

Remedial Instructional Techniques: Assessing the Effectiveness of High Imagery Teaching Techniques in the Remedial Environment

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Remedial Instructional Techniques: Assessing the Effectiveness of High Imagery Teaching
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I hereby declare that this research project is, except where specified, my own work and has not been submitted for degree purposes to any other university.

Gregg A. Ravenscroft

Abstract

The primary focus of this research is to establish whether there is improvement in the reading, writing and spelling skills of learning disabled children, where high imagery teaching techniques are used for remediation. The results of seventeen small-scale studies were combined using aggregative case survey methodology to form a sample of 93 children (63 treatment and 30 control).

Analysis indicated that children in both conditions made similar gains in phonic skills. However a significant difference in scholastic skills for children who received high imagery instruction was noted in comparison to those who received structured phonics.

Overall, the results would suggest that high imagery teaching techniques may be an alternative remediation strategy to structured phonic techniques; especially where children are not making progress in the latter. The results also indicate that progress is made regardless of gender, age, grade at school, extent of the child's learning deficit / developmental lag or level of visualisation ability.

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1 Chapter One: Introduction, Aims, Rationale and Research Questions

1.1 Introduction

It has been estimated that 10 to 15 percent of all children who are of school going age suffer from some type of learning disability with only a small percentage of that group privileged enough to receive some form of remedial therapy (Gaddes, 1980). Internationally, learning disabilities are not isolated to a specific background or culture, nor does their presence reflect on the mental capacity of the child (Langar, 1991). Children with learning disabilities often require specific types of instruction, as they are often not suited to mainstream education and the teaching techniques that are employed in the mainstream classroom situation, where the teacher engages in the process of information transfer to his/her students, which may not be conducive to his or her individual learning style (Kirk, 1972; Jansen, 1996).

The estimated prevalence of learning disabled children, from research conducted abroad, cannot be applied directly to the South African context (MacCreadie, 2001; Wilson, 2001). Research conducted by the Murray Commission (1969, in Potter 2004) distinguished three categories of learning disabled children, and estimated that 15% of all children in the country had learning difficulties and that 9% of those children required treatment. Foxcroft & Roodt (2001) suggest that when factors relating to socio-economic disadvantage are included, the incidence of learning disabilities in the South African school going population is probably far higher. Further research is therefore needed in South Africa in order to arrive at an accurate percentage of the children that are affected by learning disabilities.

The current strategy adopted for children who have been diagnosed with learning disabilities involves their enrolment in specialised educational centres. Children that

have not been diagnosed usually remain in a mainstream schooling environment and fail to perform to their full potential (Adelman & Taylor, 1993; Grasko, 2005, Potter, Grasko, & Pereira, 2006). Further knowledge of children with learning disabilities will therefore serve as a vital aid in the development of procedures supporting un-diagnosed children in mainstream classrooms (Adelman & Taylor, 1993; Grasko, 2005). Additionally further research will aid in the establishment of alternative teaching techniques that can be widely employed, outside of the specialised educational setting, so that those that learning disabilities can be remediated and overcome. The alternative is the possibility of a sustained legacy of an adult minority within the South African population who have been disenfranchised and are not able to contribute to South African society to the fullest extent of their abilities.

1.2 Factors associated with Learning Disabilities

A child with learning disabilities usually has deficiencies in the basic academics skills of reading, writing and spelling (Prior, 1996; Reid & Hresko, 1981). These three skills are conceptualised by Reid and Hresko (1981) as interlinked, with problems in one affecting the child's abilities in any of the other two. Prior (1996) provides a broad outline of how the three skills are interlinked stating that difficulties in spelling are related to difficulties in reading. Prior's (1996) theory outlines a causal framework that describes spelling difficulties as due to a deficient store of word-specific knowledge, deficient word-specific knowledge is in turn due to lack of reading as reading is required to generate this knowledge. This is a particularly challenging issue for children who experience difficulties in reading because of the discomfort the task generates (Pellegrini & Galada, 1998).

In addition to the language and cognitive problems associated with learning disabilities are the family and social problems that arise from their presence (Prior, 1996; Doehring, 1981). Lack of scholastic achievement can cause considerable anxiety for both parents and especially their children (Gibson, 1975). According to Prior (1996) the lack of

success in learning to read, write and spell in a child's early years can affect both their self-efficacy (belief about their capacity to affect their lives) and their self-concept (the way in which they perceive themselves) (Feist & Feist, 1998). Unaddressed learning disabilities can therefore be detrimental to an individual's psychological development and ultimate interaction with society.

Broom (2001) has stated that "Reading and writing are both cultural imperatives in today's information based society" and that they "will become increasingly important as avenues to reward and success." Mastery of reading, writing and spelling also forms the basis for social interaction in modern society where a member's activities are often informed through the dispersal of information from those that have been placed in positions of authority (Gibson, 1975; Carreker, 1999). This dispersal of information takes for granted the idea that all members of society are able to read and write, and therefore seldom accommodates those that are unable to do so fluently. The social repercussions for an illiterate society are diverse and could be detrimental to the overall welfare of a society.

1.3 Research Aims

The aim of this study was to aggregate data from a series of studies conducted over a five year period from 2001 to 2005 at Japari Remedial School, Johannesburg, on the effectiveness of high imagery teaching techniques in working with learning disabled children. Each of the studies focused on the use of an instructional programme called the Targeted Revisualisation Programme as a form of remediation.

The Targeted Revisualisation Programme is a remedial programme developed by Professor Charles Potter of The University of the Witwatersrand, which makes use of high imagery instruction in improving the reading, writing and spelling ability of children (Potter, 2001). It was applied between 2000 and 2005 in after-school tutorial sessions conducted with children in a full-time remedial school environment at Japari, who had

not learned using conventional remedial teaching techniques based on use of structured phonic instruction.

The children were assigned to two conditions, as part of a series of small-scale studies in which individual case studies were conducted of the instruction received by and progress made by each of these children. Using aggregative case survey methodology (Lucas 1974a; 1974b; Els, 2005), a single data set was then created for the purposes of this study. This consisted of 63 children who had received high imagery instruction, and 30 children who had received structured phonic instruction. The aim of this research is to contrast the progress made by the children in these two conditions.

1.4 The Two Different Forms of Remedial Instruction Provided in this Study

Of the 93 participants, 30 received additional remedial treatment, twice a week in the afternoons, based on provision of more of the type of structured phonic instruction they were receiving as part of their full-time remedial school programme. The remaining 63 received additional remedial treatment, twice a week in the afternoons, based on the use of high imagery teaching techniques. High imagery instruction was provided using the Targeted Revisualisation Programme.

The type of instruction provided in these two conditions which will be described in more detail below, as well as in Chapter Three. In terms of the research design utilised, each learning disabled child in the sample received one of two types of remedial instruction, as follows:

1.4.1 Structured Phonic Instruction in the Remedial Environment

Instruction in the structured phonic condition was provided using a programme based on the stages in the development of reading and spelling described by Frith (1985; 1989). Children with learning disabilities are generally identified through functional weaknesses in language and phonological system, and low scores on tests of reading, writing and

spelling, relative to normal intelligence and cognitive functioning norms (Bannatyne, 1971; Fakouri, 1991).

For these reasons, instruction in a full-time remedial school environment normally involves an attempt to address the reading, writing and spelling difficulties of children. This is normally done by providing small-group instruction which is supplemented by individual language, occupational and/or remedial therapies (Bannatyne, 1971; Fakouri, 1991). The structured phonic condition in this study focused on providing individual tutoring to children in the afternoons after school.

Structured phonic instruction refers to the teaching of the “paired association between letters and letter sounds” where reading and spelling is achieved through an emphasis on establishing the sound-symbol relationship early on in scholastic instruction (Birsh, 1991, p.499). Owing to the phonological weaknesses of many children with learning disability, structured phonics is widely used by remedial teachers, as it is believed that this structured approach assists the child in overcoming his / her difficulties in building the letter and letter sound relationship.

1.4.2 The Need for an Alternative Form of Instruction in the Full-time Remedial Environment

Structured phonics is the instructional approach of choice in the Japari Remedial School environment (Ruth Findlay, Japari Remedial School, personal communication). The reason for this is that this form of instruction enables focus on the phonological, phonic and orthographic skills of the children.

In this study, the need for an alternative form of remedial instruction was based on evidence that not all children in the school were making equal progress in structured phonic instruction. Some had not made very little measurable improvement in scholastic ability in the previous year. It is these “treatment resistant” children, in the remedial

environment, who form the focus of this study. These children are defined as “treatment resistant” in the sense that they had not responded to the types of focused phonologically-based phonic instruction offered within a full-time remedial school environment.

In an attempt to establish whether it was the factor of individual instruction which was hampering their progress, a number of small-scale studies were conducted between 2001 and 2005. Individual tutoring was provided in the afternoons after school. Of the 93 children involved in this programme, 30 were provided with individual tutoring based on the same type of phonic instruction which they were receiving as part of their classroom remedial programmes.

To establish if it was the type of remedial instruction which they were receiving which was hampering their progress, 63 of the children in these small-scale studies were provided assigned to a different form of instruction. This focused on providing tutoring based on high imagery teaching techniques, using the programme described below.

1.4.3 High Imagery Instruction

Instruction in the high imagery condition was provided using a programme called ‘The Targeted Revisualisation Programme’. The programme has been designed as a means of using high imagery instruction to teach severely learning disabled children who have not made progress using structured phonic approaches (Sfetsios 2002; Potter, 2001; 2003; 2004).

It has been used in working with children in mainstream classes as well as in the full-time remedial environment who have not responded well to phonologically-based instruction, and have not made progress using other approaches to overcoming their difficulties. The programme aims to teach both word attack as well as memory-related skills, through activities involving use of colour coding and revisualisation.

The programme uses a seven vowel system for introducing English orthography, through a series of activities which utilise high imagery techniques. At its basic levels, the focus of the programme lies on analysing words used in the context of sentences. At higher levels word, sentence and paragraphing skills are taught, through high imagery activities involving sequentialisation (Potter, 2001; 2003; 2004).

1.5 Rationale

The rationale of this study is to add to the literature concerning the effectiveness of different forms of remedial treatment, which has been a dominant theme in the literature on learning disabilities. A wide variety of different instructional approaches have been advocated by different specialists in the field (Myers & Hammill, 1969; Birsh, 1999). Ellis (1993) has suggested that one of the reasons for lack of agreement in the field has been a lack of empirical evidence on the effects of particular remedial techniques, particularly in the form of studies comparing the effects of different instructional programmes on children with reading and learning disabilities. This study aims to contrast the use of two specific remedial teaching approaches by focusing on the possibility of using high imagery instruction, based on use of mental imagery as a cognitive process, as opposed to phonologically based instruction based on use of structured phonics.

Before the advent of behaviourism and its dominance in post-second-world-war psychological thought, use of mental imagery in teaching children to read, write and spell was common practice (Gates, 1935; Monroe & Backus, 1937; Fernald, 1943). Among children with learning difficulties, opinion was divided as to whether the type of multi-sensory strategies advocated by authors such Fernald and Gates or those based on structured phonic approaches (e.g. Monroe & Backus, 1937) were preferable.

With the advent of behaviourism, use of mental imagery fell into disfavour in both psychology and education. The types of multi-sensory structured phonic approaches

advocated by Samuel Orton (Gillingham & Stillman, 1960) came to dominate the field (Chall, 1967). Owing to the consistent evidence of the link between phonological awareness and reading, structured phonic approaches are, at present, still the remedial approaches of choice (Birsh, 1999). The value of phonologically based and structured phonic approaches in the initial stages of learning to read would appear to be well established (Moats & Farrell, 2000).

Over the past thirty years, however, the role of mental imagery in cognition and in learning has again received attention in the literature (Kosslyn, 1980; 1994; Paivio, 1971, 1977; 1986; 1991; Piaget & Inhelder, 1971; Piaget & Inhelder, 1973; Shepard 1978a; 1978b). The current study attempts to highlight the potential role of high imagery instructional techniques in the full-time remedial environment, as an alternative form of instruction. It is theorised that this technique can be used with those learning disabled children who do not make progress through instructional techniques based on phonological assumptions, and instruction using structured phonics in particular (MacReadie, 2001; Wilson, 2001; Abelheim, 2002; George, 2002; Picton, 2002; Ravenscroft, 2002; Retsios, 2002; Sampson, 2002; Sfetsios, 2002, Booth, 2003; 2005; Els, 2003; 2005; Cronk, 2004; Khan, 2004; Potter, 2003; Tatic, 2004; Koeman, 2005, Rayner, 2005).

1.6 Contrasts Across and Within Different Instructional Conditions

The analysis has been conducted using a data base of 93 individual case studies collected over a five year period between the beginning of 2001 and the end of 2005. These data have been aggregated and clustered in different ways – the pooled sample size creating the possibility of contrasting results under different treatment conditions, as well as possibilities of statistical power in the analysis.

In addition to comparisons based on the use of different instructional techniques, this study will also examine variations in implementation within the mental imagery

condition. This is possible owing to variations in implementation of the high imagery instructional programme which took place in 2004.

In this year Japari Remedial School's computer centre was burgled and all the computers stolen. This effectively meant that four of the studies using the high imagery techniques in this particular year (Cronk, 2004; Booth, 2005; Khan, 2004; Tatic, 2004) had to be implemented without use of the computer-based methodology on which the parts of the Targeted Revisualisation Programme's methodology are based. The 2004 data have thus been used to form an additional contrast group within the data, enabling comparisons across instructional programmes (high imagery versus structured phonic conditions) as well as comparisons within instructional programmes (use of computer versus without use of computer conditions) to be made.

In one 2004 study (Els, 2005) the researcher made use of her own laptop computer in working with the children. Els' study has thus been included as part of the computer-based instructional condition despite her results falling under the 2004 sample grouping.

1.7 Research Questions

Based on the above variations in implementation, the following research questions will be investigated in this study:

- 1) What trends are evident from the cumulative results of studies conducted on the use of high imagery teaching techniques from 2001 to 2003?
- 2) a) Is there a difference in trends in the results in 2004 when implementation of the high imagery teaching programme varied from that taught from 2001 to 2003?
b) Is there a difference in trends in the results in 2004 when implementation of the high imagery teaching programme varied from that taught from 2001 to 2003 and 2005?

- 3) a) What trends are evident from the cumulative results of studies conducted on the use of high imagery teaching techniques from 2001 to 2005 (excluding 2004 results)?
b) Was gender an influence on scholastic performance in these studies?
- 4) a) What trends are evident from the cumulative results of studies conducted on the use of high imagery teaching techniques from 2001 to 2005 (including 2004 results)?
b) Was gender an influence on scholastic performance in these studies?

This study will also focus on the issue of whether extent of learning deficit (as measured by lag in scholastic performance relative to chronological age) influenced the results:

- 5) Does the extent of a child's deficits in English reading and spelling, as determined by the difference between his or her chronological age and reading and spelling ages, influence the gains made in high imagery instruction and structured phonic instruction?

In addition, this study will attempt to establish the influence of high visualisation ability on the results:

- 6) Is there a difference between the results of children who are able to visualise / not able to visualise and are exposed to high imagery instructional techniques as opposed to structured phonic teaching?

Finally, this study will provide information on the validity of the scholastic tests and phonic inventories used to measure the children's progress. It will provide information on the relationship between the different tests used for measuring progress in this sample of children for the data set as a whole, as a basis for comparing the gains made by the participants who received high imagery and structured phonic remedial instruction. This will be done by addressing two research questions:

- 7) a) Is there a relationship between the error scores yielded by the three levels of the Phonic Inventories for this sample?
b) Is there a relationship between the error scores yielded by the instrument on each of the levels of the Phonic Inventories, and the other scholastic tests included as dependant variables in this study?
- 8) Is there a difference in gains made in phonic skills as indicated by the results of Level 1, 2 and 3 of the Phonic Inventories for those children who received high imagery instruction and those that received structured phonic instruction?

1.8 Chapter Summary

This chapter has provided an outline of the focuses of this study, specifying its aims and rationale. The specific research questions and related hypotheses relate to variations in the type of instruction (either exposure to high imagery teaching techniques or to structured phonic teaching) received by the children in the sample, as well as variations in the way in which high imagery teaching techniques were implemented from 2001 to 2005.

Additionally this chapter has focused on the two different types of remedial therapy which form the independent variable in the study. The first condition investigated in this study is exposure to structured phonic instruction in individual tutorial sessions provided over a six month period twice a week in the afternoons after school. The second condition is exposure to high imagery teaching techniques, also provided in individual tutorial sessions provided over a six month period twice a week in the afternoons after school.

The sample used in this study is based on a single data set created using aggregative case survey methodology, consisting of the individual case study results of 63 children who

received high imagery instruction over a five year period, and the individual case study results of 30 children who received structured phonic instruction over a similar period of time. The sample is one of convenience, in which all children were learning disabled, and not performing well in their full-time remedial programmes. The age and grade of the children has varied, according to the availability of suitable participants.

The aim of the study is thus to analyse the progress made by 93 “treatment resistant” children in relation to two instructional conditions. The progress made by the children in these two conditions is contrasted. Literature relating to the types of remedial instruction provided to the children in this study is reviewed in the next two chapters. The results yielded by each of the small-scale studies are then summarised in Chapter Four. Chapter Five provides information on the methodology of the research. Table 19 in Chapter Five and Table 22 in Chapter Six will then provide an overview of the research questions and hypotheses relative to the different data sets in this study, and how these questions have been addressed in the analysis of the composite data set. The results of the analysis are then presented and discussed. Conclusions are then drawn, and limitations and needs for further research stated.

1.9 Glossary of Terms

Alphabetic Principle	“The understanding of the relationship between letters ordered left to right in a written word and phonemes ordered in a specific temporal sequence in spoken language; knowledge of the alphabetic principle is essential to the ability to read an alphabetic language” (Uhry, as cited in Birsh, 1999, pp64, 491).
Assessment	The process of collecting information to make decisions about people’s lives, learning and instruction (Salvia & Ysseldyke, 1998 in Birsh, 1999).
Colour Coding	The ability to represent the unique array of letters that defines the printed word. A visual coding ability that depends on facets of the visual system such as visual features analysis, attention to visual pattern analysis, as well as the ability to detect, represent, and categorise invariance (Potter, 2006).
Compound Words	One word made up from the parts of many, e.g. black + market = black-market, multi + sensory = multi-sensory.
Consonant Blend	Two or more adjacent consonants which together result in a smooth flow of sound (Birsh, 1999).
Creative writing	Any writing by an individual that is unique to that person. Being able to express oneself in a manner that is comprehensive to oneself and others (Haring & Schiefelbusch, 1976).
Cursive Handwriting	Joined, rounded handwriting, writing with the slanted strokes of successive characters joined and the angles rounded (Birsh, 1999).
Decode	“Word recognition in which the phonic code is broken; to determine the pronunciation of a word by noting the position of the vowels and consonants” (Birsh, 1991, p. 494).
Digraph	Two adjacent consonants or vowels in the same syllable

	representing a single speech sound (e.g., sh in wish and ee in feet) (Birsh, 2000, p.494).
Dyslexia	This is the most common learning disorder that interferes “with specific aspects of school achievement, resulting in performance substantially lower than would be expected given a child’s age, intelligence, and amount of schooling. Dyslexics have trouble matching words with speech sounds and breaking down words into sounds” (Papalia, Olds, & Feldman, 1998, p. 290).
Grapheme	“A letter or letter cluster representing a single sound (e.g. i, igh)” (Birsh, 1991, p. 495).
Homophones	“Like sounds being represented in a different manner in writing” (Ellis, 1993).
Inclusion	“The opportunity for all students with disabilities to have access to and participate in all activities in the neighbourhood school environment. A placement where all students receive services, including specialised services, in the general education setting.” (Birsh, 1999, pp 496).
Irregular words	“Words that have an unexpected spelling either because its orthographic representation does not match the pronunciation or because it contains an infrequent orthographic representation of a sound.” (Birsh, 1999, p496).
Learning Disabilities	“Children with learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written languages. These may be manifested in disorders of listening, thinking, talking, reading, writing, spelling, or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia, etc. They do not include learning problems which are

	due primarily to visual, hearing or motor handicaps, to mental retardation, emotional disturbance or to environmental disadvantage” (Reid & Hresko, 1981, p. 4).
Lexicon	“A body of word knowledge, either spoken or written” (Birsh, 1991, p. 497).
Long Vowel	Refers to a vowel sound that occurs through the use of a slightly higher tongue position than is used for short vowels (Birsh, 1999).
Mainstreaming, integration or inclusive schooling	The child is a full-time member of a regular school (Jenkinson, 1997).
Mediated	The physical art or process of making the form and structure of a word more visible where understanding is achieved through or is dependant upon a third party (Birsh, 2000).
Mnemonic strategies	“Any formal scheme designed to improve memory, including using keywords, chunking, rhyming, and visualising. Arbitrary learning is more difficult for the dyslexic student than learning that is related and logical, so devices for grouping needed facts are essential” (Birsh, 1991, p. 498).
Morpheme	The smallest meaningful linguistic unit. A morpheme may be a whole word (e.g. child), a base word (e.g. child in childhood), a suffix (e.g. –hood in childhood), or a prefix (e.g. un in untie) (Birsh, 1991, p. 498).
Morphological	“In linguistic terms, pertaining to the meaningful units of speech; a suffix, for example, is a morphological ending” (Birsh, 1991, p. 498).
Multisensory Teaching	“Any learning activity that includes the use of two or more sensory modalities simultaneously to take in or express information.” (Moats & Farrell 2000, pp1).

Orthographic coding	“The ability to represent the unique array of letters that defines a printed word. A visual coding ability that depends on such facets of the visual system as visual feature analysis, attention to visual detail, and visual pattern analysis, as well as the ability to detect, represent, and categorize invariance.” (Das & Parrila, 2001, p. 4).
Orthography	“The writing systems of a language; correct or standardized spelling according to established usage” (Birsh, 2000, p.499).
Phoneme	“A group of closely related speech sounds all of which are generally regarded as the same sound, e.g., /t/ in top and in stop is one phoneme, although it is produced differently in the two words” (Myers & Hammill, 1969, p.394).
Phonics	“Paired association between letters and letter sounds; an approach to teaching of reading and spelling that emphasizes sound-symbol relationships, especially in early instruction” (Birsh, 1991, p. 499).
Phonological	“Pertaining to a speaker’s knowledge about sound patterns in a language” (Birsh, 1991, p.499).
Phonological awareness	Both the knowledge of and sensitivity to the phonological structure of words in language. Involving the ability to notice, think about or manipulate sound segments in words. Phonological awareness progresses from rhyming to syllable counting; to detecting first, last and middle sounds; to segmenting, adding, deleting and substituting sounds in words (Birsh, 2000, p. 499).
Polysyllabic	Characterised by words that have more than one syllable (Birsh, 1999).
Prefix	An affix attached to the beginning of the word, base, or phrase and serving to produce a derivative word or an inflectional form (Merriam- Webster Dictionary).

Pseudo words	“(e.g. TRAKE) can only be pronounced by identifying the sounds represented by individual letters and letter combinations, and then blending the sounds to form a word” (Jones, Torgensen, & Sexton, 1987, p.122).
Reading	Reading is a combination of letter identification skills, phonological, grapheme, sequencing and both short and long term memory skills. Thus reading is a multiprocess and multistage behaviour (Kolb & Whishaw, 1996). Research has shown that discovering an alphabetic principle (letters and combinations of letters correspond systematically to sounds) is imperative when learning to read (Bradley & Bryant, 1985; Rayner & Pollatsek, 1989; Frith, 1985).
Regular words	Words that are spelled the way they sound. (Birsh, 1999).
Revisualisation	The process of analysis of an image formed in response to a stimulus, the process of comparison of the image with the form of the original stimulus, and the process of coding output of the image into written or graphic form (Potter, 2003).
Schema	A schema is the way a person has organized and integrated knowledge about a particulate topic (Ellis, 1993, p219).
Segregation	The complete removal of learning disabled children into special classroom and schools (Hammill & Bartel, 1971).
Self-concept	“Includes all those aspects of one’s being and one’s experience that are perceived in awareness (though not always accurately) by the individual” (Feist & Feist, 1998).
Self-efficacy	“People’s belief about their capabilities to exercise control over events that affect their lives”. People with high self-efficacy believe they can exert some measure of control over their environment (Feist & Feist, 1998).
Semantic	“Concerning the meaning of words and the relationship among

	words as they are used to represent knowledge of the world” (Birsh, 1991, p501).
Short Vowel	A vowel pronounced with a short sound, unrelated to any other letter (Birsh, 1999).
Spelling	Spelling can be perceived as being the reversal of reading. Here, the individual must turn sounds into letters (rather than letters into sounds). The dual-route model is the classic spelling model that contains the spelling-to-sound model/ the non lexical route (which works for regular words only) as well as a lexical route (which works for sight or irregular words) (McLeod & Greenough, 1980 in Rebolo, 2002).
Suffix	Letter or syllable appended to a word in word formations (Oxford Dictionary).
Syllable	A written or spoken form within a word that must have a vowel sound, it includes a prefix or suffix (Birsh, 1999).
Syntax	“The system by which words may be ordered in phrases and sentences; sentence structure; grammar” (Birsh, 1991, p. 502).
Targeted Revisualisation Programme	A five stage programme for remedial intervention which utilises mental imagery as the basis for visualisation and revisualisation, as the basis for storage of the structure of words into short and long-term memory (Potter 2000; 2001).
Transparent Orthography	An orthography of the English language based on a seven vowel system in which a, e, i, o and u are mediated as vowels in all positions in words, and y and w are mediated as consonants in positions at the beginning of words and as vowels in positions near or at the end of words (Caroline, 1956 in Potter, 2000; 2001).
Treatment Resistant	Refers to a child not responding to the form of remedial treatment they are currently receiving (Els, 2005).

Visual Imagery	“The mental representation of visual knowledge not presently visible to the eyes” (Sternberg, 1999, p217)
Visualization	“Ability to form a mental image of an object” (Kolb & Whishaw, 1996, p656).
Visually Synthesize	Once a child can recognize the parts of a word, they need to be able to look at separate parts of a word and put them together (Richardson, 1999).
Writing	Skills include: the underlying processing skills involving development in a variety of memory, motor and language areas. Examples include physical components of writing, speed of motor performance, active working memory, language formulation and ideation. The mechanical skills involve lower level tasks such as automatic letter form, use of space, basic spelling, capitalisation, and punctuation. More mature mechanisms involve speed, clarity of expression and appropriate grammar. The content skills relate to organizing and expressing ideas (Richards, 1999).

2 Chapter Two: The Development of Reading, Writing and Spelling: A Review of the Literature

2.1 Learning Disabilities

According to Reid and Hresko (1981) children with learning disabilities are seen to have a “disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written language” (p.4). The condition can be manifest in disorders of talking, spelling and reading, e.g. dyslexia, or in listening perceptual handicaps. The term learning disability is not applicable to individuals who have learning difficulties due to any form of mental retardation, emotional disturbances, and very importantly environmental disadvantages (as is often the case in South Africa).

Learning disorders have received world wide attention and have been extensively documented with the affected children identified as taking longer to develop the skills to read, write and spell than their peers (Frith, 1985). In many cases the children are segregated or removed from the standardised or mainstream school system (where the child is a full-time member of a regular school) and placed within a remedial educational setting (Jenkinson, 1997). Emphasis is now placed on the establishment of phonological awareness of letters in words, as well as receiving more time in the teaching of basic learning skills like reading, writing and spelling (Bradley & Bryant, 1985). The focus of instruction is to bring the child to a point where he/she has the ability to think about or manipulate sound segments in words without assistance (Birsh, 2000, p.499).

In some cases where the child’s learning disorder is not too severe, he or she may still continue in a mainstream educational setting but with additional lessons conducted outside of regular school time so that their learning deficit is compensated for (Frith, 1985). Another option is an inclusion school where students with disabilities have access

to and are able to participate in a mainstream school environment, but are placed in a setting where they are able to receive specialised services (Birsh, 1999).

Children affected by learning disabilities usually have near-average or higher-than-average intelligence with normal hearing and vision, but they seem to have difficulty processing sensory information (Papalia et al., 1998). The *Diagnostics and Statistical Manual of Mental Disorders, Fourth Edition Revised Text (DSM IV TR)* corroborates this theory stating that learning disorders are diagnosed when an individual's achievement on individually administered standardised measures of written expression, reading and mathematics are not relative to that expected of their age, schooling level, and level of intelligence (American Psychiatric Association, 2000). The skills deficit described by the *DSM IV TR* can be problematic in the schooling environment in the sense that the activities within each of these areas are normally structured in relation to a certain level of mastery by the child. It is expected that as a child grows older and progresses from grade to grade, so too does his/her skill level and ability to access material of a corresponding level expected (Papalia et al., 1998). In the context of a learning disabled child the progression upwards in grade is not always matched by an increase in skill level that consequently results in learning difficulties.

It is important to note that children generally do not outgrow their learning disability but rather tend to learn how to cope with them (Papalia et al., 1998). Therefore the remediation of learning difficulties has historically been seen to be structured around the child with the child learning to apply themselves in a way that enables them to overcome their difficulties (Papalia et al., 1998).

2.2 Assessment of learning difficulties

According to Salvia and Ysseldyke (1995), assessment is the process of collecting information to make decisions about people lives, learning and instruction. A series of

tests that matches the subjects to a set of specified criteria provides the information that forms the basis of any decisions pertaining to the identification of a problem.

The assessment process requires the subject to undergo a series of tests where their individual characteristics are matched to a set of testable criteria (Birsh, 1999). The results of the tests yield information that help isolate the problem.. Once a problem has been identified the assessor can then begin to identify specific solutions that could help the individuals (Adelman & Taylor, 1993). The solutions are often specific in nature because the disorder type may fall under a larger framework of recognised disorders and an individual's needs are seldom generic in nature. Therefore in the context of the assessment of learning difficulties, the assessor seeks to understand the learning disability so that a strategy for remediation can be formulated (Salvia & Ysseldyke, 1995).

The insight gained into the cause of the learning disability and its potential severity is usually dependant on the scope of the tests used and the amount of effort invested by the assessor in the process (Adelman & Taylor, 1993). The gathering of this information however will inform the development of what will hopefully be an affective remedial intervention programmes so that the child is better able to overcome his/her learning disability. Thus the purpose of assessment, according to Adelman and Taylor (1993) is the gathering of information and the formulation of judgements though the way this is conducted is contextual in nature.

The process of assessment can be costly in terms of both time and money to implement. In the context of learning disabilities some indication is usually sought to justify that the assessment take place. Traditionally a comparisons between the child's expected academic achievements and his/her intellectual abilities is one of the methods that is used within the learning paradigm to make judgements about whether or not a child potentially has a learning disability (Waterman, 1994). Other methods of ascertaining potential learning disability include reviewing school records and schoolwork, and observation of the child in a classroom setting (Waterman, 1994). Should it transpire that evidence

supports the presence of a disability then direct and dynamic assessments, that are of a psychometric nature, that delve into the learning style and manner in which a child approaches a task could be used (Waterman, 1994). In-depth analysis of the manner in which a child processes information is vital if a contextual remedial strategy is to be designed. Failure to correctly identify a learning disability will most likely result in a failed remedial intervention (Waterman, 1994).

In-depth assessments are usually carried out to assess whether or not an individual concerned requires specialised education (Japari Remedial School Admission Requirement due to the limited number of pupils the school is able to accommodate). It is a commonly held belief that a child diagnosed with a learning disability may be better taught at remedial schools. The underlying reason for this belief is that the child is seen to benefit from sophisticated teaching techniques and specially trained teachers (Papalia et al., 1998). This prevents the occurrence of a situation where the child is not able to perform on the same academic level as their mainstream peers (Papalia et al., 1998). However, should assessment reveal that the individual has, what could be termed a mild or minor learning disability, the course of action recommended is that the individual receive only extra lessons. The extra tuition serves to supplement their education and prevents the situation where the child may feel academically inadequate (Papalia et al., 1998).

It should be noted that the greater the scope of the assessment carried out, the greater the costs involved. This is especially important in the South African context because though the stated purpose of assessment is the gathering of information to form judgements about the assessment subject, lack of financial resources may often mean that the information upon which assessment decisions are based, are not as complete as they should be. This lack of clarity on the individual's context may be a factor in some cases of treatment resistance where no progress is made in the remediation programme despite the programme being tailored to suit what the individual's specific needs.

2.3 Language

Leontiev (1981) defines language as consisting of “symbols that convey meaning plus rules for combining these symbols that can be used to generate an infinite variety of messages”. It is through the medium of language that we transfer and acquire understanding. Language is therefore about more than the presence of words, whether they are spoken or written, but rather the meaning associated with them (Leontiev, 1981).

In order for language to be universal there needs to be a structured way in which it is used (Bannatyne, 1971). The English language structure for instance is different to that of French or German, hence communicating in the one does not convey meaning in the other. An individual therefore needs to be introduced and guided through the fundamentals of language, especially in the remedial context, if they are to understand it well enough to use it efficiently (Bannatyne, 1971).

Johnson (1967) suggested that language develops in stages. Likewise, Myers and Hammill (1969) theorise that the process of development occurs according to the development of inner language (meaning), comprehending the spoken word (auditory receptive language), speaking (auditory expressive language), reading (visual receptive language), and writing (visual expressive language). According to this outline of language development, the development path of the majority of individuals is therefore phonological in origin with the visual component of language linked to and following after its auditory origins (Myers & Hammill, 1969). The developmental framework of this language theory can also be seen to incorporate many aspects of cognitive function where portions of the brain specific to those sensory modalities are incorporated in the consolidation of a particular skill set (Myers & Hammill, 1969; Kirk 1972).

Chomsky theorised that children are equipped with a Language Acquisition Device or LAD - an innate mechanism or process that facilitates the learning of language (Pinker, 1994). Therefore according to this view, humans learn language because they are genetically equipped to do so (Pinker, 1994). It was Chomsky's belief that the surface

structure of a language did not in itself convey meaning (Pinker, 1994). Rather it is the system of rules that govern the use of words that allows an individual to understand deeper meaning (Pinker, 1994). This suggestion, that the acquisition of language is innate and that meaning is understood according to the set of learned rules, coincides with Mykelburst and Johnson's (1967, as cited in Kirk, 1972) theory that language development is initially internal. It is of import to note that the more complex the language, or form of language used by an individual, the more complex the rule system that is employed (Pinker, 1994; Ellis, 1984; Ehri, 1998).

2.3.1 Language Modalities

Language consists of both auditory and visual modalities that are used to convey meaning with the processes of reading, writing and spelling largely visual in nature (Bannatyne, 1971).

2.3.1.1 Reading

Gibson (1975) theorised that the ability to read forms the basis for success in school and later life since the scholastic syllabus is organised around the student's ability to access information that is stored in text. This is essentially correct as an individual is expected to expand on the information imparted to them by their teachers by becoming their own teachers, accessing information in pertinent texts. Admittedly there is a disparity between the reading of text and the ability to assimilate the meaning attached to it (Gibson, 1975). However, the ability to read fluently (extracting information from text, pictures, diagrams, graphs, and illustrated instructions) and in an automated fashion, as a skilled reader is able to, means that the amount of mental load involved in the reading process is reduced (Gibson, 1975). Once the amount of effort invested in the reading of text reduced, there is more mental capacity available for the deciphering of meaning (Kolb & Whishaw, 1996; Weiten, 1995; Gibson, 1975). Remediation for learning disabled children is therefore vital if they are to acquire enough resources to do exactly this.

Reading involves the ability to decode sentences that link up to form passages of coherent, connected text whose intended purpose it to instruct, inform, or entertain the reader (Siegel, 1989). The ability to decode text however does not automatically result in the comprehension of the knowledge contained therein (Siegel, 1989; Harley 1995). Frith & Snowling (1983) understand decoding to be the transformation of words to print, and comprehension to be the assignation of meaning to words and the text in which they appear once they have been recognised. The ability to read is therefore not a simple and natural ability, converting written text to sound, that many understand it to be. Rather it is a skill that requires both decoding and comprehension skills which are in themselves complex in nature.

2.3.1.1.1 Reading Development

Reading can therefore be considered a difficult skill to learn and acquire. Studies consider reading to involve multiple processes, each of which need to be mastered in order to read efficiently (Bradley & Bryant, 1985; Rayner & Pollatsek, 1989; Frith, 1985). These processes are letter identification skills, phonological / grapheme skills, sequencing and both short and long term memory skills (Oakhill & Yuill, 1996). Other research indicates that an awareness of the alphabetic principle (the ability to match letters and combinations of letters systematically to sounds) is vital in reading development (Ehri, 1980). This awareness plays an important role in enabling the reader to translate presented text into an internal phonological sound (Ehri, 1980). Indeed Venezky (1995) proposes that phonological awareness plays an essential part in learning to read and can be seen to be a precursor to reading development.

A wide range of studies have been conducted into the requirements of skilled reading. These studies however tend to focus on the individual's ability to recognise words, which is a unique requirement for reading, as opposed to the requisite comprehension skills, which are also needed for verbal communication (Goswami, 1998; Coltheart & Harris, 1986). The theories on reading development presented in this research report will

therefore focus on how reading comprehension is understood, while not discounting the importance of word recognition in the reading process.

2.3.1.1.2 Bottom up and top down processing

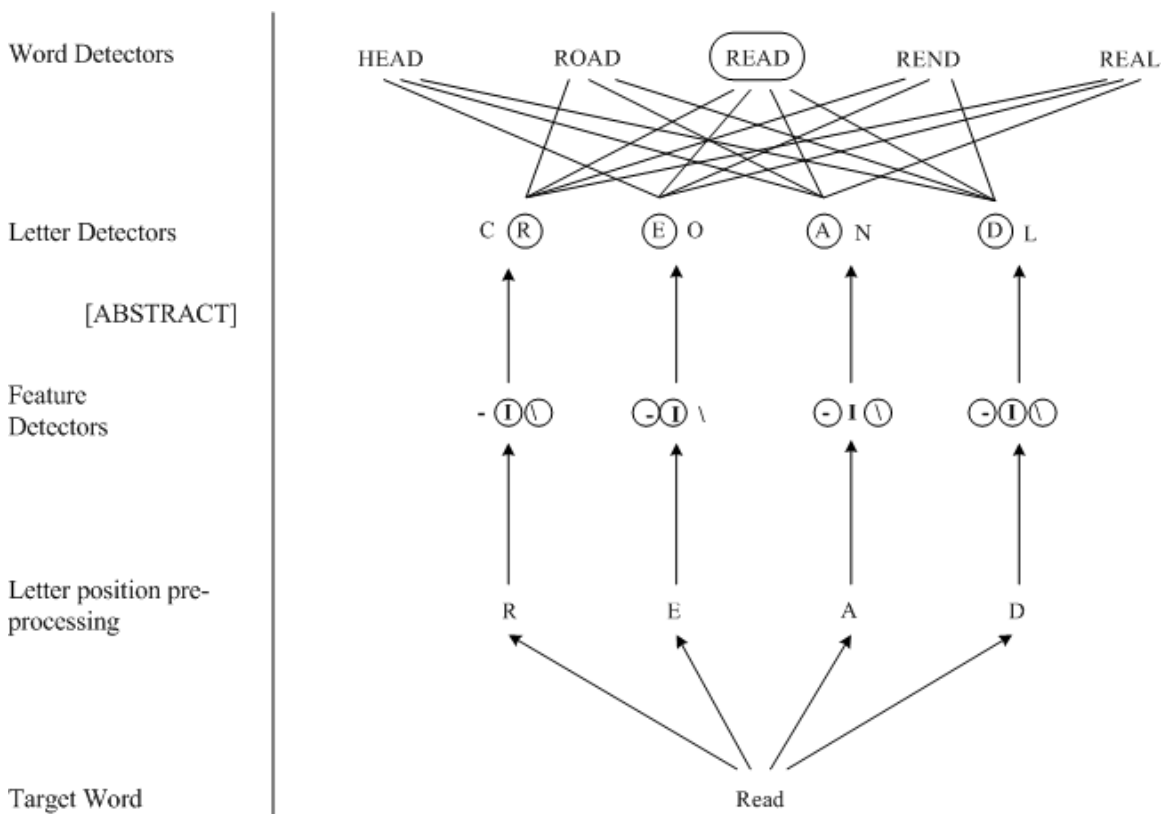
There are two distinct kinds of reading that have been identified by psychologists when trying to understand the manner in which readers recognise words. The first of the two, suggested by Johnson and McClelland (1980, in Ellis, 1993), is a bottom up approach where certain visual, phonological or orthographic cues located within words are used as a means of deciphering the words in the passage. The system is hierarchically arranged with the recognition of initial physical cues leading to the involvement of higher order cognitive functions as the demands required for further processing of the information increases (Bradley & Bryant, 1985; Eysenck & Keane, 2000). This method can be laborious in nature depending on the child's level of recognition skill, the speed of which they can recognise the visual and auditory features of the word (Eysenck & Keane, 2000).

The second method identified is that of the top down approach where initial high level cognitive processes, existing knowledge and prior expectations are used to identify the words. Top down processes help work out what individual words or phrases are through hypotheses generated by the brain (Bradley & Bryant, 1985). The context of what is being read is what helps the reader determine what word is being read on the page (Bradley & Bryant, 1985). The reader filters through a set of likely hypotheses before choosing which word would be the most suitable (Bradley & Bryant, 1985). This method can cause errors in the way in which text is perceived as demonstrated when unskilled readers misread words (the context of the story creates word expectations that are not supported by the text) (Bradley & Bryant, 1985). Top down processes do make use of visual and auditory data in word identification but only in the context of word confirmation for an existing hypothesis (Bradley & Bryant, 1985; Eysenck & Keane, 2000). The inclusion of word features in word recognition however still requires the

individual to be able to recognise features within words but not to the extent required required in a bottom up approach (Bradley & Bryant, 1985; Eysenck & Keane, 2000).

With regard to bottom up and top down process, Johnson and McClelland (1980, in Ellis, 1993) proposed the influential model of the Visual Word Recognition System (see Figure 1). According to this system written language can be identified on a number of levels; the letter-position pre-processing level, feature detection level, abstract letter detection level and abstract word detection level of processing. The theory furthermore suggests that these levels operate sequentially and are hierarchically arranged with features analysed prior to letters and letters prior to words.

Figure 1: Visual Word Recognition System



Visual Word Recognition System - Johnston
and McClelland (1980, p.150)

Johnston and McClelland (1980) explained their model as follows:

In order to read a single word it is theorised that it must first be broken down into letters based on the order in which they appear. Each letter position is then analysed for its constituent features. Various potential corresponding letters are then activated or inhibited on the basis of this feature analysis. At the level of the letter, the letter corresponding to the stimulus letter is then activated and the others inhibited. The resultant output of the letter detectors then serves as input for the word detectors. It is hypothesised that the active letter detectors activate word detectors that have letters in the specific order the letter positioning level detected. Words that do not have letters in this corresponding order are inhibited. The abstract level in the system refers to the identification of multiple potential letters that occur regardless of their specific form e.g. C and R very different letters. The same process applies to the word detector level where the processes of abstraction aids in the correct identification of the word presented in text.

The recognition of a word is mediated by the amount of exposure that individual has had to its structure and the frequency with which the word is used (Harley, 1995). Ellis (1993) theorised that the age at which a word is acquired, the context in which it is acquired, the manner in which it is used, and its frequency of use are important factors in the recognition of the word.

Further investigation in the visual recognition system has indicated that the process of word recognition as described by the bottom up and top down theories may not be segregated in quite the fashion previously suggested. Rumelhart and McClelland (1987), proposed an influential interactive activation model of visual word recognition. Their theories hypothesis that the activation of particular lexical elements occurs at multiple levels and that these activities are interactive in nature. Like Johnson and McClelland, Rumelhart and McClelland (1987) distinguish between three levels of processing, the feature level, the letter level and the word level.

The distinctive difference between the interactive activation model and the bottom up top down model is that the information that is presented at each level is seen to be represented separately in memory and that information is passed bi-directionally as opposed to a single direction as is the case in a hierarchal system (Rumelhart & McClelland, 1987). The bi-directional functioning of this model means that both bottom up and top down process are involved in word recognition (Ruddell & Unrau, 1994). The bi-directional model therefore speaks to the strengths and weaknesses inherent in both bottom up and top down processing models. This model acknowledges that neither bottom up processes and top down processes are enough on their own to adequately account for how words are recognised.

Regardless of the visual recognition approach proposed by Johnson and McClelland (1980, in Ellis, 1993) or (Ruddell & Unrau, 1994), the primary assumption is that lexical access for the word is determined by visual information and perception. Once the word is recognised the meaning of the word is accessed via the mental lexicon, a body of word knowledge, either spoken or written” (Birsh, 1991, p. 497; Ellis, 1993). Word meanings are stored in the Semantic System which is a cognitive system concerned with the “meaning of words and the relationship among words as they are used to represent knowledge of the word” (Birsh (1991, p.501). The lexicon consists of both phonological and visual information that identifies the word and informs its meaning (Coltheart & Harris, 1986).

2.3.1.1.3 The Triple-Route Model

The triple-route model (Ellis & Young, 1988; Eysenck & Keane, 1995) is based upon components identified by Ellis and Young through their studies of acquired dyslexia. The model proposes three routes between the printed word and speech (Eysenck & Keane, 1995), and is considered to provide a good account of how both normal and brain-damaged reading occurs and that normal readers utilise all three routes when reading. All

three routes are hypothesised to start with the visual analysis system, the purpose of which is to identify and group letters in printed words (Eysenck & Keane, 1995).

Ellis, Matthew, Lambon, Morris and Hunter, (2000) hypothesise that Route One makes use of grapheme-phoneme conversion specifically in the working out of pronunciations for unfamiliar words or non-words. This is done through the translation of letters or letter groups into phonemes by applying an internalised set of rules (the reader sounds out the sounds of the letters that are in the word and matches the sounds to word sounds stored within their lexicon) (Ellis et al., 2000). Individuals who suffer from surface dyslexia, where specific difficulties with reading unfamiliar words is often evident, are seen to adhere most strongly to this route in their reading (Ellis et al., 2000). However, since not all irregular words are mispronounced by sufferers of surface dyslexia, it is suggested that Route One is not exclusively adhered to (Seymour, 1994).

Ellis and Young (1988) suggest that the route typically utilised by adult readers is Route Two. At this level it is proposed that adult readers have a multitude of familiar words stored in their visual input lexicon that may become activated following visual representations of a word (Ellis et al., 2000). Subsequently, the meaning of the word is obtained from the semantic system after which the word can be spoken. Sufferers of phonological dyslexia who struggle to read unfamiliar words and non-words, are thought to use Route Two but not Route One (Eysenck & Keane, 2000). Additionally individuals diagnosed with deep dyslexia, who battle with unfamiliar words and who often make semantic reading errors, make use of Route Two due to their inability to use grapheme-phoneme conversion effectively (Ellis & Young, 1988); Seymour, 1994). Individuals with these types of dyslexia therefore rely word structure memory in order to read well.

Route Three resembles Route Two in that the visual input lexicon and the speech output lexicon are involved in the reading process (Eysenck & Keane, 2000). The difference however is that the semantic system is bypassed in Route Three, so that printed words are pronounced but not understood. Unfamiliar and non-words are also difficult to

pronounce (Eysenck & Keane, 2000). A reader may therefore recognised certain letter structures within an unfamiliar word like ch- , and sound out the remaining letters in a fairly accurate manner; but may not understand what the word means. This type of occurrence is common where a reader might read a word for the first time and then ask “what it means”. A skilled reader may infer the meaning of the word from the context of the sentence within which it is embedded.

The triple-route model is thought to provide a comprehensive account of how normal and brain-damaged reading occurs (Snowling, Goulandris, & Stackhouse, 1996). Although normal readers are thought to make use of all three routes when reading, the direct or visual lexical route is generally regarded as being the quickest (Route Two) (Snowling et al., 1996). Subsequent research into the triple-route model to reading has revealed that the main two routes, initially thought to be independent of each other, may be inter-related (Eysenck & Keane, 2000; Snowling et al., 1996). The visual lexical path to reading is therefore able to affect the processing of the non-visual lexical path and visa versa (Eysenck & Keane, 2000; Snowling et al., 1996).

2.3.1.1.4 The connectionist approach to skilled reading

This approach to the pronunciation of irregular and regular words, as theorised by Plaut (1994), is seen to be highly interactive as opposed to the three non-interactive routes in the triple-route theory. The premise of the theory is that words vary in consistency to the extent of which their pronunciation agrees with those words of a similar spelling. Consistent words can as a result generally be pronounced faster and more accurately than inconsistent words because of greater knowledge available to the reader about the correct pronunciation of such words (Plaut, 1994). This hypothesis is supported by evidence from a study documented in Eysenck and Keane (2000), who found that word naming was generally predicted better by consistency rather than regularity of spelling.

The inter-connected nature of the various routes for successful decoding of words also acknowledges the importance of phonological coding of words (Eysenck & Keane, 2000). Eysenck and Keane (2000) theorised that phonological coding occurs even when it impairs performance and that some phonological coding will inevitably occur even when a word is presented to a reader for a very brief period of time. The individual therefore makes use of the auditory lexicon access in addition to visual lexicon. Both the auditory and visual lexicons are inter-related in nature which means that developments in one lexical access route are ideally reflected in development with the other (Eysenck & Keane, 2000). Indeed the inter-related nature of reading, writing and spelling theorised by Luria (1973) would confirm such an underlying structure where visual and auditory language systems need to function harmoniously in order for language operations to occur smoothly.

2.3.1.2 Spelling

Spelling within the English language is a complex process due to a number of orthographic features inherent to the language (Birsh, 1999). These serve to complicate the alphabetic principle of word production (Carreker, 1999). Orthographic features refer to “the writing systems of a language; correct or standardized spelling according to established usage” (Birsh, 2000, p.499). The good speller therefore needs to be aware of a number of different factors. These factors need not necessarily be known in their exact theological format, rather the individual might develop what can be attributable to a sense of what is correct or incorrect when a word is spelled out.

2.3.1.2.1 Obstacles to good spelling

Rebolo (2002) cited the following obstacles facing the English speller:

- Phoneme / grapheme confusion. A phoneme is not necessarily presented by a grapheme of a single letter. For instance there are multiple grapheme representations of the phoneme /o/; the grapheme being spelt as /ough/ or /o/ depending on the word.

- Grapheme / phoneme ambiguity. A grapheme may represent two or more phonemes. For instance the vowel combination /ea/ in the words sea, head and steak produce distinctly different sounds.
- Words whose roots are from languages other than English. The phoneme grapheme relationship of these words is therefore different. These words are commonly treated as exception words, e.g. the word choir.
- Attempts to preserve certain morphological, syntactic and semantic word information by forfeiting the spelling / phonetic representation relationship. For instance the morphological ending /ed/ is pronounced differently depending on the word e.g. missed, stayed, sanded. The pronunciation of the words preserves information about the original derivation of the word even though the ending have the same letter structure.

According to Ellis (1984) competent spelling does not rely solely on a system that specifies phoneme to grapheme conversion rules. The obstacles to good spelling described by Rebolo (2002) support this view in that it demonstrates that blind adherence to this system will pose a barrier in itself. Rather competent spelling in English requires access to a lexical system that contains complete or whole word spelling representation (Ellis, 1984). Storing whole word presentation in the lexical system allows the speller to access the word as a discrete unit rather than the sum of its individual phoneme components. In the case of homonyms¹, the speller is required to remember the words as “exceptions” and produce the correct structure depending on the context within which they are used (Frith, 1989). In addition to storing word representations, the lexicon²

¹ **Homonyms:** Words that appear to sound the same yet are of different structure to one another (Ellis, 1993).

² **Lexicon:** “A body of word knowledge, either spoken or written” (Birsh, 1991, p. 497).

stores contextual data (Frith, 1989). Ellis (1984) therefore stores great import in lexical access as a requirement for good spelling ability (Ellis, 1984).

Lexical access however cannot account for all word spellings because in order for this to be true, the individual would need to be familiar with every word they wish to produce (Fischer, 2003). Fischer (2003) indicates that in order to spell unfamiliar words, there needs to be a consistent alphabetic principle or orthography in operation as well. This orthography should ideally be viewed as an individual's implementation of linguistic sensitivity that allows the structures of the word produced, to be implicitly perceived and implemented.

The linguistic sensitivity referred to by Fischer (2003) is the speller's ability to associate letter patterns with the sounds inherent to the word itself, be that grapheme-phoneme correspondence or the more complex grapheme-morpheme correspondence. The recognition of associated letter patterns to sounds also implies that the speller will develop the ability to apply these letter units to diverse words where there is a perceived phonetic match. In order to do this correctly however the speller does need to be aware of the phonetic rules that govern the way in which these letters can be combined (Harley, 1995). Therefore linguistic sensitivity is not isolated to the recognition of sound and its accompanying grapheme match but also a realization that the implementation of these components in spelling needs to operate within the broader context of the rules governing word construction (Fischer, 2003). The speller is therefore also sensitive to the rules that underlie the structure of words.

- In support of the above processes, Doehring (1981) demonstrated that it is the systematic acquisition of morphological and orthographic patterns that form the foundation of good spelling. Poor spellers, while having been exposed to the same processes as good spellers, seem to be differentiated by their lack of ability to have mastered these patterns and recognize their consistency of use across a broad spectrum of words (Adams, 1990).

Finally Moats and Farrell (2000) suggests that good spellers are able to simultaneously draw lexical data (awareness of syntax³, morphology and semantics) in addition to their awareness of sound and letter patterns in order to correctly produce words.

Good spellers therefore appear to have the following abilities;

- Well developed phonological processing skills that not only make them aware of sounds, but also support the acquisition of additional letter patterns in words as their exposure to a range of words increases (Moats & Farrell, 2000; Myers & Hammill, 1969).
- Good orthographic memory in which they are able to remember the letter patterns associated with the word sounds rather than specific words themselves (Carreker, 1999). Adams (1990) perceives this to be dependant on well developed phonological processing skills as well as not only knowing how sounds are represented but also on knowledge of how words are developed.
- The ability to apply their syntactic knowledge as well as semantic and morphological principles to the context within the words will be used.

The abilities associated with good spellers are not limited to their specific demographic but are generally utilized by all individuals (good or poor) in the spelling process (Moats & Farrell, 2000; Birsh, 1991; 1999; 2000). It is purely a matter of the manner in which these abilities are utilized (Birsh, 1991; 1999; 2000). The focus when mediating poor spelling ability should therefore look to what needs to be improved about the manner in which these systems are utilized (Potter, 2001).

³ **Syntax**: “The system by which words may be ordered in phrases and sentences; sentence structure; grammar” (Birsh, 1991, p. 502).

2.3.1.2.2 Spelling Development

Carreker (1999) suggests that spelling is a unitary process that is interactive in nature requiring both orthographic and phonological knowledge. Beginning spellers are seen to make use of a range of phonological and visual strategies when building and consolidating upon their spelling ability (Bryant & Bradley, 1985). Spelling development is therefore seen to occur in stages.

The initial stage of learning to spell is the pre-communicative stage (Moats & Farrell, 2000). During this period the child learns to differentiate between drawing and the writing of letters generally through repetitive copying exercises that require him / her to imitate the print that has been set before them (Bryant & Bradley, 1985). During this stage the child is unlikely to understand the concept of these disparate letters combining to form a word, the conventions of print such as the left to right progression of writing, nor the alphabetic principle (Bryant & Bradley, 1985).

The child is believed to proceed to the next stage of spelling developments when they grasp, for the first time, the concept of the alphabetic principle and realise that the spoken word can be reproduced in print (Hatcher, 1994). When this realisation of letters being reproduced in print is first realised, Hatcher (1994) suggests that their initial attempts at writing will be at the syllabic level rather than at the phonemic level. The child will match the sound for the letter itself to the sounds of the syllable produce in words, hence the word be will be matched to the letter b or the word see to the letter c (Hatcher, 1994).

As the learning process continues the child becomes aware that there are individual letters within words and that these individual letters each have a separate sound (Moats & Farrell, 2000). This stage of learning is titled the semi-phonetic stage and is characterised by the child's use of incomplete phonetic representations of words (Moats and Farrell, 2000). According to Adams (1990); and Hatcher (1994), children in the semi-phonetic stage are not able to fully identify all the phonemes within a word with their graphemic counterparts. This means that they may make use of a range of letters to represent a word

but not necessarily produce a series of printed letters that is entirely accurate. Such an example of this might be a letter combination of sd for the word seed. The child recognised that there was more than one letter at play in the structure of the written word but does not yet possess the skill to correctly produce them (Hatcher, 1994). Finally, some of the rules governing the structuring of letters within words are also learnt such as left-to-right nature of word production (Moats & Farrell, 2000).

Experience and continued exposure to print in all its different forms as well as the use of structured lesson planning helps early spellers to reach a complete stage of phonic awareness (Moats & Farrell, 2000). At this stage the child has a greater ability to identify the underlying sounds within a word, though most likely without the accompanying knowledge of conventional spelling patterns (Moats & Farrell, 2000). More accurate attempts at spelling are observed during this phase of spelling development (Goswami, 1998). The production of words during what is still largely the beginning stages of spelling development are largely ruled by what the child interprets to be the grapheme matches to phonemes contained within words (Goswami, 1998). The -ed ending that is present appended to verbs to denote its association with an action on the past may be produced as a t, e.g. walked spelt as walkt (Goswami, 1998). The child has not yet gathered enough experience of words and their associated structures to have developed a sense of what is a correct or incorrect word construction (Carrekar, 1999).

Moats and Farrell (2000) believe that the key to developing the sensitivity to the correct production of words is the process of reading. It is believed that this sensitivity cannot be formally taught as it is not based in any empirical rule set that the child may be introduced to in their classroom situation (Moats & Farrell, 2000). Rather it is the result of the realisation of the orthographic patterns that govern word production and their repeated structures in words that have similar sound components (Moats & Farrell, 2000). This means that should a child produce a word that they are not familiar with and is incorrect, yet embodies a familiar phoneme property, they might well get a feeling that the word is not quite right (Moats & Farrell, 2000).

Good spelling however cannot rely on the possibility that the child may make the intuitive leap in understanding the patterns that govern the manner in which words are produced (Kirk, 1972). Good spelling, like any skill, needs to initially be formally taught (Kirk, 1972). This means involving the introduction of aspects of language such as word groups, word properties such as the use of a prefix or a suffix, the inclusion of an /e/ on the end of certain words to signal that the preceding vowel is a long vowel, and many other such rules (Kirk, 1972). These rules once correctly internalised will of vital importance in the correct production of words (Kirk, 1972).

2.3.1.3 Writing

The process of writing is the presentation of language through the physical medium of print (Ellis, 1993). The way in which writing is produced is a product of the way an individual uses language and as a consequence there are varying writing systems in use throughout the world (Hatcher, 1994). According to Ellis (1993) the writing systems of the world can be divided into three distinct categories. These are: logographic writing such as seen in Chinese where each symbol represent and different spoken word; syllabic systems such as Japanese Kana where each symbol represents one syllable of the spoken language; and finally the alphabetic writing system such as English, where each character represents a particular phoneme.

None of the systems described are perfect in nature and indeed possess many inherent flaws that its users will need to account for (Coltheart & Harris, 1986). For instance, the logographic system, in which the writing represents the spoken word, does not allow an individual to reproduce a word if he/she has not been exposed to it and is actively taught its corresponding physical form (Ellis, 1993). The reverse also hold true should the individual be exposed to the physical form of a word without knowing its spoken counterpart (aspects of the symbols meaning will be inferred by the context within which they are used but this is not always done accurately) (Ellis, 1993). In a similar manner

Coltheart and Harris (1986) see a language system that consists of both mono- and polysyllables (alphabetic writing system) to prove difficult to master comprehensively as the syllabic system itself does not lend itself to an easy learning process. The English language in particular is a difficult language to master due to its diverse range of syllables as well as its many vowel combinations which are at times used to represent similar spoken sounds when their forms differ so greatly (Coltheart & Harris, 1986).

Not all syllabic languages are hard to master. The difficulty in mastering them depends on the depth of orthography that the potential language initiates needs to master (Rebolo, 2002). In South Africa the correct spelling of Afrikaans words is much easier to master than those that are English. This is because Afrikaans is what is termed a shallow or transparent orthographic language where a single sound, or phoneme, is represented by a single grapheme (Rebolo, 2002). In English this is not the case due to its origins as a “polyglot language” which has been influenced by the languages it has been exposed to during its history: Anglo-Saxon, Latin, Greek, and others (Rebolo, 2002). Each of these languages has played a role in the development of the English and this need to be understood and taken into account in order to master its intricacies.

In addition to the variable origins of English language, the orthography itself has undergone substantial changes in the last hundred years (Rebolo, 2002). These changes can be clearly seen during “The Great Vowel Shift” where the vowel sounds of the language underwent substantial changes (Rebolo, 2002). During this period, certain vowel sounds were being articulated in new positions which caused a distinct separation between phonology and spelling. For instance, Early Modern English of Shakespeare’s time referred to the vowel sound in the word bite as an /a/ as in **bay**, while in later Mature English employed in the time of Chaucer the vowel sound would have been referred to as an /e/ as in **bee** (Rebolo, 2002).

This observable shift in the English language orthography meant that what were “stable spellings now came to represent different sounds” which in turn meant that license was

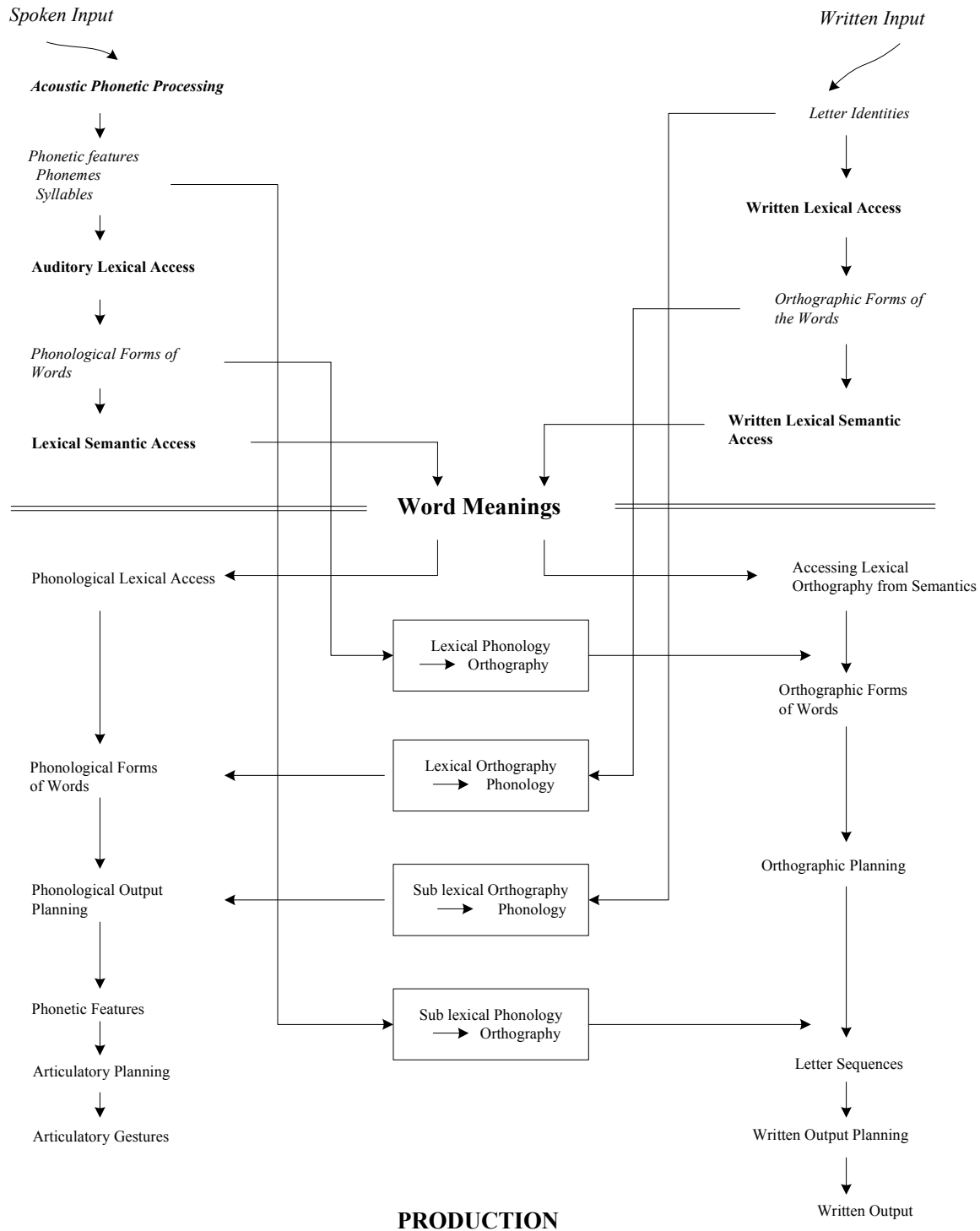
given for different graphemic combinations to be used to represent a large number of different phonemic combinations (Bradley & Bryant, 1985). The pronunciation of English language has continued to shift till the present day with the result that English language users are left with a legacy in which the modern English is a system that is largely phonetic, but with an opaque or complex accompanying orthography (Bradley & Bryant, 1985).

2.3.2 The Simultaneous Processing Model

Reading, writing and spelling theories all acknowledge the importance of phonological and auditory strategies in language production. However the auditory and visual strategies that are employed by the individual are seen to be separate from one another and in some ways hierarchical as well.

The Simultaneous Processing Model (see Figure 2) interprets the functions of language comprehension and production as inter-related with both auditory and visual strategies represented in a systematic manner that does not place emphasis on one over the other. The model therefore looks at the processes of reading, writing and spelling in a holistic manner seeing language as one unit as opposed to it consisting of disparate parts. This model also conforms to Frith's (1985, 1989) comments on connectionist theory that stressed the inter-related nature of language where developments in one aspect of language are visible in another.

**Figure 2: Simultaneous Processing Model of Language
COMPREHENSION**



**Simultaneous Processing Model of language
Comprehension**

2.3.2.1 Phonological Awareness and the Auditory Lexicon

Birsh (2000, p.499) defines phonological awareness as “both the knowledge and sensitivity to the phonological structure of words in language.” This involves the ability to notice, think about and or manipulate sound segments in words (Birsh (2000). Birsh (2000) also states that phonological awareness progresses from rhyming to syllable counting; to detecting first, last and middle sounds; to segmenting, adding, deleting and substituting sounds in words. Brady (1997) provide an elegant summation of Birch’s view stating that phonological awareness is the ability to detect and discriminate the consonant and vowel sections in a spoken word, and then to classify the word based on these phonemic properties.

Amongst normal readers phonological awareness plays a vital role in the mastery of reading and spelling words, especially those words that are unfamiliar (Frith, 1989). Normal readers have mastered the letter-to-sound (grapheme to phoneme) relationship that exists between spoken and written language (Ellis, 1984; Frith, 1989). A phoneme is described by Myers and Hammill (1969, p.394) as “a group of closely related speech sounds all of which are generally regarded as the same sound, e.g., /t/ in top and in stop is one phoneme, although it is produced differently in the two words.” A grapheme is “a letter or letter cluster representing a single sound e.g. i, igh)” (Birsh, 1991, p. 495).

A normal reader, who has a developed phonological awareness, is able to establish a number of plausible spellings when exposed to a novel word for the first time from experience gained from reading and spelling exercises (Ellis, 1984; Frith, 1989). Their word choice is informed by linguistic sensitivity, the ability to decide whether or not “the word sounds right” when read or spelt (Ellis, 1984; Frith, 1989). Amongst disabled readers however, the link between graphemes and phonemes is absent or deficient which results in incorrect pronunciation of unfamiliar or pseudo words (which are often used to test for phonological awareness) (Ellis, 1984; Frith, 1989). An example of a pseudo word is explained by Jones et al. (1987, p.122) who states that the word TRAKE can only be

pronounced by identifying the sounds represented by individual letters and letter combinations, and then blending the sounds to form a word.

Normal readers also rely on phonological awareness in order to access word meanings via the auditory lexicon (Kolb & Whishaw, 1996). These meanings are obtained by matching sounds they produce from a word, with word sounds stored in memory (Eysenk & Keane, 2000). The recognition process requires the individual to first phonetically segment the word and then sounding out the word's composite parts so that the reader can pronounce it (Eysenk & Keane, 2000). Kolb & Whishaw (1996, p.650) refer to this process in the context of reading that relies on sounding out the parts of words as phonological reading. Lack of phonological ability can therefore limit the disabled reader's ability read, comprehend and produce intelligible text.

2.3.2.2 Visual Lexicon – Orthographic Awareness

Somewhat ironically, repeated use of phonological processes for the interpretation of words results in the adoption of an alternative, more automated process of recognition that does not rely on phonological ability (Birsh, 2000). Repeated exposure to a word results in its inclusion in the visual lexicon. The reader therefore matches the visual structure of the word to that stored in memory and is subsequently able to identify the word and its associated meaning. Ellis (1984) and Frith (1989) however state that the presence of phonological ability is essential if the visual lexicon is to be built up to such a degree that automated word recognition can occur; and so that the reader can correctly interpret words if encountering them for the first time.

Readers that do not have a viable phonological path into a word typically rely on alternative strategies for decoding words, including visual recognition according to word shape and contextual references (Ellis, 1984; Frith, 1989). Contextual references allow the individual to infer what the word should be according to its placement in the context of a sentence but this is not an accurate manner of word identification as it relies on

accurate word/contextual interpretation (Ellis, 1984; Frith, 1989). The information gathered via these visual strategies is then used to activate an associated visual lexical entry and thereby the semantic meaning of the word. However it should be noted that neither of these strategies is ideal. This is because visual recognition requires the reader to rote learn words with the result that he/she will only be able to read words with which they are familiar (Brady, 1997; Ellis, 1984; Frith, 1989).

The use of the visual lexicon in reading is the most direct and most efficient route to accessing the semantic system (Brady, 1997). In the context of skilled readers it is the lexical access system that is most commonly used as it does not require the time delay inherent in phonological interpretation (Eysenk & Keane, 2000). The efficiency of this system however is dependant on the number of words that the reader has previously encountered and stored in his / her visual lexicon. This method of lexical access however provides readers with reduced phonological ability to read and comprehend text.

2.4 Language Comprehension

Das and Parrila (2001, p.4) theorise that orthographic coding is “the ability to represent the unique array of letters that defines a printed word”. The written component of language was developed to explicitly be able to transmit this code and hinges on the idea that just like words have phonological codes, or identities, so to do words have an orthographic codes, or identities (Das & Parrila, 2001, p.4). The phonological code of a word consists of the individual phonemes that combine to form the sound of the word (the sound combination is specific to the word hence its recognition) (Ehri, 1989). The orthographic code of a word consists of the manner it is represented in writing or the manner in which the graphemes are arranged that are specific to that word (Ehri, 1998).

Ehri (1998) interpreted the decoding process to entail the recognition of the correspondence between the grapheme features of the word and its phonological counterparts. Decoding of words is therefore the process of recognising the sounds that

are made inside of words because the letters within the words have come to represent not the words, but the sounds within the words (Ehri, 1998). As readers are exposed to more complex text and associated ideas, so too does the task of translation become more complex (Birsh, 2000). Birsh (2000) and Ehri (1998) in a like manner proposed that the complex the writing system used, and the manner in which words are spelt, the more difficult the word translation process becomes.

Implicit in the decoding process is the understanding of the combinatorial nature of alphabetic spelling where alternative grapheme patterns can produce the same phonological properties in the word (Ellis, 1993). These homophones, or like sounds that are represented in differing forms in writing, are common to the English language e.g. sound of the word “mane” identical to that of the word “main” (Ellis, 1993). The ability to assemble a plausible spelling for a sound is the result of acquired orthographic code where the interpretation of the grapheme within words is subject to a set of rules governing their use (Treiman, 1997, Ehri, 1998). As the internal orthographic code of an individual is acquired over time, so too does their ability to generate new words and interpret increasingly sophisticated language. The internalisation of this code however requires it to be explicitly taught and is seen to be one of the more complex higher cognitive functions (Treiman, 1997). The activity requires co-ordination of attention, rate-of processing, sequencing, memory, linguistic systems and the visual system (Treiman, 1997; Ehri, 1998).

The importance of phonological ability is therefore highlighted in the context of internalising the orthography of the English language (comprehending language) because orthographic coding relies in part on phonological ability. In the case of learning disabled children where their phonological ability is deficient or impaired, varied spelling of the same word is common (Potter, 2001). This reflects the absence of, or incorrect internalisation of the orthographic code used to produce that word as a result of the inability to match up the phonological components of the word. What is important to note is that when this situation arises the phonologically deficient individual uses visual

paths to word interpretation that are imprecise in nature with the result that reading and spelling are made more difficult (Ehri, 1998; Potter, 2001).

2.5 Chapter Summary

This chapter has defined how learning disabilities are understood and assessed within the context of this research report with the intention of highlighting that disability does not imply retardation. Additionally the traditional actions undertaken in response once positive disability diagnosis has been confirmed, the limitations of the approach and the problems typically faced by remedial tutors has been explored.

This chapter has also looked at the concept of language and the mediums through which communication takes place. Language and the way in which it is used is understood to be the result of skills that have been developed and that this development is cognitive in nature and linked to certain sensory modalities. The idea that human beings are biologically suited to language development has also been explored with the conclusion that as language development progresses so to do the associated rule systems and mental areas that are needed to sustain these functions. With this in mind it would be pertinent to indicate that learning disabilities an individual may possess might not be immediately apparent. As more complex functions are required, which in turn utilise previously unused brain areas, a disability may be evident as this previously unused brain area is developmentally stunted.

Theories on reading, spelling and writing have been explored separately and in the context of connectionist theory. It is apparent that there is a complex relationship between each of the modalities, and that isolated theory as to the manner in which they function is inadequate. The connectionist approach to language comprehension and the manner in which it is used establishes the cognitive neurological basis of reading, writing and spelling skills and the role these skills play in an individual's mastery of language.

English language orthography, the rule system that governs the way in which words are constructed used has also been explored. The literature indicates that errors in word production commonly have their root in the way children have been taught to use letters and words. Errors can therefore be resolved by paying close attention to the internalised rule systems that the child uses and correcting misconceptions as they occur.

Finally this chapter stressed the importance of phonological ability in language and the underlying role it plays in all language processes. Children with learning disabilities are understood to have less phonological ability than their non disabled counterparts and as a result are better suited to the phonological based instruction present in mainstream education. The connectionist model however illustrates how phonological ability can be assisted through the visual recognition of word patterns and their auditory equivalent stored in their lexicon. As stated by Ehri (1998) the process of recognising the sounds that are made inside of words because the letters within the words have come to represent not the words, but the sounds within the words.

An effective remedial tutor should possess both a holistic and detailed understanding of these theories in order to effectively aid the remediation process. A holistic understanding is necessary in that there is a recognition that there is an interaction between the various modes of language and that each of these modes is interdependent; and a detailed understanding in that this knowledge is essential if the root of a disorder is to be identified and the implications of this disorder understood in that individual's broader language context if he/ she is receive successful remediation.

3 Chapter Three: The Theoretical Basis of High Imagery Instruction

3.1 Introduction

The Targeted Revisualisation Programme is a multi-sensory programme which attempts to use mental imagery to provide a different form of instruction for those children with learning disabilities who do not make progress in remedial therapy. Its conception of the role of mental imagery in learning is based on the work of Jean Piaget, who has defined perception, mental imagery, language and cognition as the interlinked processes which underpin intelligence (Potter, 2003).

Piaget (1964; Piaget & Inhelder, 1971) defines perception and mental imagery as having their foundations in activity, and in particular the representational activities involved in drawing and copying. The Targeted Revisualisation Programme thus involves the child in a variety of multi-sensory tasks which introduce reading, writing, and spelling as interlinked representational activities (Potter, 2006).

The programme also assumes, based on the theories of the Russian educational and neuropsychologist Alexander Luria (1973), that the development of the processes of reading and written language are dependent on the development of a hierarchy of functional integrities within the central nervous system and the brain (Potter, 2003). The assumption is that multi-sensory tasks which introduce reading, writing, and spelling are interlinked representational activities that invoke different and more broad-based neuropsychological processes to those instructional activities based on primarily language-based or auditory instruction.

The attempt to invoke perception and mental imagery in multi-sensory instruction is thus the basis for what has been defined by Potter (2001; 2003; 2004; 2006) as high imagery

instruction. The purpose of this chapter is to review certain theories relevant to high imagery instruction, as a basis for interpreting the results of this study. The focus of the chapter is thus on the different cognitive processes involved in the multi-sensory teaching of reading, writing and spelling, as a basis for understanding of why high imagery multi-sensory teaching may be helpful in working with learning disabled children who are not making progress at school. Specifically Piaget's theories of cognitive maturation and cerebral dominance, as well as theories of cerebral dominance are reviewed to provide a framework for theorising relative to the types of cross-modal associations which high imagery instruction attempts to develop in learning disabled children.

3.2 Cognitive Processing, Mental Imagery and Cerebral Dominance

Farah (1984) and Kosslyn (1988) have pointed out that visual mental images are formed on a neurological level by activating previously stored perceptual images. Images are also constructed one part at a time, apparently based on the existence of the separate pathways 'what' and 'where'. These pathways are used for processing different kinds of information during perception, as well as the combinations of different brain systems involved in action, memory and imagining (Kolb & Whishaw, 1996).

It may also be the case that there are issues of cerebral dominance involved in how learning disabled children process information. Annette (1985), for example, has suggested that cerebral dominance exists over a genetically determined continuum, and that there is an over-representation of left and non-right handers at risk for speech learning and dyslexia. Beeman, Bowden, and Gernsbacher (2000) have suggested that there are differences in the way in which the right and left hemisphere of the brain code information, while Tallal (1993) has suggested that use of right as opposed to left hemispheric processing routes may contribute to the retarded processing speed frequently observed in dyslexics, how they are understood, as well as why they are important to the academic and social success of an individual.

These theories are reviewed in this chapter, as a basis for discussing the types of activities included in the Targeted Revisualisation Programme. The assumption is that high imagery instruction may be effective in providing the learning disabled child with a different and more visually-based set of strategies for learning to read, write and spell. It is also assumed that this type of visually-based multi-sensory teaching activities provides a basis for learning disabled children to utilise a right as opposed to a left hemispheric route for developing the neuro-cognitive associations necessary for learning to read, write and spell.

3.3 Multi-sensory teaching approaches

A multi-sensory approach refers to any learning activity that makes simultaneous use of two or more sensory modalities in the communication of information (sight, touch, smell, taste, sound) (Moats & Farrell, 2000). The assumption is that multi-sensory instruction provides the basis for all the senses, including the kinaesthetic senses, to be involved in the teaching and learning process (Moats & Farrell, 2000).

Learning through more than one sensory modality is seen to assist in the reinforcement of memory, which is important in the context of children with learning disabilities (Moats & Farrell, 2000). This corresponds with the holistic depiction of language in the simultaneous processing model.

Teaching within this paradigm enhances the individual's attention to linguistic detail through multi-sensory involvement and allows for a complete and explicit registration of linguistic information (Moats & Farrell, 2000). This assumption is that simultaneous processing of this information through phonological, visual and kinaesthetic channels stimulates the associated memory areas.

Children with learning disabilities often display a weakness in their ability to retain information and by linking the processes of listening, reading, speaking and writing with

multi-sensory modalities, more than one area of the brain is activated thereby making for a more effective learning strategy (Birsh, 1999). Kirk (1972) sees multi-sensory teaching as a means through which a specific disability, when isolated, can be mediated by improving its functioning through the use of associated areas. Mediated refers to “the physical art of the process of making the form and structure of a word more visible, where understanding is achieved through or dependant upon a third party” (Birsh, 2000).

The learning process is therefore enriched because the child is provided with more than one path to understanding. Conventional learning strategies that use only one sensory approach (uni-sensory approach) do not provide this third party solution and indeed appear to activate less total brain area during the learning process (Birsh, 1991). The assumption is that multi-sensory instruction provides a neuropsychological basis for overcoming a learning difficulty (Gillingham & Stillman, 1960).

3.4 Luria

The Russian neuro-psychologist Luria conceptualized the functions of reading, writing and spelling, and dictation as complex interactive acts that require the concerted working of numerous disparate functional areas or zones within the human brain (Luria, 1973). The systems underpinning these processes consequently cannot be viewed in isolation and are, according to Luria, not isolated to specific cortical zones or to isolated cell groups.

Luria suggests that there are specific cortical zones that perform specific roles in the complex functioning of the system within which they are organised. He goes further to state that the role performed within each zone also influences the manner in which the separate systems themselves interact with one another (Luria, 1973).

Luria (1971, in Potter, 2003) suggests that the interactions between Luria’s functional zones can gain complexity and that as this occurs so to do the scholastic skills associated

with them. This is not to say that a person's scholastic skill will automatically increase as the process of growth brings about the consolidation of functions between these areas; but rather that the two are so closely aligned that the one cannot occur without the other (Luria, 1973). In terms of this assumption, it would be expected that the complex range of reading, writing, spelling and dictation abilities accorded to adult functioning would not be present amongst children because the development of the relevant functional zones had not yet taken place.

Luria thus suggests that the activities involved in learning to read, write and spell bring about systematic changes in the way in which the brain is organised. The development of associated complex functions is also hierarchical in nature, where progress from one stage to another requires a certain level of mastery before the next could begin (Luria, 1973). It is therefore acceptable to assume that as the individual matures, the complexity of the tasks that they can perform, as well as how well they are able to use these systems in relation to one another, increase as well.

Leontiev (1981) supports the view of increased complexity of function with empirical evidence. Leontiev (1981) suggests that the frontal lobe functions of the human brain develop in two stages. In addition to Leontiev's findings, Lenneberg (1967) theorised that language development in small children is closely associated with the development of the myelin sheaths around neurons in the brain. Myelination of brain neurons due to repeated use of neuron pathways within the brain, so that neural impulses can be transmitted more efficiently, has also been extensively explored by neuropsychologists who lend credence to this view (Doehring, 1981; Papalia et al., 1998). Potter (2003) recognises this trend and has based the Targeted Revisualisation Programme on the assumption that repeated external experiences are likely to lead to a qualitative improvement in the way in which the brain engages with information.

In the context of Lurian Theory, Jansen (1996) has proposed that learning disabilities such as perceptual deficits (dyslexia and aphasia), poor visuo-motor co-ordination, and

language delays may be due to neurological dysfunction. Dyslexics typically have scholastic performance results that are lower than would be expected given their age, intelligence and amount of schooling. Additionally they appear to have difficulty matching words with their speech equivalents and are not able to break a word down into its sound components (Papalia et al., 1998, p.290). The cause of the disorder would therefore not be due to lowered intelligence but due to the manner in which the person's brain functions.

Learning difficulties are commonly associated with poor reading, writing and spelling abilities in later life (Jansen, 1996). In support of the neurological basis of learning disorders Fakouri (1991) suggests that the emergence of learning difficulties in later scholastic development may be due to the way in which complex tasks engage areas of the brain that had till that point lain dormant. These dormant areas are the cause of previously unidentified neurological dysfunction.

In treating the cause of learning difficulties Fakouri (1991) suggests that any defective functioning present in the child may be replaced by an intact neurological system at a later stage. The development of this system will however require external intervention so the process is guided in the correct manner. Potter (2001) suggests, in terms of Lurian theory, that the remediation of any difficulties that a child may experience in the areas of reading, writing and spelling requires the establishment of basic skills, memory integrities and integrative functions with remedial activities structured to achieve these objectives.

3.5 Cerebral Dominance and associated learning styles

Research in the cognitive functions and the structure of the brain have lead to a better understanding of how the various portions of the brain interact and the nature of the roles they perform. While it is understood that cognitive functions are not achieved through the sole use of a specific area but rather the concerted and interconnected of many areas; their is evidence to support the certain parts of either hemisphere in the brain are more

involved in specific functions than others (Annette, 1985). Rayner (2005) suggests that an individual's ability to flexibly apply these functions may play a role in differentiating children who respond to standard, phonological remediation techniques and children who require a more visual strategy to improve their reading and written language.

It is understood that the left hemisphere of the brain is dominant in linguistic processes and the right hemisphere is dominant in visuo-spatial processes (Rayner, 2005). Birsh (1999) theorised that children with learning disabilities struggle to make use of cognitive processes that accommodate orthographic processes and instead make use of a "Right Hemispheric Dominant" or "Non Hemispheric Dominant" style. The process of remediation however enables them to make a switch to a "Left Hemispheric" style once the orthographic processes "have been explicitly pointed out to them". Rayner (2005) suggests that some children who do not respond to Standard Remediation techniques because they are unable to shift away from a "Right Hemispheric Dominant" or "Non Hemispheric Dominant" cognitive style. Their ability to process orthographic information is therefore inhibited.

Cognitive flexibility is dependant on cerebral maturation of the prefrontal cortex (Annette, 1985). The process usually proceeds in a structured manner where the deeper layers of the brain mature before the outer layers of the brain. As this maturation takes place so too is there a corresponding increase in the range of functions that can be performed. The success of standard remediation practices is based on the assumption that the process of maturation can be structured and guided so that the child learns to make use of phonological skills occur normally amongst other children (Frith, 1989). The child is by these means therefore taught to "switch" their cognitive style to that which has been repetitively drilled into them (Rayner, 2005).

Children who are unable to perform the cognitive shift desired as a results of standard remediation therefore need to make use of other remedial strategies. Multi-sensory strategies that incorporate the child's inherent visual ability are one such alternative

(Potter, 2000). Potter's (2000) Targeted Revisualisation Programme makes use of visual strategies to break words into their constituent parts. Through a system of colour coding the child is taught to recognise that every word has a vowel; the vowel is made more distinctive through the use of colour. As the child progresses higher in the programme they are taught to focus on additional word structures like vowel diagraphs and consonant blends. Through these means the child is provided with a phoneme-grapheme hook that the child uses to interpret the structure of the word. Therefore instead of using phonic strategies to pick up on the structure of the word, the programme utilises their inherent cognitive style to remediate their written language and phonological coding deficits by matching the words to an internal visual image (Potter, 2003).

3.6 Visual Imagery

Mental Imagery is for the most part a "private" or "subjective" experience in the sense that what and individual "perceives" cannot be directly observed, and cannot be investigated on the basis of any type of non-verbal behaviour the imaginer might engage in (Richardson, 1999). For these reasons research into the nature of mental imagery has presented a challenge to mainstream cognitive psychology. Research has therefore focused on the collection of systematic verbal accounts of subject's experience of the phenomena (Richardson, 1999).

Richardson (1999) theorised that "people's ability to create, contemplate and manipulate mental images" depends upon the "integrity of their brain structures and underlying cognitive processes". Research into imagery therefore does not constitute a single homogenous field, as initially theorised, where imagery was thought to be based upon a single mechanism localised within the right cerebral hemisphere, but rather that it is a complex system which consists of a large number of different components or sub-systems (Richardson, 1999). Paivio (1971), in his attempts to increase understanding of mental imagery, completed a review of human symbolic processing that attempted to accommodate diverse findings from perception, memory and language within a common

conceptual framework (Richardson, 1999). He proposed the “dual coding model” in which he hypothesised the relationship between perceptual and verbal codes (Paivio, 1971, p.53). Paivio’s model hypothesised three levels of perception at which information might be processed:

- 1) *Representational Level* – sensory data that is provided by an item when it is perceived activates the appropriate symbolic representation in long-term memory. Paivio theorised that images activate imaginable representations of objects (imagens) in a similar manner to the way words activate verbal representations (logogens).
- 2) *Referential Level* – symbolic representations in one system activate corresponding representations in another system. Systems are therefore interconnected so that the naming or describing of an object brings about the image / visualisation of the object.
- 3) *Associative Level* – involves associative connections among images, verbal representations, or both.

According to Paivio (1971) the involvement of any of these three processes in any given task depends on the particular properties of the task itself. However in learning and remembering he considered all three levels to be participatory. Consequently it can be theorised that an individual’s performance could be based upon the image system, the verbal system, or a combination of the two. Paivio (1971) expanded upon this theory by linking it to another assumption, the “coding redundancy hypothesis”, that states that performance increases in proportion to the number of alternative memory codes available for a given item. The concept that retention increases with the imageability (familiarity) of the material is therefore explained because “the items are increasingly likely to be stored in *both* the verbal and nonverbal code (Paivio (1971, pp. 207-208). An increase in the availability of both codes therefore increases the probability of recall because there is more than one source of information retrieval available (Paivio, 1971, pp. 207-208). Therefore should one source of recall fail, for whatever reason, the other source of recall

would still provide the necessary information provided that the information for this medium was retained.

With Paivio's theories in mind, Richardson (1999) suggests that educational / instructional materials should be designed to reflect the extensive interaction of the distinct verbal and visual codes in learning. Richardson (1999) hypothesises that well-planned visual illustrations can facilitate selective encoding and elaborative processing.

Richardson (1999) notes that in Paivio's (1971) dual coding theory, the verbal system was supposed to be for specialised serial or sequential processing, whereas the image system was supposed to be specialised for simultaneous or parallel processing. The image system is therefore not important in tasks that involve the retention of familiar verbal items set out in a particular sequence as occurs in immediate memory span. Rather the performance of these verbal tasks relies on the efficiency of the verbal system. According to the redundancy hypothesis, observed effects of imageability reflects the involvement of the image system. Consequently if it is evident that the image system is not involved with certain tasks, an individual's performance should not vary with the imageability of materials. Paivio (1971) noted that there was support for this, insofar as memory span for high-imagery nouns did not seem to differ for memory span for low-imagery nouns.

Potter (2003) on the other hand, understood excessive visualisation to instead hamper efficient development of thought since, in their view, imagery has a more direct relationship to thought and form, forming a fundamental level of the hierarchical continuum of conceptualisation. Findings of research documented in Potter (2003) has suggested that over reliance on vivid perceptual cues makes concept formation more difficult and that in comparison, language may be a more efficient and effective symbolic system of thought.

Regardless of the distinct views adopted by Paivio and Bruner however, it is clear that images have “properties of symbolisation” as well as meaning and are in this respect similar in nature to language symbols in the development of cognition in an individual (Moerk, 1977).

Potter (2003) highlights different types of imagery: auditory imagery, visual imagery, kinaesthetic/haptic imagery, synaesthesia (referring to the integration of modalities), and eidetic imagery. Eidetic Imagery means “clear visual image” and pertains to images that are noted for their unusual vividness and persistence” (Forrest, 1981, p.40). Eidetic image can be defined as one that lasts longer than 30 seconds (Sfetsios, 2002).

Not all people experience eidetic imagery, and this imagery is less commonly experienced by adults than by children. In order to ascertain whether an individual experiences eidetic images, as theorised by Jaensch (1930), it is necessary to identify whether physiological afterimages are obtained after fixating on an object of intense colour for several seconds. According to Jaensch (1930) eidetic images are strongest on a dark grey background. Therefore, it seems that colour is particularly important in promoting the efficacy of eidetic imagery. It has also been suggested that closing ones eyes may improve the quality of eidetic imagery. Images of print however have been shown to not last as long when compared to images of pictures, although have not been reported to be of poorer quality in comparison to that of the latter (Forrest, 1981).

3.7 Piaget

Piaget viewed the development of formal operational thought as based upon the assumption that the process of cognitive development is the result of “a particular case of biological adaptation” (Kriegler, 1996). If adopted, this view would mean that learning disabilities present within individuals could be seen to be the result of a deficit in their biological development (Heshusius, 1989; Poplin, 1988; Kriegler, 1996). Piaget also suggests that the cognitive processes of perception, imagery, language, memory and

thought are all interlinked which, within the context of neuropsychological localisation theory, would suggest that should there be a deficit present, it is due to the ineffective collaboration of one system with another (Potter, 2001).

Piaget suggests that perception and imagery are “figurative processes” and are fundamental to the development of reading, writing and spelling (Potter, 2001; 2003). They can thus be used in the remediation of any difficulties that are experienced in those areas. The processes themselves are seen to share a common basis in activity and can be developed through processes that involve imitation such as the repeated copying of a word or an image (Piaget & Inhelder, 1971; 1973). Repetition of the task results in increased ease of recognition as the sensory threshold is lowered due to its familiarity. (Reid & Hresko, 1981).

Piaget did not specifically propose any theories about learning difficulties or the way they should be remediated, but did propose a learning strategy using mental imagery that is useful in the learning disabled context. Piaget proposed that mental imagery serves a similar function to language and has symbolic and significant properties (Piaget & Inhelder, 1971). The mental image serves as an external aid to facilitate memory for as long as required. Once the stage in development is reached when imagery is no longer needed, the child is considered to have reached a stage conducive to learning in which language becomes the principle medium for symbolism. Fernald (1943) and Ehri (1980) in a similar manner suggest that mental imagery be used in the remediation of reading, writing and spelling difficulties. The technique appears to provide the child with a visual route to skill mastery, in addition to the traditional phonic route that is employed in common learning strategies and can be used for as long as is deemed necessary (Luria, 1971; Potter, 2001).

3.8 High Mental Imagery Remedial Techniques

Targeted revisualisation is a method of remediation designed for implementation with children suffering learning disorders affecting, in particular, their English reading, writing and spelling abilities. It makes use of multi-sensory teaching methods and mental imagery to aid the learning of words, the child's orthography of the English language is mediated and their ability to analyse and memorise words and use them in context developed. Instruction is hierarchical in nature and conceptualised the remediation reading, writing, spelling and dictation as involving five sequential levels through which the child must progress to obtain mastery thereof (Potter, 2003).

Language and visuo-spatial modalities on receptive, integrative and expressive levels are linked by following a hierarchical and sequential framework that utilised high mental imagery techniques. These high imagery techniques are central to the remediation approach as the child is taught to use them along with perception and language in a process referred to as targeted revisualisation.

Single words are first visually imaged and spelled orally, then revisualised and written, demanding the use primarily of *simultaneous mental processing* as well as the *serial* component of one's *successive processing abilities*. The development of sequential memory and particularly the *syntactical* component of *successive mental processing* is later emphasised through extension of this revisualisation process to sentences and paragraphs (Potter, 2000; 2001). Critical to the revisualisation activities is the child use of computers, specifically word processor programmes like MS Word.

3.8.1 Computer Aided Learning

The Targeted Revisualisation Programme uses drawing, writing, copying, picture stories, comics and computer-based activities involving typing, colour coding and revisualisation as strategies for teaching reading, writing and spelling, in an attempt to link the oral and written form of written letters and words with both verbalisation and image. Jones et al.

(1987) state that learning disabled children often experience difficulty with decoding words phonically because of poor phonic analysis skills. This could impede lexical development as the manner in which words are taught are mostly phonological in nature with the child needing to make use of phonic skills to code words correctly (Jones et al., 1987). Slow lexical development does in turn limit the way in which they are able to use or construct meaning from the text (Jones et al., 1987).

Jones et al. (1987) have shown that computer-aided practice for the decoding of words improves the speed and accuracy of with which children recognise and understand them. They therefore propose that computers should be used help children acquire better reading and learning skills because computer use increases the child's ability to rapidly and accurately decode words.

With reference to the Targeted Revisualisation Programme, the use of computers in the revisualisation process attempts to assist the child to learn the rule systems related to the orthography, and in particular the vowel structure of written words (Potter, 2003). Following Piaget, Potter (2003) suggests that there are both static and dynamic (moving) mental images, and that both can be accessed by young children, using a process which Jaensch (1930) has defined as eidetic imagery. Forrest (1981, p.40) describes this as an image that "is noted for its unusual vividness and persistence".

3.8.2 Use of Eidetic Imagery

According to Jaensch (1930), an eidetic image normally appears on a dark background. Fernald (1943, p 182) however, reports that there are great individual differences in the types of recall images of words which young children are able to access for the purposes of learning spelling. Our own data (to which we refer later in this thesis) would support Fernald's view. Our interviews with and testing of 90 learning disabled children would suggest that eidetic imagery is available to nearly all the children, and that this imagery process is both vivid and able to be accessed by nearly all the children (Potter, Els &

Ravenscroft, forthcoming). There are also wide variations in the types of image of word form and structure which young children can access, and that the colours of foreground and background vary, especially when computer-based colour coding is used.

The Targeted Revisualisation Programme makes use of colour coding to help promote effective eidetic image (Potter, 2003). Colour coding can be performed using coloured pencils or crayons, but achieves particular vividness, accessibility and motivational value when performed on a computer, using the colour formatting tool in MS Word or other word processor programmes (Potter, 2003). By typing the words out in a word processor programme the child is also able to break the word down into its syllabic components so that the structure of the word is further clarified (Potter, 2003). The inclusion of computers and the revisualisation technique they underpin, allows the child to discern the structure of the word through a visually related modality. The aim with learning disabled children is that this strength is used so that their phonological decoding deficiencies are addressed.

The use of colour coding as an aid in helping children remember has been previously used by (Gattegno, 1969). Gattegno (1969) reported that the colouring of letters enhanced the shape of letters which in turn facilitated the recognition of words. Our own studies (Potter, Els & Ravenscroft, forthcoming; Hadfield & Potter, forthcoming) support the use of mental imagery in improving the reading, writing and spelling abilities of learning disabled children. An investigation into the use of mental imagery by children with autism with respect to reading, writing and spelling) would support the view that the development of visual memory and eidetic imagery are intimately involved with the ability to accurately code and reproduce letters, words and sentences (Hadfield & Potter, forthcoming).

3.8.3 Using Mental Imagery to Develop Word Attack Skills and Memory

Targeted revisualisation as a process involves using mental imagery to develop word attack skills and memory. As Piaget has suggested (Piaget & Inhelder, 1971), these processes are enhanced by activities involving copying and visual representation, both through writing as well as the typing and colour coding of features of the written word using computers. The process of typing the words into the computer requires the child to consciously select each letter on the keyboard thereby reinforcing letter and word structure. Colour coding of the vowel structure within the word also develops the child's ability to apply his knowledge of the sound/letter combinations used in English orthography in analysing words, as well as in remembering their structure and distinctive features (Potter, Els & Ravenscroft, forthcoming).

It is tempting to hypothesise that high imagery teaching relies on different neurological routes for learning, addressing right hemispheric capacities as a way of coding across into the left hemisphere (Annette, 1995). Whether or not this is the case lies beyond the scope of this thesis. What can be said on a functional level is that the Targeted Revisualisation Programme makes use of colour coding as a way of ensuring that the child focuses on the vowels used within words. This provides distinctive colour features within words, which can also be used for the purposes of promoting effective eidetic imagery which can be used for revisualisation purposes (Potter, 2003). By typing the words out in a word processor programme the child is also able to break the word down into its syllabic components so that the structure of the word is further clarified on a meta-cognitive level (Potter, 2003). The child therefore builds phonological ability through the visual medium as the sounds within words are mapped in a highly structured manner to their visual counterpart.

From a cognitive neuropsychological perspective, it appears likely that mental imagery involves a number of different centres in the brain (Kolb & Whishaw, 1996). It is therefore likely that the Targeted Revisualisation Programme addresses the areas of the brain used for phonological processing, but uses visual channels to do so. The reason for

suggesting this is that there is consistent evidence that the ability to process phonological information is predominantly situated in the left hemisphere of the brain, which is dominant for oral language as well as for written language functions (Kolb & Whishaw, 1996; Rains, 2002; Zillmer & Spiers, 2001). There is also evidence from analysis of acquired dyslexics (Coltheart, 1987) that damage to the left hemisphere and particular the temporal lobe areas can interfere with language functioning, as well as with reading, writing and spelling abilities.

In addition, there is consistent evidence that lack of phonological awareness is associated with later reading difficulties (Birsh, 1999; Bryant & Bradley, 1985; Moats & Farrel, 2000). For this reason a number of teaching and remediation strategies make primary use of phonological and structured phonic strategies in aiding child with a learning disability to improve their reading, writing and spelling. The implication on a theoretical level is that developmental dyslexia is a disorder which is related to weaknesses in the development of the phonological system, and that remediation should attempt to directly address these weaknesses. A phonologically impaired child is often not able to easily discriminate the phonetic segments of a word. In a full-time remedial environment however the reality is that not all children with learning disability make progress on remedial programmes which are phonologically and phonically based.

This study focuses on those children in the full-time remedial environment who have been exposed to structured phonics teaching but have not made adequate progress in their reading, writing and spelling. It focuses on the use of high imagery teaching techniques in remediation, which are contrasted with those based on use of structured phonics. Children in the high imagery condition have been taught using the Targeted Revisualisation Programme, which is based on a programme theory which advocates the use of visual strategies, visualisation, and mental imagery to teach the associations between sounds and letters which underpin the rule systems of English orthography.

The programme makes use of the results of the phonic inventories as a means of identifying how the child is making use of his or her internal language structures. The process of colour coding specific vowel structures and the visual means of representing the syllabification within each of the words allows to child correct what has been a phonologically informed rule system for generating words and instead replace it with one that is based in the visual medium. This visual medium provides clear guidelines as to how the vowels and consonants interact in the words to produce sounds. The use of a seven vowel system instead of the five vowel system further clarifies the various word structures.

The inclusion of pictures, comics and activities involving drawing, writing, copying and colour coding also aids in the development of the child's internal lexicon as they are encouraged to explore language in non-threatening visual medium. The visual and auditory cues associated with targeted words and their underlying meaning is increased as a result of the programmes activities.

By engaging with computers while revisualising target words, the child understanding of the rule systems that relate to various words is clarified and internalised. The process of typing the word out according to its syllabic components clarifies allows the child to discern the structure of the word in a visual manner. The aim is that their phonological decoding deficiencies are addressed through activities which have a high imagery, high motivational as well as a meta-cognitive base.

3.9 Summary

The literature reviewed in this chapter has focused on the use of high imagery instruction as an alternative method of remediation to standard remediation techniques based on structured phonics. A number of reasons for the lags experienced by learning disabled children have been proposed in the literature. These include developmental lag in the

maturation of brain structures, differences in cerebral dominance, as well as differences in cognitive flexibility affecting the acquisition of complex cognitive functions.

What is clear from the literature is that developmental delay in the acquisition of reading, writing and spelling does not imply that the child with a learning disability is of lower intelligence than the general population. In contrast, many learning disabled individuals have been recognised to possess above average IQ (Rayner, 2005).

Cognitive theory suggests that maturation of the brain and skills associated with these areas can be developed through the performance of associated tasks. Indeed the assumptions underlining the development of different forms of remedial intervention have usually involved an attempt to build the phonological skills associated with scholastic performance through laying the neurological basis for learning through repetition and explicit instruction (e.g. Gillingham & Stillman, 1940; Kirk, 1972; Johnson & Myklebust, 1967; Stuart, 1963).

This study focuses on situations where traditional remediation techniques based on structured phonics are apparently unsuccessful. Following Fernald (1943), the Targeted Revisualisation Programme is based on the assumption that it can be valuable in situations in which a child is not learning, to make use of alternative visuo-spatial strategies involving mental imagery. It may through this be possible to utilise the individual's natural inclination towards a visual cognitive style to develop the phonological and orthographic skills in which they are deficient.

Following Luria (1973), neuropsychological development is assumed to be hierarchical. The multi-sensory nature of the Targeted Revisualisation programme is designed to ensure that the associated functional developmental areas in perception and memory are developed at the same time the child is taught to make use of their visual abilities. The aim is for the learning disabled child to reach a point where he or she is able to move from reliance on use of mental imagery, and reliance on multisensory instruction to

integrated use of the multiple centres in the brain which underpin fluent reading, writing and spelling (Potter, 2001; 2003). This use of multiple cognitive styles is assumed to be the ultimate purpose of remediation, through the replacement of an initially immature, dysfunctional or defective system with one that is intact and integrated.

4 Chapter Four: The Two Conditions in this Research - High Imagery and Structured Phonic Instruction

4.1 Introduction

This research is based on a number of small-scale studies conducted between 2001 and the end of 2005. Each of these studies was based on implementation of high imagery instruction to a small number of children using a pre-experimental pre and post-test design, or was based on an ex post facto design based on comparison of two conditions.

The independent variable in these studies was the type of instruction to which the children were exposed. The dependent variables were the various scholastic tests used to monitor progress of the children. In each of the small-scale studies, the researchers wrote up individual case studies and also analysed the results obtained by small groups of children exposed to either high mental imagery or structured phonic instruction.

Each small-scale study was conducted using aggregative case-survey methodology (Lucas 1974a; 1974b). This allowed each of the researchers to focus on each child individually as a single case, and aggregate the results of the case studies together by clustering and case-contrast (Els, 2005).

The current research draws on the results of each of these individual studies, so that their findings can be examined aggregatively and cumulatively. In terms of this methodology, the data from all individual case studies has been aggregated and sub-setted according to the types of intervention used over the whole of the five year period between 2001 and 2005. Differences in the results of children within these subsets has in these groups have then been combined to provide data which can be used to answer the research questions and hypotheses of this research.

Intrinsic to planning the instruction received by the children in the small-scale studies was the use of an instrument called the Phonic Inventories. This was used at time of pre-testing as a basis for planning the type of instruction received by the children, and at time of post-testing to monitor their progress. As this instrument was used for diagnostic purposes, for planning the remediation received by the children, as well as for providing gain scores indicating progress of the children in both conditions, it will be described first in this chapter.

The types of instruction provided in the two conditions in the small-scale studies will then be discussed. The underlying assumptions relating of the high imagery teaching approaches used in the Targeted Revisualisation Programme will first be introduced. The underlying assumptions of the type of structured phonic instruction provided to the children will then be discussed. This will be done in a way that provides indications of how the processes carried out in the instructional programmes received by the children tie into theories of remedial intervention strategies, literacy development and orthographic competency covered in the Literature Review in the previous two chapters of this research report.

Finally, the dependent variables in the small-scale studies will be outlined. This will be done by focusing on the reliability and validity of these instruments, in relation to their use in the design for pre and post-testing the children in each of the small-scale studies on which the current research design is based. Potential co-variates in these studies will also be outline, relative to the biographical data on each child, and an imagery questionnaire used for determining the presence or absence of eidetic imagery in the children, as well as their use of eidetic imagery in learning.

4.2 The Phonic Inventories

The Phonic Inventories are an instrument which has three levels. Each of these is designed to be used at the diagnostic stage in remediation, as the basis for planning a detailed remedial programme for a child (Potter, 2001).

The development and validation of this instrument have been referred to elsewhere (Grasko, 2005; Potter, Grasko & Pereira, 2006; Pereira, 2007), and does not form a major focus of this study. However, a description of the instrument is necessary to understanding how the intervention programme was planned and implemented for each child, in the small-scale studies on which this research is based. Information on the relationship of the Phonic Inventories and the other instruments used in this research will then be provided later in this report as part of the analysis, as a basis for interpreting the analysis of results of each child in the different sub samples comprising the total data set.

4.2.1 Using the Phonic Inventories to Plan Remedial Programmes

The Phonic Inventories are three one-word-spelling tests, developed by Professor Charles Potter of the University of the Witwatersrand, Johannesburg. The inventories aim to establish the child's level of knowledge of short vowels, ending blends, vowel digraphs, polysyllabic words and morphological endings (Potter, 2001), as a basis for implementation of a remedial programme focused on the types of errors made by the child.

The Phonic Inventories are designed to be used in conjunction with cognitive, reading, spelling and dictation test results, as well as with analysis of written language samples from the child's books and written work. The aim is to establish, through error analysis, the rules and strategies the child uses in reading, as well as in creating his or her written language.

The assessment process thus highlights current competencies and weaknesses in the child's use of English language. The errors made on the three levels of the Phonic Inventories are then used to draw up a profile of the child's phonic knowledge, as well as the specific errors made. These then act as targets, for purposes of remediation.

The skills tested by the three levels of the Phonic Inventories are as follows:

- Level One tests use of short vowels, beginning blends and ending blends.
- Level Two tests use of vowel digraphs.
- Level Three tests ability to use root words as a basis for adding prefixes and suffixes, the use of the doubling rule in adding morphological endings and the ability to create compound words (a word that consists of the parts of many e.g. black + market = black-market) (Moats & Farrell, 2000).

The Phonic Inventories are scored by identifying the nature of the errors made by the child, as well as the position within the word where they occur. Errors made by the child are then classified and categorised. A table of frequencies is also created as a basis for interpreting the child's ability to understand and use alphabetic principles in creating written language.

According to Birsh (1999, p.64) the alphabetic principle is "an understanding of the relationship between letters ordered left to right in a written word and phonemes ordered in a specific temporal sequence in spoken language." The Phonic Inventory Error Classification Table therefore provides a means to identify the patterns of errors that the child makes when constructing words. This classification is then used for purposes of planning the child's remedial programme.

4.2.2 4.2.2 Interpretation of the Phonic Inventories

Research by Grasko (2005) and Pereira (2007) has indicated that the Phonic Inventories are reliable tests, which are content and construct valid. Both Grasko's and Pereira's

studies also indicate that the instrument has discriminant validity, and can be used for screening for learning disabilities in mainstream classrooms. The reason for this is that the error profiles yielded by learning disabled children are distinctive, indicating that the instrument has the potential to be used not only for diagnostic, but also for classification purposes (Potter, Grasko & Pereira, 2006).

In the context of the small-scale studies conducted between 2001 and 2005 at Japari using the Targeted Revisualisation Programme (e.g. Els, 2003; 2005; Macreadie, 2001; Ravenscroft, 2002; Sfetsios, 2002; Wilson, 2001), the Phonic Inventories were used for diagnostic purposes with children previously diagnosed as having a learning disability. The Phonic Inventories were thus used for programme planning and monitoring of progress, with children chosen to take part in an after-school programme on the basis of their scholastic and/or remedial history.

As Els (2005) has described it, the children in the small-scale studies at Japari were already pre-classified and preselected, as each child had already been diagnosed as both learning disabled as well as non-achievers in the full-time remedial school context. They were thus pre-classified as learning disabled, and then selected for additional one-to-one tutoring on the basis of the observation of their teachers that they were treatment resistant.

In the context of this study, the Phonic Inventories have thus been used to conceptualise the manner in which the remedial interventions in the programme should be implemented, as well as to focus instruction and monitor the progress made by children. The Phonic Inventories have not been used as part of an assessment process, but rather as an additional tool used to gain a greater understanding into the specific nature of the difficulties that the learning disabled child has.

In each of the small-scale studies, the aim in using the instrument was to enable greater focus on specific difficulties in reading, writing and spelling previously identified

through assessment. The Phonic Inventories have thus been used to create a focused and specific remedial programme– hence the use of the word “Targeted” in the Targeted Revisualisation Programme.

4.2.3 Use of the Phonic Inventories in Conjunction with Other Scholastic Tests

In each of the small-scale studies, the three levels of the Phonic Inventories were used in conjunction with other scholastic tests to provide information about the child’s reading and spelling abilities, as follows:

- Level One and Two were used to provide information about the child’s understanding of the alphabetic principle and how well they understood the relationship between graphemes and phonemes. The results from the test indicated how well the child was able to recognise letter structures from their auditory counterparts and thereby attach meaning to the word so that any recognised deficiencies could then be targeted and corrected in the remedial process.
- Level Three was used to provide information on the child’s application of syllabification skills in reading and spelling (how well they were able to apply learned abstract regularities or spelling patterns within written language). Skilled readers recognise letter clusters and regular patterns (/ -ed, / -ing, pre -/) as independent units of the sound they represent as well as the word within which they are contained (Frith, 1989). The final stage of the Phonic Inventories tests the child’s ability to build words, and correctly use syllabification rules as patterns differentiating between the root word and its prefix and suffix variations. Level Three of the Phonic Inventories was designed to provide information on whether the child was able to construct polysyllabic words, use morphological ending with a root word, and also use prefixes and suffixes either before or after the root word.

The other scholastic tests used in the small-scale studies yielded total raw scores, as opposed to a detailed profile of errors. Used in conjunction with other scholastic tests the Phonic Inventories thus provided distinctive information about the types of errors made by each of the children in the small-scale studies, as well as about the progress they have made as indicated by changes in their error patterns (Potter, Grasko & Pereira, 2006).

After pre-testing in each of the small-scale studies on which this research is based, the error profiles were used to target the instruction received by each of the children. This step was taken in planning instruction, both in the high imagery instruction condition, as well as in the structured phonic instruction condition. Once this step had been taken, tutoring was implemented.

4.3 The Independent Variable in the Small-scale Studies: Condition One -- High Imagery Instruction

In each of the small-scale studies aggregated in this research, the instruction provided was planned once information on each child's pattern of phonic skills and errors had been established at time of pre-testing. A decision was then taken as to which types of errors should be targeted first, and which level of the remedial programme would be appropriate.

For children in the high imagery instruction condition, the Targeted Revisualisation Programme was initially structured to focus on the errors identified by the Phonic Inventories (Els, 2003; 2005). The sequence then followed in the programme was then based on subsequent targets formed through error analysis.

In the high imagery condition, the remedial tutors were thus provided with error analyses for each child based on the Phonic Inventories applied at time of pre-testing. They were also provided with training sessions as well as handouts on how to apply the principles of high imagery instruction advocated by the programme.

The aim was to use the error profiles to target specific areas of weakness. Tutors were also encouraged to introduce variety into the programme by ‘laddering’ between different levels within the programme in relation to the child’s needs. Writing was introduced simultaneously with reading at all levels of the programme. The first guiding principle was that both decoding and encoding skills needed to be developed through activities, with reading and writing tasks being used to develop the understanding that the form of the printed word has a direct correspondence with the structure of spoken language. The second guiding principle was that high imagery activities involving reading and writing could be used as a basis for mediating understanding of the rule systems used in English orthography (Potter, 2001).

The focus of the programme used in the high imagery teaching condition was thus not only on developing memory through use of colour coding the vowel structures within words used in the programme, but also on developing metacognition. This was developed through activities involving reading and writing, focused on developing the child’s ability to identify the vowels used in words, and match the sound structure of the orally spoken word with its printed structure through writing, typing and colour coding. This was done through focus on the vowel structure of words of increasing complexity.

The levels of instruction in the high imagery programme used in the small-scale studies are outlined in the sections to follow.

4.3.1 Level One

Level One in the Targeted Revisualisation programme is introduced once it is evident that the child has developed to the point where he/she is phonologically aware and displays a readiness for reading. Sounds and letters are introduced using phono-visual principles. The aim of Level One activities is the introduction of the child to the alphabetic principle

as well as the development of an understanding of the rule system used for producing one-syllable words based on short vowel sounds (a, e, i, o, u).

Birsh (1999) defines a syllable as “a written or spoken form within a word what must have a vowel sound and include a prefix and a suffix. The introduction to mono-syllabic words introduces the child to the concept of sound forms or character combinations that are regularly repeated to form specific sounds. The target words therefore illustrate how the vowels are combined with single consonants, as well as various consonant blends and clusters, at the beginning and end of target words (Birsh, 1999).

The form and structure of words are mediated through use of writing, typing and colour coding. The consonant blends are also introduced, so that the child can learn how two or more adjacent consonants can function together to form a smooth flow of sound (Birsh, 1999). The mediated words are then placed into sentences where targeted words are written in the context of other words (the aim is the development of the sequential memory necessary to reproduce these words in context).

Colour coding is used to discriminate between vowels and consonants, and is done through the use of colour pens as well as through the use of the colour feature available on most word processor programs. The act of typing the target words on the computer helps teach the child the equivalence of words in print and in writing, as well as the difference between lower case and upper case words. As Piaget has suggested, this form of representational activity provides a basis for the development of mental imagery (Piaget & Inhelder, 1971; Potter, 2001).

Decoding, encoding and metacognitive activities involving word families are introduced. Revisualisation activities are also undertaken at this stage to establish whether the child has the capacity to use eidetic imagery in visualising and remembering the structure of printed and written words, as well as sequences of words in phrases and sentences.

4.3.2 Level Two

The aim of Level Two, as with Level One, is to develop decoding, encoding and metacognitive skills through analysis of target words, and also to develop the sequential memory skills necessary to read and write and reproduce words in the context of sentences. Level Two activities are aimed at developing a more advanced understanding of the alphabetic principle as this applies in words based on long vowel sounds.

The programme at this stage involves writing, typing and colour coding activities, focused on developing awareness of how vowels are used, in combination, in written language. Word families based on vowel digraphs involving long vowel sounds are introduced. A long vowel refers to a vowel sound that occurs due to a slightly higher tongue position than that used on short vowels which results in a the vowel being pronounced differently (Birsh, 1999).

During Level Two a seven vowel system (a, e, i, o, u, and y and w at the end of words) is introduced, following the suggestions of Sister Mary Caroline in her programme “Breaking the Sound Barrier” (1956, in Potter 2003). The aim is to make the orthography used in English in its written form more transparent. The ‘y’ and ‘w’ are thus mediated as vowels when positioned at the end of a word. As with Level One, metacognition for the form and structure of words is developed through activities involving reading, writing, typing, colour coding and revisualisation.

There is an additional focus on the development of sequential and successive processing abilities. This is done through training the ability to revisualise sentences as well as words. Revisualisation is defined as the formation of an image in response to a stimulus, comparing the image to the original stimulus, and then coding the output of the image into written or graphic form (Potter, 2003). The process of revisualisation relies on an individual’s visualisation ability which is the ability to form a mental image of an object (Kolb and Whishaw, 1996). It should be noted that not all people are able to perform this task.

As with Level One, colour coding is introduced with a focus on the vowel structure of words. The aim is for the vowel and syllabic structure of the word to become accentuated, and the orthography more transparent. As the child's understanding of the alphabetic principle develops, so this provides a metacognitive basis which can be used in English language reading and writing (Birsh, 1999, p.491).

4.3.3 *Level Three*

Level Three of the programme introduces paragraph revisualisation and consequently places increased focus on memory sequencing skills – the correct order of words required in the reproduction of dictated text.

Mental imagery was utilised in the learning of spelling through the use of exercises involving the structural and phonemic analysis of words. Target words for analysis are identified by the child from text – all words with more than one vowel being listed, typed, colour coded and then revisualised. The focus of the programme at this level lies on developing metacognitive skills relative to words of increasing complexity (e.g. monosyllabic words using vowel digraphs, as well as polysyllabic and compound words) which are identified from sentences and paragraphs which are graded.

Having compiled a list of target words, the words are then typed and structurally analysed through colour coding (the rules involved in their construction being mediated by the remedial teacher as a basis for being added to child's own rule system for decoding and encoding written language). After all vowels and vowel combinations have been colour coded, polysyllabic (words that have more than one syllable) words are then divided into separate syllables (Birsh, 1999). The child places his/her hand under the chin to establish how many times the mouth is opened in making the component parts of the word as it is spoken. This establishes the principle that when the mouth opens, the vowels are made, and when the mouth closes, consonants are made. The child then divides the words into

the same number of component syllables by either writing each syllable separately or separating the syllables with the space bar on the computer keyboard.

The target words are then encoded to memory using revisualisation techniques (Potter, 2001). The process involves looking at the word, speaking the word, storing the spoken word as an image and then reproducing the word from the image when the child's eyes are closed. After reproducing the word, the correct formation of the stored image is checked by verbalising its form, this then being compared to its original form with the eyes open. The words are then learned within the context of a paragraph, the paragraph then being reproduced in the form of dictation.

If any errors are present when testing of the words is done, the errors are listed on the left hand side to the page and retargeted to undergo revisualization again, the reason being that it is possible there was some difficulty in the original encoding to memory process. The errors are then retested later on (Potter, 2001; 2003). Through these activities, Level Three aims to build on the child's understanding of the alphabetic principle, so this provides a metacognitive basis which can be used in the sequential processes involved in reading and writing (Birsh, 1999, p.491).

4.3.4 Level Four

Level Four of the programme involves the formally taught skills of descriptive writing and creative writing. This type of writing is unique to each individual and is a result of how well the person is able to express him/herself in a manner that makes sense of their own thoughts and on that makes sense to others (Haring & Schiefelbusch, 1976).

Level Four aims to teach the child that a sentence is constructed around a single idea or mental image. In order to aid in this process the child is encouraged to write sentences that reflect key ideas or themes located within a paragraphs of a book or in the images present within a graphic novel. Mind mapping is used when teaching the child how to

write stories. Initially the construction occurs in relation to graphic ideas represented in a graphic novel, the sequence of pictures representing the progression of the idea (Potter, 2001).

Mastering the skills described above means that the child becomes conversant with the concept that a paragraph is a group of ideas and that if the main idea changes then a new paragraph begins.

As new words are introduced in Level Four, any errors present become the focus for revisualization. The process occurring in the same manner as described within Level Three with the exception that frequent repetition of the words occurs due to their use in the child's expression of ideas contained within the reading material. The process of repetition serves to further reinforce the word encoding to memory (Potter, 2003).

4.3.5 *Level Five*

Activities included at this level are orientated around exercises designed to develop and further the child's understanding of the conventions of English grammar as well as the communicative side of language.

These activities are based on the types of oral and written language exercises that the child will encounter in his/her mainstream school programme. The language grammar is taught formally and forms the basis for use in a variety of communicative language activities (these involving language styles as well as registers that are appropriate for developing analysis, integration, exposition, justification and argument). The activities are mediated, the aim being to provide the child with the basis for functioning independently at school.

4.4 The Independent Variable in the Small-scale Studies: Condition Two -- Structured Phonic Instruction

For children in the structured phonic instruction condition, the types of errors made by the children were also targeted. This was done by introducing phonic rules, by developing word families, and by constructing sentences using the words in context (Els, 2003; 2005).

The principles of the structured phonic instruction provided as the second condition in each of the small-scale studies was based on utilising Frith's theories of how sounds and letter are used to form words (i.e. how the Alphabetical Principle is applied in the English Language). The remedial tutors were first provided with error analyses of the types of errors made by each child, based on analysis of the Phonic Inventories conducted at time of pre-testing. They were also provided with training sessions as well as an instructional handbook which directed them to base their approach on Frith's theories of reading, and spelling development (Els, 2003; 2005).

The tenets of Frith's theories have two important aspects: i) that the development of reading can be divided into three main stages; and ii) that reading and spelling are closely related (Frith, 1983; 1989). These principles were applied in the structured phonic condition in the small-scale studies as follows:

4.4.1 Frith's three stages of development:

The logographic stage (Stage 1), during which the child reads and spells on the basis of learned pairings between a visual representation of a word and its meaning. In this stage some features of the written form of the word become stored in the child's mental lexicon as a logo graph or pictorial representation. During the early phases of the logo graphic stage words may be stored as pictures, while in later phases letter identification develops rapidly. At this stage, spelling development normally lags behind reading for the reason

that logographic representations become available for spelling only some time after they have become available for reading.

The substantially alphabetic nature of the English language permits, in principle, any word or potential word to be spelled by learning the relationship between phonemes and graphemes. During the alphabetic stage (Stage 2), Frith suggests that the relationship between phonemes and graphemes is acquired first for spelling and then for reading. The reason for this is that a desire to write combined with the fact that spelling principally involves the writing of sounds, direct the child's attention to the phonemes of the language and to the relationship between these phonemes and the graphemes which are used to spell them. Only when the child has begun to master this alphabetic principle for spelling does he or she begin to acquire it for reading. This lag between spelling and reading suggests that there is a transitional phase when the child is reading by eye (i.e. logo graphically) but spelling by ear (i.e. alphabetically). Evidence for this comes from the research of Bryant and Bradley (1980), who found that beginning readers/spellers could read but not spell irregular words like /light/, while being able to spell but not read regular words like /bun/. This is because they were reading using a logographic strategy but spelling using a phonological strategy.

The final stage of development (Stage 3), according to Frith, is the orthographic stage which is, once again, non-phonological. Increasing experience with the orthography of English permits the child to abstract our regularities or spelling patterns within words encountered in written language. Examples of such regularities are the spellings involved in morphemes such as /pre-/, /-ing/ and /-ed/, and the spelling patterns in words containing /ph-/, /kn-/, - ight/ or / -ought/. The process becomes non-phonological again in that these clusters or spelling patterns become represented as independent orthographic units, free of the sounds they represent. At this stage, idiosyncratic spellings (e.g. the spellings of words with a low spelling contingency such as bout, cough, tough, and laugh) also become accurately represented. These spelling patterns have to be distinguished from other words in the child's lexicon and then have to be stored as independent units in

memory. In this final phase the relationship between spelling and reading is again reversed in that the child's orthographic skills are more advanced for reading than they are for spelling.

In terms of Frith's theory, a remedial reading, writing and spelling programme would need to focus on Stage 2, with the aim of establishing the alphabetic principle as it applies to the English language as used in writing. Stage 3 would then involve focus on structural analysis of words in terms of their morphological characteristics. This is the principle which has been followed in constructing the Phonic Inventories.

4.4.2 Development of reading ability

It has been widely documented in the literature on learning disabilities that many children with learning difficulties take considerable time to develop the alphabetical principle, and require multi-sensory materials to assist in developing the skills involved in learning to read and spell. In many cases children with learning disabilities require a greater emphasis on establishing phonological awareness than other children, and require a programme which targets knowledge of the sequences of letters involved in the different vowel sounds used in the English language.

Children with learning difficulties require more time in learning the basics and the majority of available graded reading material do not match the intelligence or conceptual level of such a child. This mismatch becomes more evident the older the child with learning difficulty is, since the majority of basic reading material is written with the needs of the young child in mind. The older child is therefore made to feel inadequate in that they realise that they are reading material that is aimed at children younger than them.

For this reason each child within the programme was provided with a set of graded readers that tapped into their individual interests on the tutor's perceived need for the depth of transparent orthography they required. These readers mediated the child's phonological awareness, with the aim of establishing the alphabetical principle and how it

should be applied to the English Language. The child's enjoyment of the reader was considered vital in order to maintain their interest and to avoid the situation where reading became a "grudge" activity. Each of the readers used had carefully selected vocabulary and an orthography that ideally progressed from simple to complex text. The selection of the text was based on the results of the pre-testing that had been done on the child, with a special focus on the results of the results of the Phonic Inventories. The tutor therefore sought to deliberately mediate the child's understanding of English Orthography during the reading process.

The texts that were used ideally involved mixed forms of writing, such as narrative and descriptive writing, and contained illustrations that were intended to assist in the identification and correct understanding of the storyline. Additionally, depending on the child's level of reading ability, the size of the writing in these texts varied as well, the idea being that larger text requires less effort to decode than small text. Weaknesses identified through the reading process were assisted in the development of a child specific spelling programme that reinforced the competencies involved in decoding and encoding the written word.

4.4.3 Development of spelling ability

The approach to developing spelling ability placed value on developing phonic competencies in children. This approach placed emphasises that phonological and phonic abilities form building blocks for the processes involved in learning to read, write and spell.

The phonic rule system used by the child has been identified through the phonic inventories, where the errors the child made were analysed and categorised, as well as reading activities that the child has performed. The categorisation of errors and the language rules they are associated with allows the tutor to individually mediate the child's the correct use of short vowels with beginning and ending blends, the use of

vowel digraphs, and lastly the use of multiple syllables, prefixes and morphological endings in words.

Each of these rules was introduced and practiced. This was done through activities in which the tutor introduced the child to the phonic principles involved in words, and provided other words with a similar sound/letter structure in a word family so that the child could internalise the rule. This was then reinforced, by the use of each word in the word family in a sentence, so that the child could apply the rule, and repeat it so as to internalise the correct information.

4.5 The Dependent Variables in the Small-scale Studies: Measures and Instruments

Besides being tested on the Phonic Inventories, each child in the small-scale studies received a formal, standardized pre-test and post-test using the following instruments: The Schonell Spelling Test, The Schonell Graded Dictation Tests (B, C and D), The Schonell One Word Reading Test and The Holborn Reading Scale. Each child also received the Phonic Inventories (Levels One, Two and Three) both prior to and after the intervention. In addition to these instruments each of the participants involved in the study were questioned, through the use of a structured interview using an Imagery Questionnaire, as to their use of mental imagery.

The dependent variables in the small-scale studies were thus based on the following instruments.

4.5.1 The Holborn Reading Scale

The Holborn Reading Scale (see appendix 2) consists of 33 sentences that are used to assess the participant's reading ability. Originally designed with the intention to provide a rough assessment of a child's reading age in a short time period, the scale is widely used

in clinical work with children in South Africa. It is considered useful for implementation with children aged between five and eleven years.

The 33 sentences are arranged in an order of increasing difficulty with respect to their comprehensibility and mechanical elements. Each sentence in the scale represents a reading age of three months higher than the preceding sentence (Buros, 1959; 1968; 1969). The child is asked to read sentences aloud from beginning of the page on which the sentences appear and is stopped when he/she makes four consecutive errors. The reading age is then obtained from the corresponding figure that appears on the right-hand side of the page.

The test was formulated in 1948 by Watts (in Pumfrey, 1985). The sentences used were specifically selected so that in the initial standardising group, which consisted of more than 2000 subjects aged five and a half to ten and a half years old, the progress shown in mastery of the difficulties of reading aloud by the children was at a rate represented by an increase of one sentence in every three months. By making use of the scale a child's mechanical reading ability can be rapidly assessed. Comprehension of the sentences was not tested using this test because no norms are proved for it (although it is assumed that comparisons can be made between a child's raw scores in mechanical reading).

The test has achieved popularity because of its ease of administration and apparent ease of interpretation (Pumfrey, 1985). The test was standardised using both South African and British samples and is widely used in remedial settings. No information regarding the reliability and validity of this test is available though the test does bear evidence of skilled construction. The norms available are clearly dated (Buros, 1959; 1968; 1969).

4.5.2 The Schonell Tests

These tests (see appendix 3) are aimed at measuring spelling, reading and writing abilities of children aged seven to twelve (Schonell, 1974). It is a test used on children of average

intelligence based on words commonly used in primary school writing. The tests were originally developed for use in British Schools but have seen extensive use in South African Schools that are both mainstream and remedial in nature. Limited psychometric information is available for the Schonell test battery with the information that is available gained from data collected in Britain. The battery whoever continues to enjoy widespread use in South Africa in both mainstream and remedial settings.

4.5.3 The Schonell One Word Spelling Test

This test consists of 100 words (ten words per year assigned to ages five to thirteen and ten words for the two years fourteen and fifteen) and provides an estimate of a child's attainment in spelling. The target word is dictated to the child, then placed in the context of a sentence, and then repeated to the child for a second time (Schonell & Schonell, 1950). The child writes down each word in a list that is then marked so that the number of correctly spelled words can be calculated. The spelling age for the test begins at five years of age with every five correct answers obtained thereafter adding a year to the cumulative age calculation.

4.5.4 The Schonell One Word Reading Test

This test is suitable for children between the ages of five and fifteen and consists of a sample number of words of increasing difficulty. The words are read loud by the child across the page from left to right with the test stopped as soon as the child has read all the words in a sentence incorrectly. The examiner scores the child on a separate piece of paper which is used to obtain a raw score. The raw score is the number of words that the child has spelled correctly. A scale score (an indication of the child "spelling age") is calculated from the raw score by applying the formula $\text{Raw Score} + 50 / 10$. The resultant score has a decimal that indicates the year and month of the child's spelling age (e.g. 8,9 = 8 years and 9 months) (Schonell, 1974).

4.5.5 *The Schonell Graded Dictation Tests (B, C and D)*

These tests provide an estimate of the child's ability to write continuous material, as well as offering insight into their punctuation and spelling of words located within the context of the sentence (Schonell, 1974). The test consists of three passages of increasing difficulty (B, C and D) and requires the child to write down the sentences that are verbally read to them by the examiner. When administering the test the paragraph as a whole is initially read to the child to give them an indication of its meaning. The paragraph is then dictated in short phrases of three to four words.

These sentences are then analysed by the tested with the number of errors made in each dictation providing a raw score that can be converted, through the tables provided with the test, into the child's equivalent spelling age. It should be noted that if the raw score exceeds 25, the test is deemed too difficult for the child.

4.5.6 *The Phonic Inventories*

Besides their use for planning purposes as described earlier in this chapter, all three levels of the Phonic Inventories (refer appendix 4) were also administered as post-tests, with gain scores (as indicated by decrease in errors) forming dependent variables in the small-scale studies.

At time of post-testing, error analyses were thus also conducted of short vowel and consonant blend usage, long vowel and vowel digraph usage, ability to use root words to add prefixes and suffixes, the doubling rule, morphological endings, polysyllabic words, and compound words. This involved a process of analysing each word for integrates and errors. These were then used to create error clusters, based on the types of error made as well as the position within the words where errors were occurring.

The error analysis form (see appendix 5) was used for this purpose. After instruction, the aim of post-testing was to clarify where each child's weaknesses still lay, and to identify

whether these related to frequent errors in the use of initial consonants, initial blends/cluster, medial vowels, etc. The child's individual needs as well as progress made could thus be highlighted. Progress was gauged in relation to changes in error scores relative to each child's pre-test error profile. The changes in types of error made, as well as changes in overall error scores yielded by each of the three levels of the instrument formed dependent variables in each of the small-scale studies.

4.6 Potential co-variates in the Small-scale Studies: Measures and Instruments

4.6.1 The Biographical Questionnaire

This questionnaire (see appendix 6) was a biographical inventory used to gather information about the child's medical and schooling history. It was used to gain background information on children and provided information that was used in the small scale studies as complementary to the case study analysis (Japari Remedial School, 2000).

Given these data in the small-scale studies, gender and age were identified as potential co-variates potentially influencing the results. In addition, information on whether or not each child was able to use eidetic imagery in learning was able to be extracted from information provided by an imagery questionnaire. This also formed a potential covariate in the research design.

4.6.2 The Imagery Questionnaire

The imagery questionnaire (see appendix 7) was a semi-structured qualitative interview schedule developed by Professor Charles Potter (Potter, 2001). It has been used in the Targeted Revisualisation Programme since its inception in 2001 and is used to identify how each child visualises words as well as how imagery is used in learning and remembering the structure of words (Potter, 2001). The questions used in the

questionnaire are linked directly to the Targeted Revisualisation Programme and are used to inform the way in which each child's remediation strategy is implemented.

The instrument uses self-report measures on the sequence that is undertaken in the revisualisation process used in the programme for learning, remembering and revisualising words. The results from the study are used in conjunction with the test results from the study to determine if each child was able to use the revisualisation process. For those that were in the treatment group the test was administered prior to programme implementation as well as after. The participants in the contrast group received the mental imagery questionnaire post programme to minimise the possibility of it having any impact it may have had.

4.7 Summary

This chapter has focused on the research designs, as well as the instruments used in a series of small-scale studies conducted between 2001 and the end of 2005 at Japari Remedial School, as background to the review of these studies which will be presented in Chapter Five following. Each of the small-scale studies focused on providing tutoring to between four and six children.

The research design either involved a pre-experimental pre and post-test design involving case studies of children exposed to a high imagery teaching intervention, or an ex post facto design, based on case studies of children exposed to either a high imagery or a structured phonic teaching condition. In each study, the researcher first wrote up individual case studies and then analysed common trends across the data by aggregating the results.

Each of these small-scale studies thus followed a common methodology based on aggregative case-survey method (Lucas 1974a; 1974b). This allowed each of the

researchers to focus on each case individually as well as bring a number of case studies together by clustering and case-contrast (Els, 2005).

The independent variable in these small-scale studies has been described as involving two instructional conditions, the one being high imagery instruction, and the other instruction based on structured phonics. The dependent variables were the scholastic tests used to pre and post-test the children, as well as three phonic inventories used to analyse errors made by the children at time of pre-testing for diagnosis and programme planning, and at time of post-testing to assess gains made as reflected in decrease in errors in particular categories, as well as overall.

The research design on which the current research is based draws on the results of each of these small-scale studies, so that their findings can be examined aggregatively and cumulatively. In terms of this methodology, the data from individual case studies have been aggregated and sub-setted according to the types of intervention used over the whole of the five year period between 2001 and 2005.

As the hypotheses for the current research have been based on similarities and differences in the results of children, as well as on variations in treatment and selection which occurred, the results of each of the small-scale studies will be highlighted in the following chapter. This will be done chronologically. Trends in the data over time will also be highlighted. After reviewing the individual small-scale studies, the hypotheses for this study will be tabled in a research design table at the end of the chapter, as these relate to these trends.

Chapter Six will then present the methodology followed in integrating the data into a composite data set, the variables in the composite design, and the different statistical procedures used in analysing the composite data.

5 Chapter Five: Trends in the Small-scale Studies Providing Data for this Research

The data for this research were drawn from a number of small-scale studies, which are reviewed in this chapter. Each of the studies was evaluative, and attempted to establish whether individual children had made progress in response to particular types of instruction. Trends in the each of the individual case studies were thus aggregated in each of the small-scale studies, in an attempt to indicate common trends across the data.

In total, seventeen small scale studies were conducted at Japari over a five year between 2001 and 2005. These studies are thus reviewed chronologically in this chapter, and have also been grouped so as to indicate where the data lie with respect to the independent variable in this research, as well as according to their sample groupings relative to the research design table presented at the end of the previous chapter.

The review in this chapter is conducted with the aim of providing the reader with contextual information concerning the longitudinal development of the investigation, indicating why the hypotheses for the current research were developed, and why decisions were taken to treat certain of the data sets differently to others in the analysis. The major trends in each of the individual case studies, as well as the indications from the small-scale aggregative analyses are thus provided, in terms of their convergence with and difference to previous indications from the time-line of small-scale studies comprising this longitudinal investigation.

The hypotheses for the study are then tabled at the end of the chapter. Comments are also made at the end of the chapter concerning limitations in sampling affecting the combined data set aggregated from the small-scale studies, as well as factors such as change in selection criteria which occurred at Japari over time.

5.1 Group One

This group consists of children in mainstream education but were undergoing remedial interventions or specific learning disabilities. All seven children received high imagery remediation. These children are grouped together because unlike rest of the children included in the study they were not in full time remediation.

5.1.1 Wilson's (Wilson, 2001) findings

Table 1: Raw Aggregate Scores - Wilson's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
JWA	1			4	0	8	
JWB	1	-6	6	3	1	-2	-6
JWC	1	19	-1	5	-1	1	4
JWD	2	7	0	3	0	3	2
JWE	1	4	9	38	0	0	3
Total Gain		24	14	49	0	2	3

From the total gains made in the raw scores in the pre/post testing assessment battery as reflected in Table 1, it was apparent that tutoring using high imagery techniques resulted in considerable gains in reading and spelling ability (Wilson, 2001). The results suggested that the technique of utilising comics and that emphasis on silent reading, the decoding, colour coding and visualisation and revisualisation of words, as well as the verbalisation of imaged words made English language orthography more accessible to the participants. Analysis of writing ability amongst participants showed improvements

legibility, use of words, structure of sentences and the use of punctuation in the sentences as well.

Within the context of Wilson's (2001) study, the aggregated data indicated that high imagery instruction appeared to be an effective means of remediation, especially for learners who were resistant to traditional or structured phonic instruction. Wilson (2001) commented that the results of her study were limited, and could not be generalised as the sample size was too small to lend itself to any tests of statistical significance. The results of her study were promising enough to lead to further similar studies into the effectiveness of high imagery instruction in remedial education.

5.1.2 *Ravenscroft's (Ravenscroft, 2002) findings*

Table 2: Raw Aggregate Scores - Ravenscroft's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
GRC	1	2	12	6	1	4	8
GRD	1	12	4	5	7	7	
GRE	2	10	4	3	3	2	5
Total Gain		24	20	14	11	13	13

As in Wilson's (2001) study, in Ravenscroft's (2002) study the sample size was too small to establish whether or not the results were statistically significant. The results in Table 2 indicate that total gains were made in raw scores by each of the children. Improvements were evident in both reading and spelling. Writing ability, through analysis of work that the participants produced during the period they received high imagery instruction,

showed improvements in the depth of description in sentences as well as the manner in which the words were produced.

One of the children in this case study reported low mental imagery ability. The results for this participant showed that improvements were still made after exposure to high imagery tutoring. This is of interest in suggesting that ability to use eidetic mental imagery was not a pre-requisite skill / ability necessary for inclusion in high imagery instruction.

5.2 Group Two

This group consists of six children who were in full time remedial education. Three of the children received high imagery instruction in the form of the Targeted Revisualisation Programme while the remaining three received structured phonic instruction. These children are grouped according to the year their intervention was carried out.

5.2.3 Macreadie's (2001) findings

Table 3: Raw Aggregate Scores - Macreadie's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
EMU	1	20	6	5	3	1	1
EMV	1	19	3	0	2	0	-1
EMW	1	4	4	-2	6	1	5
Total Gain		43	13	3	11	2	5
Control Group							

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EMX	1	2	2	4	0	2	-1
EMY	1	5	6	7	0	2	0
EMZ	1	7	6	2	4	2	0
Total Gain		14	14	13	4	6	-1

It will be evident from the total gain in aggregate raw scores in Table 3 that neither the treatment nor control groups made greater overall gains in the pre/post test assessment battery in Macreadie's (2001) study. Greater gains for the treatment group were made in the Schonell One Word Reading Test, the Schonell Graded Dictation Test B and D. Greater gains were made for the control group in the Holborn Reading Scale (though this difference was negligible), the Schonell One Word Spelling Test and the Schonell Graded Dictation Test C.

Macreadie's study indicated that high imagery instruction had provided an effective means of improving reading ability. The results however were limited to the participants in the study as the sample size was not sufficient in size to allow any tests of statistical significance. Up to this point in the analysis, it was evident that Macreadie's, Ravenscroft's and Wilson's studies were convergent in indicating that high imagery instruction was an effective alternative means of remediation to traditional or structured phonic instruction. None of these studies attempted to use randomisation, but were conducted with opportunity samples of convenience. The comparable nature of these results, however, was evident, and formed the basis for further analysis.

5.3 Group Three

This group consists of fifteen children from Picton's, Retsios's and Sampson's research studies in 2002. All 15 of the children were in full time remedial education at Japari Remedial School. Twelve of the children received high imagery instruction in their remedial intervention while the remaining three received remediation structured phonic

instruction. These children are grouped according to the year their intervention was carried out.

5.3.1 *Picton's (2002) findings*

Table 4: Raw Aggregate Scores - Picton's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
JPR	1	6	3	4	1	1	1
JPS	1	7	1	6	2	2	3
JPT	2	7	3	3	1	3	4
Total Gain		20	7	13	4	6	8
Control Group							
JPO	2	12	1	11	1	0	2
JPP	2	6	3	9	3	1	1
Total Gain		18	4	20	4	1	3

No data on whether or not randomisation was attempted was available for this data

Picton's (2002) study indicated that children who received high imagery instruction performed better than those who received structured phonic instruction. Within the context of the study high imagery instruction thus provided an effective means of improving reading ability.

The results were thus convergent with the previous small-scale studies reviewed in this chapter. As with the other studies, the results were limited as the sample size was not sufficient in size to merit any tests of statistical significance. At this point in time, it was

evident that there were consistent indications that high imagery instruction was an effective alternative means of remediation to traditional or structured phonic instruction. The comparable nature of these results formed the basis for replication of the studies and further analysis.

5.3.2 Retsios' (Retsios, 2002) findings

Table 5: Raw Aggregate Scores - Retsios's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
MRP	1	20	9	12	3	7	2
MRQ	1	14	13	45	7	5	12
MRR	1	17	8	9	3	5	1
MRS	1	6	3	5	7	4	6
MRT	1	0	2	1	2	3	2
Total Gain		57	35	72	22	24	23

No data on whether or not randomisation was attempted was available for this data

In Retsios' (2002) study, the total gains made in the raw scores in the pre/post testing assessment battery as reflected in Table 5. It will be apparent that all children in the study were able to use eidetic imagery. It will also be apparent that tutoring using high imagery techniques resulted in considerable gains in reading and spelling ability.

Retsios commented on the value of using comics for developing verbal and written expression as well as for developing paragraphing skills. It was also evident that emphasis on silent reading, the decoding, colour coding and visualisation and

revisualisation of words, as well as the verbalisation of imaged words made English language orthography more accessible to the participants in her study.

Within the context of this small-scale study, high imagery instruction appeared to be an effective means of remediation, especially for learners who possessed a high level of visualisation ability, and were also resistant to the type of structured phonic instruction to which they had been exposed as part of their full-time remedial school programme. Retsios noted that the results of her study could not be generalised as the small sample size did not lend itself to tests of statistical significance.

5.3.3 *Sampson's (Sampson, 2002) findings*

Table 6: Raw Aggregate Scores - Sampson's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
YSA	1	5	1	3	2	0	3
YSB	1	20	6	30	5	5	5
YSC	1	8	5	4	-1	4	7
YSD	2	2	3	10	7	8	14
YSE	1	1	3	6			
Total Gain		36	18	53	13	17	29

No data on whether or not randomisation was attempted was available for this data

Sampson's results are presented in Table 6, and indicate that the gains made in raw scores in the majority of tests administered. This indicated that the participants in her study made improvements in reading and spelling. Overall improvements were also observed in handwriting in terms of neatness and legibility, and specific improvements were noted

in the formation of letters within words and the formation of words in cursive handwriting.

Sampson's study was thus convergent with the other studies reviewed up to this point in this chapter. Like the other participants in the other small-scale studies conducted up to the end of 2002, the subjects in Sampson's study were all identified as treatment resisters i.e. did not make progress in previous remedial interventions. The total gains made therefore appeared to indicate the effectiveness of high mental imagery instruction techniques in the remedial context. As with the other small-scale studies conducted up to this point in time, the small sample size in Sampson's study limited the generalisability of the results beyond the study's immediate context.

5.4 Group Four

This group consists of eight children from George's 2002 and Ravenscroft's 2002 research studies. All eight of the children were in full time remedial education though the educational institute was different from that of Group Three hence its inclusion as a separate grouping. Of the eight children five received high imagery instruction while the remaining three received structured phonic instruction.

5.4.1 George's (George, 2002) findings

Table 7: Raw Aggregate Scores - George's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
AGA	1	0	1	15	9	14	1
AGB	2	4	1	4	4	8	3

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AGC	2	13	2	9	2	13	8
Total Gain		17	4	28	15	35	12
Control Group							
AGD	1	3	3	1	1	3	1
AGE	1	0	3	1		1	2
AGF	1	0	0	5	2	0	4
Total Gain		3	6	7	3	4	7

No data on whether or not randomisation was attempted was available for this data

George's results are presented in Table 7, and indicate that the participants who received high imagery instruction made greater improvements in the areas of reading, writing and spelling, than those receiving structured phonic instruction. The results were not completely consistent in the area of reading as the comparison group made greater gains in sentence reading than the treatment group.

The results from the experimental and control group indicates that high imagery instruction as a technique by its own is effective for remediating reading and spelling difficulties, however this is not to say that the technique supersedes that of traditional or structured phonic instruction.

Importantly in this case study it was reported that participants in both the experimental and control groups gained in confidence and self-esteem. This was probably due to a number of factors, but would suggest that one-on-one individual remedial sessions provided in addition to group work done as part of the classroom programme, are an appropriate method for providing remediation for children with specific learning disabilities.

5.4.2 *Ravenscroft's (Ravenscroft, 2002) findings*

Table 8: Raw Aggregate Scores - Ravenscroft's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
GRA	1	28	8	3	8	1	
GRB	1	55	13	20	7	4	12
Total Gain		83	21	23	15	5	12

No data on whether or not randomisation was attempted was available for this data

The results in Table 8 indicate that the total gains made in raw scores indicate that the participants in the case study made improvements in reading and spelling. Writing ability, through analysis of work that the participants produced during the period they received high imagery instruction, showed improvements in the depth of description in sentences as well as the manner in which the words were produced.

5.5 Group Five

The group consists of four children from Abelheim's 2002 research study, all of whom were in full time remedial education. These four children were in the same remedial primary school as Group Three but are not included in that group as the four children were diagnosed as having below average IQ scores. All four children underwent high imagery instruction in their remedial intervention.

5.5.1 *Abelheim's (Abelheim, 2002) findings*

Table 9: Raw Aggregate Scores – Abelheim's Case Study

Participant	Mental	Schonell	Holborn	Schonell	Schonell	Schonell	Schonell
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	Imagery	One Word Reading Test	Reading Scale	One Word Spelling Test	Graded Dictation Test B	Graded Dictation Test C	Graded Dictation Test D
Treatment Group							
DAA	1	1	1	4		5	1
DAB	1	4	1	8	1	4	8
DAC		14	2	10	-2		
DAD		3	1	0	1	14	13
Total Gain		22	5	22	0	23	22

No data on whether or not randomisation was attempted was available for this data

All of the participants in Abelheim's small-scale study were described as having below average IQs. Each of these participants had also made marginal progress in their remedial lessons prior to their inclusion in the programme.

It will be evident from the data presented in Table 9 that substantial gains were made over the six month period of high imagery tutoring provided during the course of the programme, as indicated by gains within the tests used in the study, as well as in the total gain scores.

Two of the children in Abelheim's study possessed eidetic imagery, while two did not. The gains made by all children would thus suggest that high imagery teaching techniques can be applied both to children who can use eidetic imagery, as well as to those who do not, as well as across a range of IQs. As in the other small-scale studies reviewed up to this point in this chapter, there was thus an overall convergence indicating the potential of the high imagery teaching techniques used, both for children with high visualisation ability as well as with children without this ability.

These indications were derived from clinical and case study data. They were not able to be tested statistically, nor was it possible to generalise the results of such a small sample beyond the immediate participants.

5.6 Group Six

This group consists of eleven children from Booth's and Els's 2003 research studies, all of whom were in full time remedial education. Six of the eleven children received high imagery instruction while the remaining five received structured phonic instruction.

5.6.1 Booth's (Booth, 2003) findings

Table 10: Raw Aggregate Scores – Booth's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
LBA1	1	12	6	8	4	11	8
LBB1	2	10	12	-7	3	7	6
LBC1	1	6	7	23	6	12	
Total Gain		28	25	24	13	30	14
Control Group							
LBD1	2	10	5	0	3	1	2
LEE1	2	6	3	6	2	-7	7
Total Gain		16	8	6	5	-6	9

No data on whether or not randomisation was attempted was available for this data

The results in Table 10 indicated that the participants who received high imagery instruction in Booth's (2003) study consistently made greater improvements in the areas of reading and spelling, than those in the group receiving structured phonic teaching.

Booth also reported that the one-on-one remediation and positive reinforcement given to the participants in both groups aided most of the participants in improving their reading and writing skills.

These results thus indicated that children in both the experimental and control group instructional conditions benefited from one to one tutoring provided after school. The results also indicated that both high imagery and structured phonics instruction were effective forms of remedial teaching. However, greater and more consistent gains in reading and spelling were made by the children receiving high imagery instruction.

Booth also reported that participants in the high imagery group also appeared to make greater gains in writing ability than those in the structured phonic control group – specifically in descriptive writing ability as well as sentence length. As with the other small-scale studies reviewed in this chapter up to this point, the results were not able to be tested statistically, nor was it possible to generalise beyond the results of such a small sample.

5.6.2 *Els's (Els, 2003) findings*

Table 11: Raw Aggregate Scores – Els's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
KEA1	1	13	4	10	11	10	15
KEB1	1	3	1	4	1	7	8
KEC1	2	5	5	7	3	10	14
Total Gain		21	10	21	15	27	37

Control Group							
KED1	1	4	1	9	2	5	6
KEE1	2	2	0	4	4	-3	0
KEF1	2	6	2	7	2	0	5
Total Gain		12	3	20	8	2	11

No data on whether or not randomisation was attempted was available for this data

The results of Els' (2003) study are presented in Table 11. As with Booth's (2003) study, the results indicated that the total gains made by children receiving high imagery instruction were greater than those made by children receiving structured phonic instruction. This was the case for all scholastic tests administered, with the exception of one word spelling, where the gains made by both groups were comparable.

As with the other studies reviewed up to this point in this chapter, Els noted that the subjects in her study were highly selected, and had all previously been identified as treatment resistors (i.e. had not made progress in previous remedial interventions) prior to their inclusion in the study. The total gains made therefore appeared to indicate the effectiveness of high mental imagery instruction techniques in the remedial context with treatment resistors. For this reason, the results could not be generalised beyond this immediate participants in the study.

5.7 Group Seven

This group consists of thirty two children all of whom are in full time remedial education. The participants are drawn from research studies conducted by Cronk, Tatic, Khan in 2004 and Booth and Els in 2005. Of the thirty two participants for that year, fifteen received high imagery instruction as a remedial intervention while the remaining seventeen received structured phonic instruction.

5.7.1 Cronk's (Cronk, 2004) findings

Table 12: Raw Aggregate Scores – Cronk's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
CCA	1	-9	2	4	1	-1	0
CCB	1	5	9	7	-1	0	
Total Gain		-4	11	11	0	-1	0
Control Group							
CCC	1	20	8	16	-1	3	4
CCD	2	21	2	14	2	3	3
CCE	1	1	3	8	-1	8	6
Total Gain		42	13	38	0	14	13

No data on whether or not randomisation was attempted was available for this data

At the beginning of 2004, all Japari's computers were stolen from the school's computer centre, and were not replaced until the end of the year. As a result, the children in the high imagery condition in Cronk's study were not exposed to the type of high imagery analysis of the vowel structure of words normally provided in the Targeted Revisualisation programme using computers.

In contrast to the other small-scale studies conducted prior to 2004, the participants in the high imagery group did not make gains of the same magnitude of those in the structured phonic instruction condition. Taken at face value, the results in Table 12 would suggest that the type of high imagery instruction techniques provided in the absence of computers were of little benefit to the participants. In contrast, structured phonic techniques were of great benefit to two of the participants in Cronk's study.

In evaluating Cronk's study, it is important to note that the high imagery instruction group did not receive the Targeted Revisualisation Programme either in the form in which it was designed or in the same form as children in the high imagery condition in the previous studies reviewed up to this point in this chapter. The theft of the computers was unfortunate, but their loss may also provide evidence as to their value in the programme. In particular, Cronk's study would suggest that computer-based colour coding forms an essential part of the revisualisation process. In particular, Cronk's study indicated that the use of computers in the revisualisation process was essential to development of reading and spelling skills in the high imagery context.

5.7.2 *Tatic's (Tatic, 2004) findings*

Table 13: Raw Aggregate Scores – Tatic's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
DTA	1	1	1	5	0	5	1
DTB	1	2	15	4	-1	4	4
DTC	1	10	5	0	1	0	3
Total Gain		13	21	9	0	9	8
Control Group							
DTD	1	14	20	1	6	8	10
DTE	1	0	-1	7	0	1	-6
DTF	1	28	19	12	0	8	-2
Total Gain		42	38	20	6	17	2

No data on whether or not randomisation was attempted was available for this data

As in Cronk's (2004) study, the children in Tatic's (2004) study were also provided with high imagery instruction without the availability of computers. It is of interest that the trend in the results presented in Table 13 was very similar to those in Cronk's (2004) study presented in Table 12.

As in Cronk's study, Tatic's data indicated that the children who received high imagery instruction did not perform as well as participants in the structured phonic instructional condition. Tatic reported that while the gains made by the high imagery participants indicated consistent low gains across the test battery, they were not near the magnitude of those participants who were exposed to structured phonic instruction.

There were also indications that selection might have been a factor influencing the results. Prior to 2004, all children nominated for inclusion in the after-school tutorial programme had been treatment resisters. During 2004, this inclusion criterion was relaxed, with children being admitted into the programme immediately after entering Japari. This was different to the selection procedures adopted previously (where children selected for additional after-school tutoring had been exposed to structured phonic teaching at Japari over a period of time, and were clearly not making progress).

5.7.3 *Khan's (Khan, 2004) findings*

Table 14: Raw Aggregate Scores – Khan's Case Studies

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
SKA	1	11	6	9	6	1	3

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SKB	1	0	3	3	1	3	1
Total Gain		11	9	12	7	4	4
Control Group							
SKC	1	12	5	8	-1	4	3
SKD	1	27	2	10	1	-3	-2
SKE	1	14	12	14	-3	1	-3
Total Gain		53	19	32	-3	2	-2

No data on whether or not randomisation was attempted was available for this data

The results of Khan's (2004) study were consistent with those conducted by Cronk and Tatic in the same year. The gain scores presented in Table 14 indicated that the participants in the structured phonic condition generally made better gains than those in the high imagery instructional condition.

As in Cronk and Tatic's studies, the children in the high imagery condition in Khan's (2004) study did not have access to computer-based colour coding or computer-based revisualisation exercises. The results obtained can thus probably be attributed to the lack of access to computers, and the influence of this factor on the type of high imagery instruction received by the high imagery participants during 2004. Only on the Schonell Graded Dictation Tests in Khan's study was there evidence that children in the high imagery instruction performed better than those in the structured phonic condition (suggesting that the activities included in the high imagery condition had been better able to improve the participants' contextual spelling ability).

As with Cronk and Tatic's studies, there were also indications that selection might also have been a factor influencing Khan's (2004) results. During 2004, owing to the apparent success of the Japari after-school tutoring programme over the period 2001 to 2003, an increasing number of children were nominated for inclusion in the Targeted Revisualisation Programme. In response to the programme's apparent success, this led to

a situation in which a third of all children at Japari in the higher primary school grades were included in the after-school tutoring.

This factor may thus have influenced Khan's (2004) results, as in previous years after-school tutoring had been offered only to those children who had not made adequate progress in their classroom remedial programmes. There was thus evidence of lack of response to structured phonic instruction, prior to nomination for additional after-school tutoring.

5.7.4 Booth's (Booth, 2005) findings

Table 15: Raw Aggregate Scores – Booth's Case Studies

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
LBA2	1	-9	3	-1	5	2	4
LBB2	1	3	7	3	-2	0	2
LBC2	2	-2	5	4	5	4	2
LBD2	1	18	6	4	2	6	8
Total Gain		10	21	10	10	12	16
Control Group							
LBE2	2	6	3	-1	11	12	8
LBF2	2	0	-1	7	1	4	8
LBG2	2	3	3	11	8	-1	-3
LBH2	2	2	3	6	7	2	3
Total Gain		11	8	23	27	17	16

No data on whether or not randomisation was attempted was available for this data

As with the other 2004 studies reviewed up to this point in this chapter, in Booth's (2005) study, the results presented in Table 15 indicate that greater gains were made by the children exposed to structured phonic teaching, and less by children in the high imagery condition. This was the case for all dependent variables with the exception of one, the Holborn Reading Test.

Like the other studies in 2004, the lowered results of the high imagery group appeared to be due to lack of access to computers, which had been used in previous years for colour coding of the vowel structure within words during the revisualisation process. Selection may also have influenced the results obtained in the study.

5.7.5 *Els' (Els, 2005) findings*

Table 16: Raw Aggregate Scores – Els' Case Studies

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
KEA2	1	2	9	4	4	2	
KEB2	1	5	12	12	2	7	1
KEC2	2	2	6	5	2	5	
KED2	1	3	3	11	4		
Total Gain		12	30	32	12	14	1
Control Group							
KEE2	2	1	3	3	1	0	
KEF2	1	4	9	4	3	5	5
KEG2	2	2	2	4	-1	2	

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KEH2	1	1	0	-3	0	0	0
Total Gain		8	14	8	3	7	5

No data on whether or not randomisation was attempted was available for this data

Contrary to the other small-scale studies conducted in 2005, Els used computer-based colour coding and revisualisation in the high imagery condition. She brought her laptop with her to all sessions, and was thus able to provide the children in the high imagery condition with the types of vowel colour coding, as well as the computer-based word and sentence revisualisation activities intrinsic to the Targeted Revisualisation Programme.

It is thus of interest that the results presented in Table 16 above that Els' (2005) results were different to those presented by Cronk (2004), Tatic (2004) Khan (2004) and Booth (2005), who had not used computers for teaching the children in their studies. It was also apparent appear to be consistent with those obtained in the small-scale studies conducted between 2001 and 2003, in which computers had been used in the high imagery condition.

It is thus likely that the difference in these results can be attributed to the inclusion or lack of inclusion of computer-based activities in the revisualisation process. Els, having had access to a laptop over the entire six month period over which her study was conducted, was therefore not affected by the theft of the computers from the school. Given the variation in high imagery teaching between Els' (2005) study and the other small-scale studies conducted without access to computers in 2004, the results also indicated that the use of computers in the revisualisation process was essential to the success of the high imagery instruction programme.

In particular, Els' results indicated that those children exposed to high imagery teaching involving computer-based colour coding obtained better results than children exposed to structured phonic teaching. Els also reported greater gains in writing ability in the high imagery group. The substantial gains made by the children exposed to high imagery

teaching thus appeared to indicate that the Targeted Revisualisation Programme's instructional techniques, where implemented using computer-based colour coding of the vowel structure of words, and focus on word and sentence revisualisation, had the ability to improve the reading, writing and spelling skills of learning disabled children.

5.8 Group Eight

This group consists of eight children all of whom were in full time remedial education. The participants are drawn from Koeman and Rayner research studies in 2005. All eight of the subjects received high imagery instruction in their remedial intervention.

5.8.1 Koeman's (Koeman, 2005) findings

Table 17: Raw Aggregate Scores – Koeman's Case Study

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
JKA	1	1	6	-1	5	7	14
JKB	2	4	1	5	6	12	12
JKC	2	2	1	0	-7	-4	-3
JKD	1	8	2	4	-8	-3	-4
Total Gain		15	10	8	-4	12	19

At the end of 2004, Japari purchased new computers, with the result that during 2005, children exposed to high imagery teaching could be exposed to the types of computer-based colour coding and revisualisation activities on which the Targeted Revisualisation Programme was based. Koeman's (2005) study yielded the results presented in Table 17.

Koeman's data indicated gains across all the tests in the pre/post test assessment battery. However, there was considerable intertest scatter, with variation in the gains made by certain of the children exposed to high imagery teaching.

Koeman also reported gains in the participants' self esteem over the course of the programme, but indicated that the post-testing of the children had been a difficult process, with certain of the children not concentrating fully over the second testing session, during which the dictation tests were administered. This was apparently due to the fact that the session was conducted very near the end of term.

A testing factor may thus have influenced the results obtained. The improvements in self-esteem were of interest in suggesting the positive influence of the individual attention received from the tutor, as well as positive reinforcement given during tutoring sessions.

5.8.2 Rayner's (Rayner, 2005) findings

Table 18: Raw Aggregate Scores – Rayner's Case Studies

Participant	Mental Imagery	Schonell One Word Reading Test	Holborn Reading Scale	Schonell One Word Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Treatment Group							
CRA	1	26	3	10	-1	1	4
CRB	1	20	11	4	-1	8	9
CRC	1	20	0	-4	-2	5	-1
CRD	1	8	0	7	2	0	2
CRE	1	1	-3	-1	-8	1	-9
Total Gain		75	11	16	-10	15	5

The results in Rayner's (2005) study are presented in Table 18. Rayner's data indicated that the majority of participants exposed to high imagery instruction had made major improvements in reading, with gains also being made by certain of the children in spelling. As with Koeman's study, there was inter-test scatter, particularly affecting the dictation test results.

Read in conjunction with Koeman's data, the overall trends from the 2005 data were thus not as clear-cut as had been the case in the data from the studies conducted between 2001 and 2003. As in the other small-scale studies, the participants in the programme were all identified as treatment resisters i.e. did not make progress in previous remedial interventions. While the majority of the children made progress, certain did not. In both Koeman's and Rayner's studies, concentration during the second post-testing session may have influenced the results obtained.

Overall in 2005, the data thus indicated that while gains were made by the majority of children, there were certain children where high mental imagery instructional techniques did not appear to have been effective. However, as with the other small-scale studies conducted in previous years, it was not possible to generalise the results, or draw firm conclusions.

5.9 Hypotheses Relevant to the Aggregated Data

It will be evident from the review of the seventeen small-scale studies provided in this chapter that there was variation in the results, as well as inter-test scatter within the results. This provided the departure point for the current research.

Over the five year period from 2001 to the end of 2005, a total number of 93 children had been provided with after-school individual tutoring using either high imagery or structured phonic instructional techniques. The decision was thus taken to aggregate the

data, as the basis for investigating trends occurring across the various small-scale studies conducted.

The review provided in this chapter has also highlighted indications of broad contextual factors (eg the theft of Japari's computers; changes in selection criteria; variation in quality of tutor training as well as quality of tutoring) which appeared to have influenced the types of instruction provided at different stages over the five year period. It was thus logical to not only examine broad trends occurring within the composite data set as a whole, but also to investigate possible differences occurring within the five year period over which the data had been collected.

This was done by developing a number of detailed hypotheses, as reflected in the following research design table.

Table 19: Research Questions, Data Sources, and Expected Outcomes of this Study

Research Question	Data Sources	Expected Outcome
1) What trends are evident from the cumulative results of exploratory studies conducted on the use of high imagery teaching techniques from 2001 to 2003?	2001 2002 2003	1) There will be a significant difference between the results of children who received high imagery instruction as opposed to those who received structured phonic instruction.
2a) Is there a difference in trends in the results in 2004 when implementation of the high imagery teaching programme varied from that taught from 2001 to 2003?	2001 2002 2003 2004	2a) There will be a significant difference between the cumulative results from studies conducted in 2004 and those conducted from 2001 to 2003.
2b) Is there a difference in trends in the results in 2004 when implementation of the high imagery teaching programme varied from that taught from 2001 to 2003 and 2005?	2001 2002 2003 2004 2005	2b) There will be a significant difference between the cumulative results from studies conducted in 2004 and those conducted from 2001 to 2003 and 2005.
3a) What trends are evident from the cumulative results of studies conducted on the on the use of high imagery teaching techniques from 2001 to 2003 and 2005? 3b) Was gender an influence on scholastic performance?	2001 2002 2003 2005	3a) There will be a significant difference between the results of children who received high imagery instruction as opposed to those who received structured phonic instruction. b) Gender will play a role in the scholastic performance of children who received high imagery instruction techniques and those that received structured phonic instruction.
4a) What trends are evident from the cumulative results of studies conducted on the on the use of high imagery	2001 2002	4a) There will be a significant difference between the results of children who received high imagery instruction as opposed to those

Research Question	Data Sources	Expected Outcome
teaching techniques from 2001 to 2005 (including 2004 results that received standard TRP remediation)? 4b) Was gender an influence on scholastic performance?	2003 2004 2005	who received traditional phonologically oriented instruction. 4b) Gender will play a role in the scholastic performance of children who received high imagery instruction techniques and those that received traditional phonologically oriented instruction.
5) Does the extent of a child's deficits in English reading and spelling, as determined by the difference between his or her chronological age and reading and spelling ages, influence the gains made in high imagery instruction and structured phonic instruction?	2001 2002 2003 2004 2005	5) The child's deficits in English reading and spelling will influence the gains made in both high imagery and structured phonic instruction.
6) Is there a difference between the results of children who are able to visualise and are exposed to high imagery techniques, and children who are exposed to structured phonic teaching?	2001 2002 2003 2004 2005	6) There will be difference between the results of children who are able to visualise and are exposed to high imagery instruction and children who are exposed to structured phonic instruction.
7a) Is there a relationship between the error scores yielded by the three levels of the Phonic Inventories for this sample? 7b) Is there a relationship between the error scores yielded by the instrument on each of the levels of the Phonic Inventories, and the other scholastic tests included as dependant variables in this study?	2001 2002 2003 2004 2005	7a) There is a relationship between the error scores yielded by the three levels of the Phonic Inventories. 7b) There is a relationship between the error scores yielded by the instrument on each of the levels of the Phonic Inventories and the other scholastic tests included as dependant variables.

Research Question	Data Sources	Expected Outcome
8) Is there a difference in gains made in phonic skills as indicated by the results of Level 1, 2 and 3 of the Phonic Inventories for those children who received high imagery instruction and those that received structured phonic instruction?	2001 2002 2003 2004 2005	8) There is a difference in gains made in phonic skills as indicated by the results of Level 1,2 and 3 of the Phonic Inventories for those children who received high imagery instruction and those that received structured phonic instruction.

5.10 Summary

This chapter has presented the data and major findings of seventeen small-scale studies conducted over a five year period at Japari Remedial School. In each of the studies, a small group of learning disabled children were tutored.

The studies have been reviewed chronologically, for the reason that different trends were evident in the data over the five year period. There were also a number of contextual factors which influenced the studies over this period. These included the theft of computers from Japari, as well as changes in selection as well as quality of training provided to tutors.

These factors need to be noted at this point in the narrative, as factors which may have influenced the quality of the data, as well as its integrity as a composite data set. The reason for this is that temporal factors such as selection, change or variation in quality of tutors, as well as changes in the quality of training provided to tutors (which varied over the five year period over which the seventeen small-scale studies were conducted), may have exerted an influence on the overall consistency of the composite data set used in this research.

As a shift was evident in the trends in the small-scale studies implemented up to the end of 2003, and those which were implemented thereafter, this has been taken into account in the research questions and hypotheses guiding this study. These have been presented as a research design table at the end of the chapter, as the basis for the discussion of methodology in Chapter Six following. Besides hypotheses relating to different trends in learning gains which may or may not have occurred between 2001 and the end of 2005, four covariates have also been included in the design, namely, gender, age, degree of learning deficit/developmental lag and ability to use eidetic imagery in visualisation. A research question on the validity of the instruments used in the study has also been included in the design, owing to the highly selected nature of the sample.

6 Chapter Six: Methodology

6.1 Research Design

Each of the small-scale studies reviewed in the previous chapter had utilised a non-experimental research design, based on either a pre-experimental or an ex post facto design. The composite data set thus consisted of two conditions as an independent variable possibly affecting the results obtained over a five year period.

The research design for investigating trends in the composite data set was conceptualised as an ex post facto study. Based on the data, the relationships between the following variables would be investigated:

- **Independent variable:** Two instructional conditions (high imagery and structured phonic instruction).
- **Dependent variables:** The scholastic tests and phonic inventories administered to monitor the progress made by the children in these two conditions.
- **Co-variates:** Gender, age, degree of learning deficit/developmental lag and visualisation ability.

In addition to overall trends in the above variables in the composite data set, possible differences within the data relating to contextual factors occurring over the period 2001 to the end of 2005 will also be investigated. This would be done through a series of detailed comparisons within as well as between different subsets of the data. Information on the validity of the various instruments used in the study will also be provided, as necessary to drawing conclusions concerning learning gains as well as the development of phonic abilities in such a highly selected sample.

6.2 Sample

Given the variation within the seventeen small-scale studies reviewed in the previous chapter, some comments on the aggregated sample are necessary. Learning disabled children are by definition a highly selected sample. In addition, sampling as well as selection factors may have influenced the integrity of the data.

Each of the samples in the small-scale studies was nominated for inclusion in the afternoon tutoring programme run at Japari, by their teachers and the head remedial therapist at the school. In each of the studies, a small group of learning disabled children was identified as likely to benefit from tutoring. As the programme developed and as there was evidence of the success of previously unsuccessful children, there were additional changes in selection criteria affecting the type of child selected for the programme.

Certain of the small-scale studies involved a randomisation process for assigning children to either a high imagery or a structured phonic tutorial condition. Overall, however, the assignment of children, as well as their selection for the programme, can best be described as non-random, and based on a purposive, non-probability sampling strategy. The children were specifically selected and therefore formed an atypical opportunity sample, in which the participants' ages ranged from 6 years to 13 years. Despite a broadening of the selection criteria in 2004 and 2005, the tutoring was focused on children who were not making adequate progress in a full-time remedial environment. All children included in both conditions in the intervention can thus be termed "treatment resisters", and as such form a specific subpopulation of children with learning disabilities.

The age and gender composition of the sample by the type of remedial intervention they received is summarised in Table 20.

Table 20: Sample Breakdown by Remediation Type, Gender and Age

Structured Phonic Instruction			High Imagery Instruction		
Participant	Gender	Age	Participant	Gender	Age
EMX	1	13yrs 2mths	GRC	1	12yrs 5mths
EMY	1	12yrs 7mths	GRD	1	9yrs 2mths
EMZ	1	11yrs 7mths	GRE	1	12yrs 7mths
JPO	2	10yrs 3mths	JWA	1	11yrs 4mths
JPP	2	10yrs 11mths	JWB	1	11yrs 9mths
AGD	1	9yrs 10mths	JWC	1	10yrs 10mths
AGE	2	10yrs 5mths	JWD	2	11yrs 10mths
AGF	1	12yrs 7mths	JWE	1	12yrs 7mths
KED1	1	10yrs 4mths	EMU	1	12yrs 1mth
KEE1	2	10yrs 7mths	EMV	1	11yrs 7mths
KEF1	1	10yrs 4mths	EMW	1	12yrs 5mths
LBD1	1	12yrs 4mths	JPR	1	12yrs 3mths
LBE1	2	11yrs 2mths	JPS	1	12yrs 10mths
CCC	1	11yrs 7mths	JPT	2	10yrs 5mths
CCD	1	12yrs 6mths	MRP	1	12yrs 5mths
CCE	1	12yrs 1mth	MRQ	1	13yrs 2mths
DTD	1	13yrs 6mths	MRR	1	13yrs 3mths
DTE	2	12yrs 9mths	MRS	1	12yrs 12mths
DTF	1	14yrs 3mths	MRT	1	12yrs 7mths
SKC	1	12yrs 10mths	YSA	1	12yrs 7mths
SKD	1	13yrs 5mths	YSB	1	13yrs 6mths
SKE	2	12yrs 7mths	YSC	1	14yrs 2mths
LBE2	1	10yrs 2mths	YSD	1	14yrs 2mths
LBF2	1	9yrs 8mths	YSE	1	8yrs 5mths
LBG2	1	11yrs 4mths	AGA	1	11yrs 1mth

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LBH2	2	9yrs 5mths
KEE2	2	11yrs 1mth
KEF2	2	10yrs 12mths
KEG2	2	11yrs 9mths
KEH2	1	11yrs 8mths

N = 30

AGB	2	9yrs 10mths
AGC	1	12yrs 11mths
GRA	2	13yrs 3mths
GRB	1	13yrs 3mths
DAA	1	12yrs 4mths
DAB	2	11yrs 2mths
DAC	2	
DAD	2	
KEA1	2	9yrs 12mths
KEB1	1	10yrs 12mths
KEC1	1	10yrs 9mths
LBA1	2	11yrs 10mths
LBB1	1	11yrs 7mths
LBC1	1	10yrs 9mths
CCA	1	11yrs 7mths
CCB	1	12yrs 7mths
DTA	1	13yrs 11mths
DTB	2	12yrs 5mths
DTC	1	13yrs 6mths
SKA	1	13yrs 9mths
SKB	1	13yrs 4mths
LBA2	2	10yrs 7mths
LBB2	1	11yrs 6mths
LBC2	1	10yrs 2mths
LBD2	1	9yrs 7mths
KEA2	2	11yrs 4mths
KEB2	2	11yrs 4mths

KEC2	1	11yrs 9mths
KED2	1	11yrs 5mths
JKA	1	9yrs 0mths
JKB	2	9yrs 0mths
JKC	1	9yrs 6mths
JKD	2	9yrs 6mths
CRA	1	11yrs 7mths
CRB	1	12yrs 12mths
CRC	2	12yrs 4mths
CRD	1	12yrs 4mths
CRE	2	12yrs 7mths

N = 63

6.3 Type of after-school tutoring received by the sample

Each of the participants in the small-scale studies received withdrawal (one-to-one) type remediation (regardless of their grouping) focused on their learning difficulties in reading, writing and spelling. The assignment to either control or treatment groups was dependent on whether subjects could be matched across the two groups. The participants were at times identified by their teachers and principals as in need of inclusion in the programme due to their lack of progress in class; while at other times they had been identified by their remedial therapist as treatment resistant according to progress that had / had not been made in their remedial history.

The intervention was longitudinal over a period of five years between the beginning of 2001 and the end of 2005. The sample of 93 participants can thus be broken down into groups by year and according to the specific interventions they received. These groups can be described as follows:

- Group One (see Appendix 1a) consists of seven children from Wilson's and Ravenscroft's research studies (2001 and 2002 respectively) who were all in mainstream education but had been undergoing remedial intervention for a specific learning disability. All seven of the children received high imagery instruction in the form of the Targeted Revisualisation Programme, thus there was no contrast group in Group One.
- Group Two (see Appendix 1b) consists of six children from McCreddie's 2001 research study, all of whom were in full time remedial education. Three of the children received high imagery instruction in the form of the Targeted Revisualisation Programme while the remaining three received structured phonic instruction.
- Group Three (see Appendix 1c) consists of fifteen children from Picton's, Retsios's and Sampson's research studies in 2002. All 15 of the children were in full time remedial education. Twelve of the children received high imagery instruction in their remedial intervention while the remaining three received remediation structured phonic instruction.
- Group Four (see Appendix 1d) consists of eight children from George's 2002 and Ravenscroft's 2002 research studies. All eight of the children were in full time remedial education though the educational institute was different from that of Group Three hence its inclusion as a separate grouping. Of the eight children five received high imagery instruction while the remaining three received structured phonic instruction.
- Group Five (see Appendix 1e) consists of four children from Abelheim's 2002 research study, all of whom were in full time remedial education. These four children were in the same remedial primary school as Group Three but are not included in that group as the four children were diagnosed as having below average IQ scores. All four children underwent high imagery instruction in their remedial intervention.
- Group Six (see Appendix 1f) consists of eleven children from Booth's and Els's 2003 research studies, all of whom were in full time remedial education. Six of the eleven children received high imagery instruction while the remaining five received structured phonic instruction.

- Group Seven (see Appendix 1g) consists of thirty two children all of whom are in full time remedial education. The participants are drawn from research studies conducted by Cronk, Tatic, Khan in (2004) and Booth and Els in 2005. Of the thirty two participants for that year, fifteen received high imagery instruction as a remedial intervention while the remaining seventeen received structured phonic instruction.
- Group Eight (see Appendix 1h) consists of eight children all of whom were in full time remedial education. The participants are drawn from Koeman and Rayner research studies in 2005. All eight of the subjects received high imagery instruction in their remedial intervention.

6.4 Variation in the type of high imagery instruction received by the sample

It should be noted that the high imagery instruction conducted in 2004 differed in the manner it was implemented during the 2001, 2002, 2003, and 2005 interventions. As a result of a burglary at Japari (see Introduction pg 7), the 2004 groups were not able to work in the school's computer centre, with the exception of Els's group, who worked on the therapist's own laptop computer.

This difference in implementation has led to the exclusion of the 2004 high imagery results from those of the other years. This means that, with the exception of Els's group. The 2004 results have been examined as a separate type of high imagery instruction (high imagery instruction provided without the aim of computer-based colour coding).

While this deviation in implementation in the high imagery group was unfortunate, it lay beyond the control of the investigators. The data from 2004 have thus been examined separately in an attempt to determine any significance, in the 2004 data set, in isolation to the larger high imagery sample pool. The variance in implementation between the two treatment groups should under analysis provide insight into the underlying processes of the Targeted Revisualisation Programme, and the centrality of computer-base colour coding to type of high imagery instruction provided by the programme.

6.5 Type of structured phonic instruction received by the sample

There were no differences in the way the structured phonic remedial instruction took place in 2004 and these control subjects were therefore included along with those of other years. The type of instruction provided focused on use of a linguistic approach to structured phonic instruction, based on exposure to word families. These were supported by reading as well as sentence and paragraph writing in the sessions.

6.6 Procedure used for aggregating results, and issues of generalisability

The process of aggregation of the matching treatment and contrast group subjects was conducted year by year from 2001 to 2005. It should be noted that the different groups were taught by different therapists. There was thus no dominant influence from any one therapist's personality or skills on the data set as a whole.

These variations within the sample imply that there is an increase in the degree of generalisability that can be applied to the results of the sample as a whole. Nevertheless, it should be noted that the sample as a whole is highly selected, and that the results are representative of a particular subgroup of learning disabled children, namely, those in a full-time remedial environment who were treatment resisters, in the sense that they were not making progress in reading, writing and spelling despite being previously exposed to remedial therapy.

Interviews with their teachers and analyses of their classroom work indicated that all children in the sample had been previously using structured phonics. All children had been through a full assessment at time of intake into the school, and all were of normal to above normal intelligence, being diagnosed as learning disabled. The fact that they were also resistant to structured phonic teaching would suggest that there was a high proportion of children in the sample who could be classified as dyslexic, in the sense of having weaknesses in the phonological system.

This increased sample size is an important step in determining whether the high imagery instruction techniques as described in the Target Revisualisation Programme are an alternative method of remediation.

6.7 Methodology and Procedure followed in the Individual Studies

In a number of the individual studies, the interventions had both treatment and contrast groups, which were analysed by clustering as well cross-case comparisons using a matched-pairs methodology. This took into account the intelligence of the child, their age, their gender and the nature of their specific learning disability so that groups relevant to these demographic variables were formed.

From 2002 to 2005, assignment to the treatment or comparison group was random in nature with no preference being shown toward any one child for inclusion in the treatment group. Each child was then tested on his/her reading, writing and spelling abilities using the standard instruments referred to later in this chapter. The phonic abilities of each child were also assessed, using the three levels of the Phonic Inventories described in the previous chapter.

The assessment was conducted prior to the onset of the programme as the tests results were to form the basis of the intervention strategy. Following pre-testing each child received one-on-one remediation for a six month period, the focus of which was targeted at the areas of phonic difficulty identified at time of pre-testing. At the end of the six month period the participants were then post-tested so that comparisons could be made between the skills of each child pre and post-intervention. The aim was that post-test scores would also indicate how effective the child's intervention had been.

The initial research carried out on the Targeted Revisualisation Programme was based on qualitative methodology and made use of an aggregative case survey method. This

allowed the various study groupings to be analysed (both between the groups as well as analysing the group results as a whole with the treatment and contrast groups in contrast with one another). The limited size of the sample in each of the separate studies however did not avail itself to any substantial form of quantitative analysis. The amalgamation of the various sample sets, as is the case in this research study, lends itself to various forms of quantitative analysis. The research conducted in this study could therefore be said to be largely quantitative in nature.

Each of the children was also tested at the end of the intervention to establish whether they had the ability to visualise images of words. Testing for this ability was not conducted at time of pre-testing in order to ensure that the children were assigned to their treatment and contrast groups independently of their abilities to use mental imagery prior to intervention. As a result there were children in both treatment and contrast groups who had high imagery and visualisation abilities.

After assignment to the different instructional conditions had been made, the high imagery treatment group were then pre-tested on their mental imagery ability as an integral part of the instructional procedures to which they were exposed. The contrast group children received only a post-test, being deliberately excluded to prevent any contamination in the way the two separate techniques were implemented. Thus, while most of the children in the study at time of post-testing affirmed that they could see mental images as well as visualise words, pre-testing in this modality is unlikely to have influenced the results of the study.

What was a surprise in the data was that the vast majority of the children reported ability to use eidetic imagery, and were able to harness this ability for the purposes of visualising the form and structure of words. A small proportion did not. Given this finding, the “flagging” of all children as able to visualise and not able to visualise was thus conducted post hoc, creating an additional sample pool layer that could be examined for effect.

6.8 Data Collection

It will be apparent from the research design table that longitudinal data sources have been used to create the independent variables (IVs) necessary to answer the research questions and hypotheses of this study. In addition, a number of definite dependent variables (DVs) have been used in the analysis.

Pre and post intervention reading ability was assessed through the Holborn Reading Scale and the Schonell One Word Reading Test. Pre and post intervention spelling ability was assessed through the use of the Schonell Spelling Test as well as tests B, C and D of the Schonell Graded Dictation Test.

Information about the child's age was obtained from the Biographical Questionnaire. This information was used to calculate the child's deficit in reading, writing and spelling prior to the implementation of the programme for that year.

The presence or absence of mental imagery was established through use of a mental imagery questionnaire (Potter, 2001), as well as reports of the tutors who worked with the children. These results were collected pre and post intervention for children in the high imagery, condition, and post intervention only for children in the contrast structured phonic teaching condition. This information was then analysed to establish if and how any of the subjects had the potential to use mental imagery as a strategy for learning.

The above variables were then organised for coding purposes to create a series of spreadsheets, which were analysed using SPSS Version 14. Each spreadsheet was processed so that they are in a form that allows for the hypotheses, posed by the research questions, to be tested. The difference between the two scores indicates whether there was a measured improvement in reading and spelling, as measured by the test battery. These resultant scores were then aggregated according to test type and treatment grouping (control or experimental). Once in this form the data was then available for analysis in SPSS.

6.9 Hypotheses

1. There is a significant difference in the reading, writing and spelling results of children who received high imagery instruction as opposed to structured phonic instruction for cumulative results from studies conducted from 2001 to 2003.
2. a) There is a significant difference between the cumulative results from studies conducted in 2004 and those conducted from 2001 to 2003.
b) There is a significant difference between the cumulative results from studies conducted in 2004 and those conducted from 2001 to 2003 and 2005.
3. a) There is a significant difference between the reading, writing and spelling results of children who received high imagery teaching techniques from 2001 to 2005 as opposed to those who received structured phonic teaching (including 2004 results).
b) Gender plays a role in the scholastic performance of children who received high imagery instruction techniques and those that received structured phonic teaching.
4. a) There is a significant difference between the reading, writing and spelling results of children who received high imagery teaching techniques from 2001 to 2005 as opposed to those who received structured phonic teaching (excluding 2004 results).
b) Gender plays a role in the scholastic performance of children who received high imagery instruction techniques and those that received structured phonic teaching.
5. There is a relationship between the extent of the children's deficits in English reading and spelling, as determined by the difference between their chronological age and reading and spelling ages, and gains made in high imagery instruction and structured phonic instruction.
6. There is a significant difference between the reading, writing and spelling results of children who are able to visualise and received high imagery teaching techniques and the reading, writing and spelling results of children who received structured phonic instruction.
7. a) There is a relationship between the error scores yielded by the three levels of the Phonic Inventories.

- b) There is a relationship between the error scores yielded by the instrument on each of the levels of the Phonic Inventories and the other scholastic tests included as dependant variables.
8. There is a difference in gains made in phonic skills as indicated by the results of Level 1,2 and 3 of the Phonic Inventories for those children who received high imagery instruction and those that received structured phonic instruction.

6.10 Data Analysis

Each of the statistical tests used to test the hypotheses are based upon a set of assumptions relating to the form of the test data and the type and structure of the data set. These assumptions needed to be tested before the test results could be used to test the particular hypothesis.

There was thus a standard methodology that was followed in the data analysis, as follows:

- 1) **Step One:** Stating the Hypotheses –The basic principle followed in the analysis was that a Null (H_0) and Alternate (H_A) hypotheses were stated. Generally the alpha level was set for each of the hypotheses at $\alpha = 0.5$.
- 2) **Step Two:** Stating the Assumptions – these were specific to the type of statistical test used and were verified before the test was used.
- 3) **Step Three:** Calculate the test statistic – these were based on the tabulated results generated in SPSS as part of the analysis. The types of results differed according to the particular test performed.
- 4) **Step Four:** Evaluate the results as to whether or not H_0 is rejected favour of H_A ($p < \alpha$) or whether there was failure to reject H_0 ($p > \alpha$).
- 5) **Step Five:** Interpret the result in the context of the research question.

6.10.1 Frequency Counts

The frequency counts classified items according to a particular scheme and then arithmetically counted the number of items. The scheme referred to how the recorded responses have been grouped within a study, while the item was a standardised code assigned to a particular value e.g. whether or not the individual was assigned to the control (1) or experimental (2) group. The results from the frequency count therefore provided the researcher with a quick summation of how many times a variable was present.

6.10.2 Correlations

A correlation describes the degree of relationship between two variables and how well they vary together. The correlation co-efficient, r , quantifies the direction and magnitude of the correlation. The correlation co-efficient, r , ranges from -1 to +1.

Table 21: Correlation Relationships

Value of r (or r_s)	Interpretation
$R = 0$	The two variables do not vary together at all
$0 > r > 1$	The two variables tend to increase or decrease together
$r = 1.0$	Perfect correlation
$-1 > r > 0$	One variable increases as the other decreases
$r = -1.0$	Perfect negative or inverse correlation

6.10.2.1 Correlation Matrix

A correlation matrix is used to study the relationship between multiple variables. The matrix lists the variables on both the X and Y axis's. The intersection of the row and column for any two variables in the table is their unique correlation. The number of unique correlation pairs within each table can be calculated using the formula $(N \times (N-1)) / 2$, where N is the number of variables. Therefore in the context of this study there are

10 variables in the matrix, the number of unique correlations is $(10 * 9)/2 = 90/2 = 45$ pairs.

6.10.3 Factor Analysis – data reduction

Factor analysis attempts to identify underlying variables, or factors, that explain the pattern of correlations within a set of observed variables. Factor analysis is often used in data reduction to identify a small number of factors that explain most of the variance that is observed in a much larger number of manifest variables.

6.10.3.1 Assumptions

- 1) The variables should be quantitative at the interval or ratio for parametric statistics.
- 2) The data should have a bivariate normal distribution for each pair of variables, and observations should be independent. The factor analysis model specifies that variables are determined by common factors.

6.10.4 Independent Samples t-Test

The t-Test was used to test the mean differences between two independent groups. The t-Test was calculated so as to determine if any difference between the two groups is statistically significant. In the context of Hypothesis One, the two groups that were tested were independent from each other, each group having received a different treatment. A comparison of means was therefore undertaken, to establish whether the performance of the two groups was the same (means were not significantly different) or were different (means are significantly different). If the means were different this would indicate that the effects of the treatment experienced by either group were different from the other.

6.10.4.1 Methodology

The methodology employed in hypothesis testing, as applied to the independent samples t-test, was as follows:

1) Hypotheses

$$H_0: m_1 = m_2.$$

$$H_A: m_1 \neq m_2.$$

The alpha level is set at $\alpha = 0.5$ and the test is a two tailed test.

2) t-Test assumptions:

- a) All observations must be independent of each other.
 - b) The dependent variable must be measured on an interval or ratio for parametric statistics.
 - c) The dependent variable must be normally distributed in the population (for each group being compared). This is a normality assumption.
 - d) The distribution of the dependent variable for one of the groups being compared must have the same variance as the distribution for the other group being compared. This is the homogeneity of variance assumption.
- 3) Calculate the test statistic – results expected are a group statistics table and a table depicting the results of the independent samples t-test.
- 4) Evaluate the results as to whether or not H_0 is rejected favour of H_A ($p < \alpha$) or whether we fail to reject H_0 ($p > \alpha$).
- 5) Interpret the result in the context of the research question.

6.10.5 MANOVA (multiple analysis of variance)

The MANOVA is a technique for assessing group differences across multiple metric dependent variables (DVs) simultaneously, based on a set of categorical (non-metric) variables acting as independent variables (IVs) (SPSS Manuals – SPSS Version 14). This analysis technique was used in this study, in which one independent variable had been manipulated, to determine the effect on more than one dependant variables.

In more recent versions of SPSS the MANOVA is found under GLM (General Linear Model). The output of the test is still the same, with coefficients created for every factor,

but with the added benefit that this model handles the problem of empty cells better than a traditional MANOVA test.

6.10.5.1 Methodology

The methodology employed in hypothesis testing, as applied to the MANOVA, was as follows:

1) Hypotheses

H_0 : All the group mean vectors are equal, that is, they come from the same populations.

H_A : Not all group mean vectors are equal, that is, they do not all come from the same populations.

The alpha level was set at $\alpha = 0.5$.

2) MANOVA assumptions:

- a) All observations must be independent of each other
- b) Multivariate Normality - the sampling distributions of the DVs and all linear combinations of them are normal.
- c) Homogeneity of Variance-Covariance Matrices - There must not be substantiated differences in the variance or one group versus another for the same variable. MANOVA examines all elements of the covariance matrix of the dependent variables for differing variances; if the groups are approximately the same size, a violation has minimal impact.
 - i. The Box's M Test is used to verify equality of variance, typically the p-value in the Box's M Test needs greater than 0.06 ($p < 0.006$) but in a test scenario where the tests are not homogenous then $p < 0.001$ is acceptable.
 - ii. Levene's Test for Equality of Variances is used to test if k samples have equal variances. Equal variances across samples are called homogeneity of variance. Some statistical tests, for example the analysis of variance, assume that variances are equal across groups or samples. The Levene test can be used to verify that assumption.

$H_0: \sigma_1 = \sigma_2 = \dots \sigma_j$ / all variances are equal.

$H_A: \sigma_i \neq \sigma_j$ for at least one pair (i, j) / at least one pair of variances are not equal.

The p-value therefore needs to be less than α ($p > 0.05$) in order to fail to reject the null hypothesis (equality of variance assumed).

- d) Appropriate sum of squares (SS). There are four different types of SS that can be used depending on the structure of the sample. This SS used in this research report will use Type IV SS because there were cells that were empty and the Type IV SS accounts for those missing values.
- 3) Calculate the test statistic – results expected are Between-Subjects Factors Table, a Box's M Test, Levene's Test, Multivariate Tests (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root), and Tests of Between Subject Effects. Wilk's Lambda will be the statistical test of choice in this research report because this is the most common, traditional test where there are more than two groups formed by the independent variables. It is a measure of the difference between groups of the centroid (vector) of means on the independent variables. The smaller the lambda, the greater the differences.
- 4) Evaluate the results as to whether or not H_0 is rejected favour of H_A or whether we fail to reject H_0 .
- 5) Interpret the result in the context of the research question.

6.10.6 MANCOVA (multiple analysis of covariance)

Multiple analysis of covariance (MANCOVA) is similar to multiple analysis of variance (MANOVA), but allows the researcher to control for the effects of supplementary continuous independent variables, or, covariates. If there are some covariates within the research study then a MANCOVA should be used instead of MANOVA. Covariates are variables which have effects on the dependent variables, but their effects are not of interest. In experimental design, covariates are usually the variables not controlled by the experimenter, but still having an effect on the dependent variables.

In more recent versions of SPSS the MANCOVA is found under GLM (General Linear Model). The process for running a MANCOVA is the same as that of a MANOVA with the exception that the former includes the assignment of a covariate. The GLM MANCOVA equivalent handles the problem of empty cells better than a traditional MANCOVA test.

6.10.6.1 Methodology

The methodology employed in hypothesis testing in this study, as applied to the MANCOVA, is as follows:

1) Hypotheses

H_0 : All the group mean vectors are equal, that is, they come from the same populations.

H_A : Not all group mean vectors are equal, that is, they do not all come from the same populations.

The alpha level is set at $\alpha = 0.5$.

2) MANCOVA assumptions:

- a) All observations must be independent of each other.
- b) Multivariate Normality - the sampling distributions of the DVs and all linear combinations of them are normal.
- c) Homogeneity of Variance-Covariance Matrices - There must not be substantiated differences in the variance or one group versus another for the same variable. MANOVA examines all elements of the covariance matrix of the dependent variables for differing variances; if the groups are approximately the same size, a violation has minimal impact.
 - iii. The Box's M Test is used to verify equality of variance, typically the p-value in the Box's M Test needs greater than 0.06 ($p < 0.006$) but in a test scenario where the tests are not homogenous then $p < 0.001$ is acceptable.

- iv. Levene's Test for Equality of Variances is used to test if k samples have equal variances. Equal variances across samples are called homogeneity of variance. Some statistical tests, for example the analysis of variance, assume that variances are equal across groups or samples. The Levene test can be used to verify that assumption.

$H_0: \sigma_1 = \sigma_2 = \dots \sigma_j$ / all variances are equal.

$H_A: \sigma_i \neq \sigma_j$ for at least one pair (i, j) / at least one pair of variances are not equal.

The p-value therefore needs to be less than α ($p > 0.05$) in order to fail to reject the null hypothesis (equality of variance assumed).

- v. Bartlett's Test of Sphericity is used in a repeated measures design. The univariate ANOVA tables will not be interpreted properly unless the variance/covariance matrix of the dependent variables is circular in form. This is not of concern in this study as it is a Between Groups Subject Design.
- vi. Appropriate sum of squares (SS). There are four different types of SS that can be used depending on the structure of your sample. This SS used in this research report will use Type IV SS because there are cells that are empty and this SS accounts for those missing values.

- 3) Calculate the test statistic – results expected are Between-Subjects Factors Table, a Box's M Test, Levene's Test, Multivariate Tests (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root), and Tests of Between Subject Effects. Wilk's Lambda will be the statistical test of choice in this research report because this is the most common, traditional test where there are more than two groups formed by the independent variables. It is a measure of the difference between groups of the centroid (vector) of means on the independent variables. The smaller the lambda, the greater the differences.
- 4) Evaluate the results as to whether or not H_0 is rejected favour of H_A or whether we fail to reject H_0 .

- 5) Interpret the result in the context of the research question.

6.10.7 Single Factor ANOVA (analysis of variance)

An ANOVA is closely related to the t test. The major difference is that, where the t test measures the difference between the means of two groups, an ANOVA tests the difference between the means of two or more groups. A one-way ANOVA or single factor ANOVA tests differences between groups that are only classified on one independent variable.

6.10.7.1 Methodology

The methodology employed in hypothesis testing, as applied to the ANCOVA, is as follows:

- 1) Hypotheses:

H_0 : All the group mean vectors are equal, that is, they come from the same populations.

H_A : Not all group mean vectors are equal, that is, they do not all come from the same populations.

The alpha level is set at $\alpha = 0.5$.

- 2) ANOVA assumptions:

- a) Homogeneity of Variance-Covariance Matrices - There must not be substantiated differences in the variance or one group versus another for the same variable. The Levene's Test for Equality of Variances can be used to verify that assumption.

$H_0: \sigma_1 = \sigma_2 = \dots \sigma_j$ / all variances are equal.

$H_A: \sigma_i \neq \sigma_j$ for at least one pair (i, j) / at least one pair of variances are not equal.

The p-value therefore needs to be less than α ($p > 0.05$) in order to fail to reject the null hypothesis (equality of variance assumed).

- 3) Calculate the test statistic – results expected are descriptive statistics, Levene's test, and an ANOVA table.

- 4) Evaluate the results as to whether or not H_0 is rejected favour of H_A ($p < \alpha$) or whether we fail to reject H_0 ($p > \alpha$).
- 5) Interpret the result in the context of the research question.

6.10.8 ANCOVA (analysis of covariance)

The analysis of covariance is a combination of regression analysis with an analysis of variance. Covariance is used when the dependant variable is linearly related to another variable in addition to the affect created by the independent variable. The question is therefore are determining whether the measured affect of the independent variable is solely responsible for the observed effect.

6.10.8.1 Methodology

The methodology employed in hypothesis testing, as applied to the ANCOVA, is as follows:

1) Hypotheses:

H_0 : All the group mean vectors are equal, that is, they come from the same populations.

H_A : Not all group mean vectors are equal, that is, they do not all come from the same populations.

The alpha level is set at $\alpha = 0.5$.

2) ANOVA assumptions:

- a) Covariate - the third variable needs to be unrelated to the dependent and independent variables.
- b) Homogeneity of Variance-Covariance Matrices - There must not be substantiated differences in the variance or one group versus another for the same variable. The Levene's Test for Equality of Variances can be used to verify that assumption.

H_0 : $\sigma_1 = \sigma_2 = \dots \sigma_j$ / all variances are equal.

H_A : $\sigma_i \neq \sigma_j$ for at least one pair (i, j) / at least one pair of variances are not equal.

The p-value therefore needs to be less than α ($p > 0.05$) in order to fail to reject the null hypothesis (equality of variance assumed).

- c) Homogeneity of Regression - ANCOVA assumes that homogeneity of regression exists--that the correlation between y and z is equal for all levels of x. In other words, for each level of the independent variable, the slope of the prediction of the dependent variable from the covariate must be equal.
- 3) Calculate the test statistic – these are the tabulated results that are generated in SPSS following analysis. The types of results differ according to the test performed.
- 4) Evaluate the results as to whether or not H_0 is rejected favour of H_A ($p < \alpha$) or whether we fail to reject H_0 ($p > \alpha$).
- 5) Interpret the result in the context of the research question.

6.11 Analysis Sequence

The sequence followed in the analysis relative to the hypotheses of this study is presented in Table 22:

Table 22: Research matrix

Hypothesis	Variables	Statistical procedures
1) There is a significant difference in the reading, writing and spelling results of children who received high imagery instruction as opposed to structured phonic instruction for cumulative results from studies conducted from 2001 to 2003.	<i>Independent Variables</i> ○ Imagery versus phonic (nominal) N= 39/13 <i>Dependant Variables</i> • Scholastic test results (6)	t-Test Decision: proceed further with analysis.
2a) There is a significant difference between the cumulative results from studies conducted in 2004 and those conducted from 2001 to 2003.	<i>Independent Variables</i> ○ Imagery versus phonic (nominal) N= 39/13 ○ Years up to 2003 versus 2004 (nominal) N= 15/17 <i>Dependant Variables</i> Scholastic test results (6)	MANOVA (If assumptions not met, two way ANOVA's for each DV) Decision: if evidence supports a separate nested (without computer) condition within the high imagery condition, remove the 2004 high imagery data from the data set
2b) There is a significant difference between the cumulative results from studies conducted in 2004 and those conducted from 2001 to 2003 and 2005.	<i>Independent Variables</i> ○ Imagery/phonic (nominal) N= 48/13 ○ Years up to 2003+2005 versus 2004 (nominal) N= 15/17 <i>Dependant Variables</i> Scholastic test results (6)	MANOVA (If assumptions not met, two way ANOVA's for each DV) Decision: if evidence supports a separate nested (without computer) condition within the high imagery condition, remove the 2004 high imagery data from the data set

Hypothesis	Variables	Statistical procedures
3a) There is a significant difference between the reading, writing and spelling results of children who received high imagery teaching techniques from 2001 to 2003 and 2005 as opposed to those who received structured phonic teaching. 3b) Gender plays a role in the scholastic performance of children who received high imagery instruction techniques and those that received structured phonic teaching	Independent Variables - Imagery/phonic (nominal) 2001-2005exp/1003 -2005ctrl N= 63/30 (Gender) 2001-2005exp/2001 -2005ctrl (nominal) N= 63/30 Dependant Variables Scholastic test results (6)	MANOVA (If assumptions are not met then run individual ANOVA's for each DV) Decision: if cell sizes appear large enough, include gender as a variable Decision: test to see if any co-variates influenced the results.
4a) There is a significant difference between the reading, writing and spelling results of children who received high imagery teaching techniques from 2001 to 2005 as opposed to those who received structured phonic teaching (including 2004 participants that received standard TRP remediation). 4b) Gender plays a role in the scholastic performance of children who received high imagery instruction techniques and those that received structured phonic teaching	Independent Variables - Imagery/phonic (nominal) 2001-2003+2005exp/2001-2003 +2005ctrl N= 48/13 (Gender) 2001-2003+2005exp/2001-2003 +2005ctrl (nominal) N= 48/13 Dependant Variables Scholastic test results (6)	MANOVA (If assumptions are not met then run individual ANOVA's for each DV) Decision: if cell sizes appear large enough, include gender as a variable Decision: test to see if any co-variates influenced the results.
5) There is a relationship between the extent	Independent Variables	MANCOVA (If assumptions are not met then

Hypothesis	Variables	Statistical procedures
of the children's deficits in English reading and spelling, as determined by the difference between their chronological age and reading and spelling ages, and gains made in high imagery instruction and structured phonic instruction	- High imagery/phonic. Pre-test/post-test. N = 63/30 Dependant Variables - Scholastic test results (6) Covariate: Difference scores (Age equivalent score minus actual score at pre-test) for scholastic test results	run individual ANCOVA's for each DV)
6) There is a significant difference between the reading, writing and spelling results of children who are able to visualise and received high imagery teaching techniques and the reading, writing and spelling results of children who received structured phonic instruction.	Independent Variables - High imagery/phonic. Visualise/non-visualise. N = 51/19 Dependant Variables - Scholastic test results (6) Covariate: Difference scores (Age equivalent score minus actual score at pre-test) for scholastic test results	Report descriptive stats on incidence of visualising/non-visualising children in sample – Frequency Table MANCOVA (If assumptions are not met then run individual ANCOVA's for each DV)
7a) There is a relationship between the error scores yielded by the three levels of the Phonic Inventories.	Independent Variables - Phonic Inventory Level - Scholastic Test	First order correlation Tests of multi-collinearity

Hypothesis	Variables	Statistical procedures
7b) There is a relationship between the error scores yielded by the instrument on each of the levels of the Phonic Inventories and the other scholastic tests included as dependant variables.	<i>Dependant Variables</i> • Pre-test scores for the Phonic Inventories and the Scholastic Tests	If assumptions are met, factor analysis to seek any underlying unobservable variables that are reflected in the observed variables.
8) There is a difference in gains made in phonic skills as indicated by the results of Level 1,2 and 3 of the Phonic Inventories for those children who received high imagery instruction and those that received structured phonic instruction	<i>Independent Variables</i> ○ High imagery/phonic. Visualise/non-visualise. N = 45/24 <i>Dependant Variables</i> ○ Phonic Inventories	t-Test

6.12 Ethical Considerations

The data upon which this research is based took place with the informed consent of the parents of each child as well as the child him/herself. An information sheet was distributed to all prospective parties before the inception of the programme to ensure that no misconceptions about the programme were present. All the children in the study will remain anonymous through the use of a coding sheet. This will ensure that any reference made while analysing and writing up results will not be directly attributed to them.

Data were collected within the guidelines of the larger study supervised by Prof. Potter, consent from the schools, parents, and children having been obtained. Ethics approval was also obtained for these prior studies and consequently the inclusion of information in these studies is already open to public opinion maintaining the anonymity of the study subjects. Additional test data obtained from the school has also been subject to school approval as well as the approval of parents. There were no negative consequence for the children in each of the studies who did not wish to participate and their parents were in no way pressurised to feel that they had to include their children. Throughout the duration of the study parents reserved the right to withdraw their children at any time should they have felt that the study was harmful.

Inclusion in either of the groups, imagery based remediation vs. conventional remediation did not harm the subject. All children included were known treatment resistors and the additional remediation in either technique could only be seen as beneficial in furthering their scholastic abilities. The schooling programme and academic progress of the children was in no way inhibited as a result of their inclusion in the study as the programme ran independently from the school curriculum in which the child was involved.

6.13 Summary

This chapter has focused on the methodology adopted in this study. The primary focus of this research is to establish whether there is improvement in the reading, writing and spelling skills of learning disabled children, where high imagery teaching techniques are used for remediation. The methodology of the study has involved the development of a set of hypotheses based on review of a series of seventeen small-scale studies conducted at Japari Remedial School between 2001 and 2005, and the creation of a composite data set formed by aggregating the results of these studies.

In this way a composite data set of 93 children with learning disabilities was created, each of whom received six months of individual instruction in the afternoons after school. The age and grade of the children in these studies varied, according to the availability of suitable participants. Age, grade, degree of learning deficit/developmental lag and gender were thus included as covariates in an ex post factor research design, in which inclusion in either imagery based remediation or structured phonic remediation was conceptualised as the independent variable, and learning gains made on a number of scholastic tests were conceptualised as dependent variables.

All children included in the tutoring programme were known treatment resistors, and thus form a particular subpopulation of children with learning disabilities. Changes also took place over the five year period in the way in which treatment was applied. Sampling as well as selection of children may also have influenced the results, and are thus potential limitations affecting the generalisability of the findings. For this reason, an attempt has been made in the methodology applied in this study to develop hypotheses to compare the data yielded in different years over the five year period, as a way of testing for the influence of contextual factors involving changes in treatment, as well as changes in selection criteria on the data.

7 Chapter Seven: Results

7.1 Introduction

In conducting the analysis, the data from a number of separate studies was first aggregated, and then used to create a number of data subsets relating to the hypotheses of this study. The data were checked, wherever possible, to the original tests conducted on the children so that the integrity of the data could be substantiated. Certain original test protocols were not available as some of the original researchers had failed to store the documents for future reference.

The purpose of this validation exercise was to ensure that all values in the data matrices had been scored and coded consistently. This was necessary as certain of the tables in the original reports was presented in scaled as opposed to raw score format (MacReadie, 2001; Wilson, 2001; Abelheim, 2002; George, 2002; Picton, 2002; Ravenscroft, 2002; Rhetsos, 2002; Sampson, 2002; Sfetsios, 2002, Booth, 2003; 2005; Els, 2003; 2005; Cronk, 2004; Khan, 2004; Tatic, 2004, Koeman, 2005; Rayner, 2005). It was thus necessary in certain cases to convert positive scores back to error scores, so that the data relating to each of the variables in the study were consistent.

7.2 Coding

Each participant within the study was allocated a unique identifier that allowed him / her to be identified as a separate entity in the data whilst maintaining confidentiality. The first two letters of the identifier indicated which researcher collected the data on the child – the researcher's first initial serving this function (KE – Karen Els, LB – Lyndall Booth). The third letter indicated whether the participant was part of the experimental group (E – received high imagery instruction) or the contrast group (C – received structured phonic instruction).

Additional sample characteristics included in the analysis were then coded for statistical analysis purposes, as follows:

- **Groups** – contrast groups were coded with odd numbers while treatment groups have coded with even numbers. Thus groups 1, 3 and 5 reflected contrast groups while groups 2, 4 and 6 reflected treatment groups.
- **Gender** was coded as male = 1 and female =2.
- **Mental imagery** was rated according the three categories that reflect the individual's ability tested by the Mental Imagery questionnaire. Category 1 represented those children who report having mental imagery. Category 2 represented children who reported that they possessed no mental imagery ability.

7.3 Results

In the remaining sections of this chapter the results of the analyses will be presented in relation to the hypotheses posed in the introduction of this research report. In each section, the results will first be presented so as to test the hypotheses. Additional data concerning the sample will then be discussed, so that conclusions relative to the different subsets in the sample can be drawn.

7.3.1 Group Description Data

Descriptive data relating to each hypothesis will also be presented for each group so that the results of the statistical tests can be contextualised and interpreted. The data presented are:

7.3.1.1 Aggregated Treatment versus Contrast group Results

The mean scores for each of the reading and spelling tests have been calculated by aggregating the individual scores in each treatment grouping and then dividing the aggregate score by the number of participants within each group. The aggregate score

and the number of individuals that score has been divided includes those circumstances where no score was registered.

7.3.1.2 Mental Imagery Summary

These scores are based on a Frequency Count. This reflects the number of times a specific imagery code was registered in the overall participant pool.

7.3.1.3 Gender Summary

These scores are based on a Frequency Count. This reflects the number of males and females in both the treatment and contrast groups.

7.3.2 *Statistical Tests*

Each of the statistical tests used to test the hypotheses are based upon a set of assumptions relating to the data. In reporting the results the tests of assumptions are thus reported first, followed by the hypothesis test. This statistical information however is superfluous so the actual information that needs to be presented in this research report and has therefore been relegated to an appendix. The results of the statistical analysis have however been summarised.

7.4 Research Question 1

What trends are evident from the cumulative results of exploratory studies conducted on the use of high imagery teaching techniques from 2001 to 2003?

Hypothesis	Variables	Analysis Type
1) There is a significant difference in the reading, writing and spelling results of children who received high imagery instruction as opposed to structured phonic	<i>Independent Variables</i> ○ High imagery versus phonic (nominal) N= 39/13	t-Test Decision: proceed further

instruction for cumulative results from studies conducted from 2001 to 2003.	<i>Dependant Variables</i> ○ Scholastic test results (6)	with analysis.
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7.4.1 Q1 - Group Description Data

Table 23: Q1 - Aggregated Treatment versus Contrast group Results – 2001 to 2003

Test	Structured Phonic Instruction N = 13		High Imagery Instruction N = 39	
Schonell One Word Reading	Average Gains	4.85	Average Gains	9.87
Holborn Sentence Reading	Average Gains	2.69	Average Gains	4.53
Schonell Spelling	Average Gains	5.08	Average Gains	8.36
Schonell Dictation Test B	Average Gains	2	Average Gains	3.22
Schonell Dictation Test C	Average Gains	0.54	Average Gains	5.19
Schonell Dictation Test D	Average Gains	2.23	Average Gains	5.39

Table 24: Q1 - Mental Imagery Summary – 2001 to 2003

Structured Phonic Instruction (13)		High Imagery Instruction (39)	
Imagery Code	Participants	Imagery Code	Participants
1 – good ability	9	1 – good ability	33
2 - no ability	4	2 - no ability	6

Table 25: Q1 - Gender Summary – 2001 to 2003

Structured Phonic Instruction (13)		High Imagery Instruction (39)	
Gender Code	Participants	Gender Code	Participants
1 - male	8	1 – male	30
2 - female	5	2 – female	9

7.4.2 Q1 - Statistical Analysis Results – *t*-Test: Independent Samples *t*-Test

Appendix 8a contains the detailed statistical results for Research Question 1. The assumptions underlying the test were met: that all observations are independent of each other the data are at least interval or ratio variables for parametric statistics and normality can be assumed. The assumption for equal variance across the variables could not be

proven with the result that the appropriate test statistic was used in the interpretation of the Independent Samples t-Test results.

The results of the Independent Samples t-Test indicate that there is no visible trend that can be concluded from the cumulative results of exploratory studies conducted on the use of high imagery teaching techniques from 2001 to 2003. Hypothesis tests that sought to determine a significant difference in reading, writing and spelling results of children who received high imagery instruction as opposed to structured phonic instruction for cumulative results for 2001 to 2003 were mixed in nature and were as follows:

- No significant differences for the Schonell One Word Reading Test $t(48.970) = -2.558$, $p = 0.014$, the Schonell Spelling Test $t(50) = -1.127$, $p = 0.265$, and the Schonell Graded Dictation Test B $t(42.632) = -1.899$, $p = 0.064$, were recorded ($p > \alpha$).
- Significant differences for the Holborn Reading Test $t(39.315) = -2.221$, $p = 0.032$, the Schonell Graded Dictation Test C $t(48) = -3.662$, $p = 0.001$, and the Schonell Graded Dictation Test D $t(40.332) = -2.886$, $p = 0.006$, were recorded.

The variable nature of the results could be attributed to the small size of the sample used and the unequal number of subjects contained within each group. Further analysis with a larger subject group would provide a better indication of whether there is a trend that favours high imagery over structured phonic instruction. The decision, based on these results, is to conduct further analysis in the effects of high imagery instruction.

7.5 Research Question 2

a) Is there a difference in trends in the results in 2004 when implementation of the high imagery teaching programme varied from that taught from 2001 to 2003?

Hypothesis	Variables	Analysis Type
There is a significant difference between the cumulative results from studies conducted in 2004 and those conducted from 2001 to 2003.	<i>Independent Variables</i> - Imagery versus phonic (nominal) N= 39/13 - Years up to 2003 versus 2004 (nominal) N= 15/17 <i>Dependant Variables</i> - Scholastic test results (6)	MANOVA (If assumptions not met, two way ANOVA's for each DV) Decision: if evidence supports a separate nested (without computer) condition within the high imagery condition, remove the 2004 high imagery data from the data set

b) Is there a difference in trends in the results in 2004 when implementation of the high imagery teaching programme varied from that taught from 2001 to 2003 and 2005?

Hypothesis	Variables	Analysis Type
There is a significant difference between the cumulative results from studies conducted in 2004 and those conducted from 2001 to 2003 and 2005.	<i>Independent Variables</i> - Imagery/phonic (nominal) N= 48/13 - Years up to 2003+2005 versus 2004 (nominal) N= 15/17 <i>Dependant Variables</i> - Scholastic test results (6)	MANOVA (If assumptions not met, two way ANOVA's for each DV) Decision: if evidence supports a separate nested (without computer) condition within the high imagery condition, remove the 2004 high imagery data from the data set

7.5.1 Q2a - Group Description Data

Table 26: Q2a - Aggregated Treatment versus Control Group Results – 2001 to 2003

Test	Structured Phonic Instruction N = 13		High Imagery Instruction N = 39	
Schonell One Word Reading	Average Gains	4.85	Average Gains	9.87
Holborn Sentence Reading	Average Gains	2.69	Average Gains	4.53
Schonell Spelling	Average Gains	5.08	Average Gains	8.36
Schonell Dictation Test B	Average Gains	2	Average Gains	3.22
Schonell Dictation Test C	Average Gains	0.54	Average Gains	5.19

Schonell Dictation Test D	Average Gains	2.23	Average Gains	5.39
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Table 27: Q2a - Mental Imagery Summary – 2001 to 2003

Structured Phonic Instruction (13)		High Imagery Instruction (39)	
Imagery Code	Participants	Imagery Code	Participants
1 – good ability	9	1 – good ability	31
2 - no ability	4	2 - no ability	6

Table 28: Q2a - Gender Summary – 2001 to 2003

Structured Phonic Instruction (13)		High Imagery Instruction (39)	
Gender Code	Participants	Gender Code	Participants
1 - male	8	1 – male	30
2 - female	5	2 – female	9

Table 29: Q2a - Aggregated Treatment versus Control Group Results - 2004

Test	Traditional/Phonological Instruction N = 17		High Imagery Instruction N = 15	
Schonell One Word Reading	Average Gains	9.18	Average Gains	2.8
Holborn Sentence Reading	Average Gains	5.41	Average Gains	6.13
Schonell Spelling	Average Gains	7.12	Average Gains	4.93
Schonell Dictation Test B	Average Gains	1.94	Average Gains	1.93
Schonell Dictation Test C	Average Gains	3.35	Average Gains	2.71
Schonell Dictation Test D	Average Gains	2.27	Average Gains	2.64

Table 30: Q2a - Table 13: Q2a - Mental Imagery Summary – 2004

Structured Phonic Instruction (17)		High Imagery Instruction (15)	
Imagery Code	Participants	Imagery Code	Participants
1 – good ability	10	1 – good ability	13
2 - no ability	7	2 - no ability	2

Table 31: Q2a - Gender Summary – 2004

Structured Phonic Instruction (17)	High Imagery Instruction (15)
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Gender Code	Participants
1 - male	11
2 - female	6

Gender Code	Participants
1 – male	11
2 – female	4

7.5.2 Q2a - Statistical Analysis Results – MANOVA – Multiple Analyses Of Variance

Appendix 8b contains the detailed statistical results for Research Question 2a. The underlying assumptions of the test were met: that the observations are independent of each other, the data are at least interval or ratio variables for parametric statistics and normality can be assumed for both the sample distribution and their linear combinations. Box's Test for Equity of Covariance Matrices verified equality of variance in the sample as a whole ($p = 0.001$). Levene's test for Equality of Variances however could not be proven for each dependant variables across groups. The lack of variance between each dependant variables is however not fatal to the ANOVA results for Between-Subjects Effects due the ANOVAs robust nature. The assumption that a MANOVA can be run as a form of analysis is therefore valid.

The result of the MANOVA drawn from Wilk's Lamda (Λ) indicates that there is no significant difference between the results from 2004 and the results from 2001 to 2003 ($\Lambda = 0.640$, $F(18, 173.019) = 1.646$, $p = 0.054$). Analysis of the effect of the independent variable on the Schonell One Word Reading Test, the Holborn Reading Test, the Schonell Spelling Test, and the Schonell Graded Dictation Test B show no significant effect ($p > \alpha$). A significant effect on the dependant variables; the Schonell Graded Dictation Test C ($M = 3.59$, $SD = 4.074$), $F(3, 66) = 4.159$, $p = 0.009$), the Schonell Graded Dictation Test D ($M = 3.81$, $SD = 4.421$), $F(3, 66) = 3.278$, $p = 0.026$) were recorded. Therefore hypothesis testing that sought to determine a significant difference between the cumulative results from studies conducted in 2004 and those conducted in 2001 to 2003 has been demonstrated to be non-significant.

The analysis results from question 2a therefore indicate that as a whole the results of children exposed to the type of high imagery intervention provided in 2004 does not appear to have been significantly different to the aggregated results obtained over the years 2001 to 2003. On an individual test score basis however there does appear to have been some measurable difference according to imagery intervention type. Additionally there is variation within the data indicating that the results are mixed in nature. The lack of clear indication either way could be attributed to: the unequal sample sizes that were present – particularly the difference in contrast group size; and the mixed nature of the experimental group where a portion of the 2004 experimental subjects did receive high mental imagery remediation in a format similar to those in 2001 to 2003.

Further analysis with a larger sample for both the experimental and contrast groups could yield more conclusive results as to whether there is a separate nested (without computer) condition within the high imagery condition. The subjects within the 2004 data set will therefore not be removed from the over all high imagery sample until further analysis has been conducted that makes use of available additional sample subjects from 2005.

7.5.3 Q2b - Group Description Data

Table 32: Q2b - Aggregated Treatment versus Control Group Results – 2001 to 2003 + 2005

Test	Structured	Phonic	High Imagery Instruction	
	Instruction N = 13		N = 48	
Schonell One Word Reading	Average Gains	4.85	Average Gains	9.89
Holborn Sentence Reading	Average Gains	2.69	Average Gains	4.11
Schonell Spelling	Average Gains	5.08	Average Gains	7.29
Schonell Dictation Test B	Average Gains	2	Average Gains	2.28
Schonell Dictation Test C	Average Gains	0.54	Average Gains	4.76
Schonell Dictation Test D	Average Gains	2.23	Average Gains	4.81

Table 33: Q2b - Mental Imagery Summary – 2001 to 2003 + 2005

Structured Phonic Instruction (13)		High Imagery Instruction (48)	
Imagery Code	Participants	Imagery Code	Participants
1 – good ability	9	1 – good ability	38
2 - no ability	4	2 - no ability	8

Table 34: Q2b - Gender Summary – 2001 to 2003 + 2005

Structured Phonic Instruction (13)		High Imagery Instruction (48)	
Gender Code	Participants	Gender Code	Participants
1 – male	8	1 – male	35
2 – female	5	2 – female	13

Table 35: Q2b - Aggregated Treatment versus Control Group Results - 2004

Test	Traditional/Phonological Instruction N = 17		High Imagery Instruction N = 15	
Schonell One Word Reading	Average Gains	9.18	Average Gains	2.8
Holborn Sentence Reading	Average Gains	5.41	Average Gains	6.13
Schonell Spelling	Average Gains	7.12	Average Gains	4.93
Schonell Dictation Test B	Average Gains	1.94	Average Gains	1.93
Schonell Dictation Test C	Average Gains	3.35	Average Gains	2.71
Schonell Dictation Test D	Average Gains	2.27	Average Gains	2.64

Table 36: Q2b - Mental Imagery Summary – 2004

Structured Phonic Instruction (17)		High Imagery Instruction (15)	
Imagery Code	Participants	Imagery Code	Participants
1 – good ability	10	1 – good ability	13
2 - no ability	7	2 - no ability	2

Table 37: Q2b - Gender Summary – 2004

Structured Phonic Instruction (17)		High Imagery Instruction (15)	
Gender Code	Participants	Gender Code	Participants
1 – male	11	1 – male	11
2 – female	6	2 – female	4

7.5.4 Q2b - Statistical Analysis Results – MANOVA – Multiple Analyses Of Variance

Appendix 8b contains the detailed statistical results for Research Question 2b. The underlying assumptions of the test were met: that all observations are independent of each other, that data are at least interval or ratio variables for parametric statistics and normality can be assumed for both the sample distribution and their linear combinations. Box's Test for Equity of Covariance Matrices verified equality of variance in the sample as a whole ($p = 0.001$). Levene's test for Equality of Variances however could not be proven for each dependant variables across groups. The lack of variance between each dependant variables is however not fatal to the ANOVA results for Between-Subjects Effects due the ANOVAs robust nature. The assumption that a MANOVA can be run as a form of analysis is therefore valid.

The result of the MANOVA drawn from Wilk's Lamda (Λ) indicates that there is a significant difference between the results from 2004 and the results from 2001 to 2003 and 2005 ($\Lambda = 0.668$, $F(18, 198.475) = 1.694$, $p = 0.043$). Analysis of the effect of the independent variable on the Schonell One Word Reading Test, the Holborn Reading Test, the Schonell Spelling Test, the Schonell Graded Dictation Test B, and the Schonell Graded Dictation Test D has no significant effect ($p > \alpha$). A significant effect on the dependant variable, the Schonell Graded Dictation Test C, has a significant effect ($M = 3.52$, $SD = 4.2$), $F(3, 75) = 3.233$, $p = 0.027$). Therefore hypothesis testing that sought to determine a significant difference between the cumulative results from studies conducted in 2004 and those conducted in 2001 to 2003 and 2005 has been demonstrated to be significant in nature.

The analysis results from question 2b therefore indicate that as a whole the type of intervention high imagery intervention does appear to have been significantly different between the aggregate results of 2004 and the aggregated results of 2001 to 2003 and 2005. On an individual test score basis however there is a majority trend that indicates a

non-measurable difference according to imagery intervention type. There is therefore evidence to suggest that there is a nested (without computer) condition within the high imagery condition. The 2004 high imagery data should therefore be removed from the data set where the programme was implemented differently.

7.6 Research Question 3

a) What trends are evident from the cumulative results of studies conducted on the use of high imagery teaching techniques from 2001 to 2003 and 2005?

Hypothesis	Variables	Analysis Type
There is a significant difference between the reading, writing and spelling results of children who received high imagery teaching techniques from 2001 to 2003 and 2005 as opposed to those who received structured phonic teaching.	Independent Variables ○ Imagery/phonic (nominal) 2001-2003+2005exp/2001-2003 +2005ctrl N= 48/13 ○ (Gender) 2001-2003+2005exp/2001-2003 +2005ctrl (nominal) N= 48/13 Dependant Variables ○ Scholastic test results (6)	MANOVA (If assumptions are not met then run individual ANOVA's for each DV) Decision: if cell sizes appear large enough, include gender as a variable

b) Was gender an influence on scholastic performance?

Hypothesis	Variables	Analysis Type
Gender plays a role in the scholastic performance of children who received high imagery instruction techniques and those that received structured phonic teaching.	Independent Variables ○ Imagery/phonic (nominal) 2001-2003+2005exp/2001-2003 +2005ctrl N= 48/13 ○ (Gender) 2001-2003+2005exp/2001-2003 +2005ctrl (nominal) N= 48/13 Dependant Variables ○ Scholastic test results (6)	MANOVA (If assumptions are not met then run individual ANOVA's for each DV) Decision: Test to see if any co-variates influenced the results.

7.6.1 Q3 - Group Description Data

Table 38: Q3 - Aggregated Treatment versus Control Group Results – 2001 to 2003 and 2005

Test	Structured Instruction N = 13	Phonic	High Imagery Instruction N = 48	
Schonell One Word Reading	Average Gains	4.85	Average Gains	9.89
Holborn Sentence Reading	Average Gains	2.69	Average Gains	4.11
Schonell Spelling	Average Gains	5.08	Average Gains	7.29
Schonell Dictation Test B	Average Gains	2	Average Gains	2.28
Schonell Dictation Test C	Average Gains	0.54	Average Gains	4.76
Schonell Dictation Test D	Average Gains	2.23	Average Gains	4.81

Table 39: Q3 - Mental Imagery Summary – 2001 to 2003 and 2005

Structured Phonic Instruction (13)		High Imagery Instruction (48)	
Imagery Code	Participants	Imagery Code	Participants
1 – good ability	9	1 – good ability	38
2 - no ability	4	2 - no ability	8

Table 40: Q3 - Gender Summary – 2001 to 2003 and 2005

Structured Phonic Instruction (13)		High Imagery Instruction (48)	
Gender Code	Participants	Gender Code	Participants
1 – male	8	1 – male	35
2 - female	5	2 – female	13

7.6.2 Q3 - Statistical Analysis Results – MANOVA – Multiple Analyses Of Variance

Appendix 8c contains the detailed statistical results for Research Question 3. The assumptions underlying the test were met: that all observations are independent of each other, the data are at least interval or ratio variables for parametric statistics and normality can be assumed for both the sample distribution and their linear combinations. Box's Test for Equity of Covariance Matrices verified equality of variance in the sample as a whole ($p = 0.001$). Levene's test for Equality of Variances however could not be proven

for each dependant variables across groups. The lack of variance between each dependant variables is however not fatal to the ANOVA results for Between-Subjects Effects due the ANOVAs robust nature. The assumption that a MANOVA can be run as a form of analysis is therefore valid.

The result of the MANOVA drawn from Wilk's Lamda (Λ) indicates that there is a significant difference between the results from 2001 to 2005 results based on the type of intervention received ($\Lambda = 0.681$, $F(6, 44) = 3.437$, $p = 0.007$). Analysis of the effect of the independent variable, intervention type, on the Schonell Dictation Test C is significant ($M = 3.62$, $SD = 4.546$), $F(1, 49) = 12.902$, $p = 0.001$). No significant effect of the independent variable, intervention type, on the Schonell One Word Reading Test, the Holborn Reading Test, the Schonell Spelling Test, the Schonell Graded Dictation Test B, and the Schonell Graded Dictation Test D was recorded ($p > \alpha$). Therefore hypothesis testing determined a significant difference between the reading, writing and spelling results of children who received high imagery teaching techniques as opposed to those who received structured phonic teaching. This effect was found for the data set as a whole, but not for individual tests administered.

According to Wilk's Lamda (Λ) there is no significant difference between the results from 2001 to 2005 based on the gender of the individual ($\Lambda = 0.894$, $F(6, 44) = 0.871$, $p = 0.524$). Analysis of the effect of the independent variable, gender, on the Holborn Reading is significant ($M = 3.77$, $SD = 3.709$), $F(1, 49) = 4.164$, $p = 0.047$). No significant effect of the independent variable, gender, on the Schonell One Word Reading Test, the Schonell Spelling Test, the Schonell Graded Dictation Test B, the Schonell Graded Dictation Test C, and the Schonell Graded Dictation Test D was recorded ($p > \alpha$). Therefore hypothesis testing to determine whether gender plays a role in the success of the remediation process indicates that there is no significant role evident.

The analysis results from question 3a therefore indicate that as a whole the type of intervention appears to have been significantly different for the aggregate results of 2001

to 2003 and 2005. On an individual test score basis however a significant difference was only recorded one of the test instrument scores (the remainder testing non-significant). The analysis results from question 3b therefore indicate that gender for the main part has no effect on the improvements a child will make in any remediation strategy but does appear to be a factor that plays a part in the gains a child makes for reading. Gender could therefore be potentially excluded as a future variable in analysis because the results of question 3b indicate that it has no significant influence on the results obtained.

7.7 Research Question 4

a) What trends are evident from the cumulative results of studies conducted on the use of high imagery teaching techniques from 2001 to 2005 (including 2004 results that received standard TRP remediation)?

Hypothesis	Variables	Analysis Type
There is a significant difference between the reading, writing and spelling results of children who received high imagery teaching techniques from 2001 to 2005 as opposed to those who received structured phonic teaching (including 2004 participants that received standard TRP remediation).	<i>Independent Variables</i> ○ Imagery/phonic (nominal) 2001-2005exp/2001 -2005ctrl N= 63/30 ○ (Gender) 2001-2005exp/2001 - 2005ctrl (nominal) N= 63/30 <i>Dependant Variables</i> ○ Scholastic test results (6)	MANOVA (If assumptions are not met then run individual ANOVA's for each DV) Decision: if cell sizes appear large enough, include gender as a variable

b) Was gender an influence on scholastic performance?

Hypothesis	Variables	Analysis Type
Gender plays a role in the scholastic performance of children who received high imagery instruction techniques	<i>Independent Variables</i> ○ Imagery/phonic (nominal) 2001-2005exp/2001 -2005ctrl N= 63/30	MANOVA (If assumptions are not met then run individual ANOVA's for each DV)

and those that received structured phonic teaching.	○ (Gender) 2001-2005exp/2001 - 2005ctrl (nominal) N= 63/30 Dependant Variables ○ Scholastic test results (6)	Decision: test to see if any co-variates influenced the results.
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7.7.1 Q4 - Group Description Data

Table 41: Q4 - Aggregated Treatment versus Control Group Results – 2001 to 2005 (including 2004)

Test	Structured Instruction N = 30	Phonic	High Imagery Instruction N = 52	
Schonell One Word Reading	Average Gains	7.3	Average Gains	9.35
Holborn Sentence Reading	Average Gains	4.23	Average Gains	4.37
Schonell Spelling	Average Gains	6.23	Average Gains	7.35
Schonell Dictation Test B	Average Gains	1.97	Average Gains	2.34
Schonell Dictation Test C	Average Gains	2.13	Average Gains	4.76
Schonell Dictation Test D	Average Gains	2.25	Average Gains	4.72

Table 42: Q4 - Mental Imagery Summary – 2003 to 2005 (including 2004)

Structured Phonic Instruction (30)		High Imagery Instruction (52)	
Imagery Code	Participants	Imagery Code	Participants
1 – good ability	19	1 – good ability	41
2 - no ability	11	2 - no ability	9

Table 43: Q4 - Gender Summary – 2001 to 2005 (including 2004)

Structured Phonic Instruction (30)		High Imagery Instruction (52)	
Gender Code	Participants	Gender Code	Participants
1 – male	19	1 – male	37
2 - female	11	2 - female	15

7.7.2 Q4 - Statistical Analysis Results – MANOVA – Multiple Analyses Of Variance

Appendix 8d contains the detailed statistical results for Research Question 4. The assumptions underlying the test were met: that all observations are independent of each other, the data are at least interval or ratio variables for parametric statistics and normality can be assumed for both the sample distribution and their linear combinations. Box's Test for Equity of Covariance Matrices verified equality of variance in the sample as a whole ($p = 0.006$). Levene's test for Equality of Variances reveals that the variance of each dependant variable is similar ($p > \alpha$).

The result of the MANOVA drawn from Wilk's Lamda (Λ) indicates that there is a significant difference between the results from 2001 to 2005 (including 2004 TRP participants) based on the type of intervention received ($\Lambda = 0.775$, $F(6, 60) = 2.908$, $p = 0.015$). Analysis of the effect of the independent variable, intervention type, on the Schonell Dictation Test C is significant ($M = 3.68$, $SD = 4.391$), $F(1, 65) = 9.611$, $p = 0.003$). No significant effect of the independent variable, intervention type, on the Schonell One Word Reading Test, the Holborn Reading Test, the Schonell Spelling Test, the Schonell Graded Dictation Test B, and the Schonell Graded Dictation Test D was recorded ($p > \alpha$). Therefore hypothesis testing determined a significant difference between the reading, writing and spelling results of children who received high imagery teaching techniques as opposed to those who received structured phonic teaching. This effect was found for the data set as a whole, but not for individual tests administered.

According to Wilk's Lamda (Λ) there is no significant difference between the results from 2001 to 2005 (including 2004 TRP participants) based on gender ($\Lambda = 0.952$, $F(6, 60) = 0.509$, $p = 0.799$). Analysis of the effect of the independent variable, gender, has no significant effect on the dependant variables, the Schonell One Word Reading Test, the Holborn Reading Test, the Schonell Spelling Test, the Schonell Graded Dictation Test B, the Schonell Graded Dictation Test C, and the Schonell Graded Dictation Test D ($p > \alpha$). Hypothesis testing to determine whether gender plays a role in the success of the remediation process indicates that there is no significant role evident.

The analysis results from question 4 therefore indicate that as a whole the type of intervention appears to have been significantly different for the aggregate results of 2001 to 2005 (including 2004 TRP participants). On an individual test score basis however a significant difference was only recorded one of the test instrument scores (the remainder testing non-significant). The analysis results from question 4 therefore indicate that gender for the main part has no effect on the improvements a child will make in any remediation strategy but does appear to be a factor that plays a part in the gains a child makes for reading. Gender could therefore be potentially excluded as a future variable in analysis because the results of question 4 indicate that it has no significant influence on the results obtained.

7.8 Research Question 5

Does the extent of a child's deficits in English reading and spelling, as determined by the difference between his or her chronological age and reading and spelling ages, influence the gains made in high imagery instruction and structured phonic instruction?

Hypothesis	Variables	Analysis Type
There is a relationship between the extent of the children's deficits in English reading and spelling, as determined by the difference between their chronological age and reading and spelling ages, and gains made in high imagery instruction and structured phonic instruction	<i>Independent Variables</i> - High imagery/phonic. Pre-test/post-test. N = 63/30 <i>Dependant Variables</i> - Scholastic test results (6) Covariate: Difference scores (Age equivalent score minus actual score at pre-test) for scholastic test results	MANCOVA (If assumptions are not met then run individual ANCOVA's for each DV)

7.8.1 Q5 - Group Description Data

Table 44: Q5 - Aggregated Treatment versus Control Group Results – 2001 to 2005

Test	Structured Instruction N = 30	Phonic	High Imagery Instruction N = 52	
Schonell One Word Reading	Average Gains	7.3	Average Gains	9.35
Holborn Sentence Reading	Average Gains	4.23	Average Gains	4.37
Schonell Spelling	Average Gains	6.23	Average Gains	7.35
Schonell Dictation Test B	Average Gains	1.97	Average Gains	2.34
Schonell Dictation Test C	Average Gains	2.13	Average Gains	4.76
Schonell Dictation Test D	Average Gains	2.25	Average Gains	4.72

Table 45: Q5 - Mental Imagery Summary – 2001 to 2005

Structured Phonic Instruction (30)		High Imagery Instruction (52)	
Imagery Code	Participants	Imagery Code	Participants
1	19	1	41
2	11	2	9

Table 46: Q5 - Gender Summary – 2001 to 2005

Structured Phonic Instruction (30)		High Imagery Instruction (52)	
Gender Code	Participants	Gender Code	Participants
1	19	1	37
2	11	2	15

7.8.2 Q5 - Statistical Analysis Results – MANCOVA – Multiple Analyses Of Covariance

Appendix 8e contains the detailed statistical results for Research Question 5. The assumptions underlying the test were met: that all observations are independent of each other, the data are at least interval or ratio variables for parametric statistics and normality can be assumed for both the sample distribution and their linear combinations. Box's Test for Equity of Covariance Matrices verified equality of variance in the sample as a

whole ($p = 0.004$). Levene's test for Equality of Variances reveals that the variance of each dependant variable is similar ($p > \alpha$).

The result of the MANOVA drawn from Wilk's Lamda (Λ) indicates that there is no significant factor effect for Mental Age Difference Schonell One Word Reading Test on the dependent groups' 2001 to 2005 (including 2004 participants that received standard TRP remediation) results ($\Lambda = 0.889$, $F(6, 59) = 1.224$, $p = 0.307$). On an individual test scores basis there is a significant univariate effect for Mental Age Difference Schonell One Word Reading Test for the Schonell One Word Reading Test ($M = 9.13$, $SD = 9.431$), $F(1, 64) = 5.346$, $p = 0.024$) but not for the remaining tests on reading, writing and spelling ($p > \alpha$).

According to Wilk's Lamda (Λ) there is no significant factor effect for Mental Age Difference Schonell Spelling Test on the dependent groups' 2001 to 2005 (including 2004 participants that received standard TRP remediation) results ($\Lambda = 0.903$, $F(6, 59) = 1.053$, $p = 0.401$). On an individual test scores basis there no significant univariate for any of the six tests of reading, writing and spelling ($p > \alpha$).

Hypothesis testing therefore determines that overall there is no relationship between the extent of the children's deficits in English reading and spelling, as determined by the difference between their chronological age and reading and spelling ages, and gains made in high imagery instruction and structured phonic instruction.

The analysis relating to question five therefore indicates that the chronological age and reading and spelling ages has little influence on the gains made in high imagery instruction and structured phonic instruction. We can therefore conclude that gains made in remedial instruction should be viewed as independent of a child's deficit in reading and spelling as calculated in relation to their chronological age. Remedial therapy is therefore successful regardless of the child's deficiency gap.

7.9 Research Question 6

Is there a difference between the results of children who are able to visualise and are exposed to high imagery techniques, and children who are exposed to structured phonic teaching?

Hypothesis	Variables	Analysis Type
6) There is a significant difference between the reading, writing and spelling results of children who are able to visualise and received high imagery teaching techniques and the reading, writing and spelling results of children who received structured phonic instruction.	Independent Variables - High imagery/phonic. - Visualise/non-visualise. - Gender. N = 51/19 Dependant Variables - Scholastic test results (6) Covariate: Difference scores (Age equivalent score minus actual score at pre-test) for scholastic test results	Report descriptive stats on incidence of visualising/non-visualising children in sample – Frequency Table MANCOVA (If assumptions are not met then run individual ANCOVA's for each DV)

7.9.1 Q6 - Group Description Data

Table 47: Q6 - Aggregated Treatment versus Control Group Results – 2001 to 2005

Test	Structured	Phonic	High Imagery Instruction	
	Instruction N = 19		N = 41	
Schonell One Word Reading	Average Gains	8.42	Average Gains	10.2
Holborn Sentence Reading	Average Gains	5.37	Average Gains	4.63
Schonell Spelling	Average Gains	6.63	Average Gains	8.2
Schonell Dictation Test B	Average Gains	0.94	Average Gains	2.44
Schonell Dictation Test C	Average Gains	2.68	Average Gains	4.05
Schonell Dictation Test D	Average Gains	1.58	Average Gains	3.85

Table 48: Q6 - Mental Imagery Summary – 2001 to 2005

Structured Phonic Instruction (19)		High Imagery Instruction (41)	
Imagery Code	Participants	Imagery Code	Participants

1 – good ability	19
2 - no ability	11

1 – good ability	41
2 - no ability	9

Table 49: Q6 - Gender Summary – 2001 to 2005

Structured Phonic Instruction (19)	
Gender Code	Participants
1 – male	13
2 - female	6

High Imagery Instruction (41)	
Gender Code	Participants
1 – male	30
2 - female	11

7.9.2 Q6 - Statistical Analysis Results – MANCOVA – Multiple Analyses Of Covariance

Appendix 8f contains the detailed statistical results for Research Question 6. The assumptions underlying the test were met: that all observations are independent of each other, the data are at least interval or ratio for parametric statistics variables and normality can be assumed for both the sample distribution and their linear combinations. Box's Test for Equity of Covariance Matrices verified equality of variance in the sample as a whole ($p = 0.003$). Levene's test for Equality of Variances reveals that the variance of each dependant variable is similar ($p > \alpha$).

The result of the MANOVA drawn from Wilk's Lamda (Λ) indicates that there is no significant factor effect for Mental Imagery Ability on the dependent groups 2001 to 2005 (including 2004 participants that received standard TRP remediation) results ($\Lambda = 0.932$, $F(6, 61) = 0.739$, $p = 0.620$). On an individual test scores basis there is no significant univariate for any of the six tests of reading, writing and spelling ($p > \alpha$). Hypothesis testing therefore determines that overall there is no relationship between the reading, writing and spelling ability of children who are able to visualise and gains made in high imagery instruction and structured phonic instruction.

The analysis results from question six therefore indicate that mental imagery ability has little influence on the gains made in high imagery instruction and structured phonic

instruction. According to the statistical results we can therefore conclude that the gains made in remedial instruction should be viewed as independent of the child's mental imagery ability. Mental imagery therefore does not appear to exert a significant influence on response to either remedial situation.

7.10 Research Question 7

- a) Is there a relationship between the error scores yielded by the three levels of the Phonic Inventories for this sample?
- b) Is there a relationship between the error scores yielded by the instrument on each of the levels of the Phonic Inventories, and the other scholastic tests included as dependant variables in this study?

Hypothesis	Variables	Analysis Type
7a) There is a relationship between the error scores yielded by the three levels of the Phonic Inventories.	<i>Independent Variables</i> ○ Phonic Inventory Level ○ Scholastic Test	First order correlation Tests of multi-collinearity
7b) There is a relationship between the error scores yielded by the instrument on each of the levels of the Phonic Inventories and the other scholastic tests included as dependant variables.	<i>Dependant Variables</i> ● Pre-test scores for the Phonic Inventories and the Scholastic Tests	If assumptions are met, factor analysis for data reduction.

Factor analysis is used to determine whether there are any underlying unobservable variables that are reflected in the observed variables.

7.10.1 Q7 - Group Description Data

Table 50: Q7 - Phonic Inventory Descriptive Data - Combined

	Mean	Std. Deviation	N
Phonic Inventories Level One	16.2289	10.86539	83
Phonic Inventories Level Two	27.0843	16.77266	83
Phonic Inventories Level Three	22.9268	17.75261	82
Phonic Inventories Combined	58.8710	40.63925	93

Schonell Word Recognition	40.8696	15.99534	92
Holborn Reading Test	12.8478	9.20097	92
Schonell Spelling Test	30.8710	10.94276	93
Schonell Graded Dictation Test B	8.1099	6.05062	91
Schonell Graded Dictation Test C	15.2889	7.27354	90
Schonell Graded Dictation Test D	18.0120	7.83129	83

7.10.2 Q7A - Statistical Analysis Results – Correlation Matrix – Phonic Inventories

Table 51: Q7A - Summary Correlation Matrix

	Phonic Inventories Level One	Phonic Inventories Level Two	Phonic Inventories Level Three	Phonic Inventories Combined
Phonic Inventories Level One	1	.297(**)	.277(*)	.560(**)
Phonic Inventories Level Two	.297(**)	1	.764(**)	.897(**)
Phonic Inventories Level Three	.277(*)	.764(**)	1	.902(**)
Phonic Inventories Combined	.560(**)	.897(**)	.902(**)	1

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

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

7.10.3 Q7A - Interpretation of Correlation Matrix – Phonic Inventories

Appendix 8g contains the detailed statistical results for Research Question 7A.

1) Assumptions

- Relationship between variables is linear.
- The values are normally distributed.

2) Results

- Level One and Two of the Phonic Inventories = 0.297.

- Level One and Three of the Phonic Inventories = 0.277.
- Level One and Combined Phonic Inventories = 0.56.
- Level Two and Three of the Phonic Inventories = 0.764.
- Level Two and Combined Phonic Inventories = 0.897.
- Level Three and Combined Phonic Inventories = 0.902.

3) Interpretation

There is a weak positive relationship between Level One and Two of the Phonic Inventories (0.297) and Level One and Three of the Phonic Inventories (0.277). There is a stronger positive relationship between Level One of the Phonic Inventories and the Combined Phonic Inventory Levels (0.56).

There is a strong positive relationship between Level Two and Three of the Phonic Inventories (0.764) and Level Two of the Phonic Inventories and the Combined Phonic Inventory Levels (0.897).

There is a strong positive relationship between Level Three of the Phonic Inventories and the Combined Phonic Inventory Levels (0.902).

The results of the analysis indicate that there is a relationship between the different levels of the Phonic Inventories.

7.10.4 Q7B - Statistical Analysis Results – Correlation Matrix – All Pre-Test Variables

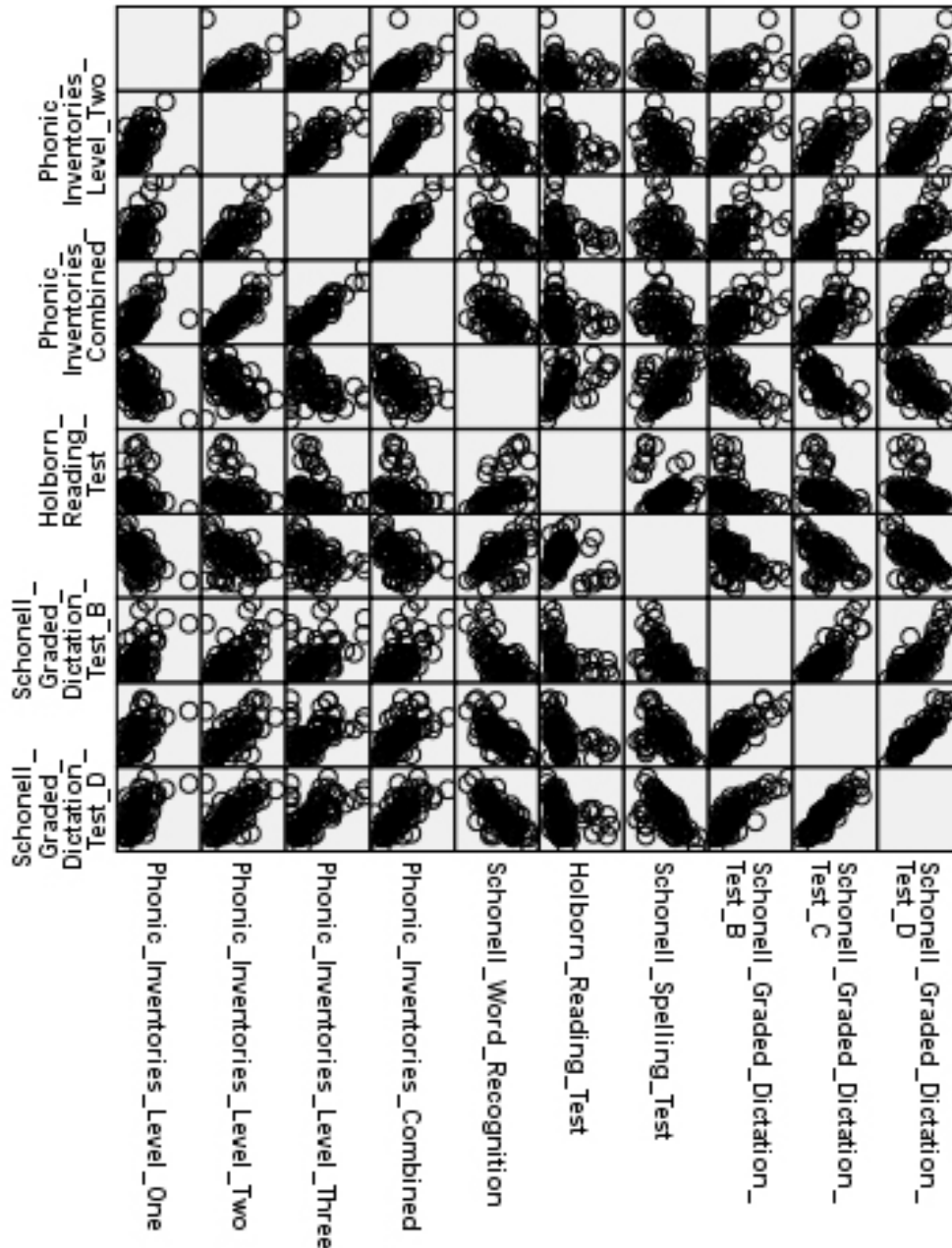
Table 52: Q7B - Summary Correlation Matrix

	Phonic Inventories Level One	Phonic Inventories Level Two	Phonic Inventories Level Three	Phonic Inventories Combined	Schonell Word Recognition	Holborn Reading Test	Schonell Spelling Test	Schonell Graded Dictation Test B	Schonell Graded Dictation Test C	Schonell Graded Dictation Test D
Phonic Inventories Level One	1	.297(**)	.277(*)	.560(**)	-.528(**)	-.202	-.481(**)	.491(**)	.524(**)	.611(**)
Phonic Inventories Level Two	.297(**)	1	.764(**)	.897(**)	-.343(**)	-.175	-.268(*)	.571(**)	.577(**)	.662(**)
Phonic Inventories Level Three	.277(*)	.764(**)	1	.902(**)	-.238(*)	-.092	-.230(*)	.430(**)	.400(**)	.556(**)
Phonic Inventories Combined	.560(**)	.897(**)	.902(**)	1	-.290(**)	-.194	-.407(**)	.571(**)	.536(**)	.602(**)
Schonell Word Recognition	-.528(**)	-.343(**)	-.238(*)	-.290(**)	1	.482(**)	.489(**)	-.588(**)	-.714(**)	-.689(**)
Holborn Reading Test	-.202	-.175	-.092	-.194	.482(**)	1	-.021	-.376(**)	-.487(**)	-.422(**)
Schonell Spelling Test	-.481(**)	-.268(*)	-.230(*)	-.407(**)	.489(**)	-.021	1	-.537(**)	-.576(**)	-.610(**)
Schonell Graded Dictation Test B	.491(**)	.571(**)	.430(**)	.571(**)	-.588(**)	-.376(**)	-.537(**)	1	.806(**)	.803(**)
Schonell Graded Dictation Test C	.524(**)	.577(**)	.400(**)	.536(**)	-.714(**)	-.487(**)	-.576(**)	.806(**)	1	.918(**)
Schonell Graded Dictation Test D	.611(**)	.662(**)	.556(**)	.602(**)	-.689(**)	-.422(**)	-.610(**)	.803(**)	.918(**)	1

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

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

Figure 3: Q7B - Correlation Graph



7.10.5 Q7B - Interpretation of Correlation Matrix – All Pre-Test Variables

Appendix 8g contains the detailed statistical results for Research Question 7B.

1) Assumptions

- Relationship between variables is linear.

- The values are normally distributed.

2) Results

The strongest correlations area as follows:

- Level One of the Phonic Inventories and the Schonell Word Recognition Test (-0.528), the Schonell Spelling Test (-0.481), the Schonell Graded Dictation Test B (0.491), the Schonell Graded Dictation Test C (0.524), the Schonell Graded Dictation Test D (0.611).
- Level Two of the Phonic Inventories and the Schonell Word Recognition Test (-0.343), the Schonell Graded Dictation Test B (0.571), the Schonell Graded Dictation Test C (0.577), the Schonell Graded Dictation Test D (0.662).
- Level Three of the Phonic Inventories and the Schonell Graded Dictation Test B (0.430), the Schonell Graded Dictation Test C (0.400), the Schonell Graded Dictation Test D (0.556).
- The Combined Levels of the Phonic Inventories and the Schonell Spelling Test (-0.407), the Schonell Graded Dictation Test B (0.571), the Schonell Graded Dictation Test C (0.536), the Schonell Graded Dictation Test D (0.602).

3) Interpretation

Level One of the Phonic Inventories has a strong negative relationship with the Schonell Word Recognition and the Schonell Spelling Test. It has a strong positive relationship with the three Schonell Graded Dictation Tests.

Level Two of the Phonic Inventories has a medium strength negative relationship with the Schonell Word Recognition Test and a strong positive relationship with the three Schonell Graded Dictation Tests.

Level Three of the Phonic Inventories has a medium positive relationship with the Schonell Graded Dictation Tests B and C and a strong positive relationship with Test D.

The Combined Level Phonic Inventories has a medium negative relationship with the Schonell Spelling Test and the strong positive relationship with the three levels of the Schonell Graded Dictation Test.

No strong relationships between the levels of the Phonic Inventories and the Holborn Reading Test are present. However a weak negative relationship does exist.

Decision: Factor Analysis on the variables to determine the nature of the relationship between the variables.

7.10.6 Q7B Interpretation of Factor Analysis – Statistical Analysis Results

Appendix 8g contains the detailed statistical results for Research Question 7B.

Figure 4: Q7B Scree Plot

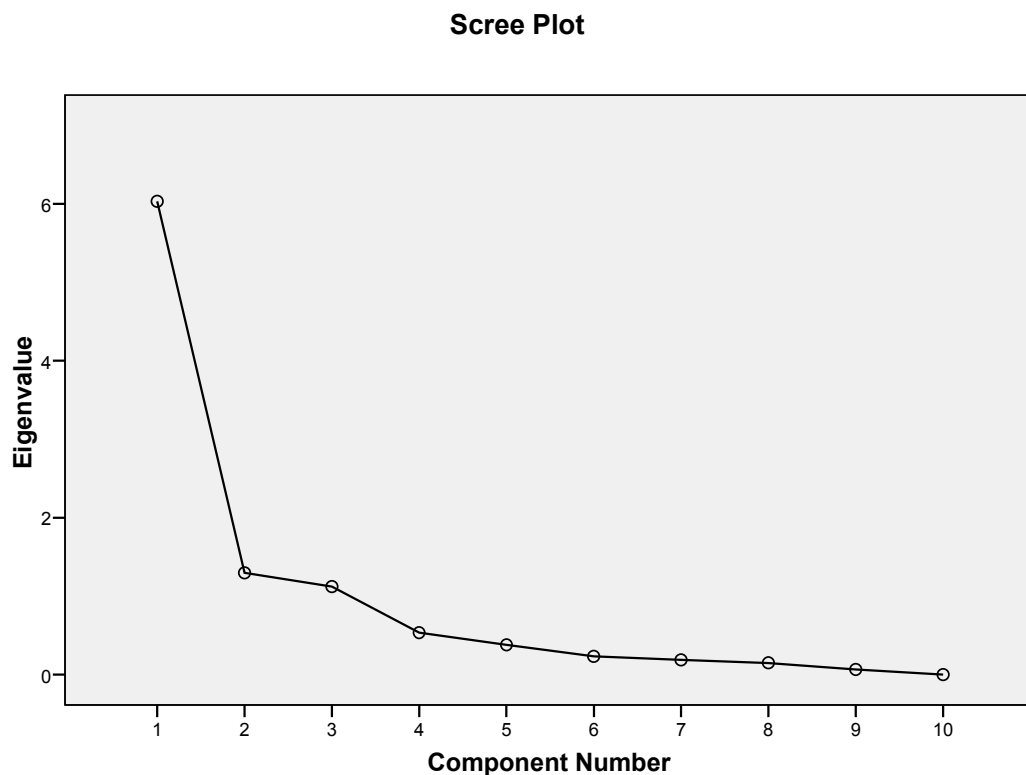


Table 53: Q7B Rotated Component Matrix(a)

	Component		
	1	2	3
Phonic Inventories Level One	.634	.397	-.046
Phonic Inventories Level Two	.374	.829	.133
Phonic Inventories Level Three	.179	.932	.028
Phonic Inventories Combined	.414	.905	.059
Schonell Word Recognition	-.783	-.219	-.361
Holborn Reading Test	-.196	-.090	-.943
Schonell Spelling Test	-.804	-.170	.442
Schonell Graded Dictation Test B	.792	.323	.223
Schonell Graded Dictation Test C	.836	.305	.320
Schonell Graded Dictation Test D	.812	.419	.212

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 5 iterations.

1) Results

The Table of Commonalities indicates that a large portion of the variance for each variable is accounted for the other components that have been identified. These results confirm the results of the correlation matrix which showed a strong relationship between the pre-test phonic inventory variables (proportion of variance for Phonic Inventories Level One = 0.561, Phonic Inventories Level Two = 0.844, Phonic Inventories Level Three = 0.901, and Phonic Inventories Combined = 0.993). Additionally however the proportion of variance for each of the components in the Table of Commonalities confirms the relationships indicated in the correlation matrix where there is a relationship between the Phonic Inventories and the scholastic test used or assessment (Schonell Word Recognition = 0.790, Holborn Reading Test = 0.936, Schonell Spelling Test = 0.871, Schonell Graded Dictation Test B = 0.781, Schonell Graded Dictation Test C = 0.895, and Schonell Graded Dictation Test D = 0.880).

The Results for the Scree Plot (Figure 4) and the Total Variance indicates that there are three main components that should be retained (variables 1, 2 and 3). The sum of these components accounts for 84.52% of the variance observed among the components.

The results of the Rotated Component Matrix show that there is a high loading on the first component and the Phonic Inventory Level One, the Schonell Word Recognition Test, the Schonell Spelling Test, the Schonell Graded Dictation Test B, C and D. There is a high loading between the second component and the Phonic Inventories Levels Two and Three, the Phonic Inventories Combined. There is a high loading between the third component and the Holborn Reading Test. For each of the components that are weaker loadings evident .e.g. component two has a weak loading between the Schonell Graded Dictation Test D, component three has a weak loading between component three and the Schonell Spelling Test.

2) Interpretation

The result of the factor analysis indicates that there are three main factors present for the pre-test scores. These factors are:

- a reading and writing factor as indicated by the strong loadings on the Phonic Inventories Level One, the Schonell Word Recognition Test, the Schonell Spelling Test, the Schonell Graded Dictation Test B, C and D.
- a sequential reading and sequential writing factor as indicated by the strong loading between the Phonic Inventories Level Two, Three and Combined.
- A sequential reading factor as indicated by the high loading on the Holborn Reading Test.

It is interesting to note that the Phonic Inventories appear to present themselves as their own factor within the pre-test battery of tests. This would appear to indicate that the Phonic Inventories are measuring something that is distinct from the other scholastic tests. Use of the Phonic Inventories therefore adds to the value of any test battery that is

conducted on reading, writing and spelling. Further research into the Phonic Inventories will provide further information as to whether or not this is indeed the case.

7.11 Research Question 8

Is there a difference in gains made in phonic skills as indicated by the results of Level 1, 2 and 3 of the Phonic Inventories for those children who received high imagery instruction and those that received structured phonic instruction?

Hypothesis	Variables	Analysis Type
8) There is a difference in gains made in phonic skills as indicated by the results of Level 1,2 and 3 of the Phonic Inventories for those children who received high imagery instruction and those that received structured phonic instruction.	Independent Variables ○ High imagery/phonic. - Visualise/non-visualise. N = 52/30 Dependant Variables ● Phonic Inventories	t-Test

7.11.1 Q8 - Group Description Data

Table 54: Q8 - Aggregated Treatment versus Contrast group Results – 2001 to 2005

Test	Structured Phonic Instruction N = 30		High Imagery Instruction N = 52	
Level One – Phonic Inventories	Average Gains	3.93	Average Gains	5.47
Level Two - Phonic Inventories	Average Gains	6.39	Average Gains	7.45
Level Three - Phonic Inventories	Average Gains	6.71	Average Gains	6.29

7.11.2 Q8 - Statistical Analysis Results – t-Test: Independent Samples t-Test

Appendix 8h contains the detailed statistical results for Research Question 8. The assumptions underlying the test were met: that all observations are independent of each other the data are at least interval or ratio for parametric statistics variables and normality can be assumed. Equal variance across the variables was proven with the result that the

appropriate test statistic was used in the interpretation of the Independent Samples t-Test results.

The results of the Independent Samples t-Test indicate that there is no visible trend that can be concluded from the cumulative results of Phonic Inventories where participants received either high imagery or structured phonic instruction. Hypothesis tests indicate that there are no significant differences for Level 1, 2 and 3 of the Phonic Inventories of children who received high imagery instruction as opposed to structured phonic instruction.

The two remedial instruction types would therefore appear to be equally effective in the manner in which they build the child's word rule knowledge. This conclusion is based on the evidence that the greater gains indicated by the greater aggregate means for Level 1, 2 and 3 are not statistically significant.

7.12 Additional Data Considerations

The possibility exists that some of the datasets results may be slightly skewed in that the subjects "ceilinged out" when completing certain tests. "Ceilinged out" in this context means that the recorded raw scores were outside of the range measured in the test. The discussion chapter discusses the potential implications of this problem for each question for this research report.

7.13 Summary

This chapter has summarised the statistical analyses conducted as part of the research design. It is thus appropriate at this point to summarise the major findings from the analyses, as follows:

1. Effects of High Imagery as compared to Structured Phonic Instruction on Reading, Writing and Spelling Abilities.

The main findings from the analyses were that there was a significant difference between the results from 2001 to 2005 based on the type of intervention received ($p = 0.007$). Hypothesis testing established a significant difference between the overall reading, writing and spelling results of children who received high imagery teaching techniques as opposed to those who received structured phonic teaching. This effect, which indicated that children exposed to high imagery instruction had made greater overall learning gains than children exposed to structured phonic teaching over the five year period, was found for the data set as a whole, but was not found for any of the individual tests administered, other than Schonell Dictation Test C.

2. Effects of High Imagery as compared to Structured Phonic Instruction on Phonic Skills

The analysis indicated that similar gains in phonic skills were by children in both conditions. This was the case for all three levels of the Phonic Inventories administered both for purposes of planning remediation, as well as monitoring the progress made by children in both conditions.

3. Effects of Gender, Age, Degree of Learning Deficit/Developmental Lag on the Results

Gender, age, degree of learning deficit/developmental lag and visualisation ability were not found to exert a significant influence on the results.

4. The relationship between the Phonic Inventories and the other Scholastic tests

On the basis of high correlations with existing standardised measures, it can be concluded that the Phonic Inventories have both content and construct validity.

The tool appears to have potential not only as a diagnostic tool, but could also be used as a means of monitoring progress made by children in response to instruction. Factor analysis indicates that the Phonic Inventory acts as its own test battery that can add value of any test battery that is conducted on reading, writing and spelling.

Overall, the results would thus suggest that high imagery teaching techniques may be an alternative remediation strategy which can be employed in cases where children with learning disabilities are not making adequate progress using structured phonic techniques. This would be the case regardless of the age or gender of the child, or his or her grade at school.

These results are discussed in more detail in relation to the research questions guiding this study, in the next chapter.

8 Chapter Eight: Discussion

8.1 Introduction

The purpose of this study was to examine data from a series of studies conducted over a five year period from 2001 to 2005 on the effectiveness of high imagery teaching techniques in working with learning disabled children. Each of the studies focused on the use of an instructional programme called the Targeted Revisualisation Programme as a form of remediation. The children included in this study were all in full time remedial education and had not learned using conventional remedial teaching techniques based on the use of structured phonic instruction. The results of each of the interpretive studies were aggregated for quantitative analysis of the seven proposed research questions.

The summary of the model that was used to analyse the data are represented below in Figure 5. The main focus was on an analysis of the type of remedial intervention that was administered to the children, with additional analyses that incorporated age, lag in scholastic performance, gender, imagery ability and how the high imagery programme was implemented.

Figure 5: Model Summary

Intervention Type

High Imagery	Structured Phonics
--------------	--------------------

Lag In Scholastic Performances

Schonell One Word Recognition Test	Schonell One Word Spelling Test
------------------------------------	---------------------------------

Gender

Male	Female
------	--------

Imagery Ability

High Ability	Low Ability
--------------	-------------

Implementation Comparison

2001 2002 2003 & 2005	2004
-----------------------------------	------

8.2 Research Questions

8.2.1 Question 1

What trends are evident from the cumulative results of studies conducted on the use of high imagery teaching techniques from 2001 to 2003?

The results of the Independent t-Test indicate that there was no conclusive trend that indicating that the results of children in the high imagery condition were statistically different to the results of children receiving structured phonic teaching, for the data gathered over this period. The gains made by the children in either treatment group could thus quite possibly have been attributed to factors other than the treatment type e.g. the intensive withdrawal type remediation that each child received rather than any specific treatment type.

It should be noted that children in both conditions made progress, as indicated by learning gains on all the scholastic tests used as dependant variables in the research. Children classified as treatment resistant in full-time remedial therapy thus made gains where they were exposed to individual and intensive after-school remedial attention. This was the case in reading ability, writing ability, spelling ability as well as phonic skills.

8.2.2 Question 2

a) Is there a difference in trends in the results in 2004 when implementation of the high imagery teaching programme varied from that taught from 2001 to 2003?

The MANOVA results indicated that there was no statistical difference between the results of high imagery and structured phonic remedial interventions conducted between 2001 and 2003 compared against those carried out in 2004. However statistically significant independent variable effects were recorded on some of the dependant variables (Schonell Graded Dictation Tests C and D). The sample size used for

comparison between the two dataset groups was, however, small and unequal in its make-up may thus have led to bias in favour of one or other of the groups compared.

b) Is there a difference in trends in the results in 2004 when implementation of the high imagery teaching programme varied from that taught from 2001 to 2003 and 2005?

The MANOVA results indicated that there was a statistical difference between the results of children taught in the high imagery and structured phonic remedial interventions conducted between 2001 to 2003 and 2005 compared against those carried out in 2004. This result indicated that the way in which the high imagery programme was conducted in 2004 (without access to computers for use in colour coding and revisualisation exercises) qualified the 2004 high imagery data set as a separate “nested layer” that should be excluded from future analysis.

8.2.3 Question 3

a) What trends are evident from the cumulative results of studies conducted on the use of high imagery teaching techniques from 2001 to 2005 (excluding 2004 results)?

b) Was gender an influence on scholastic performance in these studies?

The MANOVA results indicated that there was a statistical difference between the results from 2001 to 2005 (excluding 2004) results based on the type of intervention received. The evidence from the analysis would thus suggest that the type of high imagery instruction provided using the Targeted Revisualisation Programme’s colour coding and revisualisation techniques represents a viable means of remediation, which can be used with children who do not make adequate progress in structured phonic instruction.

The lack of statistically significant independent variable effects on the individual scholastic tests used as dependant variables (with the exception of the Schonell Graded Dictation Test C), would indicate that, where individual tests are used to monitor

progress, both high imagery and structured phonic remedial interventions would be found to be equally effective in the manner in which they improve a child's specific underlying scholastic academic skills. The significant effect favouring high imagery instruction was thus an artefact of overall trends across the data set as a whole, as opposed to effects attributable to one test.

The results would thus indicate that care needs to be taken in using scholastic tests for purposes of monitoring progress on remedial interventions. The Schonell Dictation Test B, for example, may have produced a Type 1 error, as the data indicated that some of the children may have "ceilinged out" in either the pre or post tests (or both).

Gender did not play a role in influencing the results obtained in either remediation group.

8.2.4 Question 4

- a) What trends are evident from the cumulative results of studies conducted on the use of high imagery teaching techniques from 2001 to 2005 (including 2004 results)?*
- b) Was gender an influence on scholastic performance in these studies?*

The MANOVA results indicated that there was a significant difference between the results from 2001 to 2005 (including 2004 results) based on the type of intervention received. This was found across the data set as a whole, and not for the individual tests used as dependant variables in the study (with the exception of the Schonell Graded Dictation Test C, on which significant difference was found).

The results thus indicated that the children exposed to high imagery instruction made greater gains overall than the children exposed to structured phonic instruction. This was the case over the entire five year period over which part-time afternoon individual tutoring was provided at Japari.

Gender did not play a role in influencing the results obtained in either remediation group. The results thus indicated that the types of high imagery instruction provided by the Targeted Revisualisation Programme provided a viable alternate means of remediation, for those children with learning disabilities who had not made adequate progress in structured phonic programmes.

8.2.5 Question 5

Does the extent of a child's deficits in English reading and spelling, as determined by the difference between his or her chronological age and reading and spelling ages, influence the gains made in high imagery instruction and structured phonic instruction?

The MANCOVA results indicated that deficits in English reading and spelling, as determined by the difference between his or her chronological age and reading and spelling ages did not influence the results obtained in either remediation group. However a significant univariate effect was recorded, where lag was based on the Schonell One Word Reading Test, for the Schonell One Word Reading Test. This result could be interpreted to mean that pre-existing reading ability can play a role in gains made in reading.

No significant univariate effect was, however, recorded where lag was based on the Schonell One Word Spelling Test. This would suggest that spelling and reading formed distinct abilities, as well as distinct entities in the remediation process.

8.2.6 Question 6

Is there a difference between the results of children who are able to visualise / not able to visualise and are exposed to high imagery instructional techniques as opposed to structured phonic teaching?

The MANCOVA results indicated that mental imagery ability (and in particular the child's ability to use eidetic imagery in the learning process) did not play a significant role in the gains made by children exposed to either high imagery or structured phonic instruction. This is an unexpected finding, given the similarity of the Targeted Revisualisation process to the techniques of remediation proposed by Grace Fernald (1943).

There are, however, a number of differences between Fernald's techniques and those used in the targeted revisualisation process. The Targeted Revisualisation Programme, however, places far greater emphasis than Fernald's techniques on mediation of the vowel structure of words using colour coding on computers, on structural analysis of polysyllabic words as well as on use of eidetic imagery in revisualisation. In short, the Targeted Revisualisation process is a more analytical one than the process advocated by Fernald. It also relies heavily on typing as well as writing, as opposed to the Fernald procedures which rely on writing alone.

There are also two pieces of evidence from the analyses which would provide information relevant to this distinction. The first is the evidence that in 2004, different results were obtained in the four small-scale studies in which computers were not used for colour coding and revisualisation. The second is the evidence from the analysis that children taught in the high imagery condition made equal gains in phonic abilities to children taught by structured phonics.

It is thus likely that the skills taught through the use of computers in the high imagery condition as implemented in the Targeted Revisualisation Programme, are focused on developing both word attack and phonic abilities. The skills developed are thus similar to those developed through structured phonics, but are both more visually orientated, as well as targeting visual analysis, and visual memory for words, as well as the sequential memory processes involved in the successive processing of sentences and paragraphs. Fernald's techniques, in contrast, use the written language process to develop reading

skill through increasing familiarity with the structure of written words and their use in creative writing.

What is also relevant is that the Targeted Revisualisation Programme is not only effective with children possessing high visualisation ability, as indicated by their ability to use eidetic imagery in the learning process. This would suggest that mental imagery may be of different kinds, involving different types of memory function. In addition, the results would suggest that mental imagery may be a skill that can be trained, and that the techniques in the Targeted Revisualisation Programme can be applied to a broad range of individuals whose mental imagery is undetermined.

What is also of interest is the descriptive information which emerged from the analysis. For this particular group of 93 learning disabled children, the ratio of those who reported ability to use eidetic imagery in learning relative to those who did not was 3 to 1. This would suggest that roughly 75% of the sample possessed high imagery ability. This would be in line with theories (eg Jaensch, 1930) on the prevalence of mental imagery amongst children.

The high prevalence of mental imagery amongst the sample is thus an asset, while lack of mental imagery need not be a disability in applying high imagery instructional techniques. For those children possessing eidetic imagery, high imagery instruction techniques would be likely to be effective, for the reason that they can tap into as yet unutilised skill sets. For those children without eidetic imagery, high imagery techniques would still be effective in providing a visually orientated system of analysing words, and remembering their structure.

8.2.7 Question 7

a) Is there a relationship between the error scores yielded by the three levels of the Phonic Inventories for this sample?

b) Is there a relationship between the error scores yielded by the instrument on each of the levels of the Phonic Inventories, and the other scholastic tests included as dependant variables in this study?

The results of the correlation matrix for the pre-test error scores for the three levels of the Phonic Inventories and the Combined Phonic Inventory score indicates that there is generally moderate to strong association between the Phonic Inventory variables. A high number of errors in any of the variables are therefore associated with a corresponding high number of variables in other areas. This would appear to indicate that the types of errors that are targeted within each of the levels are related and that a decrease of errors in one of the tests would be associated with a decrease in the others. These results add substance to the theory that the Phonic Inventories target differing areas of phonic competencies which by their very nature are related.

The results of the correlation matrix between the pre-test error scores for the Phonic Inventory scores and other more established scholastic tests indicate that there is an association. The nature of the relationships coincide with the areas of scholastic ability each of the tests is supposed to measure i.e. Level Three of the Phonic Inventories has strong association with tests B, C and D of the Schonell Dictation Test. The Schonell Dictation Tests measures sequential processing ability, an ability that is also required to build words from independent units of sound. Level Three of the Phonic Inventories was designed to provide information on whether the child was able to construct polysyllabic words, use morphological ending with a root word, and also use prefixes and suffixes either before or after the root word (Potter, Grasko & Pereira, 2006).

Level One of the Phonic Inventories measures how well a child is able to understand the relationship between graphemes and phonemes (necessary in order to recognise word structures and hence words). The strong association of this test with the Schonell Word Recognition Test, the Schonell Spelling Test, and the Schonell Graded Dictation Tests B, C and D therefore makes sense because each of these tests require word recognition ability.

The results of the correlation matrix prompted a factor analysis of the variables in order to determine the nature of their relationship. The factor analysis results indicate that there are three main factors present:

- a reading and writing factor as indicated by the strong loadings on the Phonic Inventories Level One, the Schonell Word Recognition Test, the Schonell Spelling Test, the Schonell Graded Dictation Test B, C and D.
- a sequential reading and sequential writing factor as indicated by the strong loading between the Phonic Inventories Level Two, Three and Combined.
- A sequential reading factor as indicated by the high loading on the Holborn Reading Test.

The factor analysis results confirm that Phonic Inventory's standing as a measure of scholastic performance and their use as a means to measure which scholastic skills are deficient and therefore in need of Targeted Revisualisation. Indeed the results indicate that the Phonic Inventories are their own factor within the battery of pre-tests which in turn suggests that this test may be used independently of the scholastic tests used to measure reading, writing and spelling skills or ideally as an additional measure alongside these tests in order to better understand the child's areas of weakness.

No residual analysis has been performed on factor analysis results for retrospective analysis. This is because Principal Component Analysis was used for the rotated results. Consequently issue relating to commonalities and residuals have not been assessed but may well be a form of analysis that is investigated in future research.

Question 8

Is there a difference in trends between the results of Level 1, 2 and 3 of the Phonic Inventories for those children who received high imagery instruction and those that received structured phonic instruction?

The results of the Independent t-Test indicated that there was no significant difference between mean gains of children who received either high imagery remediation and those that received structured phonic remediation. This result therefore indicates that the orthography of the English Language was as effectively mediated for the children in the high imagery Targeted Revisualisation Programme condition as for the children in the structured phonic condition.

What is of interest is that no significant difference was noted between the results of the two conditions on any of the three levels of the Phonic Inventories. As each level measured a different type of phonic ability, this result indicated that children learned a variety of phonic skills both through their involvement in high imagery teaching techniques, as well their involvement in instruction based on structured phonics.

8.3 Summary

Overall the results from this research indicate the following:

- Lag in scholastic performance as measured by the child's chronological age and their mental age was not an influencing factor on the gains made by children in the study;
- Gender was not an influencing factor affecting the gains made by children in the study;
- There was no difference in the improvements made between children who reported high visualisation ability (i.e. the presence of eidetic imagery and the ability to use it in learning) and children who did not report the ability to use visualisation in learning, in either the high imagery or the structured phonic conditions;
- There was a difference in the manner in which the high imagery programme was implemented in 2004 as opposed to how it was implemented in 2001 to 2003 and 2005;

- Despite this difference, there was a significant difference between the gains made by children who underwent high imagery instruction between 2001 and 2005 and the gains made by those children who received structured phonic instruction over this period; and
- That the Phonic Inventories have internal coherence in that they have strong associations amongst themselves as to the skills that they measure. Additionally the Phonic Inventories are also strongly associated with other tests that measure scholastic ability and also present themselves as a separate factor, indicating they add value to any of battery of tests that measure scholastic ability and potentially may be applied by themselves.

It is therefore concluded that high imagery instruction techniques as described and implemented in the Targeted Revisualisation Programme are a viable alternative to structured phonic techniques. The indications were that this was the case across the total data set, and that potential co-variables such as age, degree of learning deficit/developmental lag, gender and visualisation ability did not influence the results.

This would suggest that high imagery techniques are likely to be effective with those learning disabled children who do not respond adequately to structured phonic instruction regardless of the child's age, grade, gender or degree of learning deficit. They are also likely to be effective whether or not children report being able to use visualisation in learning.

It should be noted that there were a number of limitations in sampling, selection, programme implementation and research design which have influenced the results of this study. The above conclusions are based on a series of hypotheses which attempted to take certain of these limitations into account. However, in non-experimental research it is not normally possible to control all third variables, and this is particularly the case where aggregated data are used. A number of limitations are referred to in the concluding chapter following, which may have introduced biases into the results.

9 Chapter Nine: Limitations and Suggestions for Further Study

9.1 Sampling and Selection

It should be noted that the sampling procedures used in this research were based on opportunity/convenience, and that selection was also a major influence on the data. These factors potentially introduce both internal validity problems as well as limitations affecting the external validity of the results reported in this study. Further research is thus necessary which examines the role of high imagery teaching techniques both with other less highly selected samples of learning disabled children, as well as with children at school more generally.

9.2 Variations in Programme Implementation

There were variations in implementation affecting in particular the 2004 data in this study. Though the factors involved (theft of computers from the school) were contextual and beyond the control of the researchers, they nevertheless introduced limitations into the design, as well as the implementation of the high imagery condition in the tutoring programme during this year. Further research is thus necessary into the role computers play in the type of high imagery instruction provided through the Targeted Revisualisation Programme.

9.3 Level of Cognitive Ability

It should be noted that all the children who took part in the small-scale studies on which this research was based had been diagnosed as learning disabled. This was on the basis of an IQ, supported by evidence of learning deficit/developmental lag based on scores on scholastic tests relative to chronological age. IQ scores were not included as a co-variate in this research, for the reason that different IQ tests were used with the sample of

children. Further research investigating to potential role of verbal and non-verbal intelligence in high imagery instruction is thus indicated.

9.4 The Trainability of Visualisation

An unexpected finding from this study was that visualisation ability did not appear to affect the results. Given the focus of the research on high imagery instruction, further research is necessary into the types of skills trained by the Targeted Revisualisation Programme, and whether children with high visualisation ability and children with low visualisation ability adopt different strategies in learning. Theory holds that one in three children do not possess high mental imagery ability (Jaensch, 1930), and it would be interesting to establish whether mental imagery is a trainable skill. Further research is also necessary into whether the types of high imagery activities introduced in the Targeted Revisualisation Programme are able to change existing levels of mental imagery, thus opening up a range of alternative remedial strategies available to the child.

9.5 Limitations in Sampling Procedure, as well as in Sample Size

The sample used for analysis had a number of limitations, as it was based on data drawn from small-scale studies conducted over a number of years. It was the best available sample to the researcher. However, an aggregated sample has potential biases, and other potential biases apply to a sample aggregated over a five year period. Additional research with large samples drawn concurrently is thus necessary so that the results of this study can be cross-validated. From the analysis, it was evident that sample size played a role in the results obtained. This is not to say that the results reported in the previous chapters are invalid. Rather they motivate further study for purposes of cross-validation.

9.6 Limitations in Research Design

The research design used in this study was an ex post facto design. This type of non-experimental design carries with it the danger of ex post hoc propter hoc fallacies,

especially where conclusions have previously been drawn from small samples forming subcomponents of a larger sample. Though random assignment was used in certain of the small-scale studies from which the data for this research was drawn, this was not possible across all the small-scale studies reviewed in Chapter Four. Nor can it be claimed that the samples for the small-scale studies were randomly drawn. Further research is thus necessary which is able to conduct comparisons based on designs using samples which are randomly drawn, as well as randomly assigned to different conditions.

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