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A STUDY OF THE RELATIONSHIP BETWEEN REVERSALS AND SEVERAL FACTORS IN THE GRADE 2 LEARNER

BY

WENDY SMITH

97087867

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DECLARATION

A STUDY OF THE RELATIONSHIP BETWEEN REVERSALS AND SEVERAL FACTORS IN THE GRADE 2 LEARNER.

I, Wendy Smith, hereby declare that this dissertation, submitted to the University of Pretoria in fulfilment of the requirements for the degree Master in Occupational Therapy, represents my original work and has not been previously submitted to this or any other university.

Signed: _____ Date: _____

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ABSTRACT

The study examined the relationship between reversals and several factors in 141 Grade 2 mainstream learners from average classes in Department of Education schools. The sample consisted of 77 female learners and 64 male learners. 55 of the 141 learners were older than 8 years and 131 of the 141 learners were right-handed.The study made use of correlational research where two or more variables are compared by measuring differences and looking for a relationship. Incorrect letter formation, gender and reversals in reading showed a statically significant difference between the group who had reversals compared to the group that did not have reversals in the class program that was used to identify learners with reversals. Furthermore the data collected only on the learners with reversals showed a mean scaled that was below average for position in space, figure ground and visual closure as well as for the motor-reduced quotient of the Developmental Test of Visual Perception -2. This group also displayed a high percentage of learners with difficulty with directionality as well as with crossing their midline. The results of the study were limited by the research design, as well as the lack of standardized tests available to test some aspects. Difficulty in gaining permission from parents to include learners in the study was also experienced which limited the final sample size. Further studies focussing on the treatment of the factors that showed a statistically significant relationship with reversals was recommended as well as placing more emphasis correct letter formation when teaching handwriting and publishing the results of this study in a journal accessible to educators and therapists was recommended.

KEY WORDS

- Reversals
- Letter formation
- Visual perception
- Handwriting
- Directionality

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Chapter 1 – DEFINING THE ISSUES

1.1 Introduction

It is a well-known phenomenon to teachers and occupational therapists that some learners reverse their letters and numbers when they write. According to Gardner (1979) most, if not all children, will reverse letters when they first learn to write. For those learners who continue to reverse these written symbols after the initial learning phases, it becomes part of a learning problem. Reversals have a significant impact on the day-to-day schoolwork of a child with this difficulty. It affects virtually every aspect of writing, reading, mathematics and spelling e.g. if a learner writes 'bown' instead of 'down'. Another example is when he tries to do a sum but writes '9' instead of '6' and therefore gets the answer wrong. According to Marr, Windsor and Cermak (2001), reversals contribute to illegible writing. If a learner continues to reverse letters, this not only impacts on his or her schoolwork, but also on the learner's confidence and self-esteem due to their experiences of failure.

According to Youngstrom (2002), the occupational therapist's domain stems from the therapist's interest in the client's ability to take part in everyday life activities. The occupational therapist is seen as an expert in their knowledge of occupations and how participation in these occupations can be used to affect performance. Occupation is seen as the human activities that individuals, groups or a population might engage in during their daily life. Some of the occupations for a child of school going age would be activities of daily living, education, work, play, leisure and social participation (Youngstrom, 2002). For a school-going child, several of these occupations will be affected during their school hours e.g. education, play and social participation. Therefore it

is the role of the occupational therapist to ensure that the child can have meaningful participation at school. Areas of difficulty, like letter and number reversals, affect the child's ability to perform on the level expected and therefore impacts the child's education occupation.

1.2 Background to the research problem

The researcher's interest in this area started while working as an occupational therapist at Livingstone School. Livingstone School is a short-term remedial school. The school is for learners with an average to above-average IQ but who have learning difficulties. The learners come to the school for two to three years and after that they return to their mainstream schools. At Livingstone school the mainstream syllabus is followed, but every child has an individual educational programme addressing his or her specific difficulties. The school also employs the specialists needed to address the learners' difficulties which include occupational therapists, speech and language therapists, and educational psychologists. In addition, all the teachers are trained as remedial teachers. There is also a maximum of only 15 learners per class.

During the time the researcher worked at Livingstone School discussions amongst colleagues highlighted that there seemed to have been an increase in children who reverse letters in their writing during the previous five years. Through deliberating about this occurrence it appeared to correlate with the time that pre-school educators started teaching writing skills in Grade 0. It was also noticed that since this change, a large percentage of learners no longer formed their letters the correct way. The occupational therapists speculated whether there might be a relationship between these two factors.

In 2004 the researcher conducted a pilot study on 54 learners that she was treating at the time in Livingstone Primary School. Every child's letter formation on the whole alphabet as well as the numbers 0-9 was observed. A note was made of children who formed any of the letters or numbers incorrectly. A checklist was then sent to the class teacher asking if any of the 54 learners reversed often/seldom/never in class. A significant relationship was found between learners who used incorrect letter formation and learners who made reversals, especially in the younger grades (Grade 1 and 2). It appeared that the older learners had learned to compensate for their incorrect letter formation and therefore the relationship was not as obvious as in the younger learners. There was, however, still a higher incidence of reversals in children who used incorrect letter formation. After this pilot study the researcher realised that this was an area that needed further investigation.

1.3 Problem formulation

Through a search of literature the researcher noticed that handwriting and its related difficulties were studied extensively in the 1970's to early 1990's. Thereafter it appeared as though the focus of research in the educational field was more on emotional and behavioural difficulties and their effect on learning. Difficulties like poverty, single-parent families and concentration difficulties may have become more of a problem in the classroom and therefore much of the research in the educational field focussed on these areas. Asher (2006), in her study on handwriting skills in Elementary Schools, agreed that handwriting was studied extensively in the 1970's to the early 1990's. Her concern, however, was that even with all of this research the superiority of a particular method of instruction for handwriting had not yet been established.

During this search of the literature the researcher was able to find two studies that discussed the relationship between letter formation and what the studies called 'letter direction'. The one study was performed in 1973 on a six-year old boy. The study's aim was to determine if a behaviour-modification procedure combined with different instructional procedures would improve letter identification and handwriting skills (Fauke, et al. 1973). The other study was performed in 1977 on two learning-disabled boys. This study showed that severe perceptual-motor disorders in handwriting could be remediated by using reinforcement and corrective feedback (Lahey, et al. 1977). Both these studies showed potential but focused more on the behaviour modification to remediate letter formation. Both studies concluded that further research in this area was necessary.

The recent contemporary theoretical knowledge base, based on research completed on reversals and factors associated with it, is limited. Various theories that ascribe reversals to specific factors were, however, found:

- Gardner (1979) feels that the most convincing theories for reversals are those that consider impairment in visual memory.
- According to Lucas and Lowenberg (1996), children need to be taught the importance of directionality as a distinguishing factor in order to avoid the tendency to reverse.
- Frostig and Horne (1964) attributed reversals to orientation errors. They are of the opinion that reversals are due to a problem in visual perception, specifically that of position in space perception.
- Orton (1937) proposed that reversals were the result of the failure of the dominant hemisphere to properly suppress the non-dominant hemisphere. When the dominant hemisphere cannot suppress the non-dominant adequately, the reversed image

projected on the non-dominant hemisphere is the one perceived.

The researcher, however, found in practice that there were a significant number of children who no longer had any perceptual or memory difficulties, yet they still reversed in class. Furthermore, it became evident from the literature that several other factors are also hypothesised to be associated with reversals beyond the initial learning phase of writing. These factors have, however, not been empirically researched. From the researcher's own experience and study another factor, namely incorrect letter formation, emerged that could also be involved in the phenomenon that causes children to continue to reverse letters and numbers. Preston (1957), in his study on reversals, observed that various explanations had been offered concerning the origin of reversals but that these explanations are not consistent with one another. Further investigation into reversals and the factors associated with it was indicated.

1.4 Research question

What is the relationship between reversals and various factors in the Grade 2 learner? The study aimed to investigate the various factors that could be related to reversals. This will give therapists and educators a better understanding of this area of difficulty. It may also give new insight into the prevention and treatment of this difficulty.

1.5 Definition of Terms

Correct letter formation:

For the purposes of this study the correct method of letter formation will be seen as the formation used when using Nelson Script as suggested

by Inglis and Gibson (Undated). This formation correlates with the formation used in the Grade 1 FONT (Trollip, 2002) as well as in the California State Series (California State Department of Education, 1959) (Appendix A).

Directionality:

Directionality refers to the knowledge of left and right in space. Learners with this difficulty will have difficulty in drawing lines, writing or reading from left to right (Frostig, 1970).

Dyspraxia:

Children who have difficulty learning new tasks and require more repetition to learn a motor plan than others are diagnosed with dyspraxia (Murray-Slutsky, 2000).

Motor planning:

Motor planning is the process that is required to learn a skill. It is the conscious attention and effort required to master a new task or activity (Murray-Slutsky, 2000).

Reversals:

According to Gardner (1979), a reversal is a letter written with the wrong orientation. He stated that reversals could be divided into four categories:

- Mirror image: b for d
- Inversions: p for b
- Inverted reversals: p for d, u for n, 6 for 9
- Rotations: _ for l

In addition, reversing the sequence of letters within a word is different from reversing a letter in isolation e.g. ‘was’ instead of ‘saw’ or ‘45’ instead of ‘54’.

Position in space:

Position in space is the relationship of an object to the observer e.g. upright, reversed, left or right (Frostig and Horne, 1964).

Figure ground:

Figure ground is the ability to focus on the relevant stimulus and ignore the irrelevant stimulus (Hammil, Pearson and Voress, 1993).

Visual closure:

Visual closure is the ability to recognise a partially completed form from that of the whole (Hammil, Pearson and Voress, 1993).

Form constancy:

Form constancy measures the ability to match two figures that vary on one or more discriminating features i.e. size, position etc. (Hammil, Pearson and Voress 1993).

Visual memory:

Memory is a function by which information stored in the brain is later recalled to consciousness. Memory can be divided into short- and long-term memory. Long-term memories are retained longer than short-term memories because of the increased time such memories have had to link up with a number of locations in the cortex (Kaplan, Sadock and Grebb, 1994). In visual memory this information is stored in the brain via the sense of vision.

1.6 Significance and contribution of this research

The research completed on reversals and factors associated with it in the past ten years are limited. The results of this study will provide

information about factors associated with reversals. This information could be of benefit to several professionals.

The information would be beneficial to therapists who treat learners with these difficulties. The results of this study will indicate the aspects that could be associated with reversals and this will guide the therapist in planning therapy for these learners.

Educators could also benefit from the results of this study. In knowing which factors are associated with reversals this could guide the teacher to which areas needs emphasis to prevent these difficulties in learners. It could also help the educator to identify which learners are at risk for difficulties with reversals.

The results of this study also create a knowledge base that could assist future researchers in studying the treatment of reversals in learners.

1.7 Layout of chapters

This research document contains the following chapters and appendices:

Chapter 1: Describes the general outline of the dissertation. It consists of the background to the study, research question, terms used as well as a discussion of the significance and contribution of the research.

Chapter 2: Studies the theoretical knowledge related to the study. Reviewing the literature provides a theoretical framework for studying reversals and the factors related with it.

Chapter 3: Focuses on the methodology of the research project, discussing the aim, sub-aims, research design, study population as well as the procedure of the study, ethical considerations and limitations of the study.

Chapter 4: Consists of the results obtained in the study on the data collected on the whole sample as well as the data collected only on the learners with reversals.

Chapter 5: Discusses the results mentioned in chapter 4 and includes recommendations concerning the significance of the results as well as for future studies.

The following appendices are included:

Appendix A: Examples of correct letter formation
Appendix B: Examples of efficient and inefficient pencil grips
Appendix C: One-week Class Programme
Appendix D: Teacher Questionnaire
Appendix E: Screening for vision and ocular motor control
Appendix F: Observation Form
Appendix G: Consent from KZN Department of Education
Appendix H: Consent Form for principals
Appendix I: Consent Form for teachers
Appendix J: Consent Form for parents

1.8 Summary

The recent research knowledge base on letter and number reversals and factors associated with it is limited. This study looks at reversals and the association it has with factors related to it. The results of this study could be of benefit to the therapists, educators and others involved in assisting learners who have difficulty with this aspect and it would empower them to be more efficient in helping learners to overcome difficulty with reversals.

In this chapter the problem formulation was discussed. Important terms were described and the significance and contribution of the research was discussed. The layout of the chapters and appendices were also listed. In Chapter 2 the theoretical issues related to the study will be discussed.

Chapter 2 – THEORETICAL ISSUES RELATED TO THE STUDY

2.1 Introduction

Several theories have been put forward to explain the phenomenon of children persisting in reversing letters and numbers beyond the beginning stages of learning to write. In this chapter the aspects in literature that have been related to reversals as well as other factors and conditions that may be related to this area of difficulty will be discussed.

The main factors which have been associated with reversals in the literature are:

- Visual memory (Gardner, 1979)
- Visual perception (Frostig and Horne, 1964)
- Visual learner (Orton, 1937)
- Directionality (Lucas and Lowenberg, 1996)

As discussed in Chapter 1, the other factor that presented in the researcher's pilot study that may be related to reversals is letter formation. Letter formation is affected by several other factors. Therefore this chapter will also discuss the following:

- Writing instruction
- Writing readiness
- Pencil grip
- Motor planning

In the literature as well as in the researcher's clinical experience it appeared as though reversals could also be related to certain

conditions. This chapter will therefore also look at learning disabilities as well as dyspraxia and how these conditions could relate to reversals.

2.2 Visual memory

Gardner, in 1979, initially felt that the most convincing theories for reversals are those that consider impairment in visual memory to be the central problem. Symbols, especially linguistic, do not become firmly imbedded in the psychic structure. There is looseness to their accurate and precise storage and possibly impairment in their retrieval as well (Gardner, 1979). According to Schneck (2005) visual memory is "the integration of visual information with previous experiences". In order to be able to manipulate visual information you need the ability to retain the information in memory for immediate recall or to store it for later retrieval. A child with visual memory deficits may demonstrate the inability to recognise or match visual stimuli presented previously because he or she has not stored this information in memory, or is unable to retrieve it from memory (Todd, 1999).

Schneck (2005) agreed with Gardner's (1979) theory and also concluded that children with memory deficiencies have difficulty in establishing easily retrievable or recognisable sound-symbol associations. They struggle to recall the shape and formation of letters or numbers and the same letter may be written many ways on the same page. This could therefore be one of the reasons why learners reverse letters in writing.

Another factor that has been associated with reversals in the literature is visual perception.

2.3 Visual perception

Frostig and Horne (1964) felt that reversals could be attributed to a problem in visual perception. They stated that specifically position in space perception could be related to this area of difficulty. In order to test the learners' visual perceptual skills, the researcher decided to use a standardised test called the Developmental Test of Visual Perception – Second Edition, otherwise known as the DTVP-2 (Hammil, Pearson and Voress, 1993). However, before a learner's visual perceptual skills can be tested it is important to establish that a learner's vision is normal, as this area will affect the outcome on the standardised visual perceptual tests.

2.3.1 Vision

According to Russel and Nagaishi (2005), vision is the process of taking in, processing, and integrating visual and other sensory information to form a perception. If a child shows certain signs or symptoms (Appendix D) a referral to an eye care specialist is indicated. It may therefore be seen that difficulty with vision would have a significant impact on the learner's visual perception.

It is therefore important that when researching the relationship between visual perceptual skills and reversals a screening of learners' vision must be completed. This will ensure that the results of the visual perceptual test are not influenced by a factor such as vision, which could be controlled from the beginning.

2.3.2 Developmental Test of Visual Perception – Second Edition

For the purpose of this research the Developmental Test of Visual Perception – Second Edition (DTVP-2) (Hammil, Pearson and Voress, 1993) was used to assess the learners' visual perceptual skills. According to Kaplan (1996), standardised tests not only provide a uniform administration and scoring procedure, but also allow for a comparison of an individual's performance to that of a normative sample. Payne (2002), in her study "Standardized Tests: an Appropriate Way to Measure the Outcome of Paediatric Occupational Therapy?", stated that standardised tests help the therapist to present clear and objective data on the outcomes of interventions. It also helps the therapist to compare different types of interventions in order to identify the best practice.

The DTVP-2 is a battery of eight subtests that measure different but interrelated visual perceptual and visual motor abilities (Hammil, Pearson and Voress, 1993). It was designed for use on children between the ages of 4 and 10 years. Reliability and validity has empirically been established. According to Burtner, Wilhite, Bordegaray, Moedl, Roe, and Savage (1997), in order to use a test as an evaluative measure both interrater and test-retest reliability is important. These forms of reliability give the test user a measure of test stability over time and with different examiners. The most desirable reliability is considered to be above 0.90. They found that the DTVP-2 reports an interrater reliability of 0.98 for the total test. The test-retest reliability for the total test was 0.95. It would therefore be considered to be sufficient to use as an evaluation measure.

The test is divided into two parts: 'The Motor-Reduced Visual Perception Quotient' and 'The Visual-Motor Integration Quotient'. For the purpose

of this research the researcher will only be working with the 'Motor-Reduced Visual Perception Quotient'. According to the manual this quotient is the purest and most direct measure of visual perception in that only minimal motor skills are required to show perceptual competence. Even though the results of composite scores should receive more credence than subtests, the interpretation of subtests will yield information about a person's strengths and weaknesses (Hammil, Pearson and Voress, 1993). The 'Motor-Reduced Visual Perceptual Quotient' comprises of four different subtests: position in space, figure ground, visual closure and form constancy.

2.3.3 Position in space

A learner with difficulty in position in space has difficulty in perceiving the proper position of an object in relation to his body. Schneck (2005) describes difficulty with position in space as having trouble discriminating among objects because of their placement in space. When a child first starts learning names of objects, the object stays the same no matter what its orientation e.g. a chair. When children then start to learn to read, they find the orientation of the symbol is now vital to the meaning it has. The letters 'b', 'd', and 'p' are all identical regarding their form, yet they have entirely different names and meanings. The fact that the child must now concern himself with orientation is, according Money (1962), the cause of reversal errors. Cohn and Stricker (1979) also felt that children often reverse letters because they are unaware of the importance of spatial orientation. Schneck (2005) wrote that children with difficulty in position in space skills may show reversals past the age of 8 years.

2.3.4 Figure ground

According to Schneck (2005), figure ground is 'the differentiation between foreground and background forms and objects". She explains that this skill involves the ability to separate the important data from the background data that distracts. The learner must be able to attend to one aspect while perceiving that aspect in relation to the rest of the field. An example of this is a child being able to find their place in their reading book after being interrupted.

2.3.5 Visual closure

Visual closure is the identification of a form or object from an incomplete presentation. This skill enables a person to quickly recognise objects by matching them to previously stored information. An example of this is a learner is able to discriminate a pen from a pencil even if they are both partially hidden by a piece of paper (Schneck, 2005).

2.3.6 Form constancy

Form constancy is the ability to recognise a form or shape as the same even if the environment, position or size changes. A learner will therefore be able to know that the actual size of an object is the same even though it looks bigger when you bring it closer and smaller when you move it further away. This skill enables the learner to identify a letter even is it is typed, written in manuscript or written in cursive. (Schneck, 2005).

2.4 Visual learner

Orton, in 1937, was the first to propose that reversals were the result of the failure of the dominant hemisphere to properly suppress the non-dominant hemisphere. His explanation is based on the premise that the images transmitted from the retinas to the occipital lobes are mirror images of one another. When the dominant hemisphere cannot suppress the non-dominant adequately, the reversed image projected on the non-dominant side is the one perceived. This may then be the one executed when the patient is asked to write. In 1996 Lucas and Lowenberg (1996) agreed with this theory saying that the visual learner is more prone to produce reversals because they have to suppress their dominant hemisphere, which is more difficult than suppressing the non-dominant hemisphere, as it requires more neurological impulses to be activated.

Davidson (1935), Money (1962), and Critchley (1970) point out that Orton's theory might explain b-d and even p-q reversals, but it does not provide adequate explanation for b-p and d-p reversals commonly seen.

Another factor that has been associated with reversals in the literature is directionality.

2.5 Directionality

Directionality is thought to be important in the visual discrimination of letters and numbers for both reading and writing (Schneck, 2005). The child senses a difference between body sides and becomes aware that figures and objects have a right and left. The child first learns these

concepts in relation to himself and then transfers them to symbols and words. Schneck (2005) also stated that confusion over the directionality of a word may result in weak registration in visual memory.

Directionality differs from position in space as it has a movement component involved. It does not only entail knowing your left from your right side but being able to move from left to right. Henderson, Pehoski and Murray (2002) stated that handwriting requires organisation in the placement of writing on a page. This includes attention to the conventions of going from top to bottom and left to right (directionality). According to Frostig (1970), a learner with difficulties in directionality should at first be provided with some fixed cue to help him. One example of this method is to make a small mark in the upper left side corner of every paper that the learner receives in the classroom so that the learner will know from which side to begin writing. A small arrow pointing to the right at the upper left-hand corner of the paper could help the learner to initiate the correct movement. Taylor (1985) agreed that when learning to write the learner must first learn the movement pattern directly relating to a letter before a letter is introduced.

Difficulties in midline crossing as well as the child's dominance could affect the establishment of a learner's directionality:

2.5.1 Midline crossing

Poor midline crossing could also influence a learner's directionality. Baird et al. (2003) describes midline crossing as "a brain-based developmental function that requires coordination within the brain and collaboration between the brain's two hemispheres". The two sides of the brain control different functions and they must be able to function

simultaneously when an activity requires crossing the midline of the body. A learner that is reluctant to cross his midline is likely, if he is right handed, to show preference for drawing a line from right to left. This could influence the development of his/her directionality. Similarly a learner with poor coordination may choose whichever path is easier for him/her which could also result in poor directionality. They found that before learners could be instructed in correct letter formation they should have developed certain prerequisites for handwriting. The ability to cross the midline is one of the prerequisites that they listed. Another prerequisite is established hand dominance.

2.5.2 Dominance

Dominance may have a significant effect on a learner's directionality. Working from left to right is easier for a right-handed learner than it is for the left-handed learner. According to Lucas and Lowenberg (1996) the left-hander finds it more natural and comfortable to work from right to left and therefore shows a strong tendency to mirror-write. The unconscious natural response for both left- and right-handers is always to move outwards from the body when writing, which happens to be the correct directionality for the right-hander but not for the left-hander. Lewis and Lewis (1965) found that, as a group, their left-handed subjects made significantly more errors when studying the errors in the formations of letters in first-grade learners, especially reversals and inversions.

Gardner's study (1979) did not reach the same conclusion. He studied the relationship between hand preference and reversals frequency. His study did not find any significant correlation between reversals frequency and left-handedness in general.

When looking at the relationship between handedness and handwriting, Maeland (1992), in her study of children's handwriting, did not find a significant relationship between left-handers and poor handwriting either.

Poor directionality could affect a learner's ability to acquire the correct letter formation. As discussed in Chapter 1, after the researcher's pilot study it was observed that letter formation may be related to reversals.

2.6 Letter formation

According to Inglis and Gibson (Undated) the correct letter formation to use when teaching writing is the formation as shown in the 'Nelson Script' (Appendix A). The Grade 1 FONT (Trollip, 2002) shows the same formation as the Nelson script to be the correct formation. In Lewis and Lewis' study on the formation of manuscript letters they used the style found in the California State Series (California State Department of Education, 1959) as the correct formation of letters. This script also correlates with the formation used in the other two above-mentioned scripts. All three these scripts indicate a definite formation for every letter and number of the alphabet. Every letter and number has a starting point and direction in which it is formed.

Letter formation is not only important in terms of the relationship it may have with reversals but, according to Admundson (2005), it is one of the components that is used to assess legibility. It does not only affect legibility but also readability. Graham, Boyer-Shick and Tippets (1989) found that the influence of legibility components on readability is significant. Asher (2006) found in her study on handwriting instruction in elementary schools that many children referred for occupational therapy used very unusual letter formations. She concluded that this

reduced the learner's speed of writing as well as legibility. Sheffield (1996) found that teaching students the correct letter formations resulted in a significant decrease in the number of students having difficulty with written language. Graham, Berninger and Weintraub (2001) found in their study of Grade 1 to 3 learners' ability to write manuscript letters that 21% of the time these learners formed part or all of the letters incorrectly. They also found that 8% of the time these learners rotated part of or reversed the whole letter. This study found that letter formation was specifically related to letter legibility. They also found that three variables i.e. no rotations, correct formation and all parts of the letter being there, made a significant and unique contribution to the prediction of letter legibility after all the other formal characteristics, grade, gender, handedness and alphabet fluency were controlled. Interestingly they found that gender was not related to the legibility of manuscript letters. This is contrary to the findings of Lewis and Lewis (1965) in their study on the errors in formation of manuscript letters by first-grade children. They found that both before and after instruction boys made more errors than girls.

Handwriting is an important academic occupation for children (Chu, 1997). There are various aspects that could influence the learner's ability to use correct letter formation when writing. The following aspects will be reviewed:

- Writing instruction
- Readiness for writing
- Pencil grip
- Motor planning

2.6.1 Writing instruction

The 'Revised National Curriculum Statement Grades R - 9 (Schools) POLICY' does not stipulate exactly which letter formation should be used when teaching writing. The only criterion set for teaching writing in Grade 1 is: "The learner will be able to write different kinds of factual and imaginative texts for a wide range of purposes" (South Africa, 2002:23406). According to the same document, the Assessment Standards for Grade 1 are:

"The learner:

- Copies familiar words and short sentences (e.g. labels or titles for own drawings)
- Uses simple, familiar words to complete sentence 'frames' (e.g. 'My name is….'; 'I like….'; 'I do not like….')
- Writes lists with titles (e.g. 'My Friends')"(South Africa 2002:23406)

In consultation with various qualified teachers with varying lengths of experience, they all agreed that the formation used in the Nelson Script and Grade 1 FONT is the correct method of letter formation. None of them could, however, provide the researcher with a written source to confirm this fact. They all seemed to agree that this was taught to them verbally at university or college, and has been confirmed at various workshops and talks attended over the years.

Incorrect letter formation could be due to the fact that it was not taught in the correct way initially. It would, however, be very difficult to establish whether or not a learner had been taught to form his or her letters correctly. Even if you could obtain the names of learners' Grade 1 teachers, most teachers would state that they taught formation in the correct way. Not all teachers, however, insist and ensure that all the learners in their class form the letters the correct way. Through

observation the researcher has noticed that some teachers have to teach writing to classes of 30 to 40 Grade 1's and in this instance it would be impossible to ensure that every learner formed the letter correctly before moving on to the next one. Many learners also learn to write certain letters before they go to Grade 1 and could therefore have been taught incorrectly before they even started school.

In the investigation of how the accuracy and automaticity of handwriting skills transfer to composition writing, Edwards (2003) described five different approaches to handwriting instruction. Students who received handwriting instruction that included visual clues and memory retrieval components performed significantly better on printing accuracy and letter copying, and their handwriting quality was significantly better than that of students who received their instructions differently. Effective instruction included:

- Opportunities for students to copy modelled lowercase letters that were marked with arrow cues,
- Opportunities for students to write letters from memory, and
- The use of letter names while students copy and write letters.

Sheffield (1996) noted that teachers may not be aware of the long-term benefits of careful consistent teaching of handwriting. She felt that the curriculum in our schools is so full that there is often no time for the basics. Novice teachers often use publishers' copy books to teach writing and don't focus on the mechanics of writing. The child is expected to copy, self-teach and internalise the material. Karlsdottir and Stefansson's study (2002) drew a similar conclusion. They found that the causes of handwriting dysfunction can be traced to insufficient individualisation in the primary handwriting instruction. This results in adequate time not being allocated for children to learn to form certain letters correctly. Sheffield (1996) felt that without direct

teaching the attempt to learn writing often ends in a disaster. Marr, Windsor and Cermak (2001) noted in their study on writing readiness that none of the nine teachers included in their study reported to have had any training in handwriting instruction either as undergraduates or in workshops. The average number of years in teaching for these teachers was 19.8 years with a range of 7 to 30 years. Baird et al. (2003) agreed with this statement. They found that the issues that get in the way of learners acquiring the prerequisite skills needed for automaticity in writing e.g. correct letter formation and pencil grip are a lack of professional development of training in handwriting for teachers and the lack of time. They also found that the early-childhood day now has so many expectations that these skills are often not emphasised. These findings are a cause for concern especially as research has found that a child's learning of a skill like handwriting is dependent on the teacher's instruction and evaluation (Maeland, 1992).

Marr, Windsor and Cermak (2001) mentioned that learners should eventually switch from visual to kinaesthetic feedback in order to produce faster handwriting. If this switch is not made the learner may experience academic productivity problems as the demand for writing production increases in the later elementary year.

It is interesting to note that although the guidelines for teaching handwriting is not always clear in the literature, Reisman (1991), in her study on who is referred to occupational therapy for handwriting difficulties, found that the learners that had been referred to therapy achieved the lowest scores on the Minnesota Handwriting Test. Her conclusion was that teachers in regular classrooms are referring the correct learners for occupational therapy for handwriting.

According to Henderson, Pehoski and Murray (2002) handwriting is a particularly important skill in children's daily school activities. Goyen and Duff (2005) stated that it is the role of the paediatric occupational therapist to work in partnership with families and teachers to provide comprehensive assessment and management for learners with handwriting difficulties. They noted that handwriting is a complex task and that it is challenging for clinicians to make sense of the many factors that may underlie its performance. Feder et al. (2007) agreed that the relationships among factors that may contribute to handwriting performance are complex and multifactorial. They stated that it is important to provide early intervention for learners with handwriting difficulties to avoid secondary effects of academic failure such as poor self-esteem and decreased compositional fluency. Feder and Majnemer (2007), in their study on the development of handwriting, agreed that failure to attain handwriting competence has far-reaching negative effects on academic success and self-esteem. Handwriting is not only important for success at school but is a very important skill in adulthood as well. They also stated that there is evidence that handwriting difficulties do not resolve without intervention and that 10%-30% of school-aged children have difficulty in this area. It is therefore very important for learners to have the skills needed for readiness for writing before starting with this 'complex task'.

2.6.2 Readiness for writing

Some controversy exists as to when children are ready for formal handwriting instruction. Asher (2006), in her study of handwriting instruction in elementary schools, found that teachers differed in their beliefs regarding age for introduction of handwriting instruction. She describes the risk of this is that a child may have a kindergarten teacher who feels that writing should be taught in Grade 1, and then have a Grade 1 teacher who thinks it should have been taught in

kindergarten. This child will therefore reach second grade without ever receiving formal instruction in forming letters. The child would have to use his or her resources to form letters but may pick up inefficient letter formations.

Several authors have stressed the fact that children must master writing-readiness skills before handwriting instruction is initiated. These authors have also found that children who are taught writing before they are ready may become discouraged and develop poor writing habits, which may be difficult to correct later (Cermak, 1991). Ziviani (1995) stated that letter formation in manuscript requires a spatial analysis that is similar to that needed when copying geometric forms. He also stated that copying forms at some early level precedes writing.

According to Amundson (2005), letter formation requires the integration of the visual, motor, sensory and perceptual systems. Sufficient fine motor coordination is also needed to form letters accurately. Weil and Amundson (1994) performed a study in which they examined 60 kindergarten children who were developing normally and their ability to copy letter forms on the Developmental Test of Visual-Motor Integration (VMI). They found that children who were able to copy the first nine forms on the VMI could copy significantly more letters than those who could not copy these nine figures. Daly, Kelley and Krauss' (2003) results of their study confirmed the results of Weil and Amundson's study. They also found a strong positive relationship between kindergarten students' performance on the VMI and their ability to copy letter forms legibly, therefore noting visual motor integration as a requisite skill for handwriting legibility. Kulp (1999) found not only a relationship between visual motor integration and readiness for writing. Her study found that performance on the VMI

was significantly related to teachers' ratings of 7-9 year-old children's reading, math, writing and spelling ability.

Oliver (1990) stated that a developmental delay in kindergarten and first grade children often manifests itself as incomplete mastery of the readiness skills needed to print. The learners in their study followed a writing readiness programme that combined direct occupational therapy with an ongoing classroom-oriented remedial programme. Their study found that the learners benefited from the individualised instruction that emphasised multisensory training.

Readiness for writing is very important, as Karlsdottir and Stefansson (2002), in their study, found that the quality of children's handwriting develops quickly in Grade 1 and reaches its permanent level during Grade 2. They found that slower development indicates handwriting dysfunction. It is therefore very important for learners to be ready to attain this goal.

Oehler et al. (2000), in their study, looked at whether the diameter or shape of a pencil affected the pre-writing skills of learners. Their study did not support the theory that the use of large diameter or triangle-shaped pencils assisted in handwriting performance. Their study did, however, support the literature that indicates that many kindergarten children do not use an efficient pencil grip. Baird et al. (2003) listed functional pencil grasp as one of the prerequisites that is needed for handwriting.

2.6.3 Pencil grip

According to Erhardt (1993), a mature pencil grip is when the hand itself stabilises, allowing finger movement dissociated from the metacarpophalangeal joints for precise, small productions of drawings,

letters and numbers. This grip should be in place by 6 years of age. Schneck and Henderson (1990) found that in the normal development of grasp patterns children will typically use the tripod grasp at 6½ years of age and older. Pictures of various efficient and inefficient pencil grips were found in the Writing Rate Information Test (Steinhardt, Richmond and Smith, 2005) (Appendix B).

Different authors do not, however, agree on the importance of pencil grip for handwriting performance. Ziviani and Elkins (1986) did not find that speed or legibility was affected by atypical grasp patterns. Sassoon, Nimmo-Smith and Wing (1986) also found that there was not a relationship between pencil grasp and speed of writing. Schneck (1991), on the other hand, found differences in grasp between children with good and poor handwriting. These children were rated on legibility and accuracy of letter formation after printing the alphabet in lowercase letters and copying a sentence. In this study the learners with poor handwriting received lower grasp scores. All of these studies, though, only evaluated handwriting during short writing samples. Some authors suggest that handwriting could be affected more by pencil grip during longer tasks (Bailey, 1988; Bonney, 1992; Tseng and Cermak, 1993). Dennis and Swinth (1999) examined the effects of pencil grasp and length of writing task on handwriting legibility. They did not find a significant difference between the scores of participants who use a dynamic tripod grasp compared to those who used atypical grasps. There was not a significant difference between grasp and task length either. They did, however, state that because of the limited sample size in their study results should be interpreted with caution.

An aspect that could influence a learner's ability to execute the correct letter formation, even if he or she has been taught the correct

way and is using an efficient pencil grip, is difficulty in the motor planning needed for writing.

2.6.4 Motor planning

Motor planning is the conscious process that is required to master a new task or activity (Murray-Slutsky, 2000). According to Murray-Slutsky (2000), when a child learns a new task they have to organise and sequence the task into its component steps. Once the child has repeated this task several times he no longer needs to concentrate on it and the motor plan is received automatically. However, when there is a variation to the original task or the child has to perform it in a new environment the need to motor plan the activity arises again. Cornhill and Case-Smith (1996), in their study of factors that relate to good and poor handwriting, stated that forming individual letters and writing detailed and complex sequences of letters appears to require ongoing motor planning.

A child that has difficulty in learning new tasks and requires more repetition than other children to learn the motor plan is diagnosed with dyspraxia. This is one of the conditions that may be related to reversals.

2.7 Dyspraxia

Dyspraxia refers to motor planning deficits that are developmental rather than acquired (Reeves and Cermak, 2002). In its milder form it is often not detected during the first few years of life as most activities attempted at this time are unstructured and children often choose not to take part in the activities they find difficult. The problem becomes apparent once the child attends formal schooling. Here activities become far more structured and have to be completed in a specific time. Participation at this level is also mandatory and no longer

optional. In school the child may experience difficulties in handwriting and art projects that involve cutting, colouring, pasting and assembling (Cermak, 1991). Murray-Slutsky (2000) also stated that a child with dyspraxia will often reach their motor milestones within normal limits as all developmental milestones are centrally programmed and therefore do not require motor planning. A child with dyspraxia will usually only exhibit problems once he has to start interacting purposefully with the environment and learn new motor skills. These children will often appear clumsy and awkward as they are not able to organise, plan and sequence their movements.

According to Cermak (1991), problems in handwriting have been associated with arithmetic deficits, organisation and short-term memory deficits and sensory integrative dysfunction. Fine motor demands are great within the academic environment. She felt that if a child had to focus on the mechanical aspects of writing, he or she would not be able to fully attend to the content of information. There is thus a trade-off with other functions.

When one examines the contribution of motor planning to writing one must examine both copying and spontaneous writing. Copying is feedback-dependent. Spontaneous writing, however, involves feed-forward control of the written output and is dependent on the ability to utilise neuronal models or memories. A child with somatodyspraxia, however, who has problems with both feedback and feed-forward motor control, is more likely to be impaired in both copying and spontaneous writing.

According to Gardner (1979) children with ideational dyspraxia would have difficulty performing a sequence of movements such as is necessary in writing. Parham and Mailloux (2001) agreed that the skills which most children attain rather easily, such as writing the alphabet,

could be excessively challenging to children with dyspraxia. These skills can only be mastered with high motivation and lots more practise than most children require. Murray-Slutsky (2000) also stated that children with dyspraxia have difficulty with school-related tasks. She found that these learners find any task that requires tool usage difficult. These children find activities such as learning to write, forming letters between lines and spacing very difficult.

According to Murray (1991), although dyspraxia in children has not been associated with a specific hemisphere; it has been observed that some children with hypothesised left-hemisphere dysfunction may have trouble performing sequences of motor skills. This problem could affect skills requiring fine motor sequencing, such as handwriting.

Several authors therefore agree that for a child with dyspraxia the movements needed for writing are not automatic. A child with this problem seems to have difficulty forming and retrieving the proprioceptive-dependent neuronal models of the letters. This may lead to the child forming the same letter in three or four different ways, which may lead to incorrect letter formation.

In the third and fourth grades there is also a dramatic increase in the demands for written output. If the motor implementation of written work is deficient the child will experience failure at this level. Failure to keep up with the amount of work required may result in a decline in grades, motivation and in self-esteem. (Cermak, 1991).

2.8 Learning disabilities

Another condition related to reversals is learning disability. Kaplan, Sadock and Grebb (1994) use the term ‘learning disorder’. They

describe a 'learning disorder not otherwise specified' as a learning disorder that causes impairment and reflects learning abilities that are lower than those expected for a learner's age, education and intelligence. The Diagnostic Criteria for this disorder, according to the DSM-IV (1994) are:

- that it does not meet the criteria for any specific learning disorder,
- that it might include problems in all three areas (reading, mathematics and written expression), and
- that these problems significantly interfere with the learner's academic achievement.

Stromer (1977) found that children described as having a learning disability show specific behavioural deficits when learning to read and write. Waugh and Bush (1971) found that these children were characterised by letter reversals, digit reversals and that their academic performance varied from day to day. A more recent study by Schuchardt, Maehler and Hasselhorn (2008) stated that children with learning disabilities experience significant difficulties acquiring the core skill of reading, writing and arithmetic from their very first days at school.

Biederman, Faraone and Monuteaux (2002), in their study on the "Differential effect of environmental adversity by gender", found that learning disability and global functioning were modified by gender. They concluded that boys were more vulnerable to the disorder than girls. Henderson and Hall (1982) found that a majority of boys appear in almost all studies of developmental disorders. This includes learners with learning disabilities. The Child Trends DataBank (http://www.childtrendsdatabank.org) as well as the Child Development Institute (http://www.childdevelopmentinfo.com), on

their respective web pages, also state that learning disabilities are definitely more common in boys than in girls. Other studies have found boys to be more at risk for other difficulties as well. Maeland's (1992) study found that mostly boys were identified both as clumsy children and as children with poor handwriting. They also stated that the proportion of boys with poor handwriting was larger than expected if compared to other studies on developmental disorders. Further studies to investigate the reason for this were suggested. Although more recent studies could not be found, some studies completed in the 1930's and 1940's were found that stated that reversals seemed to occur more frequently in boys than among girls (Davidson, 1934) as well as some that found that they did not occur more frequently among boys than among girls (Gates and Bennett, 1933.; Potter, 1949).

2.9 Summary

A thorough discussion of the literature in this chapter revealed that there are several theories regarding what factors are related to reversals. Some authors (Gardner, 1997; Schneck, 2005) felt that memory deficiencies cause a learner to have difficulty in establishing easily-retrievable sound-symbol associations. This causes them to have difficulty in recalling the shape and formation of letters and numbers. Other authors ascribe reversals mainly to visual perceptual difficulties (Frostig and Horne, 1964; Money, 1962; Cohn and Stricker, 1979; Schneck, 2005). They stated that children often reverse letters because they are unaware of the importance of spatial orientation. Orton, in 1937, provided another theory. He felt that reversals were the result of failure of the dominant hemisphere to suppress the non-dominant hemisphere. Lucas and Lowenburg (1996) agreed with him. Other authors (Davidson, 1935; Money, 1962; Critchley, 1970), however, disagreed with this theory as they felt that it might explain b-d and p-q

reversals but could not explain b-p and d-p reversals commonly seen. Another theory found was that directionality was important in discriminating letters and numbers in both reading and writing (Schneck, 2005).

In researching directionality the researcher found that there are factors that influence a learner's directionality. These factors could therefore also have an impact on the learner's ability to orientate a letter correctly. The learner's ability to cross their midline as well as established hand dominance were some of these factors. Although it was suggested that established hand dominance is a prerequisite for handwriting, authors in the literature did not agree whether it mattered which hand it was. Some authors found that left-handedness placed a learner at risk for formation errors and reversals (Lewis and Lewis, 1965). Other authors disagreed and found that no correlation could be found between left-handedness and factors like reversals or poor handwriting (Gardner, 1979; Maeland, 1992).

In the researcher's pilot study it appeared as though there could be a correlation between incorrect letter formation and reversals. In the literature authors agree that incorrect letter formation could influence a learner's legibility, readability and speed (Amundsen, 2005; Graham, Boyer-Schick and Tippets, 1989; Graham, et al. 2001; Asher, 2006). Sheffield (1996) found that teaching the correct letter formations resulted in a significant decrease in learners having difficulty in written language.

A study of the literature regarding the factors that could influence a learner's ability to use correct letter formation was completed. The following factors were discussed: writing instruction, readiness for writing, pencil grip and motor planning.

The "Revised National Curriculum Statement Grades R - 9 (Schools) POLICY' (South Africa 2002:23406) does not stipulate exactly which letter formation should be used when teaching writing. Several authors stated that teachers may not be aware of the long-term benefits of careful, consistent teaching of handwriting (Sheffield, 1996; Karlsdottir and Stefansson, 2002). Other studies found that the prerequisites needed for automaticity in writing are often not there due to a lack of professional development and training in handwriting for teachers (Marr, Windsor and Cermak, 2001; Baird, et al. 2003). Authors agree, however, that handwriting is a complex and multifactorial skill that is very important in the learner's daily school activities (Henderson, Pehoski and Murray, 2002; Goyen and Duff, 2005; Feder, et al. 2007). Failure to attain handwriting competence has far-reaching negative effects on academic success and self-esteem (Feder and Majnemer, 2007).

Writing readiness is another factor that could influence a learner's ability to acquire correct letter formation. Controversy exists as to when children are ready for formal handwriting instruction (Asher, 2006). Several authors have stressed that children must master writing readiness skills before handwriting instruction is initiated (Cornhill and Case-Smith, 1996)

In the literature it was also evident that reversals were frequently associated with certain conditions. Two conditions that were identified were dyspraxia (Gardner, 1979; Parham and Mailloux, 2001; Murray-Slutsky, 2000; Murray, 1991) and learning disabilities (Stromer, 1977; Waugh and Bush, 1971; Schuchardt, Maehler and Hasselhorn, 2008). Some of these studies found boys to be more at risk for learning disabilities (Biederman, Faraone and Monuteaux, 2002; Henderson and

Hall, 1982) as well as some other difficulties e.g. clumsiness and poor handwriting (Maeland, 1992) and reversals (Davidson, 1934). Other studies, however, did not find reversals occurring more frequently in boys than in girls (Gates and Bennett, 1933; Potter, 1949).

In theory various factors have been associated with reversals. The recent research on this topic has been limited, though. Through the researcher's pilot study and a thorough search of the literature it appears as though there may be other factors that could also be related to reversals. This chapter discussed the literature found on these factors. Chapter 3 will focus on the methodology of the research project, discussing the aim, sub-aims, research design, study population as well as the procedure of the study, ethical considerations and limitations of the study.

Chapter 3 - METHODOLOGY

3.1 Introduction

According to Leedy (1997) methodology is the core concept underlying all research. He described research methodology as having two primary functions: to control and dictate the acquisition of data, and to capture the data after acquisition and extract meaningfulness from them. This chapter will identify the aims of the study, research design, subject selection criteria, measurement tools, data collection and data analysis procedures followed during the execution of this study, as well as look at the limitations of the study.

3.2. Aim

The aim of the study was to investigate the relationship between reversals and various factors in the Grade 2 learner.

3.2.1 Sub-aims

The sub-aims of the study were:

- To establish the relationship between reversals and incorrect letter formation in Grade 2 learners.
- To establish the relationship between reversals and visual memory in Grade 2 learners.
- To establish the relationship between reversals and age in Grade 2 learners.
- To establish the relationship between reversals and gender in Grade 2 learners.
- To establish the relationship between reversals and handedness in Grade 2 learners.

- To establish the relationship between reversals and inefficient pencil grip in Grade 2 learners.
- To establish the relationship between reversals in writing and reversals in reading in Grade 2 learners.
- To describe the central tendency of position in space skills in learners with reversals in Grade 2.
- To describe the central tendency of figure ground skills in learners with reversals in Grade 2.
- To describe the central tendency of visual closure skills in learners with reversals in Grade 2.
- To describe the central tendency of form constancy skills in learners with reversals in Grade 2.
- To describe the central tendency of the motor-reduced perceptual quotient in learners with reversals in Grade 2.
- To describe the frequency of difficulties with directionality, midline crossing and posture in learners with reversals in Grade 2

3.3 Research design

The study made use of correlational research. In this type of research the investigator is looking for a relationship between variables. The researcher compares two or more variables by measuring differences and looking for a relationship (Bailey, 1991). In all aspects of life there are relationships between different variables. This study was focussed around the investigation of the extent that one variable is accompanied by or associated with changes in a second variable. According to Brink (1978), correlational techniques establish the degree of relationship between variables. He also stated that correlation between variables demonstrated statistically does not necessarily imply that one is the cause of the other. This study would

therefore be described as a correlational study as the correlation between reversals and several factors were established.

3.4 Study population

The study population consisted of average learners in mainstream schools in Grade 2 in the Central Durban circuit in the KwaZulu-Natal (KZN) Department of Education. Learners in Grade 2 were used, as Gardner (1979) suggested that all children might reverse letters when they first learn to write in the initial instruction phase in Grade 1. For those learners who continue to reverse these written symbols after the initial learning phases it becomes part of a learning problem. An average class of mainstream schools were used. This is important as some schools divide classes according to academic abilities and if a strong or weak class is used this could skew the study results. The Central Durban circuit was chosen as the researcher, in discussion with the statistician, agreed that this circuit would be the best representation of the general South African population. This conclusion was reached as it was felt that the ratio of different cultures represented in the schools of this circuit, would be the closest to the ratio of cultures represented in the general South African population.

3.4.1 Sample selection

The sample consisted of an average Grade 2 class randomly drawn out of 10 different mainstream schools. The only selection criteria that these classes had to meet were that they had to be Department of Education schools and that they had to be an average class. An average class was defined by the fact that this class consisted of children with mixed abilities and not a class that was grouped according to ability e.g. all the strong or all the weak learners in a class.

According to the KwaZulu-Natal Department of Education and Culture: North Durban Region Information Brochure 2002 (Nair, Gasa and Koopersamy, 2002), the Central Durban circuit has 18 Government primary schools. These schools are Addington Primary, Berea Primary, Cato Crest Primary, Clarence Primary, DPHS, Glenwood JP, Glenwood Preparatory, Gordon Road Girls School, Greyville School, Hartley Road Primary, Juma Musjid Primary, Manor Gardens, Mayville Primary, Morningside Primary, Overport SRS, Penzance Primary, St Anthony's, St Augustine's. Ten mainstream schools were randomly drawn out of this circuit. The schools that were drawn were Berea Primary, Clarence Primary, DPHS, Gordon Road Girls School, Juma Musjid Primary, Manor Gardens, Morningside Primary, Overport SRS, St Augustine's and St Antony's.

3.4.2 Sample size

The study was completed on a total of 141 Grade 2 mainstream learners.

Difficulty was experienced in obtaining permission from parents to include learners in the study. Several parents refused that their children participate and many parents did not return the permission forms at all.

3.4.3 Description of the sample

The sample consisted of the following:

- 77 female learners (55%) and 64 male learners (45%)
- 55 learners older than 8 years (39%) and 86 learners younger than 8 years (61%)
- 131 right-handed learners (93%) and 10 left-handed learners (7%)

3.5 Measurement tools

3.5.1 One-week Class Programme (Appendix C)

A One-week Class Programme consisted of a specific exercise that had to be completed once a day for five consecutive days, before 10am. The researcher constructed these exercises with the help of current Grade 2 teachers and the programme consisted of typical exercises completed in Grade 2 as well as a daily memory component. The teacher explained the exercise to the class and collected all of the exercises once they were completed.

- On Day 1 the learners were asked to write 10 spelling words, which included words that covered all of the letters of the alphabet. After they completed the spelling words they were asked to look at the symbol at the bottom of the page and try and remember it.
- On Day 2 the teacher read out 10 easy sums to the class and they had to write the answers on the lines provided. The answers of the sums covered all of the numbers from zero to nine. After completing the sums they looked at the symbol at the bottom of the page and tried to remember it.
- On Day 3 the teacher read a dictation to the learners and they wrote it down. Once again, the dictation contained words that covered all of the letters of the alphabet from a to z. Again they looked at the symbol at the bottom of the page and tried to remember it.
- On the fourth day 10 spelling words were completed, again covering all of the letters of the alphabet and they looked at the symbol at the bottom of the page to remember it.
- On Day 5, 10 sums with the answers covering all of the numbers from zero to nine were completed again and they looked at the

last symbol. On Day 5, after the teacher had collected the worksheet, she gave them worksheet number 6. This worksheet contained nine different symbols. The learners then had to identify and circle the five symbols that they saw throughout the week. This was to test their visual memory of symbols.

A pilot study was completed before the actual data collection in order to establish whether this One-week Class Programme was an accurate tool in establishing which learners made reversals in class. The One-week Class Programme was piloted on two Grade 2 classes that were not included in the actual data collection. The programme was completed and marked by the researcher. The class teacher provided a list of learners who, according to her observations, has been noted to make reversals in class. This list was compared to the learners who made reversals in the One-week Class Programme in order to establish whether the programme was adequate for identifying learners who reverse letters or numbers when writing. The pilot study concluded that the One-week Class Programme was an adequate tool to identify the learners who make reversals as all of the learners whose names were written down by the teacher were identified by the One-week Class Programme.

3.5.2 Alphabet and Number sample

The researcher observed each learner individually while they wrote the alphabet and numbers zero to nine.

3.5.3 Teacher Questionnaire

The researcher constructed a Teacher Questionnaire that was completed by the class teacher of each participating class indicating

each learner's gender, handedness (use of left or right hand in writing), and indication of which learner reversed in reading (see Appendix D).

3.5.4 DTVP–2

All learners who made reversals in the One-week Class Programme were tested individually by the researcher on the four motor-reduced visual perception subtests of the DTVP–2 standardised test. Validity and reliability of this test have been established empirically and were discussed in Chapter 2 (Hammil, Pearson and Voress, 1993).

3.5.5 Screening for vision and ocular motor control

Screening for vision difficulties was completed on all of the learners that were identified as learners with reversals (Appendix E). The vision screening consisted of 16 possible symptoms that could be observed in a learner with visual difficulties (Russel and Nagaishi, 2005). The therapist observed the learners throughout the assessment and ticked any of the symptoms observed during this time.

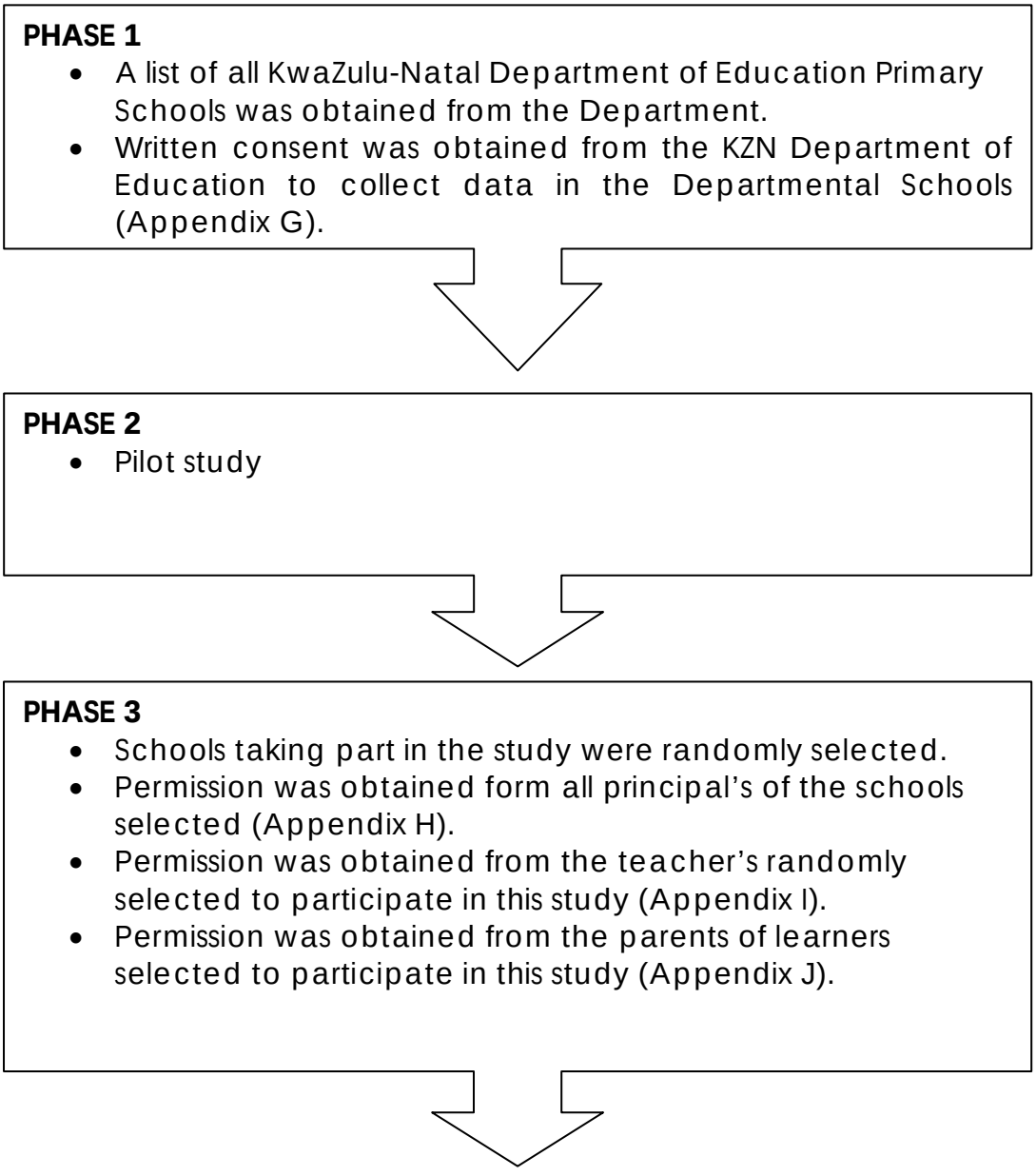
3.5.6 Observation Form

Every learner that had been identified with reversals individually completed an Observation Form (Appendix F). The researcher requested the learner to join certain dots as well as draw a circle while she was observing them. The researcher specifically observed the learner's directionality while completing these examples e.g. whether the dots were joined from left to right, top to bottom etc. The learner's posture was also observed and rated as average or poor. Other aspects observed were whether the learner sat up straight while writing, held his/her head while working, wrapped his/her legs around the legs of the chair, slid down on the seat of the chair or rested their

head on the desk while working. If any of these symptoms were observed the learner's posture was rated as poor. If the learner sat up straight on his/her chair with their feet on the ground throughout the assessment they were rated as average. The learner's pencil grip was also observed and noted on this observation form.

3.6 Procedures

The research procedure involved a number of phases. A summary of the research procedure is presented in Figure 3.1.



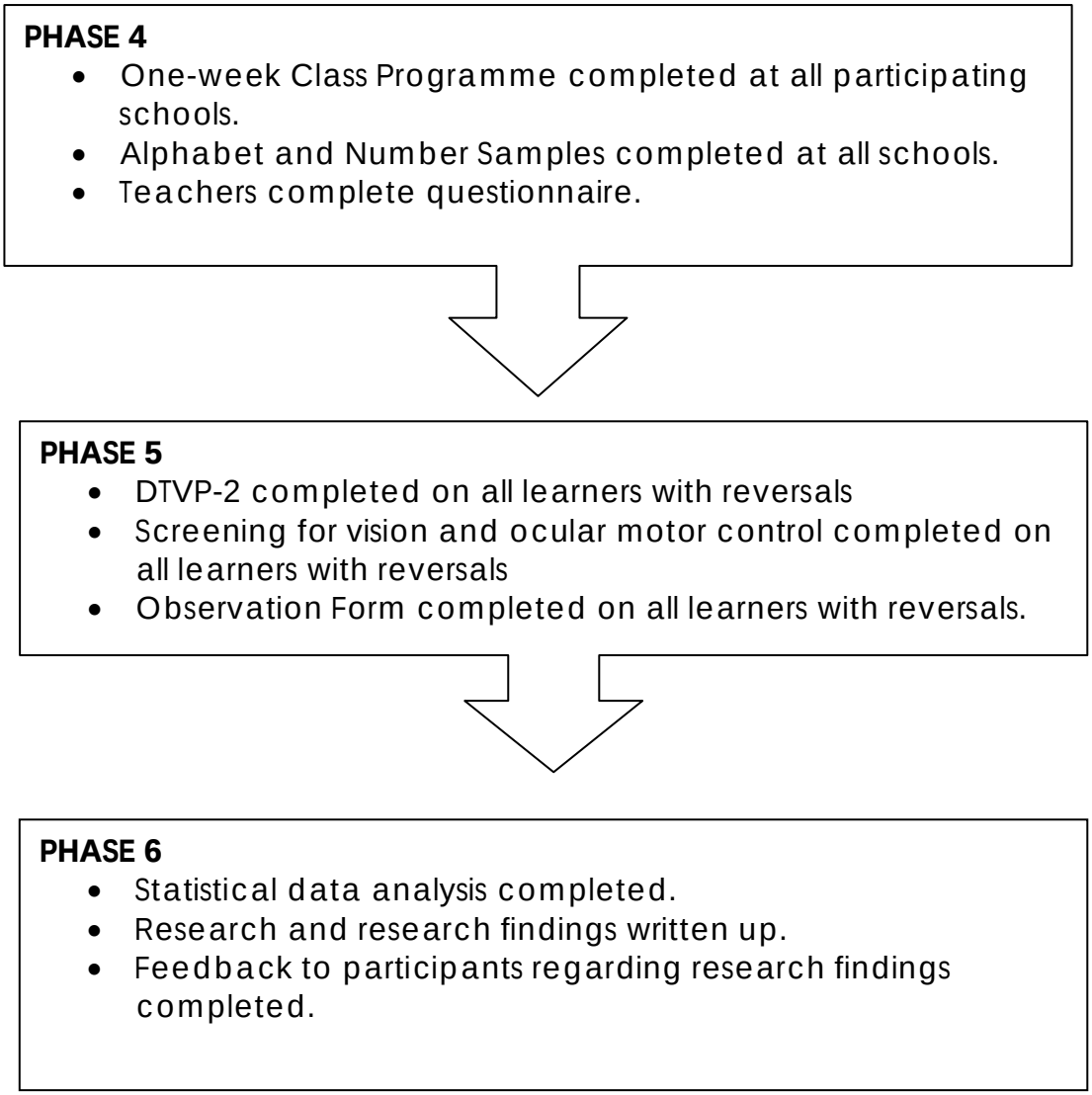


Figure 3.1 Summary of research phases

Phase 1

Phase 1 involved obtaining a list of all the Department of Education's Primary Schools in KwaZulu-Natal. This list was obtained form the KwaZulu-Natal Department of Education. Thereafter permission was obtained from the Superintendent General of the KwaZulu-Natal Department of Education to collect data in these schools (Appendix G).

Phase 2

Phase 2 involved the completion of a pilot study. According to Plug et al. (1986), a pilot study is a study that is completed before the main study in order to develop or test measuring tools. It is also used to determine and correct any possible difficulties that could arise during the actual research study. This pilot study was completed in order to test the ability of the One-week Class Programme to adequately identify learners with reversals. The pilot study was completed on two Grade 2 classes not participating in the study. The teachers were requested to write down the names of the learners in their class that they have observed making reversals in their books throughout the year. The class then completed the One-week Class Programme. The researcher marked the One-week Class Programme and compared the children who made reversals with the list provided by the teachers. The One-week Class Programme adequately identified the learners that had been named as learners who made reversals in the classroom. No changes were therefore made to the One-week Class Programme.

Phase 3

The next phase in the research was to select the schools and classes that would participate in the study. Names of all of the Department of Education schools in the Central Durban circuit were thrown into a hat and 10 schools were randomly drawn. These schools were contacted and written permission was obtained from the principals to complete the study in their schools. Thereafter an average Grade 2 class out of each of these schools was randomly selected and written consent was obtained from the class teacher to participate in the study. The next step was to obtain written permission from the parents of the learners in the classes that had been selected. Informed consent forms were sent

home which parents or guardians of the learners had to read and sign before returning to school.

Phase 4

Phase 4 involved the administration of the One-week Class Programme, Teacher's Questionnaire and Alphabet and Number Samples. An individual training session was held with each of the participating teachers explaining to them the administration of the One-week Class Programme as well as the Teacher's Questionnaire. The class then completed the One-week Class Programme during a week (Monday to Friday). The researcher collected the One-week Class Programme and collected the Teacher's Questionnaire on the Friday that it was completed. Thereafter the researcher went to each of the schools on a day discussed with the teacher. A desk and two chairs were provided for the researcher and the children came to the researcher one at a time while she completed the Alphabet and Number Sample with them.

Phase 5

Before Phase 5 could continue the researcher personally went through all of the One-week Class Programmes and identified all the learners who had made any reversals on the One-week Class Programme. Only these learners were included in the remaining part of the study. The researcher then returned to the school on another day determined by the teacher. The learners that had been identified as learners with reversals then came to the researcher one at a time again and the four motor-reduced subtests of the DTVP-2 as well as the vision and ocular motor control screening and Observation Form was completed with each of these learners.

Phase 6

During Phase 6 all of the data recorded during Phases 4 and 5 were recorded. Thereafter a statistical analysis of this data was completed with the assistance of Dr P Becker, Statistician at the Medical Research Council (MRC). Information obtained was then recorded and documented and feedback was provided to the education authorities and participants in writing.

3.6.1 Data collection

A. One-week Class Programme

The class teacher completed the One-week Class Programme (Appendix C) with her class in the designated week. The researcher then collected these exercises at the end of the week and counted the number of reversals made by each learner. The researcher also noted how many of the memory pictures the learner could remember on the fifth day.

B. Alphabet and Number sample

The researcher visited each school and observed each child individually while they wrote the alphabet and numbers zero to nine. The researcher specifically observed whether the correct formation was being used for each letter and number. Each incorrect formation was noted. At the same time the researcher also noted the way the learner held his/her pencil when writing.

C. Teacher Questionnaire

Each class teacher completed the Teacher's Questionnaire (Appendix D) noting every learner's gender, handedness and whether the child reverses in reading.

D. DTVP–2

The researcher returned to the school and tested the learners who had been identified as learners with reversals on the DTVP–2 motor-reduced visual perception subtests. These scores were converted to scaled scores and each learner's motor-reduced quotient was calculated.

E. Screening for vision and ocular motor control

A vision screening was completed on all the learners who had been identified with reversals (Appendix E). It was recommended that the learners who were identified as having possible visual difficulties through this screening be taken for a full evaluation by an optometrist or ophthalmologist. Learners whose parents did not follow through on this recommendation or learners who were identified as having visual difficulties by the optometrist or ophthalmologist were excluded from the study. One learner was identified as having possible vision difficulties. It was recommended that this learner be fully evaluated by an optometrist or ophthalmologist. At the time that the researcher started her data analysis this recommendation had not been followed through and this learner had to be excluded from the sample.

F. Observation Form

This form (Appendix F) was used by the researcher and was completed by all of the learners who had been identified with reversals. This observation form allowed for a comment on the learner's posture, directionality and pencil grip. The learners obtained a score out of three for the directionality. Their posture was rated as 'average' or 'poor'. The pencil grip with which the learner held their pencil was observed again and compared to the pencil grip used on the alphabet sample.

3.6.2 Data Recording

The data recording is summarised in Table 3.1.

Table 3.1 Data recording and level of measurement

Level of measurement	Measurement tools
Nominal – the researcher established whether or not the learner formed all his/her letters correctly. Each category of this data is mutually exclusive. No learner may be assigned to more than one group (Bailey, 1991).	• Alphabet/ Number sample • One-week Class Programme • Teacher Questionnaire • Observation Form
Interval data – this is a standardised test which measures the learner's skills in quotients and standard scores. Therefore the intervals between the numbers are considered equal and represent actual amounts (Bailey, 1991).	• DTVP–2

3.6.3 Data analysis

Different methods were used to analyse the data due to the different levels of measurement used. In Table 3.2 the methods for data analysis are summarised.

Table 3.2 Method of analysis for each sub-aim

Method of analysis	**Sub-aims**
Pearson's chi square Logistic regression	• To establish the relationship between reversals and incorrect letter formation in Grade 2 learners. • To establish the relationship between reversals and visual memory in Grade 2 learners. • To establish the relationship between reversals and age in Grade 2 learners. • To establish the relationship between reversals and gender in Grade 2 learners.

	• To establish the relationship between reversals and handedness in Grade 2 learners. • To establish the relationship between reversals and inefficient pencil grip in Grade 2 learners. • To establish the relationship between reversals in writing and reversals in reading in Grade 2 learners.
Mean Standard deviation 95% confidence interval	• To describe the central tendency of position in space skills in learners with reversals in Grade 2. • To describe the central tendency of figure ground skills in learners with reversals in Grade 2. • To describe the central tendency of visual closure skills in learners with reversals in Grade 2. • To describe the central tendency of form constancy skills in learners with reversals in Grade 2. • To describe the central tendency of the motor-reduced perceptual quotient in learners with reversals in Grade 2.
Percentage	• To describe the frequency of difficulties with directionality, midline crossing and posture in learners with reversals in Grade 2.

Data was summarised using descriptive statistics like mean, standard deviation and 95% confidence interval for continuous variables while frequencies, percentages and cross tables were used to summarise categorised variables. Logistic regression was employed to determined risk factors for reversals. The area under the receiver operator curve (ROC) was determined and reflects how well the models that were fitted describe the data. Data analysis was completed with the assistance of Dr P Becker, Statistician at the Medical Research Council (MRC).

3.7 Ethical considerations

According to Leedy (1997), the ethics involved in the use of human subjects in research projects should not go without careful scrutiny. He provided certain guidelines to follow in order to ensure this. The ways in which these guidelines were followed in this research study will be discussed in the section that follows.

3.7.1 Approval from institution

- This research study was submitted to the ethical committee of the Faculty of Health Sciences of the University of Pretoria before any of the data were collected.
- Written consent was received from the KZN department of Education to collect data in the Departmental Schools (Appendix G).
- Written consent was obtained from the principals of the participating schools giving permission for their school to be a part of the study (Appendix H).

3.7.2 Informed consent

- Teachers taking part in the study signed an informed consent procedure (Appendix I).
- Parents of all learners taking part in the study signed an informed consent procedure (Appendix J).

3.7.3 Confidentiality

- After the data had been collected, no names of learners participating in the study were used. Learners were referred to as candidate 1, candidate 2, etc.

3.7.4 Bias

- The schools used in this research where chosen randomly. According to Bailey (1991), randomisation is designed to reduce the risk of systematic bias creeping into the study. She said that

by randomly selecting your sample you ensure that the subjects are representative of the group.

- The researcher will not benefit personally in any way by the results of the study and therefore being biased towards any aspect of the result would not be in her own interest.

3.7.5 Validity:

- By randomly selecting the schools used in the sample the internal as well as the external validity of the study was increased. According to Bailey (1991,) randomisation increases the internal validity, which is the chance that we are changing and measuring what we think we are changing and measuring, as well as the external validity, which is the chance that the results found in subjects can be generalised to others who are similar.

3.8 Limitations of the study

3.8.1 Research design

Due to the fact that this study was a correlational study, a cause-effect relationship was not simulated and the researcher was, therefore, only able to establish what the relationship between various factors was.

3.8.2 Measurement tools

Certain aspects of the study were limited by the absence of standardised measurement tools being available to assess the aspect required. Although there are different standardised tests on the market that assess visual memory, all of these tests observe immediate recall. It was felt that the memory that would impact on reversals was more

long-term memory of the letters. The researcher therefore had to, in discussion with her colleagues; develop a tool to assess this particular type of memory skills. Testing of directionality and posture had also been done through tests developed by the researcher in discussion with colleagues. All of these tests were tested during the pilot study and appeared to be sufficient in assessing the areas they were developed for.

Another limitation of the study with regards to the measurement tools was that in hindsight the researcher felt that should she have collected the data on the visual perceptual difficulties of the total sample (tested on the DTVP-2) rather than just testing the group with reversals. This would have given the researcher the ability to compare the results of the two groups with each other providing a clearer picture of the relationship between reversals and visual perceptual skills.

3.8.3 Access to data

Although the researcher conducted the study in 10 different schools, the amount of data collected was limited by parents of these learners not granting permission for the learners to participate in the study. Many of the permission forms were not returned and several of the parents denied permission for their children to participate in the study.

The data was also only collected in schools in the Central Durban circuit for logistical reasons, such as time and travelling constraints. This district was selected because the researcher felt that this would be the best representation of the general South African population, as the ratio between different cultures in the schools of this district appeared to be the closest to the ratio of different cultures in the general South

African population. However extending the study to other regions could have provided valuable information for comparison of findings.

Another limitation in the collection of data was establishing whether learners that were forming their letters incorrectly were taught the correct way to begin with. All of the Grade 1 teachers from the previous years no longer worked at the school where data was collected. There were also learners in the Grade 2 classes that had come from different schools at the beginning of Grade 2. The researcher was therefore not able, for the purpose of this study, to establish whether the learners formed their letters incorrectly due to incorrect education or an inability to form them the right way.

3.8.4 Sample selection

The only selection criteria used for sample selection was that the subject had to come form a Department of Education school and that they had to be in an average class. Information regarding the pre-existence of a specific condition or treatment that has been received/ or is being received was not collected or used as an exclusion criteria.

3.9 Summary

This chapter presented a description of the methodology for this study. The main aim of this study was to study the relationship between various factors and reversals in the Grade 2 learner. The procedure involved seven phases using a correlational research design. Ethical considerations were discussed and upheld. The methods used for sample selection, data collection and analysis were described. The result obtained and the interpretation of this data will be discussed in the next chapter.

Chapter 4 – RESULTS OF THE STUDY

4.1. Introduction

The aim of this research was to study the relationship between various factors and reversals in the Grade 2 learner. The data collected during this study could be divided into two groups: data collected on both groups (learners with as well as learners without reversals) and data collected only for learners with reversals. Figure 4.1 is a representation of the content of this chapter.

Chapter 4 – Results of the study

4.1 Introduction	4.2 Data collected on total sample	4.3 Data collected only on learners with reversals
	4.2.1 Demographics of total sample 4.2.2 Establishing the relationship between reversals and incorrect letter formation in Grade 2 learners. 4.2.3 Establishing the relationship between reversals and visual memory in Grade 2 learners. 4.2.4 Establishing the relationship between reversals and age in Grade 2 learners. 4.2.5 Establishing the relationship between reversals and gender in Grade 2 learners. 4.2.6 Establishing the relationship between reversals and handedness in Grade 2 learners. 4.2.7 Establishing the relationship between reversals and inefficient pencil grip in Grade 2 learners. 4.2.8 Establishing the relationship between reversals in writing and reversals in reading in Grade 2 learners.	4.3.1 The central tendency of position in space skills in learners with reversals in Grade 2. 4.3.2 The central tendency of figure ground skills in learners with reversals in Grade 2. 4.3.3 The central tendency of visual closure skills in learners with reversals in Grade 2. 4.3.4 The central tendency of form constancy skills in learners with reversals in Grade 2. 4.3.5 The central tendency of the motor-reduced perceptual quotient in learners with reversals in Grade 2. 4.3.6 The frequency of difficulties with directionality, midline crossing and posture in learners with reversals in Grade 2.

Figure 4.1 Content of Chapter 4

4.2 Data collected on total sample (both learners with reversals as well as learners without reversals)

4.2.1 Demographics of total sample

All 141 learners included in this study are included in this section. A summary of learners with and without reversals is seen in Figure 4.2.

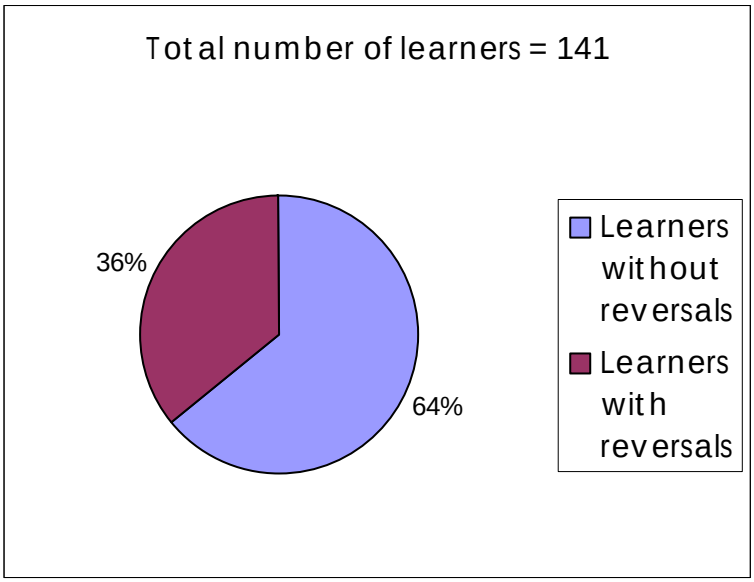


Figure 4.2 Total numbers of learners with and without reversals included in the study

It can be seen that of the 141 learners observed, 90 learners did not make any reversals in the One-week Class Programme (64%). The other 51 learners (36%) made at least one reversal in their One-week Class Programme. This is an alarming statistic as, according to Gardner (1979), learners are not supposed to continue reversing after the initial learning phase otherwise it is seen as part of a learning problem. Therefore 36% of the study group appears to have a learning problem.

4.2.2 Establishing the relationship between reversals and incorrect letter formation in Grade 2 learners

This sub-aim was aimed at establishing the relationship between learners with and without reversals and incorrect letter formation. As discussed in Chapter 2, correct letter formation is seen as the formation used in Nelson Script as suggested by Inglis and Gibson (Undated) as well as in the Grade 1 FONT (Trollip, 2002) and the California State Series (California State Department of Education, 1959) (Appendix A). As discussed in the previous chapter, the researcher observed each of these learners' letter formation individually. Of the 90 learners without reversals, 44 formed some of their letters incorrectly. This is 48.89% of this group. On the other hand, of the 51 learners with reversals in the One-week Class Programme, 44 formed some of the letters incorrectly. This is 86.27% of this group. When comparing these two groups they differ significantly (p=0.000). These results are summarised in Figure 4.3.

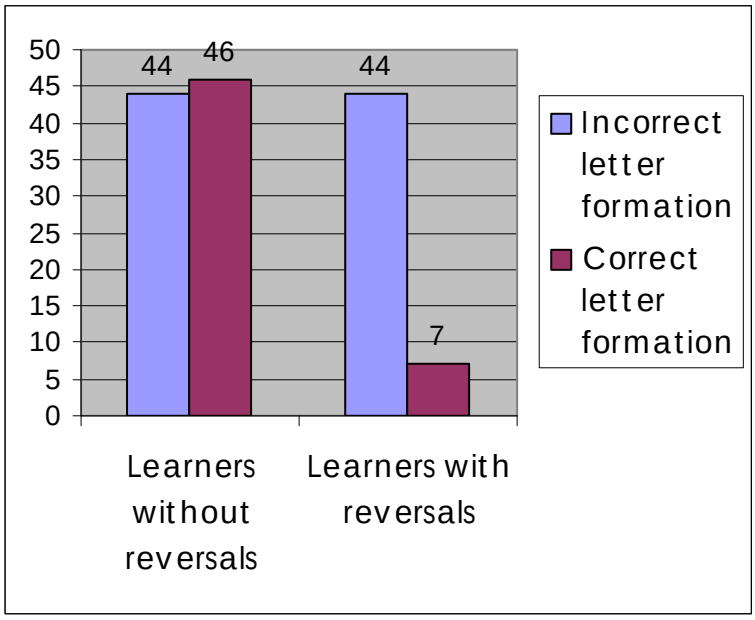


Figure 4.3 Comparison of letter formation of learners with and without reversals

This result correlates with the result of the pilot study that the researcher conducted before she initiated this study (see section 1.2). As seen in the above results, 62.41% of the all the learners used in this study formed at least some of their letters incorrectly. As there is a statistically significant relationship between reversals and incorrect letter formation it appears that more emphasis should be placed on the acquisition of correct letter formation.

4.2.3 Establishing the relationship between reversals and visual memory in Grade 2 learners

Of the 90 learners without reversals only 10 learners made errors on the visual memory component of the One-week Class Programme (11.11%). Of the 51 learners with reversals, seven learners made errors on the visual memory component (13.73%). The groups did not differ significantly for this sub-aim (p=0.789). The results are summarised in Figure 4.4.

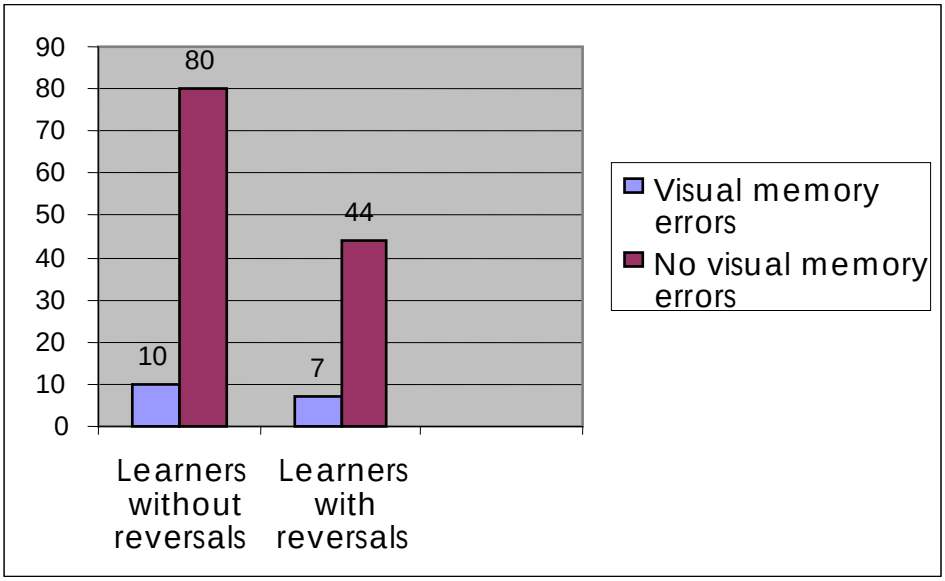


Figure 4.4 Comparison of visual memory difficulties of learners with and without reversals

4.2.4 Establishing the relationship between reversals and age in Grade 2 learners

This sub-aim was aimed at determining whether reversals were more prevalent in the slightly younger Grade 2 learner (below 8 years) than in the slightly older learner (older than 8 years). The groups did, however, not differ significantly (p=0.209). Of the 90 learners without reversals, 56.67% were younger than 8 years compared to the 68.63% in the group with reversals. The results are summarised in the following figures. Figure 4.5 illustrates the percentage of learners without reversals that were younger than 8 years compared to those older than 8 years. Figure 4.6 shows the same comparison for learners with reversals.

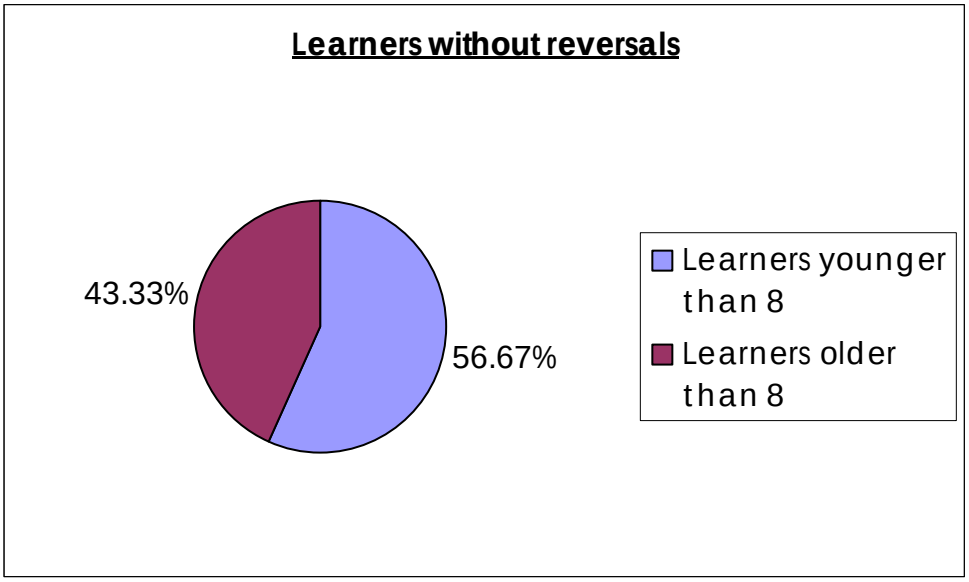


Figure 4.5 A comparison of learners younger than 8 to learners older than 8 years in the group of learners without reversals

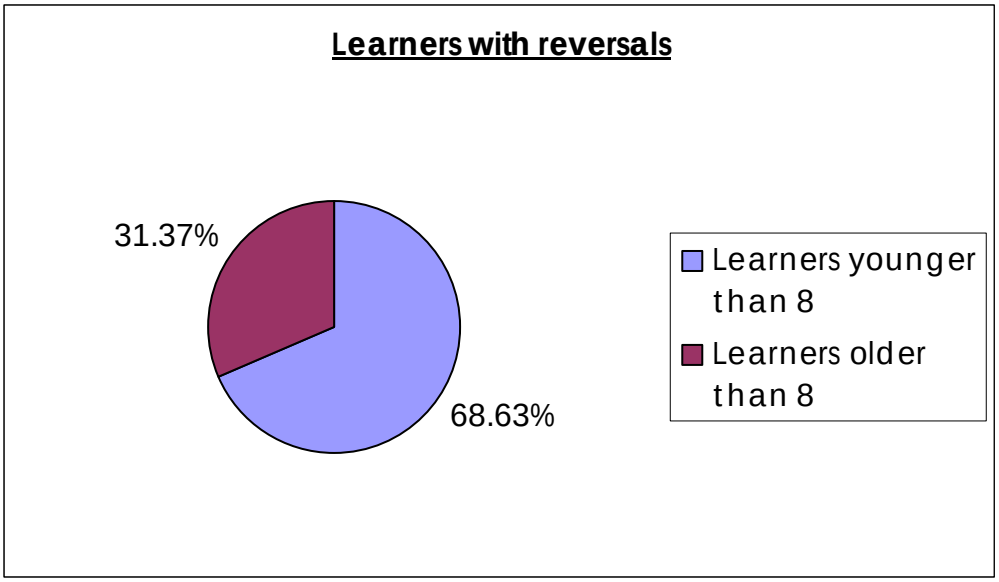


Figure 4.6 A comparison of learners younger than 8 to learners older than 8 years in the group of learners with reversals.

Although the percentage of learners younger than eight years was slightly higher in the group with reversals, the statistical difference between the two groups was not significant.

4.2.5 Establishing the relationship between reversals and gender in Grade 2 learners

According to the results of this sub-aim the relationship between boys and reversals is higher than with girls. Of the group with reversals, 60.78% were boys compared to only 36.67% boys in the non-reversal group. These groups differed significantly with a p-value of 0.008. This result is summarised in Figure 4.7.

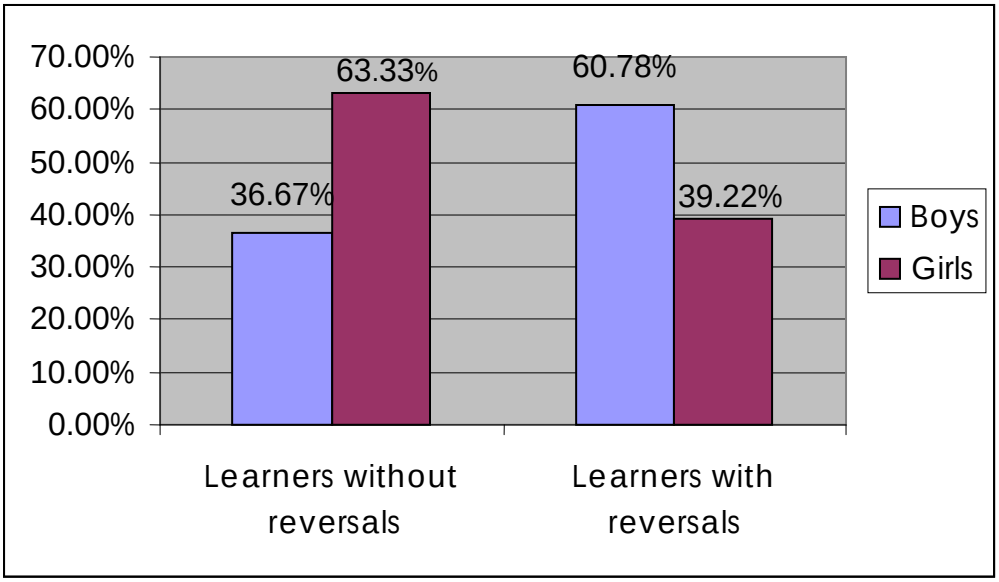


Figure 4.7 A comparison between boys and girls in the group with and without reversals.

This result indicates that as the relationship between boys and reversals is statistically higher than between girls and reversals, boys would appear to be more at risk for reversals.

4.2.6 Establishing the relationship between reversals and handedness in Grade 2 learners

This sub-aim was to determine the relationship between left- and right-handers to reversals. The results showed a p-value of 0.496, which was not statistically significant. Of the 90 learners without reversals, five were left-handed and, of the 51 learners with reversals, also five were left-handed. Therefore, it was 5.56% left-handers in the non-reversal group and 9.8% left-handers in the reversals group. The results are summarised in Figure 4.8.

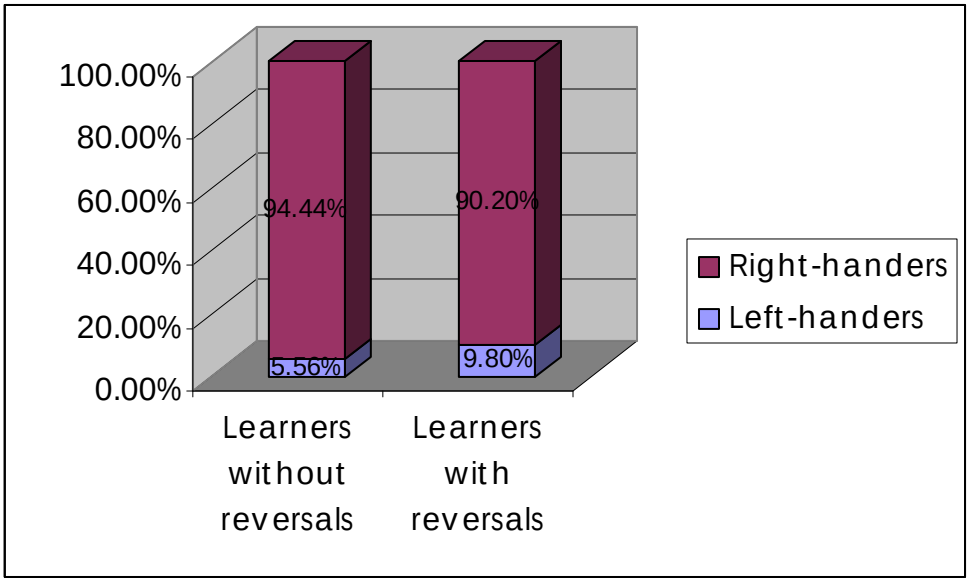


Figure 4.8 A comparison between left- and right-handers in the groups with and without reversals.

4.2.7 Establishing the relationship between reversals and inefficient pencil grip in Grade 2 learners

Of the learners without reversals, 36.67% held their pencil with an inefficient pencil grip and 43.14% of the learners with reversals held their pencil with an inefficient pencil grip. Although these groups did not differ significantly (p=0.476), the high percentage of inefficient pencil grips among Grade 2 learners is alarming and should be noted. Overall, the amount of inefficient pencil grips for the whole group was 39.01%. This is almost 4 out of every 10 learners in Grade 2. This result is reflected in Figure 4.9.

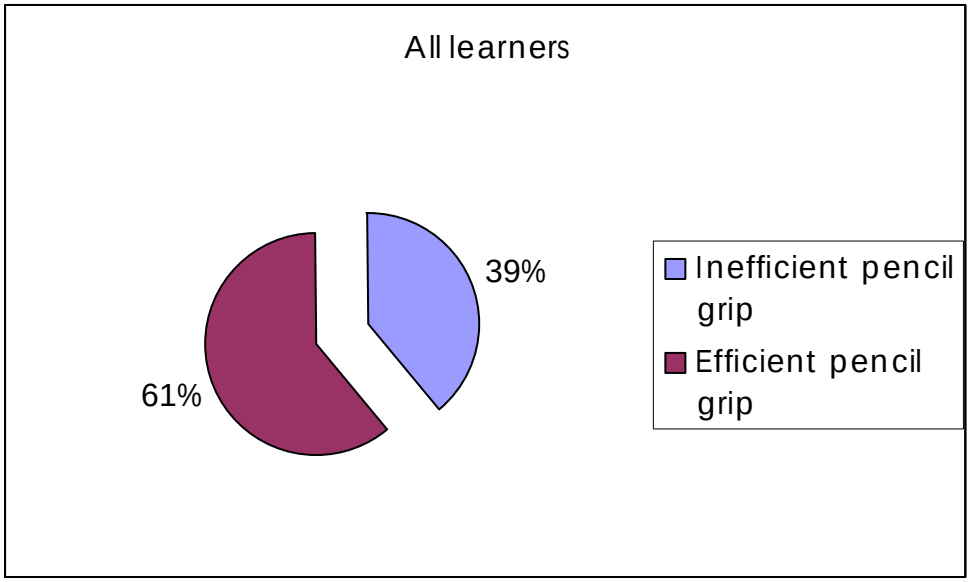


Figure 4.9 A comparison of learners using an inefficient pencil grip when writing compared to those using an efficient pencil grip for the whole group tested

4.2.8 Establishing the relationship between reversals in writing and reversals in reading in Grade 2 learners.

This sub-aim was to establish the relationship between learners who reversed in writing compared to those reversing in reading. The groups differed significantly with respect to the proportion of children who also have reversals in reading ($p=0.02$). This result is summarised in Figure 4.10. This statistically significant relationship indicates that the child who reverses in reading appears to be more at risk for reversals in writing as well.

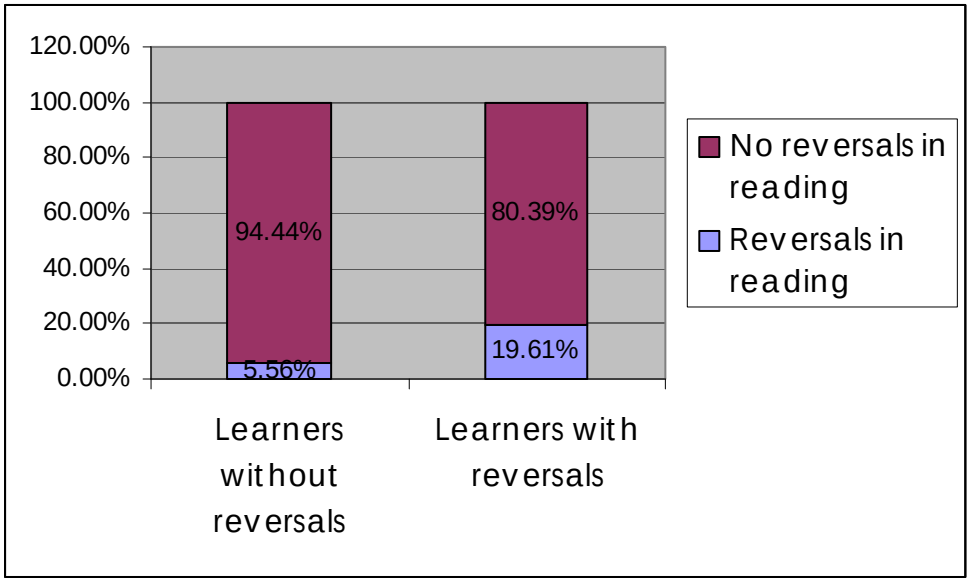


Figure 4.10 A comparison of learners with and without reversals in reading for both groups tested

The following section will discuss the data collected only on the learners that had been identified as learners with reversals on the One-week Class Programme.

4.3 Data collected only on learners with reversals

This section will discuss the data collected on the 51 learners that were identified as learners with reversals during the One-week Class Programme. For the data collected via the standardised test DTVP–2, descriptive statistics were compiled.

4.3.1 The central tendency of position in space skills in learners with reversals in Grade 2

The mean for learners tested on the position in space subtest was 6.14. An average scaled score for this subtest, according to the DTVP-2, is between 8 and 12. Therefore this mean falls within the 'below average' range.

4.3.2 The central tendency of figure ground skills in learners with reversals in Grade 2

The mean for learners tested on the figure ground subtest was 7.96. An average scaled score for this subtest, according to the DTVP-2, is between 8 and 12. Therefore this mean also falls within the 'below average' range.

4.3.3 The central tendency of visual closure skills in learners with reversals in Grade 2

The mean for learners tested on the visual closure subtest was 5.4. An average scaled score for this subtest, according to the DTVP-2, is between 8 and 12. Therefore this mean falls within the 'poor' range.

4.3.4 The central tendency of form constancy skills in learners with reversals in Grade 2

The mean for learners tested on the form constancy subtest was 8.56. An average scaled score for this subtest, according to the DTVP-2, is between 8 and 12. Therefore, this mean falls within the 'average' range. The form constancy subtest was the only one of the four motor-reduced subtests of the DTVP-2 that tested within the 'average' range. This aspect does not generally appear to be an area of difficulty for learners with reversals.

4.3.5 The central tendency of the motor-reduced perceptual quotient in learners with reversals in Grade 2

An average quotient for the motor reduced score according to the DTVP-2 is between 90 and 110. Therefore, with a mean of 80.08 for learners with reversals, this is 'below average'.

4.3.6 The frequency of difficulties with directionality, midline crossing and posture in learners with reversals in Grade 2

An observation form was completed by every learner that had been identified with reversals. The researcher requested the learner to join certain dots, as well as draw a circle while she was observing them. The researcher specifically observed the learner's directionality as well as the learner's posture and whether the learner crossed their midline during the testing.

The observations made with respect to directionality, midline crossing and posture in the learners with reversals are summarised in Table 4.1.

Table 4.1 Summary of directionality, midline crossing and posture observations for learners with reversals

Observation	Outcome	Frequency	Percentage
Directionality	1 out of 3 correct	7	14.29% (7/51)
	2 out of 3 correct	28	57.14% (28/51)
	3 out of 3 correct	14	28.57% (14/51)
Midline crossing difficulties	Yes	27	54% (27/51)
	No	23	46% (23/51)
Posture	Good	36	72% (36/51)
	Poor	14	28% (14/51)

Therefore, it can be seen that only 28.57% of the learners with reversals completed all three the directionality aspects correctly. In this aspect they had to join two dots from top to bottom, left to right and draw a circle anti-clockwise starting at the top.

Only 46% of the learners with reversals were observed to cross the midline while doing the above-mentioned. The other 54% either turned their page to do it or leaned over on their seat to avoid crossing the midline.

Of the learners with reversals, 72% were observed to have a good posture throughout the testing of the DTVP-2 as well as the directionality observation sheet. These learners sat with their back to the backrest of the chair, feet on the ground and did not lean on the desk or their hand while working.

4.4 Summary of data collected on both groups (learners with and without reversals)

The summary of results when comparing the group of learners who made reversals to the group who did not make any reversals in their One-week Class Programme follows in Table 4.2.

Table 4.2 Associations of study group with observed risk factors

Variable	Learners who did not reverse in the One-week Class Programme	Learners who reversed in the One-week Class Programme	P-value
Incorrect letter formation	48.89% (44/90)	86.27% (44/51)	0.000
Visual memory	11.11% (10/90)	13.73% (7/51)	0.789
Children younger than 8	56.67% (51/90)	68.63% (35/51)	0.209
Gender	36.67% male (33/90)	60.78% male (31/51)	0.008
Handedness	5.56% left-handed (5/90)	9.8% left-handed (5/51)	0.496
Inefficient pencil grip	36.67% (33/90)	43.14% (22/51)	0.476
Reversals in reading	5.56% (5/90)	19.61% (10/51)	0.020

When establishing the relationship between reversals and the above-mentioned variables it can be seen that the only variables that showed a statically significant difference between the group who had reversals

and the group that did not have reversals were gender, incorrect letter formation and reversals in reading.

The association of outcome (learners with reversals or without reversals) was assessed against all the observed risk variables in a multivariate way using logistic regression and the results of the full model, i.e. where all the risk factors were included, are summarised in Table 4.3.

Table 4.3 Association of outcome with risk factors using the full model

Risk factor	Odds ratio	95% confidence interval
Age	1.32	(0.58 ; 3.03)
Gender	2.60	(1.19 ; 5.68)
Inefficient pencil grip	1.53	(0.68 ; 3.43)
Visual memory	2.04	(0.60 ; 6.96)
Handedness	1.27	(0.31 ; 5.22)
Incorrect letter formation	6.08	(2.37 ; 15.58)

A stepwise logistic regression included only gender and letter formation, as summarised in Table 4.4.

Table 4.4 Association of outcome with the significant risk factors following a stepwise logistic regression

Risk factor	Odds ratio	95% confidence interval
Gender	2.39	(1.12 ; 5.08)
Incorrect letter formation	6.14	(2.47 ; 15.27)

How well these models describe the data is reflected by the receiver operator curve (ROC) and was found to be 0.769 (Figure 4.11) and 0.735 (Figure 4.12) for the full and reduced models respectively. The latter emphasises what little contribution the variables age, inefficient pencil grip, visual memory and handedness make towards distinguishing between the two groups

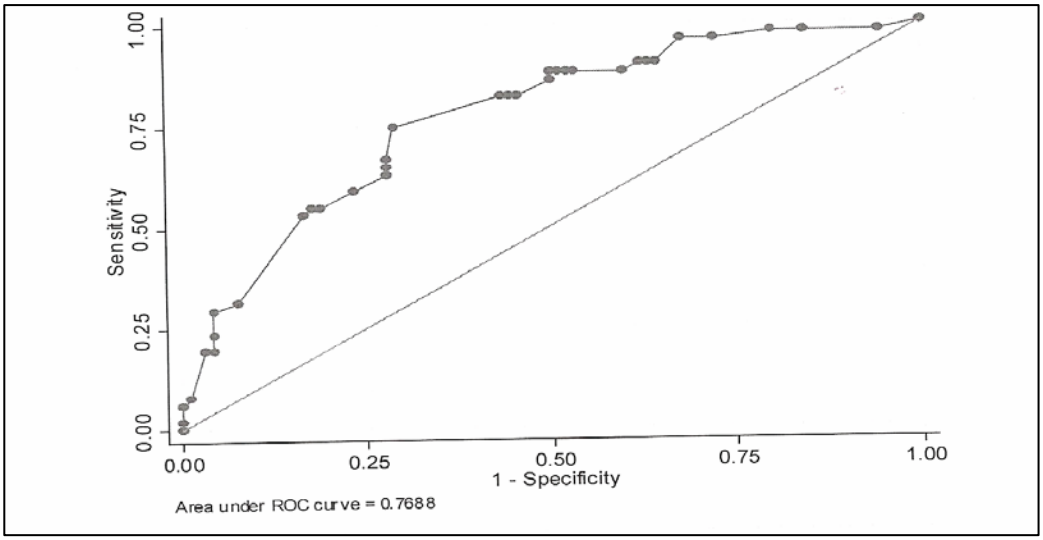


Figure 4.11 Receiver operator curve for the full model

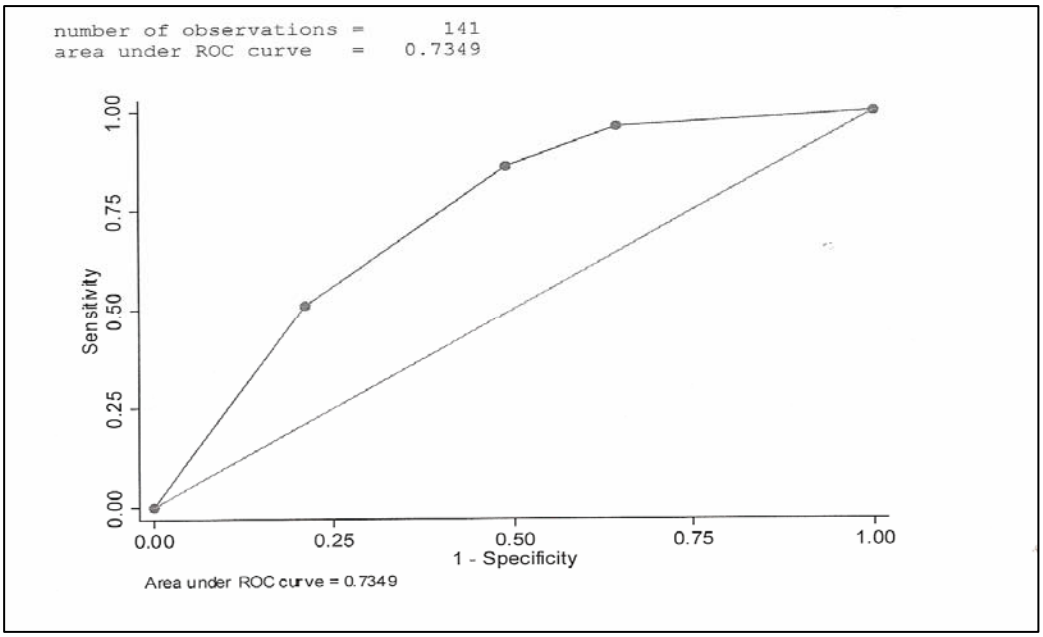


Figure 4.12 Receiver operator curve for the reduced model

Note that a relatively large Odds Ratio was observed for visual memory but, due to the small numbers with visual memory problems, visual memory dropped out during the stepwise analysis.

Thus, the most important factors when studying the relationship between reversals and the above-mentioned variables are gender and incorrect letter formation.

4.5 Summary of data collected only on the learners with reversals

The statistics gathered on the learners with reversals on the One-week Class Programme described that the mean scaled score for learners with reversals on the position in space, figure ground and visual closure subtests falls 'below average'. The form constancy scaled score's mean falls just within the 'average' range. The mean of the motor-reduced quotient of the learners with reversals was also 'below average' according to the DTVP-2 standardised test. These statistics are summarised in Table 4.5.

Table 4.5 Descriptive statistics for data collected via the standardised test DTVP–2 on the learners with reversals

Variable	Mean	Standard deviation	95% confidence interval
Position in space	6.14	2.62	(5.40 ; 6.88)
Figure ground	7.96	2.85	(7.15 ; 8.77)
Visual closure	5.4	3.25	(4.48 ; 6.32)
Form constancy	8.56	1.80	(8.05 ; 9.07)
Motor-reduced quotient	80.08	13.16	(76.34 ; 83.82)

The statistics also suggests that a high percentage of learners with reversals have difficulty with directionality (71.43%) as well as with crossing their midline (54%). A smaller percentage of learners with reversals displayed poor posture during the assessment (28%).

4.6 Summary

Chapter 4 listed the results obtained in this study. The data collected during this study was divided into two groups: data collected on both groups (learners with as well as learners without reversals) and data collected only for learners with reversals. The interpretation of the results listed in this chapter as well as recommendations will be discussed in the next chapter.

Chapter 5 – DISCUSSION AND RECOMMENDATIONS

5.1 Introduction

This study was aimed at establishing the relationship between reversals and various factors. The results obtained were presented in Chapter 4. Chapter 5 will discuss these results and include recommendations. The results will be discussed in the following order:

5.2 Discussion of data collected on total sample
5.3 Discussion of data collected only on learners with reversals
5.4 Recommendations
5.5 Conclusion

5.2 Discussion of data collected on total sample (both learners with reversals as well as learners without reversals)

5.2.1 Establishing the relationship between reversals and incorrect letter formation in Grade 2 learners

The data collected found that the relationship between the learners who made reversals and incorrect letter formation was found to be statistically significant ($p = 0.000$). Because of this statistically significant relationship between incorrect letter formation and reversals, it is alarming that 62.41% of all the learners who took part in this study formed at least some of their letters incorrectly.

As formation of letters is taught in Grade 1, one would expect that most Grade 2's would be able to form their letters correctly. The high percentage of learners with incorrect formations therefore means that

these learners are at risk for making reversals because of the statistically significant relationship between these two aspects.

The children who form letters incorrectly at this stage of learning could either have difficulty with the motor planning necessary for forming letters correctly or could have been taught or developed the incorrect letter formation. Learners with dyspraxia could also present with difficulty in acquiring correct letter formation. Several authors (Gardner, 1979; Parham and Mailloux, 2001; Murray, 1991) have commented on the effects on writing when children have dyspraxia. The writing of children with dyspraxia or difficulty with motor planning does not become automatic and mechanical. Cermak (1991) agreed with this statement saying that if a child had to focus on the mechanical aspects of writing, he or she is not able to fully attend to the content of the information. She said that this leads to a trade-off with other functions. In other words, when the learner still has to think about how to form a letter and it has not become automatic, the learner is not able to give his full attention to, for example, the spelling of the word or the orientation of the letter etc. Amundson (2005) also agreed that writing has to eventually move into the "autonomous phase" so that the child can complete handwriting automatically with minimal conscious attention.

Some children may not be forming letters incorrectly because of a difficulty with motor planning but may have been taught the incorrect letter formation either by their parents or educators. Children who have been taught or developed incorrect letter formation may be reversing letters due to this incorrect formation. The starting points and direction in which a letter is formed is designed specifically to aid children in the direction the letter should face e.g. the 'tummy letters' (c, o, a, d, g, and q) all start with the tummy and then the stick. This helps the child to

see which part of the letter comes first. Several authors stated that teachers may not be aware of the long-term benefits of careful consistent teaching of handwriting (Sheffield, 1996; Karlsdottir and Stefansson, 2002). During the researcher's study of literature various studies were also found that showed that the prerequisites needed for automaticity in writing are often not there due to a lack of professional development and training in handwriting for teachers (Marr, Windsor and Cermak, 2001; Baird et al. 2003).

It is also important to note that the "Revised National Curriculum Statement Grades R - 9 (Schools) POLICY" does not place any emphasis on the formation of letters in the teaching of writing. The only criterion set for teaching writing in Grade 1 is: "The learner will be able to write different kinds of factual and imaginative texts for a wide range of purposes" (South Africa 2002:23406). According to the same document the Assessment Standards for Grade 1 are:

"The learner:

- Copies familiar words and short sentences e.g. labels or titles for own drawings
- Uses simple, familiar words to complete sentence 'frames' e.g. 'My name is….'; 'I like….'; 'I do not like….'
- Writes lists with titles e.g. 'My Friends'"(South Africa 2002: 23406)

Marr, Windsor and Cermak (2001), in their study completed on nine classes, noted that none of the teachers included in their study reported to have had any training in handwriting instruction either as undergraduates or in workshops even though the average number of years in teaching of this group was 19.8 years.

It is important to note that letter formation is not only important in terms of the relationship it may have with reversals but, according to Admundson (2005), it is one of the components used to assess legibility.

Marr, Windsor and Cermak (2001) agreed that incorrect letter formation contributes to illegible writing. It does, however, not only affect legibility but also readability. Graham, Boyer-Shick and Tippets (1989) found that the influence of legibility components on readability is significant. This could lead to the child possibly not being able to read their own work and therefore not able to check and self-correct any work. Failure to attain handwriting competence has far-reaching negative effects on academic success and self-esteem (Feder and Majnemer, 2007).

5.2.2 Establishing the relationship between reversals and visual memory in Grade 2 learners

The factor that was most frequently associated with reversals in the literature was visual memory. Schneck (2005) stated that in order to be able to manipulate visual information you need the ability to retain the information in memory for immediate recall or to store it for later retrieval. He concluded that children with memory deficiencies have difficulty in establishing easily-retrievable or recognisable sound-symbol associations. They struggle to recall the shape and formation of letters or numbers and the same letter may be written many ways on the same page. Todd (1999) agreed that a child with visual memory deficits may demonstrate the inability to recognise or match visual stimuli presented previously because he or she has not stored this information in memory or is unable to retrieve it from memory (Todd, 1999).

Gardner felt that the most convincing theories for reversals are those that consider impairment in visual memory to be the central problem. Symbols, especially linguistic, do not become firmly embedded in the psychic structure. There is looseness to their accurate and precise

storage and possibly impairment in their retrieval as well (Gardner, 1979).

However, of the 90 learners without reversals tested during this study, only 10 learners made errors on the visual memory component of the One-week Class Programme (11.11%). Of the 51 learners with reversals, seven learners made errors on the visual memory component (13.73%). The groups did not differ significantly for this sub-aim (p=0.789). The result of this study, therefore, did not support these theories as there was not a statistically significant relationship between reversals and visual memory.

These results may, however, have been influenced by the test that was used as this test was not a standardised test. It is felt that the test developed by the researcher to identify visual memory difficulties may not have been accurate in identifying all of the learners with visual memory difficulties. The test may have been too easy or possibly could not have tested the type of visual memory needed to recall the orientation of letters. The visual memory needed for recalling the orientation of letters is possibly more long-term visual memory of symbols. Unfortunately, there was not a standardised test available that tests long-term visual memory, but all of the visual memory standardised tests available only test immediate recall. When calculating the Odds Ratio for the aspects tested on both the groups with as well as those without reversals, the Odds ratio for visual memory was quite high. It is possible that visual memory dropped out during the stepwise analysis due to the small number of learners who made mistakes on this aspect of the One-week Class Programme. This confirms that the test may have been too easy and therefore did not identify all of the learners with long-term visual memory difficulties. This area should be investigated further. Future studies should endeavour to

use or develop a test that can more accurately determine the visual memory skills needed to recall the orientation of letters.

5.2.3 Establishing the relationship between reversals and age in Grade 2 learners

The relationship between age and reversals in the Grade 2 learner was also investigated as the researcher felt that the learner's ability to acquire correct letter formation could be affected by their readiness for writing. Admundson (2005) stated that letter formation requires the integration of the visual-, motor-, sensory- and perceptual systems. Sufficient fine motor coordination is also needed to form letters accurately. According to Cermak (1991) several authors have stressed the fact that children who are taught writing before they are ready may become discouraged and develop poor writing habits which may be difficult to correct later. According to Asher (2006), controversy exists as to when children are ready for formal handwriting. Cornhill and Case-Smith (1996) did, however, state that children must master writing readiness skills before handwriting instruction is initiated. Weil and Amundson (1994) performed a study in which they examined 60 kindergarten children who were developing normally. They looked at their ability to copy forms on the Developmental Test of Visual-Motor Integration (VMI). The study found that children who were able to copy the first nine forms on the VMI could copy significantly more letters than those who could not copy these nine figures. Unfortunately, the researcher was not able to establish whether the learners used in this study were able to copy these nine forms before they started learning to write as this test was not completed on these learners in preschool.

However, a large percentage of the learners tested during this study that had not yet turned 8 years old when the data was collected. These learners therefore either had their birthday late in the second half

of the year or started Grade 1 at the age of 5 years and would therefore only turn 8 the following year. These learners could be more at risk for not having developed the underlying skills needed for writing before they started with Grade 1.

According to the data collected in this study, however, there was not a statistically significant relationship between reversals and the learners that were younger than 8 years compared to those learners older than 8 ($p = 0.209$). Readiness for writing is not linked to age but rather to the ability to copy certain forms. Therefore, as seen in the study discussed above by Weil and Amundson (1994), it is not the age of the child that determines their readiness for writing but rather their ability to perform certain tasks e.g. copying the first nine forms of the VMI. It was therefore not possible for the researcher of this study to establish whether the learners' readiness for writing when they started with this skill had a significant relationship with learners who continue to reverse letters in Grade 2.

5.2.4 Establishing the relationship between reversals and gender in Grade 2 learners

The relationship between reversals and gender was one of the factors that had a statistically significant relationship. The relationship between boys and reversals was more prevalent than the relationship between girls and reversals ($p = 0.008$). This would appear to put boys more at risk for reversals than girls. This finding agrees with some of the authors that found boys to be more at risk for reversals (Davidson, 1934). Others, however, did not find that reversals occurred more frequently in boys than in girls (Gates and Bennett, 1933; Potter, 1949). It was interesting to note in the literature that boys were not only associated with being more at risk for reversals but also with learning disabilities (Biederman,

Faraone and Monuteaux, 2002; Henderson and Hall ,1982) as well as clumsiness and poor handwriting (Maeland, 1992).

5.2.5 Establishing the relationship between reversals and handedness in Grade 2 learners

There were conflicting theories in the literature whether dominance will affect a learner's directionality and therefore lead to reversals. Lucas and Lowenberg (1996) had found that the left-handers showed a strong tendency to mirror write as they found it more natural and comfortable to work from right to left. Lewis and Lewis (1965) had also found that left-handedness placed a learner at risk for formation errors and reversals. Other authors disagreed and found that no correlation could be found between left-handedness and factors like reversals (Gardner, 1979; Maeland, 1992). The results of this study supports the findings of Gardner (1979) and Maeland (1992) as there was not a statistically significant difference between the left- and right-handed group (p-value= 0.496). It is, however, important to note that the size of the left-handed learners' sample was much smaller that the right-handers (10 left-handers compared to 131 right-handers). This may have had an impact on this result.

5.2.6 Establishing the relationship between reversals and inefficient pencil grip in Grade 2 learners

An interesting additional observation that was made in this study, which could also impact on the development of the learners' writing skills as well as their readiness for writing, is whether or not they are using an efficient pencil grip. The researcher investigated the relationship between learners with reversals and the learners who held their pencil with inefficient pencil grips. Distinction was not made between every different pencil grip but merely between the pencil grips seen as

efficient compared to those seen as inefficient for writing (Appendix B). Of the learners without reversals, 36.67% held their pencil with an inefficient pencil grip and 43.14% of the learners with reversals held their pencil with an inefficient pencil grip. Although the relationship between inefficient pencil grip and reversals was not significant (p=0.476), the high percentage of inefficient pencil grips among Grade 2 learners is alarming and should be noted.

Overall, the amount of inefficient pencil grips for the whole group was 39.01%. This is almost 4 out of every 10 learners in Grade 2. Even though there is not a statistically significant relationship between reversals and inefficient pencil grips, this does, however, have a significant impact on the learner's ability to keep up with the work pace at school. Cermak (1991) had observed that there was a dramatic increase in demand for written output in the third and fourth grade. An inefficient pencil grip, which does not allow small finger or wrist movements, tends to slow the learner down as this learner is forced to write with inefficient wrist or whole arm movements. Cermak (1991) noted that failure to keep up with the amount of work required may result in a decline in grades, motivation and self-esteem.

5.2.7 Establishing the relationship between reversals in writing and reversals in reading in Grade 2 learners

An area that did show a statistically significant difference between the group with reversals compared to the group without reversals was reversals in reading ($p = 0.02$). This statistically significant relationship indicates that the child who reverses in reading appears to be more at risk for reversals in writing as well. It may be found that the learners who reversed in reading as well as writing could be reversing due to an underlying visual perceptual difficulty.

This correlates with the data collected on the position in space skills of learners with reversals. The mean score on the position in space subtest of the DTVP-2 used during this study was 6.14 which falls in the 'below average' range (See 5.3.1).

From the earlier resources accessed an association between reversals and position in space was suggested. Frostig and Horne (1964) felt that reversals could be attributed to a problem in position in space perception. The child has difficulty in perceiving the proper position of an object in relation to his body. Schneck (2005) agreed with these earlier resources and describes difficulty with position in space as having trouble discriminating among objects because of their placement in space. When a child first starts learning the names of objects, the object stays the same no matter what its orientation e.g. a chair. When children then start to learn to read, they find the orientation of the object is now vital to the meaning it has. The letters 'b', 'd', and 'p' are all identical regarding their form, yet they have entirely different names and meanings. The fact that the child must now concern himself with orientation is, according Money (1962), the cause of reversal errors. Cohn and Stricker (1979) agreed with this theory Schneck (2005) wrote that children with this difficulty may show reversals past the age of 8 years and show confusion regarding the sequence of letters or numbers in a word or in mathematics problems. It may also affect the writing and spacing of letters and words on paper.

5.3 Data collected only on learners with reversals

5.3.1 The central tendency of position in space skills in learners with reversals in Grade 2

When considering the individual subtests performed on the learners with reversals the mean score for the position in space subtest was 6.14, which falls in the 'below average' range. An average scaled score for any subtest on the DTVP–2 is between 8 and 12.

In the literature the researcher found that several authors ascribed reversals mainly to visual perceptual difficulties, especially position in space (Frostig and Horne, 1964; Money, 1962; Cohn and Stricker, 1979; Schneck, 2005).

The results of this study therefore supports these theories as the mean for position in space for learners with reversals on the DTVP-2 fell in the 'below average' range.

5.3.2 The central tendency of figure ground skills in learners with reversals in Grade 2

The mean for the figure ground subtest was 7.96, once again falling just below average. Although no theory has been found associating figure ground with reversals, the mean for this subtest fell just below average (Average= 8-12). This mean was, however, not as low as the mean for position in space.

When testing visual perceptual skills it is important to note that although perceptual tests try to isolate certain skills for the purposes of evaluating them, the other skills are still necessary to complete the test. Therefore, a learner's poor position in space skills could also affect his score on the

figure ground test even though this is not the main focus of this test. This is why the DTVP-2 states that the composite quotients are the most useful values derived from the DTVP-2. These scores are, according to the manual, highly reliable and composed of several representative subtests rather than just one. (Hammil, Pearson and Voress, 1993).

5.3.3 The central tendency of visual closure skills in learners with reversals in Grade 2

The mean for visual closure, however, was the lowest of the four subtests tested. The mean for this subtest was 5.4, falling in the 'poor' range. This is significant because letter formation and planning depend on visual closure skills. When a learner starts a letter or writing task they need their visual closure skills to complete this aspect. The learner must be able to break the letter up into its components (analysis) e.g. stick and a ball, and put it back together correctly (synthesis) e.g. first the stick then the ball for a letter 'b'. Difficulty in this area could therefore affect a learner's letter formation which, according to this study, has a significant correlation with reversals (see 5.2.1).

In the literature no theories could be found linking this skill to reversals. In practice the researcher has, however, found that visual closure is more often than not the last visual perceptual skill to develop. If there are any difficulties in any of the other perceptual skills this often affects the score of the visual perceptual subtest. As explained in 5.3.2, it is also not possible to isolate this skill and the result may have been affected by the learners' below average figure ground as well as spatial relations skills.

5.3.4 The central tendency of form constancy skills in learners with reversals in Grade 2

The mean for form constancy on the data collected for this study was 8.56. This score was the only one of the four motor-reduced aspects tested that fell in the 'average' range. This aspect does generally not appear to be an area of difficulty for learners with reversals. Form constancy involves the recognition of the dominant features of certain figures or shapes even if they appear in different positions, sizes, textures etc. (Hammil, Pearson and Voress, 1993). This aspect should therefore not be affected by difficulty with position in space skills, as the position or orientation of a shape is not important but only the ability to recognise the dominant features.

5.3.5 The central tendency of the motor-reduced perceptual quotient in learners with reversals in Grade 2

The motor-reduced subtests of the DTVP–2 were completed on all of the learners who presented with reversals in the One-week Class Programme. An average quotient, according to the DTVP-2, is between 90 and 110. The learners with reversals scored a mean of 80.08 for the motor-reduced quotient. This, therefore, falls in the 'below average' range. This result would thus support the theories that associate reversals with visual perceptual difficulties. Perceptual difficulties are often associated with learning disabilities. As most of the schools that the data was collected in have very large size classes (between 30 and 45 learners per class) as well as limited resources, these learning disabilities may not have been diagnosed. In most cases however these difficulties are identified but because of the lack of resources the schools are not able to provide these learners with the assistance they need. Another reason for the visual perceptual difficulties could be that most of the learners attending schools in this

districts come from homes with limited resources. Most of these learners would not have attended pre-school and would have had limited exposure to activities such as puzzles and educational games to develop their visual perceptual skills.

5.3.6 The frequency of difficulties with directionality, midline crossing and posture in learners with reversals in Grade 2

Another aspect of the learners' development that, according to the literature, has an impact on the learners' letter formation is their directionality. Schneck (2005) stated that directionality is an important factor in the visual discrimination of letters and numbers for both reading and writing. Learners who have difficulty with directionality, e.g. they work from right to left instead of left to right, or form their circles in a clockwise direction, often end up forming letters incorrectly. Directionality provides the correct starting point for the formation of letters. This incorrect formation of letters could then, again, lead to reversals. Of the data collected on the learners with reversals 71.43% of the learners made an error on the worksheet assessing directionality. We can thus see in 71.43% of the learners who continue to reverse some of their letters in the second half of Grade 2 that the development of their directionality is not adequate. The results in this study suggest that there is a high correlation between learners who reverse letters and those whose directionality has not been established.

An aspect of a learner's development that could have an influence on the development of his/her directionality is midline crossing. A learner who is reluctant to cross their midline is likely, for instance, if they are right-handed, to show preference for drawing a line from right to left. This could affect the development of that learner's directionality. Of the learners with reversals observed during this study 54% were

observed to avoid crossing their midline by either turning their page or leaning to the side of their work.

5.4 Recommendations

5.4.1 Further research on the treatment of factors found to have a statistically significant relationship with reversals is indicated

Reversals appear to be more prevalent in the mainstream Grade 2 classroom than might have been thought in the literature. The percentage of learners who still make reversals in the second half of Grade 2 is a concern (36%). As mentioned in 5.2.1, the theoretical knowledge base for this aspect of childhood development is limited. Further studies should be completed investigating the factors that have shown a statistically significant relationship with reversals in this study. As this was only a correlational study it would be beneficial if a study could be completed establishing the effect on reversals in the classroom over a period of time, after the above-mentioned factors are improved. Further studies should focus on the treatment of the factors that showed a statistically significant relationship with reversals. These studies will be able to establish whether improvement of these aspects will eliminate reversals in the classroom. Although dyspraxia was not researched in this study due to its relationship to incorrect letter formations, this area should also be included in future studies on reversals.

5.4.2 Further research on the relationship between visual memory and reversals is indicated

The researcher feels that an aspect that could be investigated further is visual memory. Even though this factor did not show a statistically

significant relationship with reversals, it is felt that this area needs to be explored further. The results of this study did not support the theories found in literature. Further studies in this area must consider carefully the measurement tool used to test visual memory. The memory needed for remembering the orientation of a letter is long-term memory and not short-term memory, as tested by most standardised tests. Careful consideration of this must be done to ensure that the results reflect the correct aspect of visual memory needed to prevent reversals. As discussed in 5.2.3, future studies should try to find or develop a test that can more accurately determine the visual memory skills needed to recall the orientation of letters. Future studies should also look at other memories that could influence this aspect e.g. auditory memory.

5.4.3 More emphasis should be placed on the development of correct letter formation in the Grade 1 learner

A very high percentage of the learners assessed in this study (62.41%) formed some of their letters incorrectly. This is a concern especially when considering the impact of incorrect letter formation as well as the statistically significant correlation between learners with reversals and incorrect letter formation. Teachers in the classroom must be encouraged to place emphasis on the correct formation of letters. The writing of a letter has not been established when a learner can write a letter but only once they can write the letter forming it correctly and automatically. As correct formation of letters appears to have a significant impact on the learning process, the Department of Education should consider placing more emphasis on this particular aspect in the Grade 1 curriculum. As this study was conducted in KZN Department of Education schools the researcher is obliged to feed back the results of this study to the Department. Emphasis will be placed on these recommendations during this feedback.

5.4.4 Publication of the results of the study

It would be beneficial if the results of this study are published, not only in a journal available to occupational therapists but also in a journal accessible to educators, as the results of this study have significance for both of these groups. The correlation found in this study between reversals and certain factors, e.g. letter formation, indicate that reversals may be prevented in some cases by adequately training educators on the importance of these skills. As stated by several authors in the literature (Sheffield, 1996; Cermak, 2001; Baird, et al. 2003; Karlsdottir and Stefansson, 2002) there is a lack of training in teaching handwriting correctly. The results of this study, if published in a journal that is available to educators, could contribute to combating this lack experienced by teachers.

5.5 Conclusion

From this study the following conclusions can be drawn. Reversals appear to be more prevalent in the general mainstream Grade 2 population than may have been suggested in the literature. There are three factors that have shown a statistically significant relationship with reversals. These factors were incorrect letter formation, gender and reversals in reading. Other aspects that occurred frequently in the testing of learners with reversals during this study were difficulty with motor-reduced visual perceptual skills (especially position in space, figure ground, visual closure), directionality and midline crossing. All of these factors should be considered carefully when working with learners with reversals.

The high occurrence of learners with incorrect letter formation in Grade 2 is a concern. Emphasis should be placed on this skill as this difficulty

not only correlates with reversals but also has an impact on legibility and readability of writing.

Reversals have a significant impact on the day-to-day schoolwork of a child with this difficulty. It affects virtually every aspect of learning - writing, reading, mathematics and spelling. If a learner continues to reverse letters this not only impacts on his or her schoolwork but also on the learner's confidence and self-esteem due to their experiences of failure. Teachers and occupational therapists should continue to work together to limit the impact that this area of difficulty has on the learner in the classroom.

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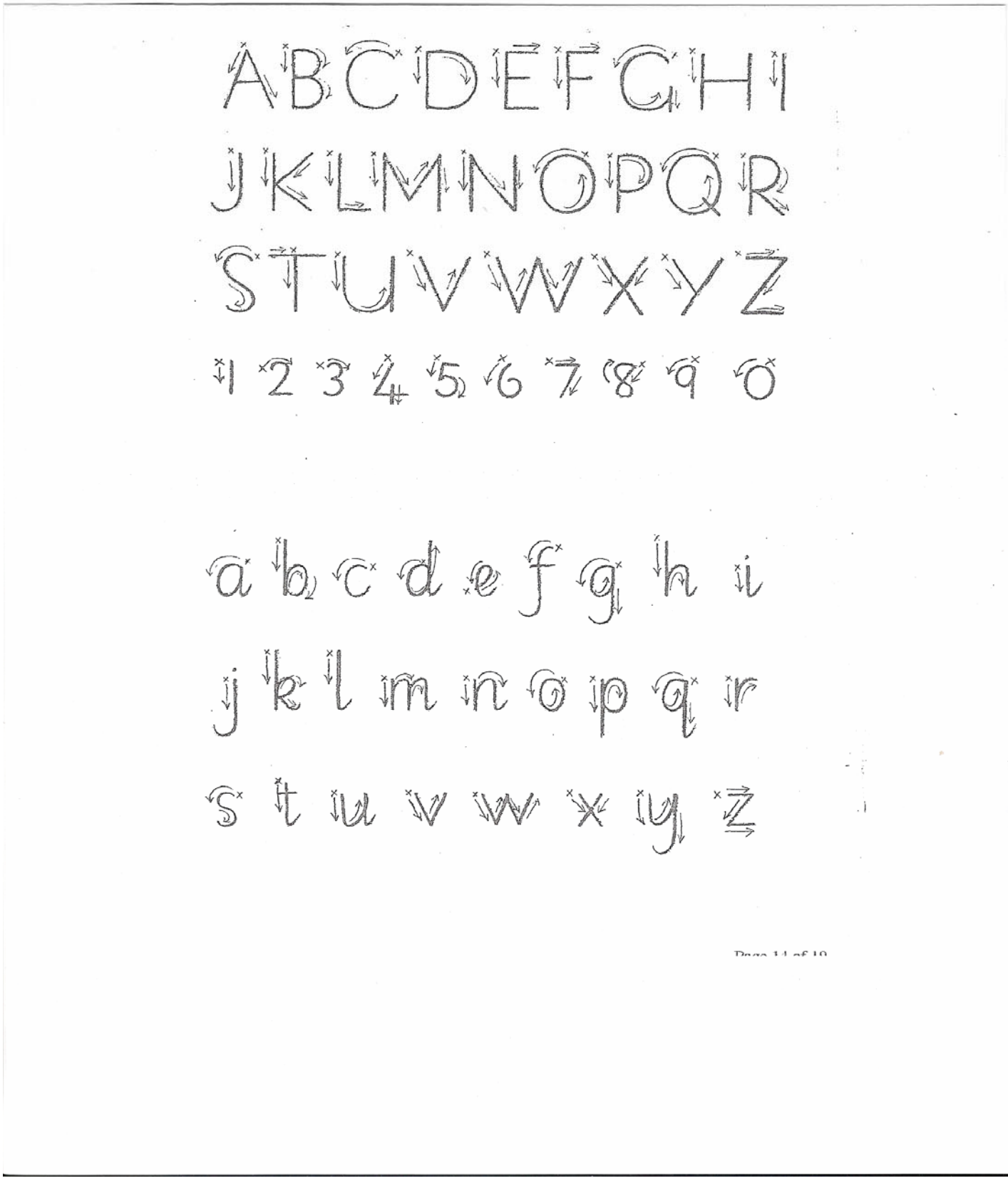
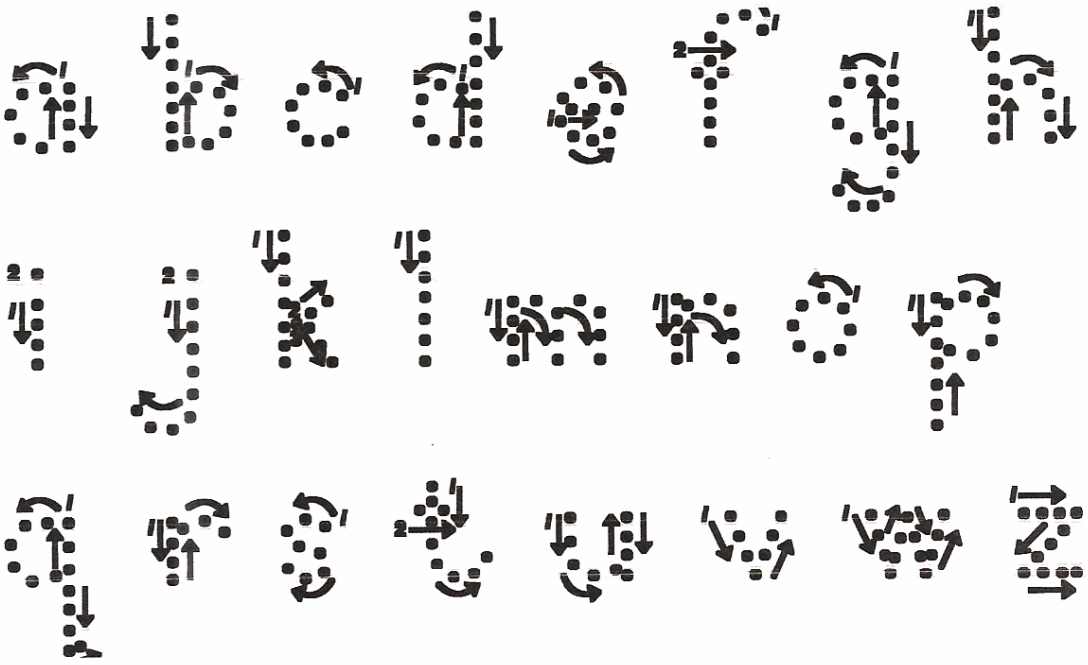
APPENDIX A

Nelson script



Grade 1 FONT

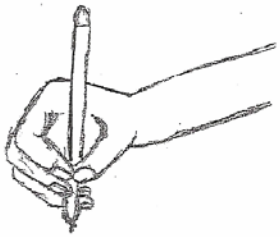


California State Series (California State Department of Education, 1959)

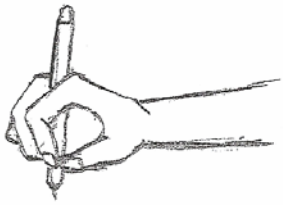
APPENDIX B

Efficient pencil grips

TRIPOD

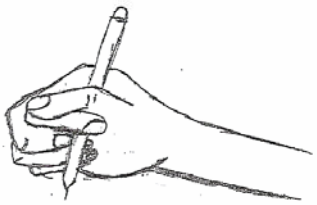


QUADRUPOD

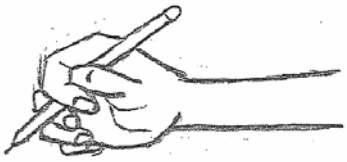


ADAPTED TRIPOD

Inefficient pencil grips

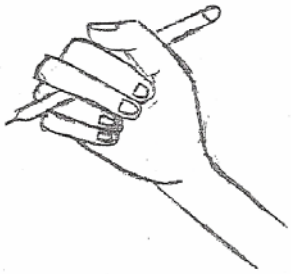


THUMB WRAP

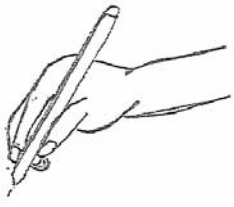


THUMB TUCK

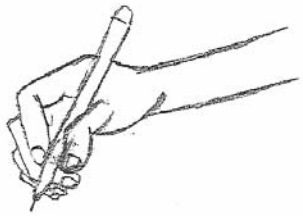
HOOKED WRIST



INTERDIGITAL BRACE



CLOSED WEB SPACE



UNSTABLE THUMB

APPENDIX C

GRADE 2 ONE-WEEK CLASS PROGRAMME

Dear _____

Thank you for agreeing to take part in this Research Study. Your assistance is appreciated and is of great importance to this study. Please remember that this data will not be used to attain the level of your class's functioning. I will only use it to establish the prevalence of reversals. It is vital for the reliability of the study that you take note of the following:

- Please do not correct any mistakes made by the children.
- Please do not give any indication of orientation of letters e.g. if a child asks which way 'a' 'b' or 'd' goes just say: "Just do it the way you think it must be."
- If you have any visual reminders of letter orientation displayed (e.g. alphabet charts or words like 'bed' written on their desks), please cover them for the duration of these exercises every day.
- At the end of each exercise please place all completed worksheets in the envelope provided.

Thank you for your valued participation,

Wendy Smith

DAY 1:
Please ask the learners to write their names on Worksheet 1.
Ask the learners to write the following words from dictation:

Ball, duck, queen, fish, gold, zebra, home, jelly, party

You may spell these words for the children as this is not a spelling test, as long as you do not give any indication of the orientation of letters.
When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.
Please collect all sheets when completed.

DAY 2:
Please ask the learners to write their names on Worksheet 2.
Ask the learners to write the answers to the following sums on the worksheet:
a) 2 + 2 = ___
b) 4 + 3 = ___
c) 7 + 3 = ___
d) 1 + 1 = ___

e) 3 + 2 = ___
f) 2 + 1 = ___
g) 5 + 1 = ___
h) 5 + 4 = ___
i) 0 + 1 = ___
j) 4 + 4 = ___

You may help them with the sums if they have difficulty, as this is not a maths test. Please remember not to give any indication of the orientation of numbers.

When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.

Please collect all sheets when completed.

DAY 3:

Please ask the learners to write their name on Worksheet 3.

Ask the learners to copy the following from the Blackboard:

The happy zebra danced around the big fire.

The king and queen ate jelly made from sugar.

Please remember not to correct any errors.

When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.

Please collect all sheets when completed.

DAY 4:

Please ask the learners to write their names on Worksheet 4.

Ask the learners to write the following words from dictation:

Zip, quack, baby, doll, eggs, food, hen, jar, map, tree.

You may spell these words for the children as this is not a spelling test, as long as you do not give any indication of the orientation of letters.

When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.

Please collect all sheets when completed.

DAY 5:

Please ask the learners to write their names on Worksheet 5.

Ask the learners to write the answers to the following sums on the worksheet:

a) 1 + 1 = ___
b) 4 + 1 = ___
c) 6 + 3 = ___
d) 1 + 2 = ___
e) 3 + 3 = ___
f) 5 + 5 = ___
g) 3 + 1 = ___

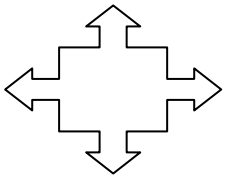
h) 2 + 5 = ___
i) 0 + 1 = ___
j) 3 + 5 = ___

You may help them with the sums if they have difficulty, as this is not a maths test. Please remember not to give any indication of the orientation of numbers.
When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.
Please collect Worksheet 5.

Please ask the learners to write their names on Worksheet 6. Ask the learners to look at the symbols on the worksheet and circle all the symbols they remember seeing on their worksheets during this week.
Please collect all sheets when completed.

WORKSHEET 1

Name: _____



WORKSHEET 2

Name: _____

a) ___

b) ___

c) ___

d) ___

e) ___

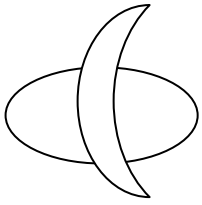
f) ___

g) ___

h) ___

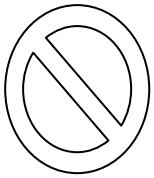
i) ___

j) ___



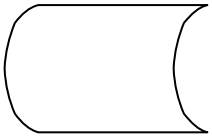
WORKSHEET 3

Name: _____



WORKSHEET 4

Name: _____



WORKSHEET 5

Name: _____

a) ___

b) ___

c) ___

d) ___

e) ___

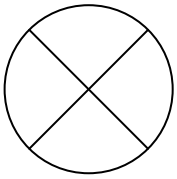
f) ___

g) ___

h) ___

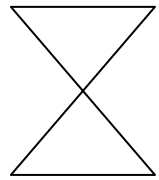
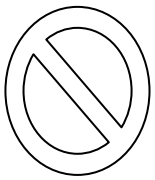
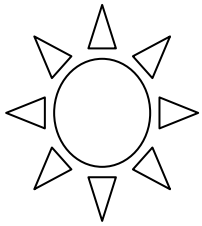
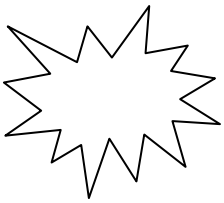
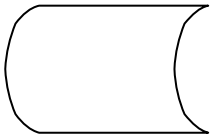
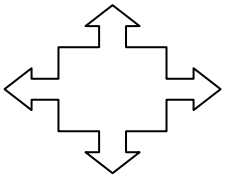
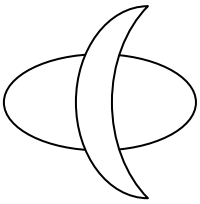
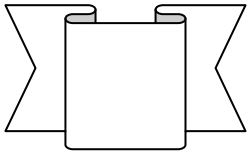
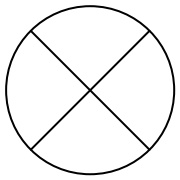
i) ___

j) ___



WORKSHEET 6

Name: _____

APPENDIX D

Date: _____

Dear Teacher,

Please could you fill in the following table as accurately as possible?

Please note that reversals only refer to children transposing a letter or number e.g. 'b' instead of 'd', or 'u' instead of 'n'. This does **not** include sequencing errors e.g. 'saw' instead of 'was', or 'on' instead of 'no'.

Thank you!
Wendy Smith (Occupational Therapist)

Name	Gender	Does the child write with his left or right hand?	Does the child ever reverse when reading? (Yes / No)

APPENDIX E

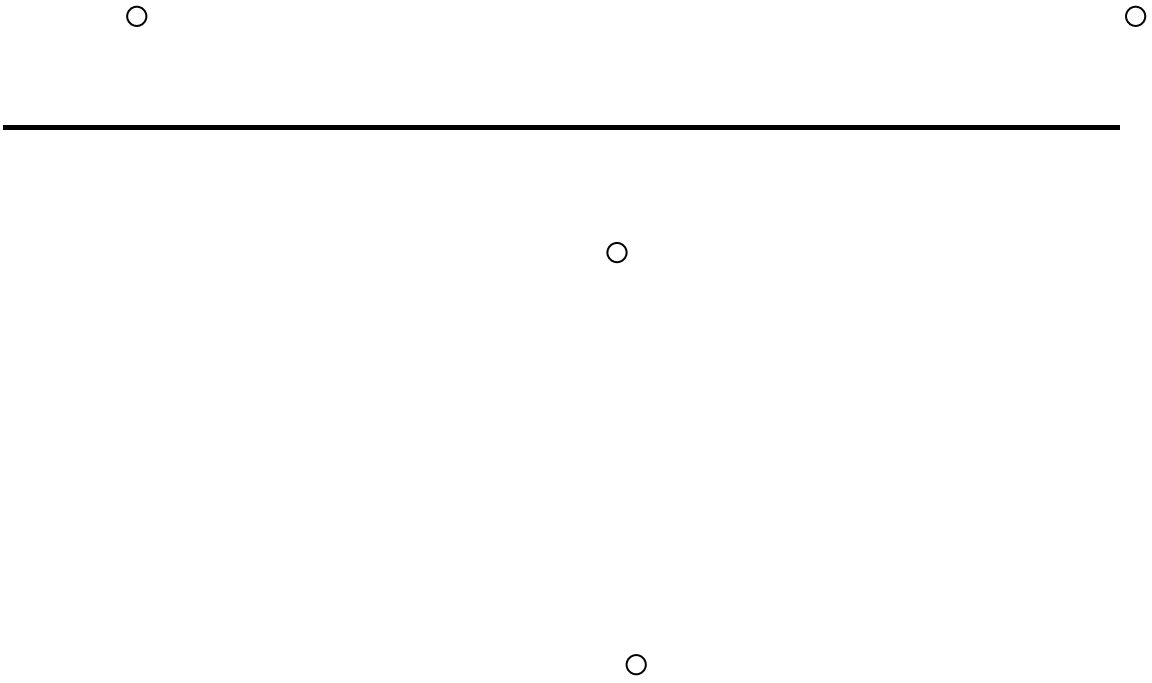
Vision Screening (Russel and Nagaishi, 2005)

Does the learner show any of the following signs or symptoms (tick where applicable):

- Eyes shake or randomly wander
- Eyes are not able to follow the face of the parent
- Pupils of the eyes are excessively large or small
- Pupils of the eyes are not black; a cloudy film appears to be present
- Eyes are not in alignment
- Child frequently rubs eyes
- Child turns or tilts head when looking at detail
- Child covers or closes one eye when looking at detail
- Child squints frequently
- Child complains of tired eyes
- Child does not appear to focus with central vision
- Day vision is markedly different than night vision
- Child responds significantly better to objects on one side of the body than on the other
- Child sits excessively close to the television
- Child avoids or becomes tired after close work
- Child appears clumsy or frequently bumps into objects when walking and running.

APPENDIX F

Please join the following dots:



Please draw a circle:

- Does the learner show any signs of avoiding crossing his/her midline during any part of the assessment?
- The learner's posture during the assessment is average / poor
- Pencil grip: tripod / four-point / closed web space / thumb wrap / thumb tuck / hooked wrist / other: _____

APPENDIX G

PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATALI
PROVINSIE KWAZULU-NATAL

DEPARTMENT OF EDUCATION
UMNYANGO WEMFUNDO
DEPARTEMENT VAN ONDERWYS

Telephone : 033 355 2453
Fax : 033 342 0275

Private Bag X9137
Pietermaritzburg
3200

228 Pietermaritz Street
Pietermaritzburg, 3201

INHLOKOHHOVISI HEAD OFFICE PIETERMARITZBURG

Enquiries: Dr M? SHAMASE
Imibuzo:
Navrae:

Reference: Research for MA
Inkomba:
Verwysing:

Date: 09/03/2005
Usuku:
Datum

Ms Wendy Smith
219 Rinaldo Road
Glen Anil
4051

Dear Wendy Smith

PERMISSION TO CONDUCT RESEARCH IN KZN SCHOOLS

Your application to conduct research in KZN schools on the topic: "To establish a correlation between incorrect letter/number formation and reversals in the Grade 1 and 2 learner" is approved subject to the following conditions:

- ✓ **Principals, educators and learners are under no obligation to assist you in your investigation.**
- ✓ **Principals, educators and leaners should not be identifiable in any way from the results of the investigation.**
- ✓ **You make all the arrangements concerning your investigation.**
- ✓ **Teaching and Learning programmes are not to be interrupted.**
- ✓ **A photocopy of this letter is submitted to the principal of the school/institution where the intended research is to be conducted.**
- ✓ **Your research will be limited to the identified learners**
- ✓ **A brief summary of the content, findings and recommendations are provided to the Superintendent-General of this Department.**
- ✓ **The Department receives a copy of the completed report/dissertation/thesis.**

It is hoped that you will find the above in order.

Best Wishes.

DT NDHLOVU
SUPERINTENDENT-GENERAL

APPENDIX H

Date: _____

Dear _____,

Introduction
Your school has been invited to volunteer for a research study. Before you agree to take part in this study you should fully understand what is involved. If you have any questions which are not fully explained in this form, do not hesitate to ask the investigator. You should not agree for your school to take part unless you are completely happy about all the procedures involved.

What is the purpose of this study?
I am an occupational therapist currently completing my Master's degree. My research topic is to establish the relationship between various factors and the reversals of letters and numbers (e.g. 'b' instead of 'd'). In order to do this I need to observe the letter formation of a sample of children, as well as investigate whether they reverse their letters in class.

Has the study received ethical approval?
This study's research protocol was submitted to the Faculty of Health Sciences' Research Ethics Committee, University of Pretoria and written approval has been granted by that committee. The study has been structured in accordance with the Declaration of Helsinki (last update: October 2000). A copy of the Declaration may be obtained from the investigator should you wish to review it.

I have also obtained permission from the KwaZulu-Natal Department of Education to conduct this study. Your school has been randomly drawn from all the primary schools in the Central Durban circuit to participate in this study.

What is the duration of this study?
Inclusion in the study would entail the following:

- One average Grade 2 class would be required to take part in the study.
- The teacher would then have to complete a One-week Class Programme with her class. This programme will consist of the whole class doing a short exercise every day for five consecutive days (see attached Appendix). These exercises are very simple and will be similar to the type of exercises they do in Grade 2.
- I would have to go into the classroom and check every child's letter formation.

- After completion of the One-week Class Programme, the learners that have been identified as learners with reversals will then be tested on the DTVP-2 (a standardised test) to establish whether they have visual perceptual difficulties.

What are the children's rights as a participant in this study?
The children's participation in this study is entirely voluntary and their parents can refuse for their child to participate or stop at any time without stating any reason.

Confidentiality
All information obtained during this study is strictly confidential. Data that may be reported in scientific journals will not include any information which identifies the children as a participant in this study. Any information uncovered regarding the children participating in this study will be held in strict confidence. Children's parents will be informed of any finding of importance but this information will not be disclosed to any third party without the parent's written permission.

Informed consent for principals of schools
I hereby confirm that I have been informed by the investigator, Wendy Smith (Occupational Therapist), about the nature of this study. I have also received, read and understood the above written information regarding the study.

I am aware that the results of the study, including the children's personal details regarding date of birth, initials and diagnosis will be anonymously processed into a study report.

Children's parents may at any stage, without prejudice, withdraw their consent for their child's participation in the study. I have had sufficient opportunity to ask questions and (of my own free will) declare my school prepared to participate in the study.

Principal's Name: _____
Principal's Signature: _____
Date: _____
Investigator's Name: _____
Investigator's Signature: _____
Date: _____
Witness's Name: _____
Witness's Signature: _____
Date: _____

(**Attached Appendix)**

GRADE 2 ONE-WEEK CLASS PROGRAMME

Dear _____

Thank you for agreeing to take part in this Research Study. Your assistance is appreciated and is of great importance to this study. Please remember that this data will not be used to attain the level of your class's functioning. I will only use it to establish the prevalence of reversals. It is vital for the reliability of the study that you take note of the following:

- Please do not correct any mistakes made by the children.
- Please do not give any indication of orientation of letters e.g. if a child asks which way 'a', 'b' or 'd' goes just say: "Just do it the way you think it must be."
- If you have any visual reminders of letter orientation displayed (e.g. alphabet charts, or words like'bed' written on their desks), please cover them for the duration of these exercises every day.
- At the end of each exercise please place all completed worksheets in the envelope provided.

Thank you for your valued participation,
Wendy Smith

DAY 1:
Please ask the learners to write their names on Worksheet 1.
Ask the learners to write the following words from dictation:

Ball, duck, queen, fish, gold, zebra, home, jelly, party

You may spell these words for the children as this is not a spelling test, as long as you do not give any indication of the orientation of letters.
When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.
Please collect all sheets when completed.

DAY 2:
Please ask the learners to write their names on Worksheet 2.
Ask the learners to write the answers to the following sums on the worksheet:

a) 2 + 2 = ___
b) 4 + 3 = ___
c) 7 + 3 = ___
d) 1 + 1 = ___
e) 3 + 2 = ___

f) 2 + 1 = ___
g) 5 + 1 = ___
h) 5 + 4 = ___
i) 0 + 1 = ___
j) 4 + 4 = ___

You may help them with the sums if they have difficulty, as this is not a maths test. Please remember not to give any indication of the orientation of numbers.

When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.

Please collect all sheets when completed.

DAY 3:

Please ask the learners to write their name on Worksheet 3.

Ask the learners to copy the following from the Blackboard:

The happy zebra danced around the big fire.

The king and queen ate jelly made from sugar.

Please remember not to correct any errors.

When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.

Please collect all sheets when completed.

DAY 4:

Please ask the learners to write their names on Worksheet 4.

Ask the learners to write the following words from dictation:

Zip, quack, baby, doll, eggs, food, hen, jar, map, tree.

You may spell these words for the children as this is not a spelling test, as long as you do not give any indication of the orientation of letters.

When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.

Please collect all sheets when completed.

DAY 5:

Please ask the learners to write their names on Worksheet 5.

Ask the learners to write the answers to the following sums on the worksheet:

a) 1 + 1 = ___
b) 4 + 1 = ___
c) 6 + 3 = ___
d) 1 + 2 = ___
e) 3 + 3 = ___
f) 5 + 5 = ___
g) 3 + 1 = ___
h) 2 + 5 = ___

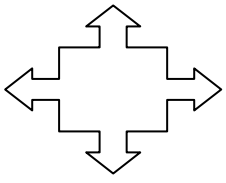
i) 0 + 1 = ___
j) 3 + 5 = ___

You may help them with the sums if they have difficulty, as this is not a maths test. Please remember not to give any indication of the orientation of numbers.
When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.
Please collect Worksheet 5.

Please ask the learners to write their names on Worksheet 6. Ask the learners to look at the symbols on the worksheet and circle all the symbols they remember seeing on their worksheets during this week.
Please collect all sheets when completed.

WORKSHEET 1

Name: _____



WORKSHEET 2

Name: _____

a) ___

b) ___

c) ___

d) ___

e) ___

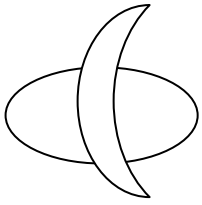
f) ___

g) ___

h) ___

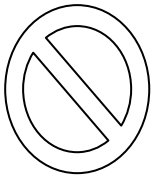
i) ___

j) ___



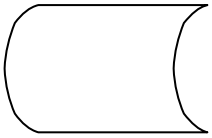
WORKSHEET 3

Name: _____



WORKSHEET 4

Name: _____



WORKSHEET 5

Name: _____

a) ___

b) ___

c) ___

d) ___

e) ___

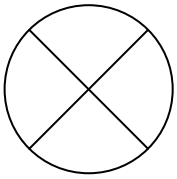
f) ___

g) ___

h) ___

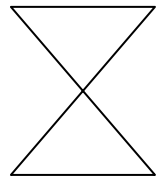
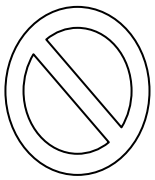
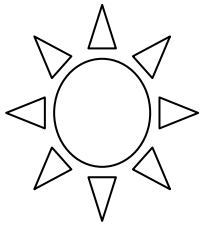
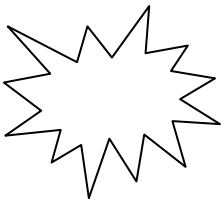
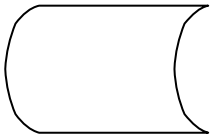
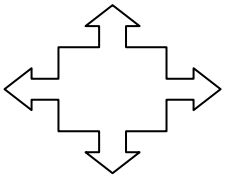
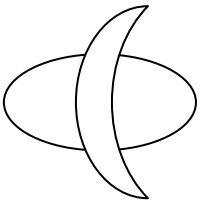
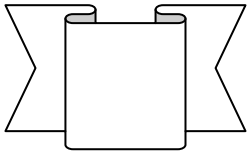
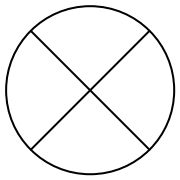
i) ___

j) ___



WORKSHEET 6

Name: _____

APPENDIX I

Date: _____

Dear _____,

Introduction
Your class has been invited to volunteer for a research study. Before you agree to take part in this study you should fully understand what is involved. If you have any questions that are not fully explained in this form, do not hesitate to ask the investigator. You should not agree for your class to take part unless you are completely happy about all the procedures involved.

What is the purpose of this study?
I am an occupational therapist currently completing my Master's degree. My research topic is to establish the relationship between various factors and letter and number reversals (e.g. 'b' instead of 'd'). In order to do this I need to observe the letter formation of a sample of children, as well as investigate whether they reverse their letters in class.

Has the study received ethical approval?
This study's research protocol was submitted to the Faculty of Health Sciences' Research Ethics Committee, University of Pretoria and written approval has been granted by that committee. The study has been structured in accordance with the Declaration of Helsinki (last update: October 2000). A copy of the Declaration may be obtained from the investigator should you wish to review it.

I have also obtained permission from the KwaZulu-Natal Department of Education to conduct this study. Your school has been randomly drawn from all the primary schools in the Central Durban circuit to participate in this study.

What is the duration of this study?
Inclusion in the study would entail the following:

- One average Grade 2 class would be randomly drawn to take part in the study.
- I would have to go into the classroom and check every child's letter formation
- You (the teacher) would then have to complete a One-week Class Programme with your class. This programme will consist of the whole class doing a short exercise every day for five consecutive days (see attached Appendix). These exercises are very simple and will be similar to the type of exercises they do in Grade 2.

- After completion of the One-week Class Programme, the learners that have been identified as learners with reversals will then be tested on the DTVP-2 (a standardised test) to establish whether they have visual perceptual difficulties.

What are the children's rights as a participant in this study?
The children's participation in this study is entirely voluntary and their parents can refuse for their child to participate or stop at any time without stating any reason.

Confidentiality
All information obtained during this study is strictly confidential. Data that may be reported in scientific journals will not include any information which identifies the children as a participant in this study. Any information uncovered regarding the children participating in this study will be held in strict confidence. Children's parents will be informed of any finding of importance but this information will not be disclosed to any third party without the parent's written permission.

Informed consent for principals of schools
I hereby confirm that I have been informed by the investigator, Wendy Smith (Occupational Therapist), about the nature of this study. I have also received, read and understood the above written information regarding the study.

I am aware that the results of the study, including the children's personal details regarding date of birth, initials and diagnosis, as well as my personal details, will be anonymously processed into a study report.

Children's parents may at any stage, without prejudice, withdraw their consent for their child's participation in the study. I have had sufficient opportunity to ask questions and (of my own free will) declare my class prepared to participate in the study.

Teacher's Name: _____
Teacher's Signature: _____
Date: _____
Investigator's Name: _____
Investigator's Signature: _____
Date: _____
Witness's Name: _____
Witness's Signature: _____
Date: _____

(**Attached Appendix)**

GRADE 2 ONE-WEEK CLASS PROGRAMME

Dear _____

Thank you for agreeing to take part in this Research Study. Your assistance is appreciated and is of great importance to this study. Please remember that this data will not be used to attain the level of your class's functioning. I will only use it to establish the prevalence of reversals. It is vital for the reliability of the study that you take note of the following:

- Please do not correct any mistakes made by the children.
- Please do not give any indication of orientation of letters e.g. if a child asks which way 'a', 'b' or 'd' goes just say: "Just do it the way you think it must be."
- If you have any visual reminders of letter orientation displayed (e.g. alphabet charts, or words like 'bed' written on their desks), please cover them for the duration of these exercises every day.
- At the end of each exercise please place all completed worksheets in the envelope provided.

Thank you for your valued participation,
Wendy Smith

DAY 1:
Please ask the learners to write their names on Worksheet 1.
Ask the learners to write the following words from dictation:

Ball, duck, queen, fish, gold, zebra, home, jelly, party

You may spell these words for the children as this is not a spelling test, as long as you do not give any indication of the orientation of letters.
When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.
Please collect all sheets when completed.

DAY 2:
Please ask the learners to write their names on Worksheet 2.
Ask the learners to write the answers to the following sums on the worksheet:

a) 2 + 2 = ___
b) 4 + 3 = ___
c) 7 + 3 = ___
d) 1 + 1 = ___
e) 3 + 2 = ___
f) 2 + 1 = ___

g) 5 + 1 = ___
h) 5 + 4 = ___
i) 0 + 1 = ___
j) 4 + 4 = ___

You may help them with the sums if they have difficulty, as this is not a maths test. Please remember not to give any indication of the orientation of numbers.

When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.

Please collect all sheets when completed.

DAY 3:

Please ask the learners to write their name on Worksheet 3.

Ask the learners to copy the following from the Blackboard:

The happy zebra danced around the big fire.

The king and queen ate jelly made from sugar.

Please remember not to correct any errors.

When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.

Please collect all sheets when completed.

DAY 4:

Please ask the learners to write their names on Worksheet 4.

Ask the learners to write the following words from dictation:

Zip, quack, baby, doll, eggs, food, hen, jar, map, tree.

You may spell these words for the children as this is not a spelling test, as long as you do not give any indication of the orientation of letters.

When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.

Please collect all sheets when completed.

DAY 5:

Please ask the learners to write their names on Worksheet 5.

Ask the learners to write the answers to the following sums on the worksheet:

a) 1 + 1 = ___
b) 4 + 1 = ___
c) 6 + 3 = ___
d) 1 + 2 = ___
e) 3 + 3 = ___
f) 5 + 5 = ___
g) 3 + 1 = ___
h) 2 + 5 = ___
i) 0 + 1 = ___

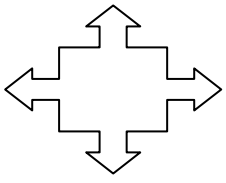
j) 3 + 5 = ___

You may help them with the sums if they have difficulty, as this is not a maths test. Please remember not to give any indication of the orientation of numbers.
When this has been completed ask the learners to look at the symbol at the bottom of the sheet and to try to remember it. Let them look at this symbol for 1 minute.
Please collect Worksheet 5.

Please ask the learners to write their names on Worksheet 6. Ask the learners to look at the symbols on the worksheet and circle all the symbols they remember seeing on their worksheets during this week.
Please collect all sheets when completed.

WORKSHEET 1

Name: _____



WORKSHEET 2

Name: _____

a) ___

b) ___

c) ___

d) ___

e) ___

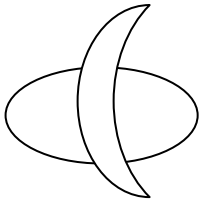
f) ___

g) ___

h) ___

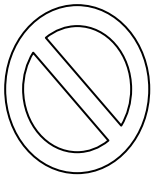
i) ___

j) ___



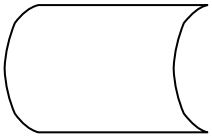
WORKSHEET 3

Name: _____



WORKSHEET 4

Name: _____



WORKSHEET 5

Name: _____

a) ___

b) ___

c) ___

d) ___

e) ___

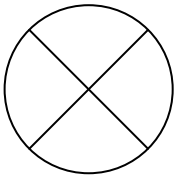
f) ___

g) ___

h) ___

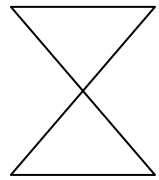
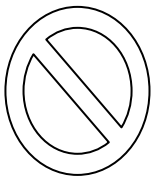
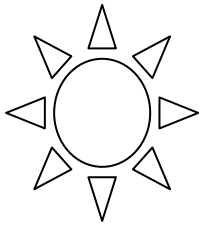
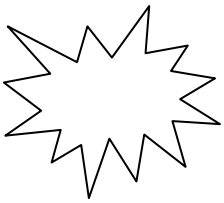
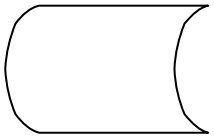
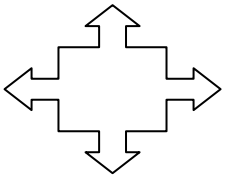
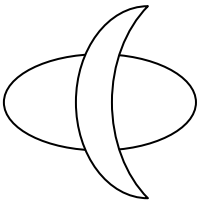
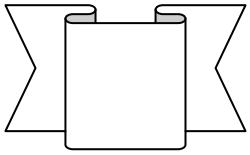
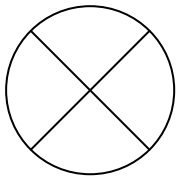
i) ___

j) ___



WORKSHEET 6

Name: _____

APPENDIX J

Date: _____

Dear Parent,

Introduction
Your child has been invited to volunteer for a research study. Before you agree to take part in this study you should fully understand what is involved. If you have any questions which are not fully explained in this form, do not hesitate to ask the investigator. You should not agree for your child to take part unless you are completely happy about all the procedures involved.

What is the purpose of this study?
I am an occupational therapist currently completing my Master's degree. My research topic is to establish the relationship between various factors and letter and number reversals (e.g. 'b' instead of 'd'). In order to do this I need to observe the letter formation of a number of children, as well as investigate whether they reverse their letters in class.

Has the study received ethical approval?
This study's research protocol was submitted to the Faculty of Health Sciences' Research Ethics Committee, University of Pretoria and written approval has been granted by that committee. The study has been structured in accordance with the Declaration of Helsinki (last update: October 2000). A copy of the Declaration may be obtained from the investigator should you wish to review it.

I have also obtained permission from the KwaZulu-Natal Department of Education as well as your child's school to conduct this study.

What is the duration of this study?
Inclusion in the study would entail the following:

- One average Grade 2 class would be randomly drawn to take part in the study.
- I would have to go into the classroom and check every child's letter formation
- The teacher would then have to complete a One-week Class Programme with her class. This programme will consist of the whole class doing a short exercise every day for five consecutive days. These exercises are very simple and will be similar to the type of exercises they do in Grade 2.
- After completion of the One-week Class Programme, the learners that have been identified as learners with reversals will then be

tested on the DTVP-2 (a standardised test) to establish whether they have visual perceptual difficulties.

What are my child's rights as a participant in this study?
Your child's participation in this study is entirely voluntary and you can refuse for him/her to participate or stop at any time without stating any reason.

Confidentiality
All information obtained during this study is strictly confidential. Data that may be reported in scientific journals will not include any information which identifies your child as a participant in this study. Any information uncovered regarding your child participating in this study will be held in strict confidence. You will be informed of any finding of importance, but this information will not be disclosed to any third party without your written permission.

Informed consent for parents / guardians (on behalf of minors under 18 years old)
I hereby confirm that I have been informed by the investigator, Wendy Smith (Occupational Therapist), about the nature of this study. I have also received, read and understood the above written information regarding the study.

I am aware that the results of the study, including the children's personal details regarding date of birth, initials and diagnosis will be anonymously processed into a study report.

I may, at any stage, without prejudice, withdraw my consent for my child's participation in the study. I have had sufficient opportunity to ask questions and (of my own free will) declare my child prepared to participate in the study.

Parent / Guardian (s) Name: _____
Parent / Guardian (s) Signature: _____
Date: _____
Investigator's Name: _____
Investigator's Signature: _____
Date: _____
Witness's Name: _____
Witness's Signature: _____
Date: _____