject group and the control group on tests of naming speed, phonological awareness and reading**

The performance of the subject and control group on all tests administered is presented in Table 3. Raw data (standard scores) for the control group is presented in Appendix M1, Table M1. Raw data (standard scores) from the subject group is presented in Appendix N, Table N1. Results are given as standard scores, unless otherwise stated. It should be noted that the average range for standard scores is between 85 and 115 (Markwardt, 1989). NS letters was not a standardised test and therefore could not be presented in mean standard scores. The results of this comparison are presented in Table 4.

Table 3

Mean Standard Scores for the Subject and Control Group on Tests of NS, PA and Reading

	Subjects	Controls
NS objects	89.66	101.40
NS digits	82.88	100.68
PA blending	86.10	103.44
PA deletion	85.45	104.72
PA isolation	77.75	100.76
PA segmentation	100.50	106.60
Reading sight word efficiency	70.08	95.34
Reading comprehension	68.68	97.32
Reading non-words	93.28	106.12
Reading non-word efficiency	81.52	99.84
Reading sight word efficiency	70.08	95.36

The results shown in Table 3 identified that the subject group presented with mean standard scores that were lower than the control group on all tests. However, it was evident that the subject group did not present with a mean standard score below 85 on tests of NS objects (standard score 89.66), PA blending (mean standard score 86.10), PA segmentation (mean standard score 100.50) and non-word reading (mean standard score 93.23). This suggests that the subject group did not, on average, have a deficit in these areas. These findings may be explained by the intervention adopted with these learners which will be expounded on in the Discussion. Table 3 also shows that the mean standard scores for the control group fell within the normal range of 85 – 115 on all tests administered. This provides support for the validity and the appropriateness of each test to the sample population.

Table 4 outlines the results (in seconds) of the subject and control group on the NS letters test. These results could not be recorded in standard scores since the test was not standardised.

Table 4

Comparison of the Results of the NS Letters Test (Subject and Control Group, Presented in Mean Seconds)

	NS letters
Subjects	95.30
Controls	65.53

With respect to Table 4, it can be seen that the subject group took 30 seconds longer, on average, to complete the letter NS test. In combination with the NS digits and NS objects results in Table 3, Table 4 serves to provide evidence for the answer to the question raised in the Methodology concerning the sensitivity of NS objects in identifying NS deficits in learners with dyslexia. It appeared that NS objects did not identify an overriding deficit in NS in the subject group.

With the difference in performance of the subject and control group established, it was necessary to determine that the difference between the groups on performances of NS, PA and reading were statistically significant. Table 5 serves to establish whether the difference was significant.

Table 5

Mean Difference in Standard Scores between Subject and Control Group and the Significance of the Difference

	Mean difference	Sig (2-tailed)
NS objects	11.72	0.00*
NS digits	17.12	0.00*
NS letters	30.12	0.00*
PA blending	17.80	0.00*
PA segmentation	6.10	0.00*
PA deletion	17.34	0.00*
PA isolation	23.01	0.00*
Reading recognition	27.56	0.00*
Reading comprehension	28.64	0.00*
Non-word reading	12.84	0.00*
Non-word reading efficiency	18.32	0.00*
Sight word reading efficiency	24.28	0.00*

\* Significant at the  $p < 0.01$  level

The results in Table 5 report on the difference in scores of subjects and controls on test administered. NS letters was included in this test. Using 2 tailed t-tests, the differences between mean scores for the subject and controls groups for all tests were found to be significant ( $p < 0.01$ ) in Table 5. Subjects were found to have mean standard scores, in Table 3, that were above 85, suggesting that they did not present with an overall deficit in these tests. Table 5 shows that although the difference was significant between subjects and controls on NS objects (11.72), PA segmentation (6.10) and non-word reading, these differences were not as big as the differences in other tests, for example PA isolation (23.01) or reading recognition (27.56). Despite this finding, the results reported in Table 5 lend support to the applicability of the tests to the sample population since they consistently identified the subject group to be weaker than the control group.

In order to offer further evidence for the appropriateness/validity of the test battery to the sample population, an additional procedure was conducted. Kolmogorov-Smirnov test for normality was conducted to determine whether the results of the tests were taken from a normal distribution. A significance level of  $p < 0.05$  was interpreted that there was a significant difference between the current results and a normal distribution, thus suggesting that the present results were not normally distributed. The data in Table 6 gives the Kolmogorov-Smirnov significance levels.

Table 6

Kolmogorov-Smirnov Test for Normality p values

Test	Kolmogorov-Smirnov p value
NS object	0.14
NS digits	0.10
NS letters	0.57
PA blending	0.25
PA segmentation	0.21
PA deletion	0.18
PA isolation	0.11
Reading recognition	0.09
Reading comprehension	0.09
Non-word reading	0.13
Non-word efficiency	0.09
Sight-word efficiency	0.12

\* Kolmogorov-Smirnov test for normality is significant at the level  $p < 0.05$

Table 6 reported on the significance of the difference between the results from the control group and those of a normal distribution. Since none of the p values were less than 0.05, it can be noted that using the Kolmogorov-Smirnov test for normality on all tests in the present study, there was no significant difference between these test

results and a normal distribution. Therefore, it is evident that the test results were taken from a normal distribution, which was the control group in this study.

### **4.3. Subtype distinctions**

In order to address one of the main aims of the study, namely to determine whether a sample of Grade 2 learners with dyslexia, aged between 7.9 - 9.7 years could be divided in distinct subtypes according to the presence or absence of PA and/or NS deficits, the method of Deeney et al. (2001) was adopted. As mentioned previously, NS letters could not be used as a valid measure of an NS deficit as this was an informal, non-standardised test with no standard scores. For this reason, all NS deficits were categorised according to deficits in NS objects and digits. As mentioned in the Methodology, two levels of PA were adopted to categorise learners into subtypes of dyslexia, these were the PA total score and the phoneme-level score. Figure 3 outlines the differences in frequency of each subtype according to the level of PA used.

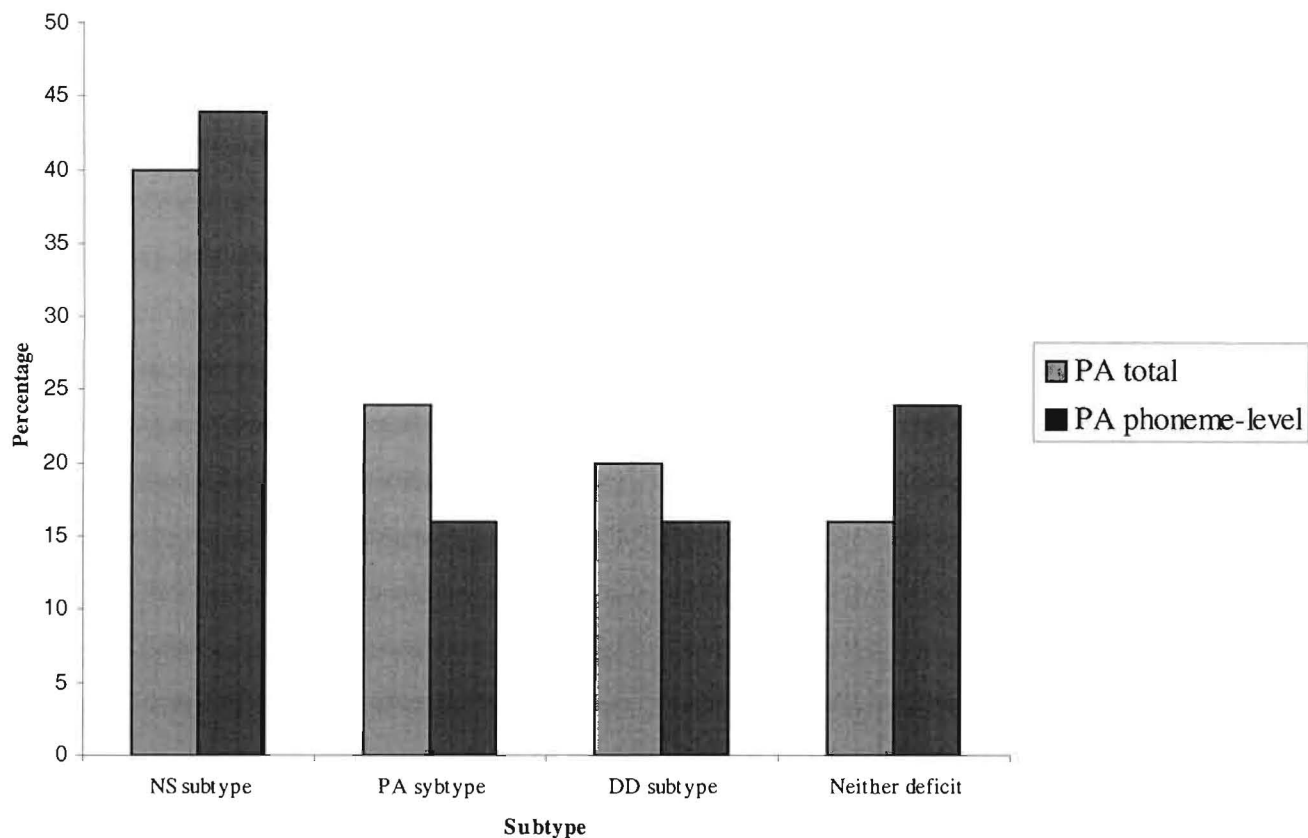


Figure 3

#### Differences in frequency of subtype according to the level of PA used

As noted from Figure 3, there is a difference in the frequency of each subtype of dyslexia according to the level of PA. This difference in frequency has implications for diagnosis and intervention of learners with dyslexia (O’Carroll, personal communication, February 18, 2005). For example, in Figure 3, PA phoneme-level scores appeared to be more sensitive to the NS and ‘neither deficit’ subtypes of learners with dyslexia. The phoneme-level identified 44 percent and 24 percent respectively, which is in contrast to the total PA level which identified 40 percent and 16 percent respectively. On the other hand, PA total score appeared to be more sensitive to the PA and DD subtypes, identifying 24 percent and 20 percent respectively. This is in contrast to the phoneme-level which identified 16 percent in both the NS and DD groups. It is suggested from the results presented in Figure 3 that there is a 4 – 8 percent difference in frequency of subtypes according to the level of PA used.

Therefore, because of the implications of the sensitivity of the test in identifying deficits and categorising learners, it is necessary to describe the performances of each learner at the two different levels of PA. Therefore, the following tables (Tables 7 – 14) will report on the results of each learner according to each level of PA. These results will assist in the critical evaluation of the subtype classification system in the Discussion. It must be noted that PA isolation results were not altered in either case since this task involves only phoneme-level awareness (identifying initial, medial and final phonemes). Further, NS scores will only be reported once in the Total PA tables, as they do not change with the altered PA level.

### **4.3.1 NS subtype**

#### **4.3.1.1 Total PA score**

Forty percent of the sample of dyslexic children presented with a NS deficit in the absence of a core PA deficit. Table 7 outlines the assessment results (in standard scores) of each of the NS subtype subjects in order to make clear the rationale for the distinction of the NS subtype (average standard score at or below 85 was considered core deficit). The following abbreviations have been made throughout Table 7 - Table 14:

NS ob = NS objects

NS lett = NS letters

NS dig = NS digits

PA blend = PA blending

PA seg = PA segmentation

PA del = PA deletion

PA iso = PA isolation

Av = average

Table 7

## Assessment Results for the NS Subtype (Total PA Score)

Subject	NS ob	NS dig	NS lett	Av NS	PA blend	PA seg	PA del	PA iso	Av PA
1	82	69	118	75.50	95	100	82	111	97
2	69	69	147	69	102	81	113	94	97.50
3	69	82	92	75.50	109	100	107	114	107.6
6	79	83	84.6	81	99	107	71	110	96.75
8	80	69	131	74.50	103	71	82	96	88
10	69	99	73.4	84	94	95	98	102	97.25
11	69	69	131	69	75	94	77	103	87.50
18	75	73	111	74	112	98	93	110	103.20
19	88	82	84.6	85	103	113	116	106	109.50
22	85	78	105	81.50	95	77	76	98	86.50

It can be noted from Table 7 that some learners presented with isolated deficits in PA. However, because their average standard score for the total PA measures was within one standard deviation of the mean, these learners were not categorised with core PA deficits. Further, two learners (learners 10 and 19) presented with one of their NS standard scores above the cut-off of 85 (NS digits and NS objects respectively). This issue has caused concern among skeptics of the DDH and will be addressed as a criticism in the Discussion.

#### 4.3.1.2. Phoneme-level PA score

Phoneme-level scores, in contrast to total-PA scores (Table 7) from the PHAT, were also used to classify learners as mentioned above. The results of the learners' phoneme-level scores are presented in Table 8. The average NS scores have not been repeated in Table 8.

Table 8

## Assessment Results for the NS Subtype (Phoneme-Level PA Score)

Subject	PA blend	PA seg	PA del	PA iso	Av PA
1	101	115	95	111	105.50
2	92	79	113	94	94.50
3	109	79	95	114	99.25
6	91	107	74	110	95.50
8	101	101	92	96	97.50
10	91	109	98	92	97.25
11	81	87	83	103	88.50
18	111	86	112	110	104.50
19	101	81	81	106	92.25
22	91	115	76	98	95

Fifty percent of the learners' scores on PA tasks improved using the phoneme-level results. These were learners 1, 8, 11, 18 and 22. One explanation of these findings centres on the intervention with these learners and will be addressed in the Discussion. However, using the phoneme level of analysis did not alter any of these learners' subtype classification as they all remained above the average standard score of 85.

#### 4.3.2. PA subtype

##### 4.3.2.1. Total PA score

Twenty four percent of the subject group presented with a core PA deficit in the absence of an NS deficit. Table 9 outlines the results of the PA subtype using the total PA score in order to specify the criteria used to categorise the learners into this subtype of dyslexia.

Table 9

Assessment Results for the PA Subtype (Total PA Score)

Subject	NS ob	NS dig	NS lett	Av NS	PA blend	PA seg	PA del	PA iso	Av PA
7	94	89	126.00	91.50	57	82	88	106	83.25
9	90	99	69.42	94.50	93	63	66	100	80.50
12	91	82	84.50	86.50	75	75	55	90	73.75
13	91	91	66.84	91.00	72	83	82	106	85.00
20	99	85	65.97	92.00	51	73	51	106	70.25
23	91	82	107.10	86.50	66	73	69	78	71.50

Once again, the PA results did not present a uniform deficit in PA skills. Some learners presented with scores that were above a standard score of 85. Also, it is interesting to note that only one of the PA subtype learners in Table 9 presented with a deficit in PA isolation. This subject, learner 23, had a standard score of 78 on the PA isolation subtest. One explanation for this finding may be the type of intervention received by the learners, which will be addressed in the Discussion. Two learners in Table 9 (learners 12 and 23) presented with isolated deficits in NS digits. This issue will be revisited later when the type of NS test to use in diagnosing an NS deficit will be discussed.

#### 4.3.2.2. Phoneme-level PA score

As argued above, the phoneme-level test results are offered to critically evaluate the subtyping of learners. Table 10 presents the results of assessments for the PA subtype using the phoneme-level scores. Again, average NS scores are not repeated in Table 10.

Table 10

Assessment Results for the PA Subtype (Phoneme-Level PA Score)

Subje ct.	PA blend	PA seg	PA del	PA isolat	Av PA
7	91	89	78	106	91
9	91	77	55	100	80.75
12	71	95	47	90	75.75
13	70	91	86	106	88.25
20	51	70	51	106	69.25
23	72	73	69	78	73.25

Four learners' PA scores improved using the phoneme-level results. These were learners 7, 12, 13 and 23. Using this level of PA, the average PA scores of learners 7 and 13 improved beyond the standard score of 85 cut-off point. These learners would therefore be reclassified into the 'neither-deficit' group using the phoneme-level PA scores. This finding has important theoretical and clinical implications for diagnosis and intervention.

### 4.3.3. Double deficit subtype

#### 4.3.3.1. Total PA score

Twenty percent of the subject group was classified into the double deficit subtype of dyslexia. Table 11 outlines the assessment results and average standard scores of the double deficit subtypes using the total PA results.

Table 11

Assessment Results for the Double Deficit Subtype (Total PA Score)

Subject	NS ob	NS dig	NS lett	Av NS	PA blend	PA seg	PA del	PA iso	Av PA
14	76	79	71.84	78	87	81	58	95	80.25
15	69	85	69.55	77	99	73	51	102	81.25
16	82	83	102.20	82.5	75	81	65	95	79
21	85	75	87.71	80	73	73	57	104	58.75
24	76	69	121.70	72.5	51	85	82	98	79

It is clear from the data in Table 10 that learners in the double deficit group presented with average standard scores for NS *and* PA that were below 85. Therefore, using the criteria of Deeney et al. (2001), these learners are considered to have core deficits in both PA and NS. Once more, it is noted that none of the learners presented with a deficit in PA isolation. However, in this subtype, most learners' PA scores were below 85 for each subtest. The exceptions were learners 14 and 15 whose PA blending score were 87 and 99 respectively.

### 4.3.3.2. Phoneme-level PA

Table 12 shows the results for the double deficit subtype learners using the phoneme-level PA scores.

Table 12

Assessment Results for the Double Deficit Subtype (Phoneme-Level PA Score)

Subject	PA blend	PA seg	PA delete	PA iso	Av PA
14	86	85	51	95	79.25
15	98	73	51	102	81
16	91	95	65	95	86.50
21	67	83	41	104	73.75
24	51	87	82	98	79

Subjects 16 and 21 improved their PA scores at this level of PA. Furthermore, using this level of PA, subject 16 would be reclassified into the 'neither-deficit' subtype. Once again, the importance of the level of PA used to classify learners has been highlighted.

### 4.3.4. Unclassified learners

#### 4.3.4.1. Total PA

Four of the learners in the subject group did not present with any deficit in NS or PA, in the presence of a severe reading disability (dyslexia). Table 13 presents their average standard scores. 'Neither-deficit' in this case refers to the absence of a deficit in NS and PA as evidenced by a standard score of above 85.

Table 13

Assessment Results for the ‘Neither-Deficit’ Subtype (Total PA Score)

Subject	NS ob	NS dig	NS lett	Av NS	PA blend	PA seg	PA del	PA iso	Av PA
4	98	86	77.89	92	102	93	69	107	92.75
5	119	94	82.29	92	103	113	116	109	110.25
17	92	87	76.46	89.5	99	111	109	102	105.25
25	108	84	97.68	96	95	69	94	94	88

Most of the subjects in Table 13 presented with PA scores in each subtest that were above 85. The exceptions were learners 4 and 25 whose PA deletion and PA segmentation score was 69. All learners presented with NS scores that were above 85.

#### 4.3.4.2. Phoneme-level PA

Table 14 presents the results of the assessments for the above learners using the phoneme-level scores only. Results from this level of analysis will be contrasted with Table 13, in which total PA scores were presented.

Table 14

Assessment Results for the ‘Neither-Deficit’ Subtype (Phoneme-Level PA Score)

Subject	PA blend	PA seg	PA del	PA iso	Av PA
4	92	109	69	107	94.25
5	101	109	116	109	108.75
17	99	117	109	102	106.75
25	91	75	86	94	86.50

Subjects 4 and 17 improved their PA scores using the phoneme level task. However, learners 4 and 25 persisted with a deficit in PA deletion and segmentation. It was

noted from Tables 13 and 14 that none of the learners in the ‘neither-deficit’ group would be reclassified under these conditions.

#### **4.3.5. Summary of findings using phonological awareness total score and phoneme-level phonological awareness score**

The results presented in Figure 3 and Tables 7 – 14 report that there was a difference in frequency of each subtype according to the type of PA skill used in the categorisation process. These discrepancies have implications for diagnosis and intervention for this population. There is an immediate need to standardise the level of PA adopted in research. Table 15 reports on the learners whose classification into a subtype of dyslexia was altered according to the level of PA used.

Table 15

PA Results of Learners Whose Classification Changed According to the Level of PA Used

Subject	PA total	Phoneme-level
7	83.25	91
13	85.00	88.25
16	79	86.50

Table 15 reports that learners 7, 13 and 16 improved their PA scores at the phoneme-level to a point above the cut-off criterion of 85. Table 15 suggests that three learners in the sample (12 percent) were affected by the choice of PA level.

#### 4.4. Relationships between naming speed, phonological awareness and reading

##### 4.4.1. Rationale for the exclusion of age from the data analysis

As noted in the Methodology, age was excluded from data analysis. Table 16 provides the rationale for this exclusion.

Table 16

Pearson's Correlation Co-efficients for NS, PA and Reading with Age of Learners in the Subject and control Groups (N = 50)

	Age
NS objects	-0.03**
NS digits	-0.30**
NS letters	-0.29*
PA blending	-0.03**
PA segmentation	-0.03**
PA deletion	-0.34**
PA isolation	-0.27*
Reading recognition	-0.36**
Reading comprehension	-0.37**
Reading non-words	-0.36**
Reading non-word efficiency	-0.32**
Reading sight-word efficiency	-0.31**

\* Pearson correlation is significant at the level  $p < 0.05$

\*\* Pearson correlation is significant at the level  $p < 0.01$

Since age correlated significantly with measures of NS, PA and reading, it was necessary to rule out age as a variable from further correlations. Thus, the following results should be interpreted with age ruled out.

#### 4.4.2. Rationale for exclusion of phonological coding in working memory (verbal short term memory)

In order to justify the exclusion of the memory tasks from the analyses of the present study, the correlations for the verbal short-term memory tasks (TAPS) with PA and reading in the subject group are presented. Table 17 presents the correlations between verbal short-term memory and PA.

Table 17

Correlations Between Verbal Short-Term Memory and PA in the Subject Group  
(N = 25)

	PA blending	PA segment	PA isolation	PA deletion
Auditory digit memory	0.19	0.08	0.18	0.08
Auditory word memory	0.19	0.15	0.14	0.09

\* Pearson correlation is significant at  $p < 0.1$  level (2-tailed)

It can be noted from Table 17 that the verbal short-term memory tests adopted in this study were weakly correlated with PA skills in the subject group. These correlations ranged from 0.08 – 0.19. Further evidence for excluding verbal-short term memory from the data analysis is noted in the weak correlations with reading. Table 17 outlines these results in the subject group.

Table 18

Pearson's Correlation Co-efficients Between Verbal Short-Term Memory and Reading in the Subject group (N = 25)

		Reading recognition	Reading comprehe nsion	Reading non- words	Reading non-word efficiency	Reading sight word efficiency
Auditory memory	digit	0.18	0.16	0.20	0.30	0.04
Auditory memory	word	0.17	0.07	0.02	0.33	0.24

\* Pearson's correlation is significant at the 0.05 level (2-tailed)

\*\* Pearson's correlation is significant at the 0.1 level (2-tailed)

The results in Table 18 were not significant at  $p < 0.1$  or  $p < 0.05$  for any of the correlations performed between PA and reading with verbal short-term memory. These correlation ranged between 0.02 – 0.33. Therefore, because of these weak correlations, verbal short-term memory was excluded from the analyses.

#### **4.4.3. Correlation Co-efficients between naming speed and phonological awareness**

In this section the relationship between NS and PA in the subject and control groups will be examined. As alluded to in the Introduction, Wolf and Bowers (1999) purport that weak correlations between NS and PA in children with dyslexia provide evidence that the two deficits are distinct from one another. Therefore, results from this analysis will assist in lending support to the DDH (Wolf & Bowers, 1999), and will have further bearing in the Discussion when intervention issues are addressed. Table 19 presents the results for the correlation between NS and PA in the subject group.

Table 19

Pearson's Partial Correlation Co-efficients Between NS and PA in the Subject Group (N = 25)

	NS objects	NS digits	NS letters
PA blending	-0.09	-0.14	-0.04
PA segmentation	0.29	0.01	-0.24
PA deletion	0.14	0.10	-0.07
PA isolation	0.06	0.52	-0.24

\* Pearson's correlation is significant at the level 0.1 (2-tailed)

Using Pearson's Partial Correlation Co-efficients none of the correlations between NS and PA were found to be significant for the subject group as shown in Table 19. Table 20 shows the results of the correlation between NS and PA in the control group.

Table 20

Pearson's Partial Correlation Co-efficients Between NS and PA in the Control Group (N = 25)

	NS objects	NS digits	NS letters
PA blending	-0.27	-0.00	0.05
PA segmentation	-0.60**	-0.26	-0.25
PA deletion	-0.15	-0.11	0.08
PA isolation	-0.02	0.13	-0.31

\*\* Pearson's correlation significant at the 0.01 level (2-tailed).

Once again, the relationship between these two variables appears weak. The exception in this case is the correlation between NS objects and PA segmentation ( $r = 0.60$ ,  $P < .05$ ). To further highlight the significance of these findings, an investigation into the

correlations between the PA tasks in the subject group is necessary. Table 21 shows the results of the Pearson's Partial Correlations Co-efficients for the PA tasks in the subject group.

Table 21

Pearson's Partial Correlations Co-efficients Between PA and PA in the Subject Group (N = 25)

	PA blending	PA segment	PA deletion	PA isolation
PA blending	-	0.56**	0.51*	0.56**
PA segment	0.56**	-	0.63**	0.63**
PA deletion	0.51*	0.63**	-	0.25
PA isolation	0.56**	0.63**	0.25	-

\* Pearson's correlation is significant at the 0.05 level (2-tailed).

\*\* Pearson's correlation is significant at the 0.01 level (2-tailed).

The correlations between PA tasks presented above suggest a strong relationship between these measures. That is, each task is measuring a different aspect of the same construct (Castles & Coltheart, 2004; Robertson & Salter, 1997). In light of the findings in Table 19, Table 20 and Table 21 these correlations highlight the independence of NS. NS did not correlate significantly with PA in the subject and control groups, whereas PA and PA correlated significantly. This suggests that NS is not part of a broader PA skill.

#### **4.4.4. Correlation co-efficients for naming speed, phonological awareness and reading**

In order to explore the relationship between NS, PA and reading as mentioned in the Aims, Pearson's Partial Correlation Co-efficients were calculated. Wolf and Bowers (1999) use the independent contributions of NS and PA to reading as evidence to support the separation of the deficits. The types of reading skills assessed were the

direct access (sight-word reading, and sight-word reading efficiency tests) and the speech-recoding route (non-word reading and non-word reading efficiency test). A reading comprehension test was also administered. Pearson's Partial Correlation Coefficients between NS and the above-mentioned reading measures are presented in Table 22.

Table 22

Pearson's Partial Correlation Co-efficients Between NS and the Five Measures of Reading in the Subject Group (N = 25)

	NS objects	NS digits	NS letters
Reading recognition	0.00	0.63**	-0.59**
Reading comprehension	-0.09	0.34	-0.24
Reading non-words	0.05	0.29	-0.19
Reading non-word efficiency	0.03	0.31	-0.24
Reading sight-word efficiency	0.12	0.84**	-0.54**

\*\* Pearson's correlation is significant at the 0.01 level (2-tailed)

In the above table, NS objects appears to have little significance to the reading skills assessed in this study, with correlations of between 0.00 and 0.12. This result replicates the finding of Spring and Davis (1988). Further, the large correlations (Cohen, 1977) between NS digits and letters with reading recognition (sight word reading) and sight word reading efficiency replicate the findings of previous research and will be addressed in the Discussion.

As will be addressed in the Discussion, a correlation between NS and reading comprehension was calculated while controlling for the effect of word recognition. Spring and Davis (1988) suggest that the reading comprehension scores of learners might be secondary to the ability of the learners to recognize words. The results from this analysis are presented in Table 23.

Table 23

Pearson's Partial Correlation Co-efficients Between NS and Reading Comprehension (with word recognition taken out) in the Subject Group (N = 25)

	Reading Comprehension
NS objects	.30*
NS digits	.42*
NS letters	.42*

\* Pearson's correlation significant at the 0.05 level (2-tailed)

In order to explore the possible contributions of PA skills to reading, Pearson's partial Correlation Co-efficients for PA and reading were calculated using both the total PA scores and the phoneme-level PS scores. Table 24 presented the correlations between the total PA scores and reading in the subject group.

Table 24

Pearson's Partial Correlation Co-efficients Between Total PA Score with the Five Measures of Reading in the Subject Group (N = 25)

	PA blend	PA segment	PA delete	PA isolation
Reading recognition	0.32	0.26	0.49*	0.27
Reading comprehension	0.16	0.17	0.54**	-0.10
Reading non-words	0.31	0.45*	0.34	0.50*
Reading non-word efficiency	0.04	0.27	0.38	0.18
Reading sight-word efficiency	0.00	0.09	0.29	-0.00

\* Pearson's correlation is significant at the 0.05 level (2-tailed)

\*\* Pearson's correlation is significant at the 0.01 level (2-tailed)

In order to investigate the correlation between the phoneme-level PA score and reading, a Pearson's Correlation was performed. Castles and Coltheart (2004) purport that the phoneme level is more strongly correlated with reading than any other PA level task. PA isolation (final) and (medial) are also further analysed as they may be more strongly correlated with reading than the initial, medial and final score together (O'Carroll, personal communication, February 24, 2005). Table 25 outlines the results.

Table 25

Pearson's Partial Correlation Co-efficients Between PA Phoneme-Level Score and the Five Measures of Reading in the Subject Group (N = 25)

	PA blend	PA segment	PA delete	PA isolation (final)	PA isolation (medial)
Reading recognition	0.42*	0.41*	0.45*	0.27	0.29
Reading comprehension	0.32	0.25	0.56**	0.00	0.08
Reading non-words	0.34	0.60**	0.37	0.32	0.44*
Reading non-word efficiency	0.31	0.41*	0.42*	0.17	0.19
Reading sight-word efficiency	0.16	0.41*	0.37	0.27	0.03

\* Pearson's correlation is significant at the 0.05 level (2-tailed)

\*\* Pearson's correlation is significant at the 0.01 level (2-tailed)

Tables 24 and 25 reveal that phoneme-level and total PA correlations with reading yield different results. Phoneme-level scores appeared to be more strongly correlated with reading due to the finding that there were eight correlations that reached significance in Table 25, as opposed to four that reached significance in Table 24. In the Table 25, PA segmentation and deletion appear as the strongest measures of PA with significant correlations in four and three out of the five reading measures.

#### **4.5. Questionnaires to Speech and Language Therapists**

The information provided by SLTs has been tabulated in Table 26 with respect to each learner's classification into a subtype. Three learners in the sample had not received Speech and Language Therapy intervention due to their recent admission to the school. The types of therapy offered to these learners as stated by the therapists fell into six broad categories. Each intervention aim has been categorised according to the following guidelines.

- ✓ Phonological awareness included rhyming, auditory perceptual skills, analysis, synthesis, sound awareness, deletion and manipulation
- ✓ Receptive language (R language) included receptive semantics, syntax and vocabulary
- ✓ Expressive language (E language) included expressive semantics, syntax and vocabulary
- ✓ Articulation - artic
- ✓ Word finding - W/F
- ✓ Auditory memory - aud mem

Table 26

Outline of Intervention Aims in Relation to Deficit Subtypes and Duration of Intervention

Subject	Subtype	Years/months in therapy	Intervention aims
1	NS	2 years	PA, R & E language, artic
2	NS	2 years	PA, R & E language
3	NS	3 years	Artic, R & E language
6	NS	7 months	PA, E Language
8	NS	7 months	PA, E language
10	NS	2 months	PA, W/F, E language
11	NS	1 year 3 months	PA, E language, aud mem
18	NS	2 years	PA, R & E language
19	NS	-	-
22	NS	2 years	PA, R & E language
Average		1 year 10 months	
7	PA	10 months	PA, artic, R language
9	PA	1 year 10 months	PA, E language, artic
12	PA	1 year 5 months	PA, R & E language
13	PA	2 years	PA, R & E language
20	PA	4 years	PA, R & E language
23	PA	1 year 2 months	-
Average		2 years 2 months	
14	DD	1 year 2 months	PA, R & E language
15	DD	5 months	PA, R & E language
16	DD	3 years	PA, R language, W/F, aud mem
21	DD	1 year	PA, R language, artic
24	DD	-	-
Average		1 year 2 months	
4	No deficit	1 year	PA
5	No deficit	2 years 9 months	PA, R language, artic
17	No deficit	1 year 9 months	PA, aud mem, E language, W/F
25	No deficit	-	PA
Average		1 year 10 months	

Three learners in the subject group had not received any intervention from the SLT services as the schools due to their recent admissions. Table 27 provides an outline of the language intervention with these learners.

Table 27

Summary of the Aims of Intervention for the subject group

	Receptive and expressive language	Receptive language	Expressive language	No language intervention	Word finding	Auditory memory	PA
%	40	16	20	8	12	12	95

Table 27 reports that 95 percent of learners who received Speech and Language Therapy intervention received PA training. Twelve percent received intervention for auditory memory. In terms of language intervention, the majority of learners in the subject group received intervention for receptive language *and* expressive language (40 percent). Sixteen percent received intervention for receptive language and 20 percent received intervention for expressive language, 12 percent had not commenced therapy and 8 percent of learners did not receive intervention for receptive or expressive language. Tables 26 and 27 also highlight the absence of explicit intervention for NS or fluency. However, as will be noted later, it is possible that SLTs were addressing some of the issues of fluency/speed in their work on lexical access in word finding intervention. This will be elaborated on in the Discussion.

With respect to the subtype and severity, Table 28 presents the average percentile rank for reading comprehension and reading recognition according to each subtype. The subtype classification system used in this table is the total PA score classification.

Table 28

Average Reading Comprehension and Word Recognition Scores (Percentile Rank) According to Each Subtype

Subtype (PA total score)	Reading comprehension	Word recognition
NS	5.7	5.9
PA	1.8	2.6
Double deficit	1.4	1.8
Neither-deficit	4.0	5.5

The results in Table 28 suggest that there is a possible link between reading severity and subtype of dyslexia. As suggested by Wolf and Bowers (1999) the NS subtype had an average reading comprehension and reading recognition score that was higher than any other subtype. Although Wolf and Bowers (1999) do not offer explanations for this hypothesis, it is suggested that the NS subtype learners are better able to sound words out (using their PA) or parts of words in order to read words and therefore understand the sentence.

#### 4.6. Reliability of analyses

As noted in the Methodology, inter-rater reliability was not an issue in the present study. However, a potential source of bias may have been in the intra-rater reliability measures. In order to calculate intra-rater reliability, 10 percent of the tape recorded sessions was randomly selected for re-analysis two weeks after administration of the assessments. The agreement between the two recordings was calculated, using a statistical correlation. Cucchiarini (1995) state that 95 percent agreement is the minimum correspondence acceptable in Speech-Language Pathology research. The correlation between the two recordings approximated 1 ( $r = .98$ ). This meant that the percentage agreement between the two recordings was 98. Therefore, the intra-rater reliability of the measurements was established.

Katzenellenbogen et al. (1997) suggest that in order to evaluate the instrument, observer and subject variations in a study, the examiner should repeat measures on a sub-sample of the study sample. Ten percent of the sample was randomly selected for re-assessment four weeks after the initial assessment. Test situations were consistent with the initial situations. A parallel group t-test was performed to determine the significance of the average difference between the assessment results for each subtest. The probability values ranged from 0.09 - 0.43. These values do not indicate a significant difference between the measures since they are above the significance level of 0.05. Therefore, it can be suggested that the instrument, observer and subject variations that may render the results unreliable were not a significant factor in the present study.

#### **4.7. Validity**

Issues concerning the generalisability (internal and external validity (Hite, 2001)) of the study will be addressed in the Discussion section. Arguments for the validity of the test battery, however, have already been presented. The results from Tables 3, 5 and 6 offered justification for the validity of the study. The control group's scores on all tests fell within the normal limits (standard score between 85 and 115) in Table 3. Learners with dyslexia performed at a lower level on tests of PA, NS and reading than learners without dyslexia (Table 5) and this difference in performance between the subject and control group was statistically significant (Table 6). Therefore, following from these arguments, the tests are believed to be appropriate for the Cape Metropole sample.

Despite the evidence for the validity of the test battery above, the NS letters test (Table 4) have not been included. Evidence for the validity of this test is an issue that warrants attention. The motivation for the validity of the NS letters test will be presented below.

#### **4.7.1. Validity of naming speed (letters) test**

In a longitudinal study by Wolf et al. (1986), digit and letter NS tests were found to be strongly correlated with each other ( $r = 0.84$ ). The following statistical analyses aimed to prove the criterion-related validity of the NS letters test in the present study:

- The correlation between the letter and digit NS tests was found to be significant in the subject group ( $r = -0.72$ ,  $p < .001$ ,  $N = 25$ ).
- Using partial correlations which controlled for age, the correlation for the subject group was significant ( $r = -0.67$ ,  $p < .001$ ,  $N = 25$ ).
- The correlation for whole group was also found to be significant ( $r = -0.77$ ,  $p < .001$ ,  $N = 50$ ).

The above analyses thus served to establish the criterion-related validity of the NS letters test. Since there was no way of identifying a deficit in NS letters due to the lack of standard scores, the NS letters test could not be used in the present study to categorise learners into subtypes. However, this test was useful in the correlational statistics in which the NS letters test provided further information about the relationships between the variables NS, PA and reading.

#### **4.8. Concluding statements**

A brief outline of how the results served to meet the aims of this study will follow. However, before the aims of the study can be addressed, it is imperative to state the case for the validity of the test battery. To assess the validity of the test battery a number of procedures were adopted. The most convincing argument was presented in Table 6, in which Kolmogorov-Smirnov's test for normality p values were presented. It was evident in Tables 3, 4 and 5 that the learners with dyslexia performed below the learners without dyslexia on all assessments performed. The difference was found to be statistically significant in Table 5.

Descriptive statistics were employed to address the main aim of the study, which was to determine whether a sample of Grade 2 learners with dyslexia could be categorised

into subtypes according to the presence or absence of NS and/or PA deficits. It was found that these learners could be categorised according to NS and/or PA deficits. In order to determine the frequency of subtypes in the sample of Grade 2 learners with dyslexia, each learner was categorised into a subtype according to the criteria of Wolf and Bowers (1999). It was evident that the level of PA used to categorise learners affected the frequency of each subtype. This was evident in Tables 7 to 14, as well as in Figure 3.

To offer further evidence of the independence of NS and PA, the relationship between NS and PA was explored. A motivation for the exclusion of verbal short-term memory and age was offered. Correlations between these skills identified that NS and PA were weakly correlated with one another, but PA skills were strongly correlated with one another. To explore the relationships between NS and PA with reading, more correlations were performed. It was found that NS and PA had different contributions to reading.

To document the main therapeutic approaches used with the Grade 2 learners with dyslexia, the results from the questionnaire to the SLTs was tabulated. It was found that SLTs did not address NS or fluency per se. Information concerning the word finding and receptive vocabulary scores of the learners with dyslexia was also documented in the above results. Although not stated as an aim of the study, these results offered further valuable insight into the deficits of these learners. This information will be expanded on in the following section. Finally, the relationship between the subtype and severity of the reading disorder was explored. Again, this was not an aim of the study but it did serve to suggest a potential relationship between these variables that could be explored in future research.

## **CHAPTER 5: DISCUSSION**

### **5.1. Introduction**

In the following section, the results of this study will be discussed. The order of the discussion will follow the aims of the study to ease interpretation. An overview of the comparison of the subject and control groups' performances on tests of NS, PA and reading will be presented. This will provide the basis for the subtyping, since the results of the study can be interpreted with confidence. A detailed discussion concerning the issues surrounding subtypes will be addressed. This discussion will include a critical evaluation of the categorisation system which outlines issues of PA and NS type and level. The identification of the 'neither-deficit' subtype in this study deserves exploration since 16 percent of the subject group presented with no deficit in NS or PA. A brief outline of the influence of subtypes on reading severity will be offered since this may be an important relationship for prediction and intervention. Finally, a critical evaluation of the subtype categorisations will be expounded upon as well as the implications for diagnosis and intervention. The results of the correlational statistics will then be discussed. Documented outcomes of the questionnaires to the SLTs will be discussed in relation to the word finding and receptive language scores of the subject group. Issues of reliability, internal and external validity will be outlined. The section will end with a report on the ethical procedures that were adopted as a consequence of this study.

### **5.2 Comparison of the subject and control group on tests of naming speed, phonological awareness and reading**

Tables 3, 4 and 5 served to provide evidence for the validity of the test battery to the sample population. Learners with dyslexia performed at a lower level on all tests of PA, NS and reading than learners without dyslexia (Tables 3 and 4). This difference in performance between the subject and control group was statistically significant (Table 5). For these reasons, the tests are believed to be appropriate for the Cape Metropole sample. In addition to this motivation, Table 6 reported that there was no

significant difference between the results from the control group and a normal distribution.

### **5.3. Subtypes of dyslexia**

One of the main aims of this study was to determine whether a sample of Grade 2 learners with dyslexia, between 7.9 – 9.7 years of age could be categorised in subtypes according to the presence or absence of PA and/or NS deficits. Findings from previous studies have shown that some children with dyslexia do not present with a core PA deficit (as argued by the PDH), their primary deficit being in the domain of NS (Wolf & Bowers, 1999; Wolf et al., 2000; Wolf et al., 2002). There is little disagreement about the existence of NS deficits in learners with dyslexia (Bowers & Swanson, 1991; Wolf & Bowers, 1999) and there is little disagreement about the existence of PA deficits in learners with dyslexia (Blachman, 1994; Wagner & Torgesen, 1987). These hypotheses have been supported in the present study. Although Wolf and Bowers (1999) as well as Wolf et al. (2000) provide strong support for the separation of PA and NS by documenting the processes involved in rapid naming, the discovery of distinct subgroups offers further support and evidence in favour of separate categorisation.

Adopting the classification criteria of Deeney et al. (2001) established that the subject group could be categorised into subtypes according to their profiles on NS and PA tests. However, this study uncovered some theoretical difficulties with classification that may have implications for diagnosis and intervention. Figure 3 reports the frequency of subtypes of dyslexia in the sample using the total PA score and phoneme-level PA scores for each subtest. Figure 3 revealed that there was a difference in the frequency of subtypes according to the level of PA used. The following section will outline some of these theoretical complications.

#### **5.3.1. Issues of phonological awareness**

Despite the finding of distinct subtypes in the sample, it was evident that the measures used to classify learners were important in diagnosis of core PA deficits. While some theorists purport that a comprehensive battery which includes all levels of PA

(syllable and phoneme) is necessary to identify PA deficits, others suggest that it is the phoneme level that is more important.

In light of the considerable inconsistencies in the literature concerning the measures used to diagnose PA and in order to critically evaluate separate categorisation of learners with dyslexia, analyses were performed using total PA scores (syllable and phoneme levels) as well as PA phoneme level scores. Both methods offered different results in the present study and have implications for diagnosis and intervention. As noted in Figure 3, there was a 4 – 8 percent difference in the frequency of each subtype in this study according to the level of PA used. Table 15 noted that 12 percent of the learners in the subject group were affected by the level of PA used. For example subjects 7 and 13 (Table 9) would be re-classified using the phoneme level tasks to ‘neither-deficit’. Table 10 shows that their PA scores moved beyond the 85 criterion.

There is a possibility that learners may be over or under identified/diagnosed according to the level of PA assessed. This also has implications for the efficiency and effectiveness of intervention. Learners may not be given appropriate treatment according to their true underlying deficits. These implications extend to the economic level. Learners who are over identified are given costly treatment which may be inappropriate. Learners who are under diagnosed may not be given treatment which may result in their continued difficulty with reading and subsequent behavioural and social adjustment problems (Temple, 2002). Professionals diagnosing and treating dyslexia should be cautious of adopting one level of PA over the other until the issue has been addressed and resolved in future research studies.

Despite these implications for diagnosis and intervention of those learners whose subtype classification changed, it was also evident from Tables 7 – 14 that some learner’s PA scores improved using the phoneme-level. Castles and Coltheart (2004) note that the phoneme level is more difficult to execute than syllable level tasks. However, in this study, thirteen learners improved their PA score at the phoneme level of analysis. A possible explanation for some of the learners improved phoneme-level PA scores, is the type of intervention adopted with these learners. Although this cannot be concluded from the study, it is possible that intervention for this age group

is aimed at phoneme-level tasks since these learners are required to read and spell at this level (Scott & Brown, 2002). Sustained awareness training at the phoneme level may have led to benefits at this level to the detriment of the syllable level. These conclusions, however, are tentative and require further investigation.

In addition to the differences in prevalence using the total PA and phoneme-level PA scores, differences in prevalence could be observed according to the choice of PA subtest. The following section will contrast the present study with a similar study in the literature with the intention of outlining the differences in prevalence according to the subtest chosen. Wolf et al. (2002) conducted a study similar to the present study. These authors categorised Grade 2 and 3 learners on tests of NS letters, phoneme deletion and phoneme blending. Table 29 relates the findings of the present study to the study by Wolf et al. (2002). Fifteen percent of the Wolf et al. (2002) sample of one hundred and forty four learners was categorised as NS, 19 percent as PA and 60 percent as double deficit.

Table 29

Comparison of the Total PA Score in the Present Study with Wolf et al. (2002) Expressed in Percentages

	Present study (total PA score)	Wolf et al. (2002) study
NS	40	15
PA	19	24
Double Deficit	2	60
Neither-deficit	16	6

The differences in prevalence of the double deficit and NS subtypes in the separate studies may be explained in terms of the intervention received by each learner or by the measures used to diagnose a core PA. With respect to intervention, apart from three learners who had not commenced therapy, all learners had received PA training in the present study. This may explain the lower percentage of learners in the double deficit group compared with the Wolf et al. (2002) study. Wolf et al. (2002) do not

specify whether their sample received intervention, nor do they state the type of intervention they may have received. It is assumed that a percentage of the NS learners in the present study presented with PA deficits as well as NS deficits at the onset of therapy, placing them in the double deficit group. This would follow from the suggestion by Wolf and Bowers (1999) that the most severely impaired readers (those learners who require specialized education in an LSEN school) are in the double deficit subtype of dyslexia. Had this been the case, it would explain the SLTs' aims of PA in the intervention efforts. However, since they have received ongoing PA training their PA deficits may have been remediated, rendering them NS subtype learners. In contrast, it cannot be concluded from the information provided by Wolf et al. (2002) that this was the case in their sample.

With respect to the measures used in diagnosis, using the phoneme deletion and phoneme blending tasks to diagnose a core PA deficit may explain the difference. Table 30 addressed the deletion and blending scores from the results.

Table 30

Comparison of the Present Study (Phoneme-Level Deletion and Blending) with Wolf et al. (2002) Expressed in Percentages

	Present study (Phoneme delete and blending)	Wolf et al. (2002) study
NS	28	10
PA	28	24
Double Deficit	32	60
Neither-deficit	12	6

It is evident that the results approximate those of Wolf et al. (2002) but do not follow them exactly. However, these differences serve to highlight the importance in adopting certain criteria to measure core PA deficits.

### 5.3.2. Issues of naming speed

The influence of PA levels and tests has been addressed above. The same concerns in changes in prevalence are noted for the NS subtype. NS letters could not be used in this study; however, Spring and Davis (1988) commented that NS digits and letters were more appropriate in the assessment of NS than NS objects. Further, because NS digits and NS letters correlated significantly, these authors used the NS digits test. Adopting this view, the following prevalence would be identified as shown in Table 31.

Table 31

Prevalence of Subtype Using NS Digits and NS Objects Expressed in Percentages

	NS digits	NS digits plus NS objects
Single deficit (NS)	40	40
Single deficit (PA)	12	24
Double deficit	32	20
'Neither deficit'	16	16

The most noticeable changes using the NS digits test are in the double deficit subtype, which increased from 20 percent to 32 percent and the single deficit (PA) which halved from 24 percent to 12 percent. Once again, the difficulties with non-standardised criteria for categorising learners are marked by the contrast in prevalence in Table 31. As mentioned previously, these differences in prevalence may have implications for diagnosis and intervention of learners with dyslexia. It is noted that the choice of NS test used to diagnose a deficit in NS influences whether the learner would be identified as presenting with an NS deficit or not. In turn, this would influence the type of intervention offered to this learner. For example learner 12 (Table 12 and 13) presented with a deficit in NS digits but not in NS objects. The average of these scores exceeded the cut-off of 85 and this learner was therefore classified as having no deficit in NS.

### 5.3.3. 'Neither-deficit' subtype

Despite the evidence that children with dyslexia can be separated into categories according to their PA and NS skills, the present study suggests that this diagnostic battery is not yet complete. The existence of learners in the subject group who were unclassified according to the double-deficit criteria is an issue that warrants attention. Some authors have acknowledged the fact that the diagnostic battery is not yet complete. It is "by no means clear that skill deficits (in dyslexic children) are restricted to the phonological domain" (Nicolson & Fawcett, 1994, p. 148) or the NS domain (Badian, 1997), nor are they confined to reading and spelling (Nicolson, Fawcett & Dean, 2001). Wolf et al. (2002) employed the above criteria to subtype one hundred and forty four learners in Grades 2 and 3. From their sample, they identified nine learners who were unclassified using the above criteria. In the study by Lovett, Steinbach and Fijters (2000) twenty-six of their one hundred and forty learners were not identified using the double-deficit criteria. It is possible that the cut-off point adopted by Deeney et al. (2001) was not sensitive enough to detect deficits in NS or PA in these learners. However, it may also be argued that according to the tests used (PHAT and PhAB) to assess NS and PA that a standard score on any subtest at or below 85 is regarded as a deficit. Only two learners (learners 4 and 25) presented with isolated deficits (Table 6 and 7).

The most compelling explanation for this fourth deficit type is offered by Badian (1997). This author recommends the extension of the DDH to a triple deficit hypothesis to include an orthographic processing subtype. According to Bowers and Wolf (1993), orthographic processing refers to the visual processing of letters and letter patterns into words, e.g. is the recognition of the correct visual form of a letter or word. Adams and Bruck (1993) (as cited in Badian, 1997) suggest that when the orthographic pattern recognition system is unstable, the establishment of links to other processes (e.g. phonological, meaning) will be compromised. Furthermore, Badian (1997) states that although NS and PA contribute to reading, orthographic processing may also play an important role. In addition orthographic and phonological skills make independent contributions to reading (Olson, Forsberg, Wise & Rack, 1989 as cited in Badian, 1997).

If it is accepted that orthographic processing contributes to reading acquisition, then as Badian (1997) suggests it is possible that yet another subtype of dyslexia exists. In the investigative study by Badian (1997) this author measured orthographic skill by presenting dyslexic children with an array of 27 letters and 14 numbers (displayed in 5 rows). The children had to cross out any incorrectly oriented letters or numerals. The phonological awareness measure was a phoneme deletion task as well as a non-word reading test. Rapid naming was assessed using the RAN (Denckla & Rudel, 1974 as cited in Badian 1997). The method of classification into subtypes was the same as the present study and followed the criteria of Deeney et al. (2001). Badian (1997) identified 7.1% of the sample of twenty-eight children with dyslexia who presented with an orthographic deficit in the absence of phonological or NS deficits.

In addition to the orthographic processing deficit hypothesis, Joanisse, Manis, Keating and Seidenberg (2000) offer a further explanation for the 'neither-deficit' subtype. This alternative theoretical view implicates linguistic capacity, which is hypothesized to consist of phonological, morphological/syntactic and pragmatic awareness. More specifically, Tunmer (1989) (as cited in Muter 2003) as well as Tunmer and Hoover (1992) (as cited in Plaza, 2003) reported evidence that syntactic awareness may account for the variance in decoding ability of children with dyslexia, even after phonological awareness had been controlled.

Joanisse et al. (2000) identified in their study into the relationship between dyslexia and three aspects of language, in addition to a phonological subtype, a language impaired group of children with dyslexia. Their language-impaired group was identified using scores obtained from the following tests of language: the Clinical Evaluation of Language Fundamentals (CELF) Word Structure (Semel, Wiig & Secord, 1995 as cited in Joanisse et al., 2000), the Weschler Intelligence Scale for Children (Weschler, 1992 as cited in Joanisse et al., 2000) vocabulary task and a test of inflectional morphology similar to the one originally devised by Berko (1958) (as cited in Joanisse et al., 2000). Their method of classification into the language-impaired subtype was based on averaged standard scores for the language tests that were at or beyond one standard deviation below the mean. These authors concluded that the dyslexic group had a delay in language skills, particularly in morphology,

rather than a phonological impairment alone. However, Muter (2003) commented that “it appears that children use their phonological skill in combination with their syntactic ability to read words and to understand and recall what they read and hear” (p. 63). The link between syntactic awareness and reading was made clear by Tunmer and Chapman (1998) (as cited in Muter, 2003). These authors suggested that children combine incomplete phoneme-grapheme information with their knowledge of sentence constraints so that they may identify unfamiliar words. That is, children may be able to draw on their knowledge of sentence structure in which an unfamiliar word is embedded to decide on a likely pronunciation.

Despite these tentative suggestions concerning the nature of the ‘neither-deficit’ subgroup, the issue is cause for further investigation. The deficits in orthographic processing and morphology/syntax could not be investigated in the present study due to time limitations of the study (the Western Cape Education Department would not allow data collection in the fourth term of school) as well as time limitation in relation to the assessment of each learner. The inclusion of orthographic and morphology tests would have rendered the study unfeasible. Furthermore, the orthographic processing test was beyond the scope of the researcher’s experience and qualification.

#### **5.3.4. Overview of subtypes of dyslexia**

It was evident that learners with dyslexia in the present sample could be categorised in subtypes according to the presence or absence of NS and/or PA deficits. However, the categorisation of these learners according to the DDH was rendered complicated due to the inconsistencies in the literature concerning the level of PA as well as the type of NS test to use. It was shown that the total PA scores and the phoneme-level scores altered the prevalence of each subtype (as shown in Figure 3). As mentioned previously, twenty two learners’ average PA scores changed according to the level of PA adopted, thereby altering the prevalence of each subtype. Additionally, the choice of PA subtest influenced the prevalence.

The prevalence of the subtypes was also altered by the choice of NS test. The NS digits test was used to reanalyse the data with the results presented in Table 31. These differences in prevalence are cause for concern as it has implications for the diagnosis

and intervention of affected learners (learners whose classification alters according to the level and choice of PA used).

It was evident from the findings of this study that the subtype system may be insufficient in identifying all the possible underlying deficits in dyslexia. This was suggested by the existence of the 'neither-deficit' group. Some suggestions concerning the underlying causes of this groups' reading difficulties were suggested, including orthographic processing deficits and morphological/syntactic deficits.

### **5.3.5. Influence of subtype on reading severity**

Children in the double-deficit group are thought to have more profound reading difficulties than the single deficit children (Wolf & Bowers, 1999; Wolf et al., 2000a) because the double-deficit children have less compensatory mechanisms to fall back on (Badian, 1997). Also, research has identified that NS deficit children present with less severe reading deficits than PA deficit children who in turn have less severe deficits than double deficit children (Wolf & Bowers, 1999; Wolf et al., 2000).

These findings have been replicated in Table 28 using reading comprehension and reading recognition as measures of reading achievement. Taking the average percentile rank, the NS group was found to be the strongest in both reading measures, followed by the 'neither-deficit' group. PA subtype learners were found to be slightly stronger than double deficit learners' scores.

Little explanation for this finding is offered in the literature. However, as alluded to earlier, it is possible than learners with NS deficits are better able to sound words out in order to gain access to the sub-lexical components of the word. In Figure 1, these learners may use the route from the orthographic representation to the sub-lexical representation where they may begin to access the phonological form of the word or words. Once they have begun to access this form, they may begin to access the word using context (Torgesen et al., 1999) or by reading the word if it is spelled phonetically (Ramus, 2001). In both cases, these learners will gain access to the semantic lexicon, at which point they will understand what they have read. These learners' compensatory skill, which is at the sub-lexical level, may be more effective

in reading words than the compensatory skills of the PA subtype (speed of processing). The double deficit learner on the other hand, may not have access to either compensatory strategy, rendering reading very difficult.

This is an issue that requires further attention and research as it has implications for prediction. Future research that identifies a consistent influence of subtype on reading severity will justify critical studies about possible compensatory skills in learners with dyslexia (Wolf et al., 2000). With the knowledge that double deficit learners are weaker in reading than single deficit learners, educators and other professionals can make more informed decisions on placement and intervention for these learners. As stated above, Wolf and Bowers (2000) assert that one advantage of categorising children into subtypes, is that it improves the predictive capacity of those professionals working with these children. This implies that knowledge about the types of deficits (their subtype classification) may provide some indication of the learner's progress in reading programmes at school. In addition, the effectiveness of programmes may be advanced through knowledge of severity and subtype, by providing guidelines concerning the learner's strengths and weaknesses as well as outlining crucial compensatory strategies for classroom activities.

### **5.3.6. Critical evaluation of subtype classification**

#### **5.3.6.1. Theoretical**

While distinct categories of children with dyslexia provide a convenient framework for professionals diagnosing and treating dyslexia due to the predictive qualities of the categorisation (Wolf & Bowers, 2000), it may oversimplify the picture of reading disabilities. Wise (2001) argues that "children do not fall into neat groups with or without phonological and naming deficits, these abilities actually vary normally and continuously among children" (para 4). In addition, the present study has shown that reading behaviour may depend on abilities and factors outside those PA and NS skills assessed. The argument that learners with dyslexia do not fall into NS and PA categories is noted by the finding of the 'neither-deficit' subtype in this sample and was presented above. The possible orthographic processing deficits and morphology deficits of children with dyslexia could not be addressed in the present study, but are

cause for concern when attempting to categorise learners with dyslexia. These suggestions imply that children with dyslexia do not constitute a homogenous group (Casalis, 2003). In order to address the full potential range of deficits in dyslexia, Johnson (1994) (as cited in Greene, 1996) advocates for a full psycholinguistic assessment including tests of “phonology, morphology, syntax, semantics and pragmatics” (p. 52). From the findings of the present study, the inclusion of NS tests is suggested in the test battery proposed by Johnson (1994) (as cited in Greene, 1996).

### **5.3.6.2. Practical**

Another major criticism of the categorisation system employed in the present study is evidenced by the isolated PA deficits found in the NS subtype and the isolated NS deficits in the PA subtype. These results are reported in Tables 7 – 14. These findings may suggest that there is a developmental aspect to the deficits in NS and PA. The issue of the stability of PA over time is a complex issue. Blachman (1994) has suggested that the stability (and therefore remediation) of PA was a question that required urgent attention. The stability of PA is rendered complicated by the suggestion by Castles and Coltheart (2004) that “phoneme awareness does not exist independently of graphemic knowledge” (p. 105). In addition, Wagner et al. (1993) contend that children show “dramatic changes in their competency for tasks that require isolating and manipulating phonemes” on entering school (p. 83). Therefore, learning to read, and the frequency of exposure to words, has a bearing on the development of PA skills. As noted by Castles and Coltheart (2004) it may be difficult to separate the development of PA from the development of graphemic knowledge. The maturational lag model maintains that learners with deficits in NS and PA may eventually catch up with their peers (Korhonen, 1995). This model, however, has not received much support in the literature. Korhonen (1995) assessed the persistence of NS deficits in a nine-year longitudinal study of nine-year-old learners with dyslexia. This author noted that NS deficits persisted and were evident nine years after the initial assessment. These deficits, that may be considered residual within the maturational lag hypothesis, require urgent attention in the literature.

The choice of subtests of PA and NS influenced the classification of learners. For example, learner 8 (Table 7) in the NS subtype presented with deficits on PA

segmentation (SS = 71) and deletion (SS = 82) tests. The averaged SS on all PA tasks, however, was above 85 (SS = 96) placing this learner in the NS subtype despite the deficits in PA segmentation and deletion. In the literature, the choice of test appears arbitrary. As mentioned previously, Wolf et al. (2002) administered the phoneme deletion and blending tasks to categorise their learners. Bowers (1995) (as cited in Wolf & Bowers, 1999) used the Test of Auditory Analysis (Rosner & Simon, 1971 as cited in Wolf & Bowers, 1999) which is comparable to the PA deletion test of the present study.

To further highlight the importance of the choice of PA tests in categorising learners, Wolf (1997) administered the non-word reading test as a measure of phonological ability. As noted in Appendix N, Table N1, only two learners (subjects 15 and 24) in the subject group of this study presented with deficits in non-word reading. Using the non-word reading test as a measure of phonological processing would have therefore resulted in only two learners being classified as having core PA deficits.

Besides the difficulties with PA measures, there are discrepancies concerning which NS measures to use. NS letters could not be used in the present to categorise learners into subtypes because it was not standardised. Therefore, there was no standard score to use as a measure of the learner's functioning and no cut-off criterion could be used. However, considering only NS digits and objects as single measures of NS deficits reveals the cause for concern. For example, learner 10 (Table 7) in the NS subtype would be reclassified into the 'neither-deficit' subtype had only NS digits been used (NS digits SS = 99). Besides the theoretical concerns, this reclassification has direct implications for intervention with this learner. Taking into account the argument above, placing learners into subtypes can sharpen our understanding of their strengths, weaknesses and compensatory strategies. Placing learner 10 in the 'neither-deficit' subtype would imply that this learner had a strength in NS. However, it is not clear, from the results of this study, that learner 10 does have a strength in NS because of his weak objects NS score (SS = 69).

Therefore, the major contemporary criticisms of the DDH (and consequently subtyping learners) are the inconsistent use of PA measures as well as NS measures. It appears, from the results of the study, that each task yields different outcomes and the

subtype classification depends on the task used. Further research and standardisation of the PA measures used in the DDH are urgently needed both for theoretical and practical purposes. Perhaps use of an in-depth PA measure such as in the present study is not possible in screening batteries in South Africa because of the length of time it would take to administer (approximately 20 minutes). However, the most robust and predictive measure of PA and NS from this study should be empirically proven and adopted in screening tests in South Africa.

### **5.3.7. Implications for diagnosis and intervention**

#### **5.3.7.1. Diagnosis**

The present study may have implications for the classification of Grade 2 learners with dyslexia in LSEN schools in the Cape Metropole. The findings of the study strongly suggest that NS and PA are separate deficits and should be diagnosed as such. Therefore, the results emphasize the importance of including NS measures, in addition to PA measures, in diagnostic and screening batteries (Wolf et al., 2002). As alluded to in the previous section, however, there is an urgent need for further research to standardise the PA and NS measures that are most appropriate for diagnosis. Wagner et al. (1994) have demonstrated that the combination of PA and NS measures provides the strongest prediction of reading to date. The inclusion of an NS test in pre-school and Grade 1 test batteries may identify those learners whose NS problems presage later possible delays in fluent reading and comprehension, but who may otherwise have been missed due to their adequate PA skills (Morris et al., 1998 as cited in Wolf et al., 2002).

Wolf and Bowers (1999) report how learners whose NS deficits are not picked up early, often present in later Grades with comprehension and fluency problems. Additionally, Blachman (1994) asserts that within the current framework of diagnosis and intervention, PA deficits of the double deficit learner may get a learner into a specialized reading programme, but the NS deficit is what will keep him/her there - the treatment resisters. A further benefit of including NS measures in the screening battery is that it may indicate a need for further assessment into underlying factors

that may be affecting fluent reading (Wolf et al., 2000a). This is particularly important if adopting the domain-general nature of the deficit indexed by NS measures.

### **5.3.7.2. Intervention**

The present study may have implications for how dyslexia is treated in the Cape Metropole. It has been made apparent by the realization of the DDH that intervention efforts for NS and PA should differ in type and nature (Wolf et al., 2000b). However, in order to understand the type of proposed intervention, the arguments presented in the literature concerning the domain-general or domain-specific nature of NS deficits require further explication, since this will have direct implication for intervention methods.

As mentioned in the Introduction, the two hypotheses concerning the relationship between processes underlying NS deficits and reading failure are the domain-general and domain-specific nature of the skill of NS (Wolf & Bowers, 1999). Despite the finding that NS and PA subtypes exist independently in the sample, similar conclusions as to the general or domain-specific deficit (as introduced in the Introduction) could not be made due to limitations in the scope, research design and methodology of the study. However, Wolf and Bowers (1999) assert that the DDH approach to intervention includes both domain-specific and domain-general hypotheses as two possible sources or contributors to the slower NS of dyslexic learners.

Referring to the present study, 60 percent of the NS subtype learners presented with NS deficits in NS objects *and* digits (Table 10). Although NS letters could not be used to determine a deficit in NS (it is not a standardised measure), it is interesting to note, when considering Figure 3, that the average for NS letters in the control group was 65.40 seconds (average for subject group = 95.53). Furthermore, the learners who presented with deficits in both NS objects and NS digits presented with longer NS letters times than the remaining four learners. This implies that the learners with deficits in NS objects *and* digits may have a general processing speed deficit that is not specific to any type of stimuli, whereas the remaining learners may have a stimuli-specific NS deficit. The finding supports the domain-general hypothesis. Examples of

domain general learners in Tables 10 would be subjects 1, 2, 3, 8, 11 and 18 and domain-specific would be 16 and 19. The basic premise of the alternative approach to intervention within the DDH will be presented succinctly below.

As discussed by Wolf et al. (2000), NS is conceptualized as the final product of both lower level perceptual, attentional, articulatory and lexical processes and higher level cognitive and linguistic processes which require extremely rapid rates of processing. Many of these processes are believed to be used in word recognition (Wolf et al., 2000). Therefore, in order to address the deficits in reading within the DDH, a more comprehensive emphasis on fluency across all underlying components is believed to be the most beneficial (Wolf et al., 2001). In this way, the approach is more domain-general.

The major, theoretically based tenet of this new approach to intervention is two-fold, focusing on phonological skills and decoding, but adding to this a new stress on rate of processing in each component skill (Wolf et al., 2000). Automatic processing at these levels is hypothesized to promote fluency in word recognition and comprehension (Wolf et al., 2001). Wolf and her colleagues (2000) have devised a programme, the RAVE - O (Retrieval, Automaticity, Vocabulary Expansion and Orthography), to address multiple possible sources of dysfluency in readers with dyslexia. At the lexical level, where words are permanently stored (Ramus, 2001), the programme places emphasis on lexical retrieval. This issue will be revisited later, but it is important to state that vocabulary growth (and consequently lexical retrieval) is an essential component to the fluency-based intervention programme. The rationale for focusing attention on vocabulary development and retrieval is evident in the common requirements for rapid retrieval of oral and written words as well as its link to comprehension (Wolf & O'Brien, 2001). The two central axes for lexical retrieval are the activation of different modalities in the introduction and practice of core words to enhance storage, and a metacognitive approach to the retrieval of words that are difficult to access or find (Wolf et al., 2000a). At the sub-lexical level, the programme places emphasis on vision-related processes such as orthographic pattern recognition and auditory processes such as faster phoneme identification. The programme offers "daily emphasis on practice and recognition of the most frequent orthographic patterns in English" (Wolf & O'Brien, 2001, p. 135). The implementation of this

intervention programme is recommended to run parallel to pure phonological intervention efforts and programmes:

This theoretically based stance to intervention in dyslexia is in stark contrast to the PDH. Already mentioned is the fact that the PDH subsumes NS skills within phonological processing thereby categorising the deficits together (Wagner et al., 1993; Wolf & Bowers, 1999; Wolf & Bowers, 2000). Theoretical support for the PDH has been offered in the Introduction. Indeed, much of the support for this categorisation comes from the notion that the efficiency with which children are able to retrieve phonological codes reflects the intactness of the underlying phonological information (Wagner et al., 1993). In this way, clear phonological representations are necessary before the fluent and efficient retrieval of verbal codes to name visual stimuli (NS) (Elbro, 1998). Within the PDH phonological tasks are trained in the absence of attention to automaticity or vocabulary development aimed at improving word retrieval (Wolf & O'Brien, 2001). Robertson and Salter (1997) recommend phonemic awareness training at the word, syllable and phoneme levels for PA deficits. These intervention methods represent the sub-lexical level of phonological representation, without the emphasis on lexical processes of the DDH method. The importance of access at the lexical level of representation separates the PDH and DDH views to intervention.

#### **5.4. Relationship between naming speed and phonological awareness**

##### **5.4.1. Correlations between naming speed, phonological awareness and reading with age**

The importance of determining the relationship between age and the three variables (NS, PA and reading) of the present study has been stated by Kail and Hall (1994). These authors contend that “as children develop, they process information more rapidly” (p. 949). In addition, they emphasize the impact of age on tasks in which response time is measured. The pattern of change is noted across a range of perceptual and cognitive tasks indicating that a global mechanism is responsible for change in information processing speed. Kail and Hall (1994) claim that this change in speed

means that tasks are completed more rapidly, in a limited period of time with superior performance.

Spring and Davis (1988) contend that age and digit NS are linked by revealing a significant correlation ( $r = 0.69$ ) between the two variables. In order to investigate whether a relationship existed between age and all NS, PA and reading tasks in the present study, a correlation was performed. The Pearson's Correlation Co-efficients are presented in Table 16. Ten of the fourteen correlations were found to be significant at  $p < 0.01$  and two were significant at  $p < 0.05$ . The remaining correlations, however, were approaching significance and could be described as 'medium'. Spring and Davis (1988) removed age as a source of variance from their analyses. Since age was found to correlate with most variables in the present study, and because the distribution of scores around the mean for the control group was within normal limits, Pearson's Partial Correlation Co-efficients were analysed and interpreted in the study.

#### **5.4.2. Correlation between naming speed and phonological awareness**

Research findings in support of the DDH were offered and discussed in the Introduction. The hypothesis that children with dyslexia can be categorised according to the processes underlying NS and PA has already been presented and supported in the findings of this study. In addition to the cognitive-structural findings presented above, several other types of evidence support the separation of NS from phonological processing.

Correlations between NS and PA have been found to be relatively weak (Blachman, 1984 as cited in Wolf & Bowers, 1999; Cornwall, 1992; Wolf et al., 2000). Wolf and Bowers (1999) purport that the weak relationship between NS and PA tasks is another source of evidence for separation of the deficits.

Despite this argument, there has been some variability in the finding of the correlations between NS and PA (Wolf et al., 2000). To investigate the relationship between NS and PA in the present sample of learners with dyslexia, correlational statistics were employed. Findings from these data offer further evidence for the

separation of NS and PA deficits in the diagnosis and treatment of learners with dyslexia in South Africa.

Cornwall (1992) reported that the correlation between auditory analysis (segmentation) and letter naming in her study was weak ( $r = 0.12$ ,  $p < 0.05$ ) with the correlation between naming and phonological deletion tasks also relatively weak ( $r = .35$ ,  $p < 0.05$ ). Felton and Brown (1990) (as cited in Wolf & Bowers, 1999) found no significant relationship between naming speed and all measures of phonological processing. Further, Goldberg, Wolf, Cirino, Morris and Lovett (1998) found no significant relationship between phoneme elision (deletion) and PA blending tasks with serial naming ( $r = .12$ ). In addition, Bowers and Swanson (1991) discovered weak correlations between PA isolation and digit NS ( $r = 0.31$ ,  $p < 0.05$ ).

The findings from the present study concur with the results from most of the previous investigations into the relationship between NS and PA. As seen in Table 19, Pearson's Partial Correlation did not yield any results that were significant at the  $p < 0.05$  level in the subject group. Pearson's Partial Correlation for the control group (Table 20) yielded one correlation that was significant at the  $p < 0.01$  level. Cornwall (1992) concluded from the weak correlation between NS and PA that "these abilities may represent unique aspects of the reading process, as opposed to an overall phonological ability" (Cornwall, 1992, p. 537).

To place greater emphasis on the above findings, a closer look at the correlations between the chosen PA measures was necessary. From the Pearson's Partial Correlation Co-efficient performed for the subject group (Table 21) it was evident that the correlations between most PA measures were significant. These correlations ranged from .25 - .63. This indicates the adequate criterion-related validity of the measures, which highlights the independence of NS from PA. It follows that if NS is correctly subsumed under phonological processing, the correlation between these measures (NS and PA) should be consistently significant, as seen with most PA measures. However, this was not the case suggesting that NS does not belong to the broad category of skills known as phonological processing.

### **5.5. Correlations between naming speed, phonological awareness and reading**

In conjunction with the finding that NS and PA are weakly correlated with one another, Wolf and Bowers (1999) propose that NS and PA have “differential contributions to specific aspects of word recognition” (p. 421). In the present study this question was addressed by comparing the correlations of NS, PA and different types of reading skills in-keeping with the research design. The intended outcome was to identify potential relationships between the variables (Hite, 2001) in order to provide direction for further investigative research. As mentioned in the significance of the study, this type of research data is important as a preliminary step to more expensive and time-consuming experimental/causal research designs (Hite, 2001).

Pearson’s Partial Correlation Co-efficients between NS, PA and five different measures of reading were calculated (Table 22, 24 and 25). It is important to note that in the present study, only two learners in the subject group presented with non-word reading deficits (Appendix N, Table N1). This finding is contrary to previous research. A major tenet of the phonological deficit hypothesis, that has received so much attention and support as a core deficit in dyslexia (Cornwall, 1992; Iversen & Turner, 1993; Torgesen, Wagner & Rashotte, 1994), is that phonological deficits of the dyslexic learner manifest primarily in the processing of novel words (non-words) (Rack, Snowling & Olson, 1992). This is because nonsense words are visually unfamiliar and cannot be recognized directly. These words therefore require the learner to sound out the individual sounds and blend them together thus using their PA skills (Rack et al., 1992) at the sub-lexical level (Ramus, 2001).

The dyslexic learners who have deficits at this level (indexed by their core PA deficit) are hypothesised to have deficits with non-word reading because of the reliance on PA in non-word reading. In the present study, however, eleven subjects out of the sample of twenty-five presented with a core deficit in PA, yet only two of these learners presented with a deficit in non-word reading. Possible reasons for this finding are presented below.

Snowling (1981) performed a study on non-word reading in children with dyslexia. Children with dyslexia read eighteen single-syllable and eighteen two-syllable non-words. The researcher recorded the time they took to pronounce the stimuli as well as the accuracy of each pronunciation. Snowling (1981) noted that the deficits in non-word reading were more pronounced on two-syllable words that contained consonant clusters within syllables. This finding may underlie the criticism of the PhAB non-word reading test. Only two of the ten two-syllable non-words in the PhAB contain consonant clusters within syllables. Furthermore, the fact that the present test was performed in untimed conditions may have been a source for the discrepant findings. Snowling (1981) noted that overall the dyslexics were slower than the reading-level-matched group. This was supported in the present study using the non-word reading efficiency test. Performance of the dyslexic group on measures of non-word reading efficiency was significantly below average for all subjects.

It is important to note, however, that the non-word reading mean score for the subject group was significantly lower than the mean score for the control group. Therefore, although only two learners presented with a deficit in non-word reading according to the criteria of a standard score at or below 85, the subject group were significantly weaker than the control group. This highlights the suggestion that the test was not sensitive enough to detect sub lexical deficits in the subject group.

The performance of the subject group on this non-word reading task, while exceptional in the context of previous research, may have impacted on the correlations between PA, NS and reading. The nature and extent of this impact, however, is beyond the scope of the paper but should be addressed by further studies in this area.

## **5.6. Correlation between naming speed and reading**

The following sections have been organised to fit the results of the correlations of the study. The correlations have been grouped together to ease interpretation after which an outline of the findings is presented.

### **5.6.1. Reading recognition and sight-word reading efficiency**

Pearson's Partial Correlations between NS and reading have been presented in Table 22. Significant correlations were identified for digit NS with reading recognition and sight-word reading efficiency ( $r = .63$  and  $.84$ ) and for letter NS with reading recognition and sight-word reading efficiency ( $r = -.59$  and  $-.54$ ). These results are in-keeping with the results of three research groups. The study by Bowers and Swanson (1991) identified that digit and letter NS was significantly correlated with exception word retrieval latencies and accuracy (sight-word reading speed/efficiency and accuracy). Wolf et al., (1986) reported a correlation of  $.66$  between digit and letter NS and word recognition (reading recognition). Spring and Davis (1988) reported a correlation of  $.60$  between digit NS and the Reading Recognition subtest of the Piat - R. The correlation between digit NS and sight-word reading in the present study was found to be  $.63$  ( $p < 0.01$ ) and between letter NS and sight word reading  $.59$  ( $p < 0.01$ ). Furthermore, in the present study digit and letter NS correlated significantly with sight-word reading efficiency ( $r = 0.84$  and  $r = 0.54$ ,  $p < 0.01$ ). The relationship between NS and sight-word reading is argued to be a logical one since both processes depend on automatic, rapid symbol retrieval (Wolf, 1991).

As alluded to earlier, the reading recognition test used in the present study included three words that could be classified as regular words, thereby potentially allowing reading through the speech recoding route. The impact of this criticism is beyond the scope of the paper, but should be borne in mind in further studies of a similar nature.

### **5.6.2. Non-word reading and non-word reading efficiency**

Wolf et al. (1986) found that digit and letter NS was significantly correlated with non-word reading efficiency as well as non-word reading accuracy in their sample of children between the ages 5 - 8 (kindergarten to Grade 2). Spring and Davis (1988) found that digit NS was significantly correlated with non-word reading ( $r = .55$ ,  $p < 0.01$ ), which was not supported in these findings ( $r = .29$ ,  $p < 0.05$ ). From the finding that digit NS was correlated with both reading recognition and non-word reading, and

that the difference was not significant, these authors concluded that digit NS taps a process common to both word recognition routes. However, this hypothesis could not be supported in the present study. Digit, as well as letter NS (which was not addressed in the Spring & Davis, 1988 study), appeared to be correlated with the direct access (lexical) route to reading words while being weakly correlated with the speech-recoding (sub-lexical) route as measured by non-word reading and non-word reading efficiency.

### **5.6.3. Reading comprehension**

Correlations between NS and reading comprehension are reported in Table 23. Some studies have noted that digit and letter NS are significantly but indirectly related to reading comprehension because of the shared variance of comprehension with word identification accuracy and speed (Wolf & Bowers, 1999). That is, the correlation of reading comprehension with digit and letter NS may be secondary to the learner's word recognition abilities (Spring & Davis, 1988). In order to address this issue, a Pearson's Partial Correlation Co-efficient was calculated after controlling for variance contributed to reading by the word recognition scores (Bowers & Swanson, 1991). The results yielded significant correlation for all NS measures and reading comprehension. It is noteworthy, however, that the reading comprehension test was measured under untimed conditions, for which reading speed was not a factor.

### **5.6.4. Role of object naming speed in reading correlations**

With respect to object NS, the results from the study have revealed object NS to be weakly correlated with most measures of reading in the age group used in the study, apart from reading comprehension as noted above. Furthermore, as mentioned in the validity of the NS letters test, it was found that digit and letter NS were significantly correlated with each other ( $r = .68, p < 0.05$ ), which is a reflection of the findings of Wolf et al. (1986) who found that the correlation between the two was  $r = .84$  to  $r = .86$  in different grades. This is in contrast to the weak correlation between digits and object NS ( $r = .33, p < 0.05$ ) and letter and object NS ( $r = -.38, p < 0.050$ ). The results of this study therefore, provide evidence that object NS is weakly correlated with reading measures, whereas digit and letter NS appeared to have a stronger relationship

with reading. Further investigative studies into the nature of the relationship are necessary, as some theorists have suggested that it is the graphological stimuli (digits and letters) that pose the difficulty for learners with dyslexia. This information would assist in developing screening batteries as mentioned previously.

### **5.6.5. Summary of correlations between NS and reading**

From the above results, it is suggested that the skills measured by the digit and letter NS tests are important in word recognition, or sight-word reading accuracy and efficiency. These measures were also found to be related to reading comprehension possibly via its shared variance with accuracy of word recognition (Spring & Davis, 1988; Bowers & Swanson, 1991). NS objects appeared to be weakly correlated with reading measures. Consequently, it may be suggested that digit and/or letter NS tests rather than object NS be adopted in screening tests aimed at identifying the underlying cause of learners with reading disorders in this age range. This has also been suggested by Wolf and Bowers (1999).

### **5.7. Correlations between phonological awareness and reading**

The relationship between PA and reading has been extensively researched (Wagner et al., 1993), with its major contribution to reading being at the alphabetic stage (Snowling, 1992) during which phonemic awareness is essential in developing phoneme-grapheme correspondences (Snowling & Stackhouse, 1996). As mentioned previously, analyses were performed using both PA total scores (Table 24) and PA phoneme level scores (Table 35). The following discussion will be conducted with reference to each.

#### **5.7.1. Non-word reading**

Rack et al. (1992) have argued that PA skills play a major role in the development of nonsense word reading. Bowers and Swanson (1991) as well as Cornwall (1992) identified significant relationships between PA tasks (deletion) and non-word reading. In the present study PA segmentation and isolation at the total PA (Table 24) and phoneme-levels (Table 25) were correlated significantly with non-word reading. PA

isolation (medial) appeared as the stronger PA isolation factor with a correlation of  $r = 0.44$  ( $p < 0.05$ ). PA deletion did not correlate significantly at the  $p < 0.05$  level.

### **5.7.2. Sight-word reading/reading recognition**

Bowers and Swanson (1991) discovered a relationship between PA deletion and sight word reading. PA deletion (total PA and phoneme-level) was correlated with reading recognition (sight-word reading) in the present study. This finding is in support of the findings of Wolf et al. (2002) who noted that PA deletion (phoneme level) made unique contributions to word recognition (sight-word reading). Furthermore, these authors identified that PA blending (phonemes) was significantly correlated with sight-word reading. The present study concurred with this view at the phoneme level with a correlation of  $r = 0.42$  ( $p < 0.05$ ) between PA blending and reading recognition (sight-word reading) (Table 25). PA segmentation (phonemes) was also correlated with sight-word reading in the present study (Table 25). Therefore, at the phoneme level, PA blending, segmentation and deletion appeared to be significantly correlated with sight-word reading.

### **5.7.3. Reading comprehension**

Cornwall (1992) as well as Wolf et al. (2002) identified significant correlations between phoneme deletion and reading comprehension. This was supported in the present study at the total PA ( $r = .49$ ,  $p < 0.05$ ) and phoneme-levels ( $r = .56$ ,  $p < 0.01$ ) of analysis (see Table 24 and 25).

### **5.7.4. Non-word and sight-word reading efficiency**

At the phoneme level of analysis, PA segmentation was correlated significantly with non-word and sight-word reading efficiency ( $r = .41$ ,  $p < 0.05$ ) in the present study. PA deletion (phoneme) was correlated with non-word reading efficiency. These findings do not support any of the previous studies used in the literature review of the present study. One possible explanation is that these reviewed studies have not included tests of word reading efficiency in their reading batteries.

### **5.7.5. Summary of correlations between PA and reading**

Correlations between PA and reading performed with the total PA and phoneme level scores reveal different results. At the total PA level significant correlations were identified between PA deletion and reading recognition ( $p < 0.05$ ) and comprehension ( $p < 0.01$ ). PA isolation and PA segmentation correlated significantly with non-word reading ( $p < 0.05$ ). The phoneme level analysis confirmed these correlations. However, this level yielded more significant relationships between PA and reading. These were in phoneme segmentation which was correlated significantly with all reading measures except reading comprehension and phoneme deletion which correlated with non-word reading efficiency. PA blending, which did not correlate significantly with any of the reading measured using the total PA score, correlated with reading recognition at the phoneme level. Thus, it can be concluded that phoneme level tasks correlated more strongly with reading than PA measures that incorporate all levels (Castles & Coltheart, 2004). This may suggest, as Castles and Coltheart (2004) believe that the phoneme-level is a better predictor/indicator of reading than syllable levels. This has implications for a screening battery which will make use of those tests that are most strongly correlated with reading (Muter, 2004).

### **5.8. Occurrence of word finding and receptive vocabulary deficits in the subject group**

The results of the subject group's word finding and receptive vocabulary scores were documented in this study in Appendix M, Table M1, as they provided important insight into the deficits of the subject group. Seventy-seven percent of learners with dyslexia selected for this study presented with a deficit in word finding, thereby validating the claim of Wolf (1991) that the "most frequently noted characteristic in children with dyslexia outside their reading impairment is subtle dysnomia" for this sample (p. 207).

The significance of documenting word finding scores in children with dyslexia was stated by Wolf and Segal (1992): "dyslexic children's word finding problems in accuracy and fluency reflect deficits that underlie both naming and reading problems" (p. 52). The guiding premise of the study by Wolf (1991) was that "the time and

subprocesses used to access and retrieve a verbal label in the act of naming (word finding) are intrinsically related to the time and subprocesses used to access and retrieve a word in the process of reading” (p. 207). Wolf (1991) asserts that the two systems intersect and that word finding deficits provide further insight into the deficits of the dyslexic learner.

Ramus (2001) comments, indirectly, on the nature of the intersection. Speech production begins with the selection of the appropriate word at the semantic level. Since the name of the object is not inherent in the object itself, a phonological representation of the object must then be located by search of long-term memory (Katz, 1986) (phonological lexicon). This is followed by access at the sub-lexical level and the conversion into an articulatory representation. Thus it is evident that the word finding system links with the lexical and sub-lexical levels of phonological representation. These levels of lexical representation have in turn been linked to the phonological deficits of children with dyslexia (Ramus, 2001) and are involved in the retrieval and access of phonological labels in NS tasks (Wolf & Bowers, 1999). The outline of the word finding system above indicates that breakdown in the system causing difficulties in word finding can occur at any level (Katz, 1986). Although extensive evidence has been offered for the breakdown at the phonological level, the possibility exists that a semantic breakdown could cause the deficits. Therefore, receptive vocabulary scores for each subject (learners with dyslexia) were obtained. Table 32 provides a summary of the information in Appendix M.

Table 32

Percentage of Learners in Each Subtype Presenting with Word Finding, Receptive Vocabulary Deficits or Both

Subtype	Percent of learners with word finding deficits	Percent of learners with language deficits	Percent of learners with word finding & language deficits
NS	70%	30%	30%
PA	83%	67%	66%
DD	80%	20%	0
No-deficit	75%	25%	25%
Average	77%	35%	30%

Although the validity of the word finding test used in the study is in question (Kara, 1992), over three quarters of the sample presented with word finding deficits on this test. The highest frequency of word finding deficits was noted in the PA subtype with 83 percent of the learners in this subtype presenting with word finding deficits. The lowest frequency of word finding was noted in the NS subtype with 70 percent of the learners in this subtype presenting with word finding deficits.

In contrast to the high percentage of learners who presented with word finding deficits, only 35 percent presented with receptive vocabulary deficits. Referring to the model of lexical access of Ramus (2001) (Figure 1), tests of receptive vocabulary assess the functioning of the semantic lexicon. Wolf and Segal (1992) found from their study of 8 000 children, using the Peabody Picture Vocabulary Test (PPVT) that dyslexic learners did not have blatant problems with vocabulary knowledge (semantic lexicon), but rather, as already stated, had difficulty with the retrieval of the vocabulary. In other words, word finding difficulties were evident in the presence of adequate vocabulary knowledge (e.g. PPVT). This implies that the deficits in reading as noted in each subtype, cannot be attributed to a receptive vocabulary deficit: learners who have difficulty reading certain words, do not generally have the same difficulty comprehending words presented auditorily (Castles & Coltheart, 1993). One possibility for the existence of word finding difficulties in the presence of generally adequate receptive vocabulary has been offered by Katz (1986) who purports that the phonological-level difficulties of the learner with dyslexia underlies the difficulties with naming (word finding). It is the quality of these representations that affects retrieval and the child's ability to learn to read (Muter, 2003).

Another important reason for documenting word finding deficits in learners with dyslexia was made apparent by Wolf and Segal (1992) as well as Wolf (1991). These authors suggest that knowledge of learners' word finding abilities will increase the specificity of predictive, diagnostic and intervention efforts. Tests of word finding should therefore be included in any test battery. As alluded to earlier, however, the current test of word finding used in the schools may not be appropriate for the population in which it was administered. There is a need to develop and standardise tests on South African children.

## 5.9. Current interventions

Torgesen et al. (1999) have noted that the type of reading instruction provided to a learner with reading difficulties can influence the subjects' scores on assessment measures. Therefore, a questionnaire to the SLTs involved with the subject group provided information concerning the intervention aims for each learner. Table 26 outlines the results from the questionnaire and Table 27 summarises the findings of the questionnaires. Ninety-five percent of learners (in the subject group) received PA training, 90 percent received language training and 13 percent received intervention for word finding deficits. The rationale for the questionnaire was two-fold.

Firstly, the questionnaires provided insight into the categorisation of the learners into subtypes. With only one exception, all intervention aims for the subject group included PA (95%). This finding may begin to account for the large percent of NS subtype learners in the sample. These learners have received, on average, one year and ten months of therapy aimed at improving PA skills. It is worth noting that these learners continue to receive therapy aimed at improving their PA skills. One reason for this is the classification method used in the study. The total PA and phoneme-level scores have offered different results. Learners whose *average* standard scores at both levels of analysis were within one standard deviation of the norm were not classified as presenting with a core deficit in PA. However, twelve learners did present with isolated PA (total) deficits and six learners with PA (phoneme-level) deficits in certain of the subtests administered. For example, a learner presented with a deficit in PA segmentation, but was not classified as a PA deficit because the average of the scores was within one standard deviation of the norm.

Secondly, the questionnaire served to broadly identify the approaches to intervention currently adopted by SLTs working with the subject group in LSEN schools. Wolf and Bowers (1999) have stipulated that the intervention efforts of NS and PA subtypes should differ. Findings from the questionnaire indicated that the overriding intervention aim is PA for the four deficit types identified in the study. This confirms the suspicions of Wolf et al. (2000) who contend "fluency is largely unaddressed in most current reading interventions" (p. 376). The current intervention may not adequately serve the NS and double-deficit subtypes of the sample. The need for more

investigative studies is noted. Further studies in this area may identify and develop more appropriate intervention aims and methods that address all four deficit subtypes. It is not clear from the findings of the questionnaire, however, whether SLTs are aware of NS deficits (and the processes underlying NS). Therefore, it cannot be said that they ascribe to the PDH by subsuming NS under PA. Since the DDH is new in South Africa, the therapists may not be aware of the implications of separate classification. This may explain the absence of fluency-based intervention aims.

Furthermore, as Ehren and Ehren (2001) noted, SLTs are only recently beginning to expand their roles in the school system in United States of America to include written language. These authors hypothesise that SLTs have dealt with verbal/auditory communication in the past, and therefore have a tendency to remain in the verbal/auditory realm (PA). In fact, Naremore, Densmore and Harman (1997) contend that the main concern of SLTs is “what comes out the child’s mouth and what goes into the child’s ear” (p. 156).

Despite the absence of fluency based interventions in the questionnaire of the study, and the possible reluctance of SLTs to deal with written language, it must be noted that SLTs may unwittingly be addressing some of the underlying causes of slow processing speed by addressing word finding deficits in their attempts to improve receptive vocabulary. “At the lexical level, the (RAVE - O) programme places simultaneous emphasis on more fluent lexical retrieval skills alongside directly instructed semantic development” (Wolf et al., 2000, p. 377). There is simultaneous emphasis on vocabulary and retrieval of lexical items that is based on the assumption that one retrieves fastest what one knows (Wolf, 1997). In the first pilot study of the the ‘RAVE - I’ trained children on language games aimed at increasing their breadth and depth of knowledge of a specific set of words and improving their ability to retrieve these and related words rapidly and accurately. Findings from the pre and post test comparisons revealed substantial improvement in vocabulary knowledge as well as improved rate on an untrained continuous NS task (Wolf, 1997). “Vocabulary growth is thereby conceptualized as essential to both rapid retrieval (in oral and written language) and also to improve comprehension, an ultimate goal in the (RAVE - O) programme” (Wolf, 1997, p. 135).

Therefore, word retrieval problems of dyslexic readers were amenable to treatment and the gains made were generalisable to other NS tasks (Wolf & Segal, 1995 as cited in Wolf, 1997). These vocabulary elaboration and retrieval aims of the RAVE - I and RAVE - O fall within the SLTs role in LSEN schools (as noted by the reported focus on these activities in the questionnaire to SLTs). Thirteen percent of the subjects were receiving intervention for word finding, despite the finding that seventy-six percent of the subjects presented with word finding deficits on the most recent assessment. The language training reported by the SLTs did include receptive and expressive vocabulary. Hence, SLTs may be addressing the vocabulary elaboration that is recommended by proponents of the DDH.

In conclusion, “improvements in decoding and word-reading accuracy have been far easier to obtain than improvements in reading fluency and automaticity” (Wolf et al., 2000, p. 377). While fluency and automaticity were not reported by SLTs in the present study, it is possible that these professionals are addressing these issues, to some extent in their focus on word finding and receptive and expressive vocabulary. Since “oral language forms the foundation of written language” (Naremore et al., 1997, p. 158) SLTs may be in an ideal position to address the foundations of reading. This topic is an important and pertinent opportunity for future research.

## **5.10. Generalisability**

### **5.10.1. Internal validity**

Generalisability is composed of internal and external validity. The internal validity refers to the generalisability from the sample to the original population of interest (Hite, 2001). The population in the present study is Grade 2 English-speaking children with dyslexia between 7.9 - 9.7 years of age attending LSEN schools in the Cape Town Metropole. Table 3 – 7 served to establish the validity of the study to the sample. Further, since the conclusions of the study were the result of rigorous research design, methodology, data analysis and interpretation, the generalisability of the study to the population is high (Hite, 2001).

### **5.10.2. External validity**

Establishing the external validity, however, is more difficult. External validity refers to the “potential generalisability beyond the original population of interest to other populations” (Hite, 2001, p. 73). Hite’s (2001) first recommendation when assessing generalisability is to determine whether the test conditions of the research reviewed is comparable to the present study. This is certainly the case in the present study since the inclusion criteria were taken from previous influential research such as Wolf and Bowers (1999) and Nicolson and Fawcett (1990).

Hite (2001) notes that in order to establish the external validity of the study, it is imperative to establish that the instruments used in the research review are appropriate for the current research setting. Already noted is the appropriateness of the test battery administered by the researcher to a sample of the original population. Without realising this, the results and utility of the results would be in serious question since the tests were not standardised on the population from which the sample was taken (Hite, 2001).

To further establish external validity, Hite (2001) suggests looking at the characteristics of the sample and general populations. It is noted that the difference between the characteristics of these two population groups may not be sufficiently small to demonstrate good generalisability. Due to economic challenges and language differences in the South African population the sample population may be far removed from the general population where eleven official languages obscure the comparison. Economic hardships further complicate the situation because of the relationship between poverty and literacy (Aziz et al., 1991).

### **5.11.1. Reliability**

The reliability was maximised in this study in the following ways:

- Instrument variation was minimised in the study
- Inter-rater reliability was maximised
- Intra-rater reliability was shown to be acceptable ( $r = 0.98$ ).
- Instrument, observer and subject variations were tested through re-assessment of learners. The difference in the two measures did not reach significance.

### **5.12. Ethical considerations**

#### **5.12.1. Feedback from the researcher to control group (General procedures)**

According to Kellaghan and Greaney (2001), assessments of learners are not only used to make educational policy decisions, but are also there to provide feedback to the learners. All results were made available to parents at their request. One parent, from the control group of learners, contacted the researcher requesting information on the assessment results. A 10-minute telephone conversation was held with the parent who was assured that the learner had attained adequate levels of achievement on each subtest that was administered.

### **5.12.2. Feedback to control group (Specific ethical procedure)**

As mentioned in the Methodology section, one learner from the control group was excluded from the study due to a deficit in reading as detected by the assessment measures. In this case, the learner's parents were contacted, as stated in the letter to parents, and were informed of the outcome of the assessment. The parents were provided with a home programme and referred to a private SLT. Furthermore, the learner's class teacher benefited from the study by attending the two one-hour feedback sessions presented at the school. Please refer to Appendix V for further details.

### **5.12.3. Feedback to subject group**

Two parents of learners in the subject group contacted the researcher requesting feedback from the assessments. In each case, parents were given the option to meet with the examiner. The parents preferred to conduct the feedback session over the telephone. Each telephone conversation lasted between 10 and 15 minutes.

During the telephone conversation the following issues were discussed. Parents were briefed about the nature of the study and given a succinct outline of the DDH, PDH and NS's role within the DDH and PDH in terms and using language that could be understood by parents who do not have a background in reading development. No jargon was used apart from the PDH and DDH. The results of their child's assessments were then relayed. The particular strengths of the learners were provided first, with the weaknesses addressed last. The possible impact of their weaknesses (for example PA deficits affecting non-word reading) was discussed. The researcher then assured the parents that their child's educator and SLT would receive feedback from the study. Permission from the parents was requested before the educator was told (in private) of the learner's name and subtype classification.

#### **5.12.4. Feedback to participant schools**

All schools received a copy of the results. One of the LSEN schools did not attend the feedback session. One mainstream school received two one-hour feedback/information giving sessions. The remaining schools received one one-hour session. The difference in length between the sessions was the result of educators requesting further information. An outline of the contents of these feedback sessions is provided in Appendix V.

During this feedback, therapists and educators discussed, with the researcher, the findings, conclusions and implications of the study. In this way, the study created awareness of the skill deficits in children with dyslexia and encouraged professionals to develop their own knowledge and skills in diagnosis and intervention for these learners. The notes (Appendix V) from the session were left with the school and one article (Wolf et al., 2000) on intervention for fluency deficits was e-mailed to the schools.

#### **5.13. Limitations of the study**

Although IQ scores were used in the present study in the subject inclusion criteria to define learners as dyslexic, they were not used to match the control and subject groups nor were they used in any of the analyses that were performed on the subject group results. Wolf et al. (2002) identified a significant relationship between IQ and phonological measures (PA deletion and blending) but not between IQ and NS. With the relationship in mind, the exclusion of IQ is one limitation of the study since it could not be statistically controlled (McDougal et al., 1994).

While the study attempted to determine the type and frequency of intervention of the learners with dyslexia, Cornwall (1992) has commented on other factors such as task persistence, compliance with homework demands and class participation which could account for achievement on word recognition. These aspects, although potentially important when investigating underlying deficits in learners with dyslexia, were not addressed in the questionnaire in the present study. This information may have

provided further insight into the subtype that was classified as 'neither-deficit'. Furthermore, SLTs were targeted while excluding other professionals such as remedial educators and Educational Psychologists. The intervention aims of these professionals could therefore not be identified and addressed in the present research.

The sampling method in the study may be a potential limiting factor. By selecting learners with dyslexia from LSEN schools, this method systematically excluded learners in mainstream schools experiencing difficulty in reading, who are also possibly dyslexic. The Government's White Paper 6 on Inclusive Education makes this a valid criticism of the study since many learners with learning difficulties such as dyslexia are being encouraged to remain in mainstream schools.

Further, the study did not take account of hyperactivity in the learners in the control and subject groups. Hyperactivity and medication (such as Ritalin) was not documented in the present study. Gardner (1994) noted that hyperactivity may influence a learner's performance on assessment measures. This criticism should be controlled for in future studies.

Further investigation into the language abilities and speech production of the learners in the sample would have provided greater insight into their skill deficits (as noted above for the 'neither-deficit' group) as well as their reading abilities. Grammatical awareness has been linked to reading comprehension (Muter, 2004). Thus, more in-depth information concerning language functioning of the sample of learners with dyslexia may have been useful in understanding their reading comprehension scores. This information would have assisted in identifying and ruling out the possible underlying deficits of the 'neither-deficit' subtype.

With respect to the speech production of the learners in the subject group, an articulation-rate test would have been useful. Baddeley (1986) (as cited in Morton & Schwartz, 2003) has noted that a strong determinant of memory span is rehearsal speed. While the digit and word span tests are widely used as measures of verbal working memory (Cohen & Heath, 1990) verbal rehearsal rate has been linked to reading (Morton & Schwartz, 2003) and memory span. The rate of articulation of learners presenting with NS deficits requires further investigation (Wolf et al., 2000).

While Obregon (1994) (as cited in Wolf & Bowers, 1999) demonstrated that the difference in naming between average and dyslexic readers was not due to an articulation rate deficit, Wolf et al., (2000) state that more work is needed with regard to rate of articulation.

The issue of which NS test should be used to diagnose an NS deficit is a further criticism of the present study. It has been shown that NS digits and letters are more important for reading (Spring & Davis, 1988) than NS objects. This was replicated in the present study. However, NS objects was included in the analyses and interpretation of the data. Future research should be conducted to confirm that NS objects has little relationship with reading. Following from the finding that NS objects were weakly correlated with reading measures, it is suggested that NS objects be excluded from screening test batteries, and possibly from future research in this area.

#### **5.14. Implications for further research**

##### **5.14.1. Diagnosis**

As previously discussed, one of the major directions for further studies is to standardise the tests used to diagnose NS and PA deficits. This study highlighted the differences in prevalence of subtypes according to the test results used. Obviously, this has implication for diagnosis as well as intervention. Research on the NS and PA process will develop our understanding of reading acquisition and the variety of ways it can fail to develop (Wolf et al., 2002). Furthermore, while the present study advocates for the inclusion of NS in the standard battery, further research is necessary to identify the underlying cause of the reading disorder in the 'neither-deficit' subtype in the sample so that these learner's deficits may be detected in screening tests.

This study assessed learners with dyslexia in Grade 2, who had had Speech and Language intervention. As already mentioned, the fact that learners had received intervention could have altered their profiles on tests of NS, PA and reading. In order to gain a purer picture of the deficits in NS and PA, it may be necessary to perform a similar study with younger pre-school learners.

### 5.14.2. Intervention

The most important and complicated implication of the present findings are that the processes underlying NS require new methods and forms of intervention (Wolf et al., 2002). Initially, research is required to determine the knowledge and perceptions held by SLTs in the school system in South Africa of NS deficits and their impact on reading. This research may incorporate investigations into the perceived roles in terms of intervention for dyslexia, of SLTs in the school system. In addition, this information may serve to determine whether or not these professionals address written language *per se*.

The role of the SLT in dyslexia is an issue that requires clarification. As Ehren and Ehren (2001) as well as Greene (1996) have noted, these professionals are well equipped to deal with this language-based reading disorder because of their knowledge of language. Furthermore, SLTs *are* currently providing intervention to these learners in the domain of PA. To maximize effectiveness and efficiency of intervention for learners with dyslexia in South Africa, the training and perceived roles of these professionals may need to be revisited.

A further central issue is the design of intervention programmes that reach the source of NS deficits. This issue is complicated due to the multiple possibilities of causes of the root problem and because each level of possible breakdown is not well understood (Wolf et al., 2002). The domain-specific versus domain-general nature of the deficit is of importance since both possibilities require unique interventions. Furthermore, as noted by Wolf et al., (2002), there is not enough evidence that rate of processing, as indexed by NS tasks, is amenable to treatment or whether underlying gains will generalize to reading. Also, because of the hypothesized importance of NS (and PA) for reading, factors that increase its effectiveness should be looked at carefully. Blachman (1994) recommends addressing issues of length of treatment, components of treatment and timing of treatment. With these issues in mind, the NICHD (National Institute for Child Health and Development) has devised an experimental, comprehensive, fluency-based programme called RAVE - O (Retrieval, Automaticity, Vocabulary Elaboration - Orthography, Wolf, Miller & Donnelly 2000). The effectiveness of this programme has not yet been established. However, the use and

applicability of the programme to the South African population is an area of research that may attempt to answer some of the questions above.

### **5.15. Concluding statements**

Wolf and Bowers (1999) have documented the processes underlying NS and have provided a visual heuristic of the processes (Figure 2). It is evident that NS relies on a number of skills outside the phonological level. Proponents of the PDH purport, however, that NS is part of a broad phonological skill. The differing perspectives have major implications for diagnosis and treatment of dyslexia. The present study, in conjunction with the information in Figure 2 provides support for separate categorisation. It was found that NS and PA occurred independently in the sample of Grade 2 learners with dyslexia. In addition, NS and PA were found to have differential contributions to reading, a finding that has been used in previous research to suggest that NS and PA are separate skills.

Despite this confirmation, this study uncovered many complications with categorising learners according to NS and/or PA deficits. The literature is unclear on what measures to adopt. Prevalences changed according to the types of test results used. This has major implications for the learners whose subtype categorisation changed according to the test result adopted. Proponents of the DDH advocate for categorisation as it will enhance diagnosis, prediction and intervention. However, it was evident from this study that categorisation in itself may confuse issues of diagnosis, prediction and intervention because of the lack of clarity on test measures. The need for research into the most valid and appropriate tests of core NS and PA deficits is highlighted by this study.

The study noted that word finding deficits are one of the most common difficulties found among learners with dyslexia, although the validity of the test for word finding was brought into question. Current intervention were not addressing the fluency issues of the NS subtype, per se, but it was hypothesized that SLTs may be addressing some of the lexical access issues recommended in the RAVE - O. The present study also assisted in creating awareness among SLTs of the underlying causes of dyslexia and encouraged further professional development in this area. The generalisability of this

study was commented on and noted to be internally valid. However, issues of external validity posed threats to the generalisability of the study.

## CHAPTER 6: CONCLUSION

The central question raised by this research concerns the hypothesised independence of NS and PA in a sample of Grade 2 learners with dyslexia in the Cape Metropole. While the PDH has received overwhelming support over the past two decades as the single cause of the reading disorder known as dyslexia, the present study as well as those by Wolf and her colleagues offer evidence in support of a second core deficit underlying dyslexia. Wolf and Bowers (1999) provide convincing theoretical arguments for the separate categorisation of NS and PA. The present study offered convincing practical evidence to add support to the independence of NS and PA. The study revealed that a sample of learners with dyslexia could be categorized into subtypes of dyslexia according to the presence and/or absence of NS and PA deficits, using Deeney et al's. (2000) method of classification. It was evident, however, that the level of PA as well as the test result(s) used to diagnose a core PA deficit was problematic in the study. The literature does not provide clarification on this issue which was noted as an important direction for future research.

There was little disagreement that phonological deficits (particularly in PA (Plaza, 2003)) underlie the disorder for some learners with dyslexia. Using the PA total score assessment results, in the present study, 44 percent of the sample presented with a core deficit in PA (24 percent pure PA and 20 percent double deficit). However, there was also no doubt that NS underlies the reading disorder for some learners with dyslexia. Forty percent of the sample presented with a core NS deficit. This relatively high percentage of learners in the NS subtype may be accounted for by the intervention received by learners in the sample group of the study or the test results used to diagnose a deficit. Since it is apparent that PA skills can be enhanced through the implementation of a dedicated PA programme (Snowling & Stackhouse, 1996) and since the current data base identified a trend in the intervention with the learners which was 95 percent PA, it is possible that PA deficits are less prominent. Further, the data did not include information on the initial presenting deficits of the learners before they commenced with a therapy programme. Therefore, it cannot be precluded

that these learners did not present with PA deficits at the onset of therapy. Assessing learners before they attend school or enter an intervention programme is one suggested research direction for subsequent studies.

The future definition of dyslexia as a phonological deficit, as purported by Hulme & Snowling (1997) as an exciting possibility, may have been rendered unfeasible and inaccurate by studies and findings such as these. For the definition of dyslexia as a phonological deficit to be acceptable it would be necessary to identify phonological impairments in all children with dyslexia, but they should not be observed in individuals who are not dyslexic (Hulme & Snowling, 1997). While the control learners in the present study did not present with phonological impairments, it could not be shown that all learners in the subject group presented with core phonological impairments.

There is now cumulative evidence from this and reviewed studies that PA and NS make independent contributions to the variance in reading recognition, non-word reading, reading comprehension, sight word and non-word reading fluency (Wolf et al., 2002) thereby demonstrating that the processes underlying NS are related to, but also separate from PA (Wolf et al., 2002). The co-occurrence of NS with PA deficits in the present study characterised the most impaired readers on measures of reading comprehension and reading recognition. NS deficit learners presented with less severe reading impairments than the PA subtype learners. The influence of subtype on severity of reading was therefore identified using rudimentary methods. However, these findings only suggest possible relationships between subtype and severity and should be investigated further in future studies. The finding that NS and PA skills did not correlate significantly with one another was argued as further evidence for separate categorisation of the two skills.

Despite these convincing arguments, the current practice is to subsume NS under phonological processing (Wolf & Bowers, 1999). Within this system NS deficit readers are either misclassified as having phonological deficits and given inappropriate treatment, or missed altogether because of their adequate phonological skills (Wolf & Bowers, 2000). The significance of this classification and treatment is noted in the present study. From these findings it emerged that the intervention efforts of SLTs dealing with learners with dyslexia are largely based on PA skills, even when learners did not present with core PA deficits within the classification system used. This PA intervention did not incorporate issues of fluency at lexical and sub-lexical levels to improve reading speed and fluency, as is recommended for learners with NS or rate of processing deficits (Wolf et al., 2000). However, it was suggested that perhaps SLTs are addressing aspects of lexical retrieval fluency in their intervention for word finding and vocabulary. Wolf et al. (2002), however, noted that fluency and rate of processing are largely unaddressed in most reading intervention programmes.

Although the present study supported separate categorisation of NS and PA, evidence was provided that learners with dyslexia do not form a homogenous population (Castles & Coltheart, 1993). Wolf et al. (2002) acknowledge that NS and PA do not encompass all possible levels of breakdown in reading failure. Sixteen percent of the subject group in the present study presented with a deficit in reading that could not be accounted for by either NS or PA. This finding implies that the categorization system is incomplete. Badian's (1997) hypothesis accounted for the reading deficit in the subtype of learners who did not present with NS or PA by addressing orthographic processing. According to Badian (1997), orthographic processing is a separate source of reading failure. Within this system, four subtypes of learners are identified.

It is evident that dyslexia is the consequence of a breakdown in a complex ensemble of processes (Wolf et al., 2002). Lyon (1983) (as cited in Blachman, 1997) stated that the development of reading is a complex process requiring the participation of cognitive, linguistic and perceptual sub skills.

A deficit in any of these may lead to dyslexia, hence highlighting the heterogeneity of the disorder. In light of prediction, diagnosis and intervention efforts in South Africa, however, it is critical that the hypothesised independence of NS, PA and orthographic processing be resolved. Assessment and intervention methods in South Africa should meet the complexity of these processes for the most effective and efficient treatment of the reading disorder. As experts agree, the best solution to the problem of failed reading is to allocate (effective) resources for early identification and prevention (Snow, Burns & Griffin, 1998 as cited in Wagner et al., 1999). The need for further studies in the South African context is thereby emphasised.

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## APPENDICES

### Appendix A

Letter of permission to Western Cape Education Department

Ms Amanda Cresswell

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Rondebosch

7700

Ph: 021 686 2070

Dr R. S. Cornelissen

Western Cape Education Department

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Dear Sir

### **PERMISSION TO CONDUCT RESEARCH AT SCHOOLS IN THE CAPE TOWN METROPOLE**

I am a postgraduate student registered for the degree Masters in Communication Sciences and Disorders at the University of Cape Town. I am registered with the Health Professions Council as well as the South African Council of Educators. I am currently working within a special needs environment and have an interest in developmental dyslexia. I have therefore decided to perform my dissertation in this area.

The topic of my thesis is *“The Profile of Skill Deficits in Grade 2 Learners with Dyslexia”*.

I am investigating a new understanding of the core deficits in dyslexia that may have implications for the way dyslexia is diagnosed and treated. It is hoped that research in the area of naming speed and phonological awareness deficits will assist Speech and Language Therapists in developing and implementing methods of intervention that address both these underlying deficits.

I am seeking permission from the Education Department to conduct the study at three LSEN schools and two mainstream schools in the Cape Town Metropole. I will require twenty-five learners from LSEN schools and twenty-five learners from mainstream schools. The data collection will take place during the third term 2004 - 30 August - 23 September 2004.

Should permission be given, I will contact each head teacher of the selected schools in writing, requesting permission to conduct the study at their school. Subsequently educators will be contacted (see attached) and asked to send letters to all learners in their class. These letters will inform parents of the nature and purpose of the study. Should parents give consent for their child to take part in the study, parents will be requested to send a signed consent form back to school. They will also be requested to fill out a case history form and return it to the educator.

In order to assist in this study, Grade 2 educators will be asked to identify, from those learners whose parents have given written consent, all learners in their classes who fit the selection criteria. I will collect the list of names from each educator. Assessment schedules will be arranged with educators at each school.

I will administer standardised assessments of reading (whole word recognition, sounding out, reading comprehension), phonological awareness (awareness of sounds in language)

and naming speed (naming 50 digits as fast as possible) in a period lasting no longer than an hour each, at a time which does not affect the service delivery of the school.

Principals and learners/parents will be under no obligation to participate in the study. In addition, the above-mentioned parties will not be identifiable in any way from the results of the study and all participants will be assured of complete anonymity and confidentiality. Participants may withdraw from the study at any time.

A brief summary of the content, findings and recommendations of the study will be sent to the Director: Education Research and the Department will receive a copy of the completed dissertation. A copy of the results will also be sent to the schools following submission of the results.

Please do not hesitate to contact me, or my supervisor, should you require any further information.

I look forward to your response.

Yours faithfully,

Ms Amanda Cresswell

Principal researcher

Amanda Cresswell

Phone: (021) 686 2070

[ajsmith@webmail.co.za](mailto:ajsmith@webmail.co.za)

Supervisor

Mrs P Sorour

Phone (021) 406 6318

[gdi@iafrica.com](mailto:gdi@iafrica.com)

Appendix B

Letter to head teachers at LSEN schools (schools A and B)

Dear Sir/Madam

**PERMISSION TO CONDUCT RESEARCH WITH GRADE 2 LEARNERS WITH  
DYSLEXIA AT YOUR SCHOOL**

I am a postgraduate student registered for the degree Masters in Communication Sciences and Disorders at the University of Cape Town. I am registered with the Health Professions Council as well as the South African Council of Educators. I am currently working within a special needs environment and have an interest in developmental dyslexia. I have therefore decided to perform my dissertation in this area.

The topic of my dissertation is "*The Profile of Skill Deficits in Grade 2 Dyslexic Learners*".

I am investigating a new understanding of the core deficits (naming speed and phonological awareness) in dyslexia which may have implications for how dyslexia is diagnosed and treated. It is hoped that research in this area will assist Speech and Language Therapists in developing and implementing methods of intervention that address both these underlying deficits.

Permission to undertake the study has been granted from the Head of Western Cape Education Department (see attached). Data for the study will be obtained from formal, tape recorded assessments of the learners' phonological awareness (awareness of sounds in a language), naming speed (ability to name 50 digits as fast as possible) and reading abilities (whole word recognition, sounding out and reading comprehension) during the period 30 August to 23 September 2004.

In order to complete the study I would sincerely appreciate it if Grade 2 educators could send letters, consent letters and case history forms home with each learner in their class. In order to identify suitable candidates from those learners whose parents give consent, I have provided the Grade 2 educators with a list of the criteria (see attached) for inclusion. I would be grateful if each Grade 2 educator would then make a list of suitable candidates (from the list of learners whose parents have given consent) and I will then collect the list from the educator.

I will request the resident school psychologist and Speech and Language Therapist to provide IQ scores and results of word finding and receptive language tests respectively for the selected learners. These learners will then undergo assessments as mentioned above. The assessments should take no longer than an hour and a half each and will be conducted at the convenience of the educators in order to minimize disruptions to service delivery.

I would like to stress that head teachers and learners/parents are under no obligation to participate in the study. The above-mentioned parties will not be identifiable in any way from the results of the study and all participants will be assured of complete anonymity and confidentiality. Participants may withdraw from the study at any time. A copy of the results will be sent to the school and feedback will be given to the parents and educators (on request) following submission of the results.

Therefore, I am seeking permission to perform the study at your school. I am requesting permission to contact your Grade 2 educators to identify (possible) dyslexic learners, who fit the subject selection criteria. I am requesting permission to administer standardised assessments of phonological awareness, naming speed and reading to eight of these learners.

Please do not hesitate to contact me, or my supervisor (details below), should you have any queries. Please fax the consent form to (021) 637 4816

I look forward to your reply.

Yours faithfully

---

Ms Amanda Cresswell

Principal researcher

Amanda Cresswell

Phone: (021) 686 2070

[ajsmith@webmail.co.za](mailto:ajsmith@webmail.co.za)

Supervisor

Mrs P Sorour

Phone (021) 406 6318

[gdi@iafrica.com](mailto:gdi@iafrica.com)

Appendix C

Permission Form (LSEN schools)

**FOR ATTENTION: AMANDA CRESWELL**

**FAX NO: 021 637 4816**

I, \_\_\_\_\_ Head Teacher of \_\_\_\_\_ School,  
understand the above information and **DO/DO NOT** give consent for the above study to  
be conducted at the school.

I understand that no party is under obligation to participate in the study and any  
participant may withdraw from the study at any stage. Participation in the study will not  
affect service delivery and all communication with participants will be treated with strict  
confidentiality.

Signed by \_\_\_\_\_

Date \_\_\_\_\_ -

## Appendix D

Letter to head teacher at mainstream schools (schools C and D)

Dear Sir/Madam

### **PERMISSION TO CONDUCT RESEARCH WITH GRADE 2 LEARNERS AT YOUR SCHOOL**

I am a postgraduate student registered for the degree Masters in Communication Sciences and Disorders at the University of Cape Town. I am registered with the Health Professions Council as well as the South African Council of Educators. I am currently working within a special needs environment and have a keen interest in dyslexia. I have therefore decided to perform my dissertation in this area.

The topic of my dissertation is "*The profile of Skill Deficits in Grade 2 Dyslexic Learners*". I am investigating a new understanding of the core deficits in dyslexia that may have implications for how dyslexia is assessed and treated. It is hoped that research in the area of naming speed and phonological awareness deficits will assist Speech-Language Pathologists in developing and implementing more effective methods of remediating the reading deficits in developmental dyslexia.

Permission to undertake the study between 30 August and 23 September 2004 has been granted from the Head of Western Cape Education Department (see attached).

In order to complete the study I require a group of learners who are reading at an age-appropriate level with which to compare the dyslexic learners. I would sincerely appreciate it if Grade 2 educators could send letters, consent letters and case history forms home with each learner in their class. In order to identify suitable candidates from those learners whose parents give consent, I have provided the Grade 2 educators with a list of the criteria (see attached) for inclusion. I would be grateful if each Grade 2

educator would then make a list of suitable candidates (from the list of learners whose parents have given consent) and I will then collect the list from the educator.

Twelve learners (school C) and thirteen learners (school D) will be randomly selected from those learners whose parents have agreed to participation and who have been identified by the educators. Each child will then be required to undergo a tape recorded assessments of phonological awareness (awareness of sounds in a language), naming speed (ability to name 50 digits as fast as possible) and reading abilities (whole word recognition, sounding out and reading comprehension). The assessments should take no longer one hour each and will be conducted at the convenience of the educators in order to minimize disruptions to service delivery.

I would like to stress that head teachers, educators and learners and their parents/guardians are under no obligation to participate in the study. The above-mentioned parties will not be identifiable in any way from the results of the study and all participants will be assured of complete anonymity and confidentiality. Participants may withdraw from the study at any time. A copy of the results will be sent to the school on request and feedback will be given to parents and educators on request following submission of the results.

In the event that a learner is identified with a deficit in any of the areas tested, the parents will be contacted (as stated in the letter to the parents) and the school will also be notified (following permission from the parents). A meeting will be set up with the parents and the researcher during which the parents will be offered a number of different options concerning the intervention that they may wish to pursue. They may wish to be referred to the nearest school clinic, or to a private Speech and Language Therapist. However, the researcher will also offer the parents an individualised home programme which will include a half hour session, with the parents, on how to implement the programme, as well as a half hour session with the class teacher on classroom management.

Please do not hesitate to contact me, or my supervisor (details below), should you have any queries. Please fax the response form to the following fax number: (021) 637 4816. I look forward to your reply.

Yours faithfully

---

Ms Amanda Cresswell

Amanda Cresswell  
*Principal investigator*  
072 395 0820  
(021) 686 2070 (h)

Pharyn Sorour  
*Supervisor*  
082 907 9974  
(021)797 2573

Appendix E

Permission form (mainstream schools)

**FOR ATTENTION: AMANDA CRESWELL**

**FAX NO: 021 637 4816**

I, \_\_\_\_\_ Head Teacher of \_\_\_\_\_ School,  
understand the above information and **DO/DO NOT** give consent for the above study to  
be conducted at the school.

I understand that no party is under obligation to participate in the study and any  
participant may withdraw from the study at any stage. Participation in the study will not  
affect service delivery and all communication with participants will be treated with strict  
confidentiality.

Signed by \_\_\_\_\_

Date \_\_\_\_\_

## Appendix F

### Letter to teachers at LSEN schools

Dear Sir/Madam

I am currently doing my Masters degree in Speech-Language Pathology through the University of Cape Town's Communication Sciences and Disorders Department.

I am investigating a new understanding of the core deficits in dyslexia that may have implications for how dyslexia is assessed and treated. It is hoped that research in the area of naming speed and phonological awareness deficits will assist speech-language pathologists in developing and implementing more effective methods of remediating the reading deficits in developmental dyslexia.

In order to complete the study I would sincerely appreciate it if you would send a letter, consent form and case history form (attached) home with each learner. This letter will inform parents of the purpose and relevance of the study. Parents are requested in the letter to return a signed consent form if they agree for their child to take part in the study and a case history form to the class teacher. Once you have received a signed consent form from parents, I would appreciate it if you could assist me by identifying ALL learners in your class who fit the subject selection criteria (below). I will collect the list of names at a time which is convenient to you.

I will be visiting the school in the third term between 30 August and 23 September 2004 and will need to take the learners out for an individual assessment lasting up to one hour. You will be contacted two weeks prior to the visit to set up a convenient time and venue for the assessment.

I am searching for dyslexic children. Dyslexia is defined as a "disorder in children, who despite normal classroom experience, fail to attain the language skills of reading that are

expected considering their intellectual abilities. This does not include poor readers whose reading level is in keeping with their overall development.”

Please could you identify children (whose parents have given consent) who fit the following criteria:

- ✓ Between 8 and 9 years of age
- ✓ A reading delay - their reading is lower than expected for the age. For example, an 8 year old girl, in Grade 2 who is reading at a level expected of a 7 year old.
- ✓ Average or above average IQ (doing well in other areas outside written language). I will be collecting IQ scores from the resident psychologist, so this is just a guide.
- ✓ No sensory deficit - hearing or vision
- ✓ No emotional problems
- ✓ No attention deficit (and/or hyperactivity) disorder
- ✓ Normal speech
- ✓ The home language of each subject must be English.

Please note all children in your class who meet the above criteria. I will collect this list from you at your earliest convenience.

Please do not hesitate to contact me on (021) 637 9080 or 072 395 0820 should you have any questions.

Thank you for your time and assistance with this research.

Amanda Cresswell

Speech and Language Therapist

## Appendix G

### Letter to teachers at mainstream schools

Dear Sir/Madam

I am currently doing my Masters degree in Speech-Language Pathology through the University of Cape Town's Communication Sciences and Disorders Department.

I am investigating a new understanding of the core deficits in dyslexia that may have implications for how dyslexia is assessed and treated. It is hoped that research in the area of naming speed and phonological awareness deficits will assist speech-language pathologists in developing and implementing more effective methods of remediating the reading deficits in developmental dyslexia.

In order to complete the study, I would sincerely appreciate it if you could send a letter, consent form and case history form home with each learner in your class, in which parents are informed of the purpose and relevance of the study. Parents are requested in the letter to return a signed consent form and case history form if they agree for their child to take part in the study. Once you have received a signed consent form from parents, I would appreciate it if you could assist me by identifying ALL children in your class who fit the subject selection criteria (below). I will collect the list of names at a time which is suitable for you.

I will be visiting the school in the third term between 23 August and 30 September 2004 and will need to take the learners out for an individual assessment of reading, phonological awareness and naming speed lasting up to one hour. You will be contacted two weeks prior to the visit to set up a convenient time, preferably a morning session.

In the event that a learner is identified with a deficit in any of the areas tested, the parents will be contacted (as stated in the letter to the parents) and the school will also be notified (following permission from the parents). A meeting will be set up with the parents and

the researcher during which the parents will be offered a number of different options concerning the intervention that they may wish to pursue. They may wish to be referred to the nearest school clinic, or to a private Speech and Language Therapist. However, the researcher will also offer the parents an individualised home programme which will include a half hour session, with the parents, on how to implement the programme, as well as a half hour session with yourself on classroom management.

I am looking for the learners in your class who fit the following criteria (and whose parents have signed a consent form):

- ✓ Between 8 and 9 years of age.
- ✓ Reading is 'age appropriate' – that is, they are not reading above or below the expected level for their age and grade.
- ✓ No sensory deficit - hearing or vision
- ✓ No emotional problems
- ✓ No attention deficit (and/or hyperactivity) disorder
- ✓ Normal speech
- ✓ The home language of each subject must be English.

Please note all children in your class who meet these criteria. I will collect the list from you at your earliest convenience.

Please do not hesitate to contact me on (021) 637 9080 or 072 395 0820 should you have any questions.

Thank you for your time and assistance in this research project.

Yours faithfully,

Amanda Cresswell  
Speech and Language Therapist

## Appendix H

### Letter to parents of LSEN learners

Dear parent/guardian

I am currently doing my Masters degree in Speech-Language Pathology through the University of Cape Town's Communication Sciences and Disorders Department. I am registered with the Health Professions Council as well as the South African Council of Educators.

I am completing my post-graduate dissertation on the nature of difficulties experienced by Grade 2 dyslexic readers in Special Needs schools in the Cape Town area. I am investigating a new understanding of the problems in dyslexia that may have implications for how dyslexia is assessed and treated. It is hoped that research in this area will assist speech-language pathologists in developing and implementing more effective methods of remediating the reading deficits in developmental dyslexia.

The head teacher of your son/daughter's school has agreed to participate in the study. In order to complete the study I require the reading profiles of Grade 2 learners at special needs schools. I hereby kindly request your consent for your son/daughter to take part in the study.

You are under no obligation to do so, and may withdraw from the study at any time. Should you give consent for your child to participate, you will be required to give consent for an assessment of your child's phonological awareness (awareness of sounds in the language), naming speed (ability to name digits quickly) and reading skills (reading by sight, by sounding out and reading comprehension). I will perform the assessments, which will be tape-recorded. Once the study has been completed, the audiotapes will be stored securely for further analysis by those directly involved in the study, should this be

necessary. A copy of the tape as well as the assessment results will be made available to you at your request.

The assessment will take place at your child's school at a time which is convenient for the teacher to ensure that your son/daughter does not miss any important work. The assessment will last up to one hour (including a break). Your child's IQ score, word finding and receptive language scores will be collected from the school.

If you decide that your child may participate in the study, please complete the consent form and case history form and send these back to your child's class teacher. I wish to stress, however, that should you decide not to give consent, or should you decide to withdraw your child from the study at any time, this will not influence your child's programme at school in any way.

Information supplied by you and results from the assessment will be handled with strict confidentiality and no party will be identifiable from the results of the study.

Please do not hesitate to contact my supervisor or me (details below) should you have any concerns or questions.

Amanda Cresswell  
*Principal investigator*  
072 395 0820  
(021) 686 2070 (h)

Pharyn Sorour  
*Supervisor*  
082 9079 974  
(021)797 2573

Yours sincerely

Amanda Cresswell  
Speech Therapist

Appendix I

Parental consent (LSEN)

<b>Parent Consent Form      Please fill in and return to the class teacher - Thank You</b>
--

I \_\_\_\_\_, parent/guardian of \_\_\_\_\_

(name of parent)

(name of child)

understand the above information and **DO/DO NOT** give permission for my child to participate in the study.

I understand that I may stop my child from participating in the study at any stage. I understand that my choice to participate or not to participate, and my decision to withdraw my child from the study, will not affect my child's programme at the school in any way.

I have been assured of complete confidentiality and my child will remain anonymous throughout the research procedure. My son/daughter and I will not be identifiable in any way from the results of the study, which will be made available to me at my request.

Signed \_\_\_\_\_

Date \_\_\_\_\_

## Appendix J

### Letter to parents at mainstream schools

Dear parent/guardian

I am currently doing my Masters degree in Speech-Language Pathology through the University of Cape Town's Communication Sciences and Disorders Department. I am registered with the Health Professions Council as well as the South African Council of Educators. I am completing my post-graduate dissertation on the nature of difficulties experienced by Grade 2 dyslexic readers in Special Needs schools in the Cape Town area. It is hoped that research in this area will lead to more efficient remediation of the reading difficulties experienced by dyslexic learners in line with current international trends.

The head teacher of your son/daughter's school has agreed to participate in the study. In order to complete the study I require a group of learners who are reading at an age-appropriate level, that is, a group of learners who are not dyslexic, to form a control group.

I hereby request your consent for your son/daughter to take part in the study. You are under no obligation to do so, and may withdraw from the study at any time. Should you give consent for your child to participate, you will be required to give consent for an assessment of your child's phonological awareness (awareness of sounds in the language), naming speed (ability to name digits quickly) and reading skills (reading by sight, by sounding out and reading comprehension). I will perform the assessments, which will be tape-recorded. Once the study has been completed, the audiotapes will be stored securely for further analysis by those directly involved in the study, should this be necessary. A copy of the results will be made available to you at your request.

The assessment will take place at your child's school between 30 August and 23 September 2004, at a time which is convenient for the teacher to ensure that your son/daughter does not miss any important work. The assessment will last up to one hour

(including a break). Results from this assessment will be made available to you at your request.

In the unlikely event of your child being identified as having a problem in any of the areas assessed, you will be notified. Should you wish, a meeting will be set up with yourself and the researcher during which a possible plan of action will be discussed. These include referral to the nearest school clinic, or a private Speech Language Pathologist, and/or an individualized home programme which will include a half hour discussion with yourself and the class teacher on how to implement the programme at home and in the classroom.

If you decide that your child may participate in the study, please complete the consent form and case history form and send these back to your child's class teacher. I wish to stress, however, that should you decide not to give consent, or should you decide to withdraw your child from the study at any time, this will not influence your child's programme at school in any way.

Information supplied by yourself and results from the assessment will be handled with strict confidentiality and no party will be identifiable from the results of the study. Please do not hesitate to contact me or my supervisor (details below) should you have any concerns or questions.

Yours sincerely

Amanda Cresswell  
Speech Therapist

Amanda Cresswell  
*Principal investigator*  
072 395 0820  
(021) 686 2070 (h)

Pharyn Sorour  
*Supervisor*  
082 907 9974  
(021)797 2573

Appendix K

Parental consent mainstream

<b>Parent Consent Form      Please fill in and return to the class teacher - Thank You</b>
--

I \_\_\_\_\_, parent/guardian of \_\_\_\_\_ hereby  
(name of parent) (name of child)

understand the above information and **DO/DO NOT** give permission for my child to participate in the study.

I understand that I may stop my child from participating in the study at any stage. I understand that my choice to participate or not to participate, and my decision to withdraw my child from the study, will not affect my child's programme at the school in any way.

I have been assured of complete confidentiality and my child will remain anonymous throughout the research procedure. My son/daughter and I will not be identifiable in any way from the results of the study, which will be made available to me at my request.

Signed \_\_\_\_\_

Date \_\_\_\_\_

Appendix L

Case history form for parents of LSEN and mainstream learners

1. Your child's name: \_\_\_\_\_
2. Your child's date of birth: \_\_\_\_\_
3. Home address: \_\_\_\_\_
4. Home telephone: \_\_\_\_\_
5. Father's occupation: \_\_\_\_\_
6. Father's highest level of education (please tick most relevant box)

Standard	1	2	3	4	5	6	7	8	9	10	Tertiary
----------	---	---	---	---	---	---	---	---	---	----	----------

7. Mother's occupation: \_\_\_\_\_
8. Mother's highest level of education: (please tick relevant box)

Standard	1	2	3	4	5	6	7	8	9	10	Tertiary
----------	---	---	---	---	---	---	---	---	---	----	----------

9. Was your child born full term or pre-term? \_\_\_\_\_
10. Were there any complications at birth? \_\_\_\_\_
11. Has your child ever been hospitalized? \_\_\_\_\_
12. If yes, what for? \_\_\_\_\_
13. Is your child on any medication? \_\_\_\_\_
14. Has your child ever suffered any emotional difficulties? \_\_\_\_\_
15. Has your child ever had speech therapy, occupational therapy or physiotherapy? \_\_\_\_\_
16. If yes, when was this and for how long? \_\_\_\_\_
17. Is there a history of speech, language or literacy difficulties in the family - please specify \_\_\_\_\_
18. Please indicate a rough estimate of the income **per adult** per week in the household (please tick relevant box)

R100 - R350	R350 - R1000	R1000 - R7000	R7000 - R12 000
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Appendix M

Table M1

Subject description

Gender	Age	No.	Repeat	Subtype	Time in therapy	Receptive language	Word finding	Reading compr (age equivalent)	Reading recognition (age equivalent)
M	8.4	1		NS	2 years	N	N	6.5	6.6
F	8.2	2		NS	2 years	Y	Y	6.6	6.4
M	8.4	3		NS	3 years	Y	N	6.8	6.8
M	8.3	4		'Neither'	1 year	Y	N	6.5	6.7
M	8.11	5		'Neither'	2 years 9 months	Y	N	6.5	6.9
M	9.7	6	R	NS	7 months	N	N	7.0	6.4
F	8.9	7		PA	10 months	Y	Y	6.4	6.4
F	8.10	8		NS	7 months	Y	N	6.7	6.5
M	8.9	9		PA	1 year 10 months	Y	N	6.7	6.10
M	8.9	10		NS	2 months	Y	Y	6.11	7.0
M	8.11	11		NS	1 year 3 months	Y	N	6.5	6.7
M	8.9	12		PA	1 year 5 months	Y	Y	5.11	5.11
M	9.0	13		PA	2 years	N	N	6.7	6.11
M	9.7	14	R	DD	1 year 2 months	Y	N	6.8	6.3
M	9.6	15	R	DD	5 months	Y	N	6.9	6.8
F	8.6	16		DD	3 years	Y	N	6.4	6.5
M	9.7	17	R	'Neither'	1 year 9 months	N	N	7.3	6.8
M	8.7	18		NS	2 years	Y	Y	6.5	6.5
F	8.9	19		NS	-	Y	N	7.1	6.11
M	9.7	20	R	PA	4 years	Y	Y	6.5	6.1
M	8.2	21		DD	1 year	N	Y	6.6	6.0
M	8.4	22		NS	2 years	N	N	6.8	6.2
M	8.4	23		PA	1 year 2 months	Y	Y	6.8	6.6
M	8.5	24		DD	-	Y	N	6.0	6.0
M	9.2	25		'Neither'	-	Y	Y	7.2	6.8

\* No. = subject number

\* Y = deficit

\* R = repeating Grade 2

\* N = no deficit

Appendix N

Table N1  
Subject standard scores

Subject No.	NS Objects	NS digits	NS letters	PA blending	PA segmentat ion	PA deletion	PA isolation	Reading recognitio n	Reading comprehe nsion	Reading non-words	Reading non-word efficiency	Reading sight-word efficiency
1	82	69	118	75.5	95	100	82	75	68	98	84	68
2	69	69	147	102	81	113	94	76	74	92	73	80
3	69	82	92	109	100	71	114	73	73	101	90	74
4	98	86	77.89	102	93	69	107	76	68	94	75	67
5	119	94	82.29	103	113	116	109	73	63	98	91	87
6	79	83	84.6	99	107	71	110	60	67	97	80	71
7	94	89	126	57	82	88	106	67	61	101	88	74
8	80	69	131	103	71	82	96	68	66	94	80	60
9	90	99	69.42	93	63	66	100	73	66	94	79	84
10	80	69	131	103	71	82	96	76	73	101	83	84
11	69	69	131	75	94	77	103	70	63	94	87	67
12	91	82	84.5	75	75	55	90	62	55	99	87	66
13	91	91	66.84	72	83	82	106	73	64	94	83	74
14	76	79	71.84	87	81	58	95	59	60	89	79	73
15	69	85	69.55	99	73	51	102	64	61	85	74	61
16	82	83	102.2	77	99	73	51	71	64	94	87	68
17	92	87	76.46	99	111	109	102	64	71	95	86	69
18	75	73	111	112	98	93	110	71	66	95	80	69
19	88	82	84.6	103	113	116	106	78	79	89	79	69
20	99	85	65.97	51	73	51	106	57	56	87	78	59
21	85	75	87.71	73	73	57	104	72	74	94	88	54
22	85	78	105	95	77	76	98	71	75	92	87	65
23	91	82	107.1	66	73	69	78	75	77	87	79	72
24	76	69	121.7	51	85	82	98	69	62	84	62	65
25	108	84	97.68	95	69	94	94	69	74	94	84	73

Appendix O

Table O1

Comparison of subject and control groups

	Average age	Females	Males
Subjects	8.65	5	20
Controls	8.32	6	19

Appendix P

Control group standard scores

No.	Age	NS objects	NS digits	NS letters	PA blending	PA segment ation	PA deletion	PA isolation	Reading recog	Reading compre	Reading non- word	Reading non-word efficiency	Reading sight word efficiency	
F	1	8.6	105	102	54.79	112	105	104	113	98	95	105	96	98
M	2	8.7	98	88	69.7	103	109	100	96	89	91	110	98	90
M	3	7.9	100	121	56.84	112	106	98	112	107	105	110	123	114
M	4	8.1	113	90	74.48	109	112	94	104	106	103	107	107	112
M	5	8.1	103	115	54.1	102	108	88	94	92	96	102	100	100
M	6	8.3	102	94	73.34	102	104	92	114	101	97	116	105	104
M	7	8.1	120	111	52.46	95	104	100	101	112	102	113	102	104
F	8	8.2	98	99	75	102	93	94	94	99	99	113	99	99
M	9	8.1	112	97	68.52	95	89	94	111	95	108	104	98	86
M	10	8.7	101	97	62.53	117	117	116	110	92	96	105	104	98
M	11	8.2	110	102	69.06	95	97	94	101	115	105	105	115	108
M	12	8.2	97	96	70.8	102	89	100	107	100	101	105	93	86
M	13	8.3	118	109	54.82	102	108	107	114	99	97	105	108	105
F	14	8.10	108	107	66.95	103	109	110	110	95	97	98	106	104
M	15	8.4	105	90	59.33	102	108	107	101	104	102	116	93	92
M	16	8.9	98	91	58.92	93	109	104	106	103	94	98	109	86
F	17	8.4	86	92	75.79	109	116	107	111	101	101	109	93	102
M	18	8.2	124	111	58.12	102	104	107	114	94	92	103	92	92
F	19	8.8	103	105	75.26	112	109	110	110	105	90	109	93	113
M	20	8.2	110	119	57.28	102	108	94	104	94	98	103	94	102
F	21	8.7	110	101	66.7	93	94	104	106	98	101	103	102	98
F	22	8.7	117	103	77.28	103	98	93	103	95	88	102	90	86
M	23	8.9	119	109	58.36	112	98	104	113	90	89	105	97	92
F	24	8.1	106	96	72.32	95	108	94	104	90	87	97	87	16
M	25	7.9	97	97	72.35	112	116	104	112	95	99	110	92	97

Appendix Q

Questionnaire to Speech and Language Therapists

**Please answer the following questions. The forms will be collected from you at your convenience.**

**THANK YOU FOR YOUR TIME!!**

1. *Name of learner* \_\_\_\_\_

2. *Number of years and months in Speech Therapy* \_\_\_\_\_

4. Has the learner ever repeated a Grade? \_\_\_\_\_ If so, which Grade? \_\_\_\_\_

5. Main aims of therapy a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

d) \_\_\_\_\_

Appendix R

Example of letter naming speed test used in the present study

**o a s d p a o s p d**  
**s d a p d o a p s o**  
**a o s a s d p o d a**  
**d s p o d s a s o p**  
**s a d p a p o a p s**

## Appendix S

### Validity and reliability of reading tests

#### 1. Piat - R (Markwardt, 1989)

##### **Validity**

The Content Validity of the Piat - R was maximized during the extensive developmental processes for each of the subtests (Markwardt, 1989). The Content Validity was also determined using the split-half and Kuder-Richardson estimates. Results provided objective evidence of the extent to which each subtest measures a clear content domain (Markwardt, 1989). Evidence of the Construct Validity of the Piat - R can be found in the following three sources:

- 1 Developmental changes - evidence of an increase with age or grade
- 2 Correlation with other tests
- 3 Factor analysis

##### **Reliability**

The Piat - R employed four methods of estimating the reliability of its reading measures, namely the “split-half, Kuder-Richardson, test-retest and item response theory” (p 59). Each type of test provided measures of reliability from slightly different perspectives. Each test yielded satisfactory results, suggesting that the Piat - R is of sound reliability.

## Appendix T

### Description of phonological processing tests

#### **1. PHAT (Robertson & Salter, 1997).**

##### **Validity**

The authors of the PHAT purport that the content validity of the test is high since the test was developed following “extensive review of available tests and the literature which indicated the particular items and skills selected were those reflective of necessary phonological awareness skills” (Robertson & Salter, 1997, p 52).

Exclusion of some PA tests (e.g. rhyming) implies that a broad assessment of PA could not be conducted resulting in reduced content-related validity (Moskal & Leydens, 2000). Content-related evidence is concerned with the extent to which the assessment instrument adequately samples the content domain (Moskal & Leydens, 2000). However, it has already been discussed that the subtests chosen were done so in consultation with an expert in the field of dyslexia and that they reflect those chosen by Wagner et al., (1993).

##### **Reliability**

The reliability of the PHAT was established by using the test-retest and internal consistency methods, which yielded “highly satisfactory levels of reliability” (Robertson & Salter, 1997, p 52).

## Reliability

Torgesen et al., (1999) report that the average alternate forms reliability co-efficients (content sampling) all exceed .90. The test - retest (time sampling) co-efficients range from .83 to .96. The magnitude of the co-efficients reported from all the reliability studies suggests that there is little error in the TOWRE and that examiners can have confidence in the results.

## Appendix U

### Validity and reliability of naming speed tests

#### **1. PhAB (Frederickson *et al.*, 1997)**

##### **Validity**

Content and construct validity was identified by the authors of the PhAB to be of a high standard.

##### **Reliability**

Internal consistency of the PhAB was assessed using Cronbach's Alpha. The co-efficients for each subtest yielded highly satisfactory results thereby demonstrating the reliability of the test instrument.

#### **2. Non-standardised NS letters test**

Only tentative statements about the validity of this non-standardised test can be made. The finding that an NS digits correlates significantly with NS ( $r = -.72$   $p < 0.05$ ) advocates for the validity of this test, as noted in the Discussion section.

##### **Reliability**

The "test-retest" procedure was adopted to determine the reliability of the test. This was established using the results from the five learners randomly selected to undergo re-assessment of the full battery of tests. Results are presented in the Results section.

## Appendix V

Overview of the contents of the feedback sessions to the schools in the study

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### *“A description of the profile of skill deficits in Grade 2 learners with dyslexia”*

The purpose of the study was to determine the clinical reality of the Double Deficit Hypothesis (DDH) of Wolf and Bowers (1999). This hypothesis has important implications for the diagnosis and treatment of dyslexia in South Africa since it purports that naming speed (NS) and phonological awareness (PA) are separate deficits and should be treated as such. A brief overview of the Phonological Deficit Hypothesis (PDH) vs DDH will be presented.

PDH – well researched over the past three decades. PDH purports that the deficit in reading is at the level of the phonological lexicon (lexical and sublexical). Phonological processes, especially PA, are thought to be causally related to reading. Longitudinal studies have shown PA skill in pre-school are 80% accurate in detecting reading difficulties in Grade 2 (Muter, 2004).

DDH – proponents of the DDH purport a new source of reading disabilities. Dyslexia is not only a phonological problem but the underlying deficits in NS are seen as an independent source of dyslexia. The vast majority of children and adults with dyslexia have NS deficits. They are slow to name visually familiar symbols (example of object and letter NS test shown). This NS deficit stemmed from work of Geschwind who suggested that it was the ability to name colours is related to reading because ability to attach a verbal label to an abstract symbol is the same for naming colours and in reading. But later studies found that naming per se was not related to reading but rather the speed at which children named colours was most predictive. NS test (digit and object) for this study is taken from the PhAB (Phonological Assessment Battery (Robertson & Salter,

1997). An example of the letter NS test used in this study has been presented in order that the educators and SLTs may get a better understanding of the type of test used to test NS.

Should NS be subsumed under phonological processing (overhead projector slide presented of the following)? NS depends on:

- Activation of attention resources
- Bihemispheric visual processes (global shape and finer details) – identification and recognition of stimulus and integrate with known mental representations.
- Lexical processes including semantic, phonological and retrieval.
- Motor commands – translate the phonological info into an articulated name.

It can be seen that NS does access phonological processes, but these processes are only a subset of what is used in serial naming.

Importance of the serial format – the serial format approximates the requirements for reading as it includes the complexity and extent of processing speed demands of reading. NS may be an earlier and simpler approximation of reading ability that can be used (before a child learns to read) to detect processing speed deficits at an early age. Both reading and serial naming use integration of attentional, perceptual, conceptual, lexical and motoric processes in rapid serial processing.

Where does word finding fit in? Speech production includes the selection of the appropriate word at the semantic level (word finding), the retrieval of the phonological form at the level of the phonological lexicon followed by access at the sub-lexical level and the conversion into an articulatory representation. Both NS and PA interact with the phonological lexicon, therefore, it can be seen how NS, PA and word finding can be related. However, NS adds processing speed requirements as well as the other aspects mentioned above.

## Appendix W

### AIMS of the study

1. To determine whether a sample of learners with dyslexia, between the ages 7.9. – 9.7, in the Cape Metropole could be categorised into subtypes according to the classification of Deeney et al. (2000) (overhead projector slide presented).
2. To describe the relationship between NS (naming speed) and PA (phonological awareness) in the subject and control groups.
3. Explore the relationship between NS, PA and reading.
4. Determine the current therapeutic interventions adopted by SLTs with the subject group.

### **Method**

Sample: Criteria for all – English, mid-high SES, no sensory deficits. Criteria for learners with dyslexia – reading age 18 months below chronological age, IQ 80 or above. Controls – average reading and doing well in areas outside written language.

25 learners with dyslexia, 25 learners without dyslexia selected from five schools.

All children underwent a battery of tests (below), subtype classification criteria identified a core deficit as an average standard score at or below one standard deviation below the mean (see Table 1). Correlational statistics employed to explore relationship between NS, PA and reading. Questionnaire given to SLTs pertaining to the type of intervention used with the learners with dyslexia.

Table 1

Criteria for Classifying Learners into Subtypes

	Description
Single deficit (NS)	These learners presented with a core deficit in NS with no deficit in any of the PA tasks assessed.
Single deficit (PA)	These learners presented with a core deficit in the PA tasks with no deficit in any of the NS tasks.
Double Deficit	These learners presented with a core deficit in both the NS and PA tasks assessed.
No-deficit	These learners, although they presented with severe reading impairments, did not present with any deficit in NS or PA.

**Assessments:**

- NS objects, digits, letters
- PA blending, segmentation, deletion and isolation (total PA and phoneme-level PA scores were used)
- Reading – recognition (sight words Piat - R) non-word (PHAB) comprehension (Piat – R), non-word and sight word reading fluency (TOWRE)

**Outcomes**

- Dyslexic learners significantly weaker in all assessments.
- Control group scores not dissimilar to those of a normal distribution.
- Frequency of subtypes as follows (using total PA scores):

1991). NS objects appeared to be weakly correlated with reading measures. Consequently, it may be suggested that digit and/or letter NS test rather than object NS be adopted in screening tests aimed at identifying the underlying cause of learners with reading disorders in this age range. This has also been suggested by Wolf and Bowers (1999). NS correlated with and predicted variance in sight word reading, comprehension (when controlling for sight word) and fluency measures.

Correlations between PA and reading performed with the total PA and phoneme level scores reveal different results. At the total PA level significant correlations were identified between PA deletion and reading recognition ( $p < 0.05$ ) and comprehension ( $p < 0.01$ ) and PA isolation and PA segmentation correlated significantly with non-word reading ( $p < 0.05$ ). The phoneme level analysis confirmed these correlations. However, this level yielded more significant relationships between PA and reading. These were in phoneme segmentation which was correlated significantly with all reading measures except reading comprehension and phoneme deletion which correlated with non-word reading efficiency. PA blending, which did not correlate significantly with any of the reading measured using the total PA score, correlated with reading recognition at the phoneme level. Thus, it can be concluded that phoneme level tasks correlated more strongly with reading than PA measures that incorporate all levels (Castles & Coltheart, 2004).

Current interventions for all subtypes was mostly PA. However, SLTs may play an important role in improving fluency of lexical retrieval in their vocabulary elaboration training.

### **Implications of the study**

The study has implications for the diagnosis of reading disorders in SA. Current practice is to subsume NS under PA. Within this system, NS learners will not be identified or will be misclassified due to their adequate decoding (PA) skills. Thus the study advocates for

the inclusion of NS tests in the battery of tests given to preschool children as well as Grade 1 and 2 learners. Furthermore, children with NS deficits may be given inadequate intervention that does not address their underlying NS deficit. There is, however, a great deal of work that still needs to be done in this area. There are many unanswered questions such as type of intervention for NS and whether it is amenable to remediation and whether NS skill improvement translates to reading improvement. One intervention programme in the USA – the RAVE – O is in the process of being tested and validated. SLTs are encouraged to read further about lexical retrieval and fluency in the skills which SLTs already deal with.

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