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ASSESSMENT AND REMEDIATION OF SUCCESSIVE PROCESSING DEFICITS USING THE PASS INFORMATION PROCESSING MODEL

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Submitted in fulfilment of the requirements for the degree

M.Ed. (by dissertation)

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DECLARATION

I hereby declare that this dissertation is my own unaided work. It is being submitted for the degree of Master of Education (Educational Psychology) at the University of the Witwatersrand, Johannesburg. It has not been submitted for any degree or examination at any other university.

Melinda Churches — 24 December 1999

Melinda Churches — Date

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ABSTRACT

The rationale for this study was to match the remedial needs of children with appropriate programmes. The aims were (1) To test the usefulness of screening instruments modelled on subtests of the Naglieri-Das Cognitive Assessment System in identifying South African children with specific learning disabilities. (2) To study the effects of the PASS Remedial Programme (PREP) in addressing the needs of children with deficits in successive processing. (3) To study the effects of a programme based on Whole Language (WL) principles when used with children with reading problems due to extrinsic factors. Screening instruments were used to identify seven children with a successive processing deficit for the PREP experimental treatment group. Seven children who showed a general delay in beginning reading skills were selected for the WL experimental group. A PREP control group and a WL control group were also identified. Both treatment groups received twenty-four intervention sessions. When the PREP and WL experimental groups were compared, there were significant differences in gains in successive processing for the PREP group but gains in word reading skills were statistically the same for the two groups. This was an indication that the remedial programmes were suited to the needs of the children in the groups. General implications for specialised education programmes in South Africa and future directions for research on remediation are also presented.

Keywords: remediation, successive processing, PASS model, Whole Language

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Chapter One
Background to the Study

1.1 Introduction

Contemporary Context for the Study

South African education suffers from the enormous demands placed on its resources, not the least of which are children with special needs. In *Reconceptualizing the Nature and Extent of Special Educational Needs in South Africa*, Donald (1993) describes specialised educational needs as both intrinsic and extrinsic. Malnutrition, poverty, and insufficient healthcare provision impact on the cognitive development of children and result in the likelihood that "intrinsic disability may be created at up to double the rate of incidence than is the case in more privileged contexts," (p. 141).

The issue of defining the need for specialised education becomes even more complex when considering disabilities due to extrinsic factors. Children with no intrinsic deficits, i.e., no impairment in learning ability, are still casualties of South African social and political history, of a system which for many years educationally impoverished minority population groups. Illiterate, innumerate, many children have not mastered basic skills for a myriad of reasons beyond their control. "Although it is difficult to define the precise extent of this group, it is reflected in excessively high drop-out rates, failure rates, and evidence of widespread underachievement in relation to potential in, particularly, African education," (Donald, p. 141).

Within the context of widespread educational reform, the South African educational system faces the enormous task of addressing these specialised needs along with those of mainstream children. Reliable measures and relevant programmes are essential in the restructuring of South African education.

Relevance to Specialised Education in South Africa

Identification of children with specialised needs presents a special challenge to existing, overextended structures. Traditional measures of ability are costly, time consuming, and require the services of trained personnel; they are available only to a fortunate few. Tests in general usage have been normed on English-speaking population groups and measure acquired knowledge, that which is gained through participation in the dominant culture (Utley, Haywood and Masters, 1992). The majority of South African children has had little exposure to this culture and even if they had the opportunity for assessment, could not be assured of a fair appraisal. A testing instrument which would require little training in administration and free from cultural bias could be used to streamline the testing process to assure that children with specific learning disabilities were identified for

further testing and, ultimately, participation in programmes to address their particular, individual needs.

There is a pressing need to try new tests which measure the ability of children to draw on their own cognitive abilities to acquire knowledge. Given the diversity of South African society, a cross-cultural measure is of particular relevance. Traditional standardised intelligence tests neither remediate nor prescribe and so make no provision for change beyond identification of problems (Kriegler and Skuy, 1996). Screening instruments which differentiate between intrinsic and extrinsic learning problems would be a first step in addressing the need for prescription. Remedial programmes could then be adapted to suit children's needs.

1.2 Subject and Purpose of the Study

This study tested the usefulness of screening instruments in the identification of specific learning disabilities in the South African context as well as the effects of two remediation programmes, the PASS Reading Enhancement Program and a programme based on Whole Language principles. Its purpose was to extend the means and materials available for the broad and diverse demands of specialised education in South Africa, specifically in the area of beginning reading skills.

This research tested the equivalent effectiveness of two different programmes, using two different samples, in an effort to study programmes relevant to current needs in specialised education. The PASS Reading Enhancement Program (PREP), used with children identified as having intrinsically based learning problems, was introduced in South Africa in 1996. Although the PREP has been shown to be effective in other cultures, (Das, Mishra and Pool, 1995), it had not been used in a controlled study of South African children until the current study. The PREP was chosen for this research because it could be of particular relevance in South Africa where programmes are needed for children with specific, intrinsic learning disabilities.

The second remediation programme was based on Whole Language principles and was selected for use with children whose learning problems were the result of factors other than cognitive deficits. The range of extrinsically based learning problems is broader, with roots in any one of many socio-economic, environmental, linguistic, and/or educational factors. The Whole Language remediation programme allowed for individuation and for developing language and reading skills through experience. As such, it could be used to address a variety of special needs and is adaptable to any number of learning situations.

A study of the effectiveness of instruments for identifying special needs and of programmes designed to address them has special relevance in the South African context. The problems of the learning disabled and of those who, for extrinsic reasons have not yet acquired basic skills, complicate a system already overloaded by pressing demands.

The need for an efficient and purposeful method of identification of learning disabilities, and for remediation appropriate to varying needs, is indisputable.

1.3 Scope of this Dissertation

This study focuses on the very beginning phase of reading, the ability to decode individual words. Access to print is, of necessity, the first measure of the ability to read. The investigation of that access receives priority in this particular study of reading disability which encompasses the first two subskills of reading, decoding and word recognition. It does not purport to deal with the third subskill, comprehension, which is beyond the scope of this study.

Comprehension has been the focus of research since Huey (1908/1968) described it as "the most remarkable specific performance that civilisation has learned in all its history," (p.6). There have been innumerable models of reading comprehension. Understanding of printed text "relies heavily on children's already developed language knowledge and their ability to construct meaning from elements in sentences, larger units of discourse, and narrative and expository works," (Ruddell and Ruddell, 1994, p.9). It is the ultimate goal of reading but its entwinement with language development, knowledge base, socio-cultural factors, indeed text itself, involves complex cognitive processes beyond the scope of this study. It is included in this discussion as essential to a definition of reading but the study itself deals with the underlying cognitive processes of decoding deficits that interfere with the first step in the reading process, i.e., access to print.

The tasks undertaken in this study, then, can be summarised as follows:

1. A summary of the PASS information processing model within the context of cognitive psychology, a review of the processing studies upon which it is based, and relating the model to the acquisition of beginning reading skills.

2. A review of the literature pertinent to the application of the PASS information processing model, its assessment instrument, the Naglieri-Das Cognitive Assessment System, its remediation programme, the PASS Reading Enhancement Program, and to the application of Whole Language principles in a remedial context.

3. A summary of the results of a study based on these principles and conducted at Thuthuka School, Braamfontein, Johannesburg from August 1996 to April, 1997.

1.4 Summary

The South African educational system provides unique challenges as educationists seek to deal with its complex needs. Provision for specialised education accounts for a significant portion of these needs. If these specialised educational needs are to be recognised and addressed, tests are needed that are suited to the South African context. Identification becomes meaningful when it is followed by supportive programmes that seek to remediate learning problems. It was the purpose of this chapter to introduce a study which deals with the specialised educational needs particular to South Africa.

Chapter Two
The Development of a Cognitive Perspective on Reading

2.1 Introduction

The borders between the fields of psychology and education have increasingly blurred during the last four decades. The purpose of this chapter is to place current reading theory in its modern context that reflects influences from psychologists and psycholinguists. The development of information-processing theory is presented, particularly the Luria-Das model, as well as comment on traditional and contemporary measures for assessing ability.

2.2 The Cognitive Psychology Inheritance

Until the1950's the process of reading had been viewed fairly simply. Behaviourists thought that readers translated written symbols into an aural code in order to understand sounds, which reflected oral speech. No distinctions between comprehension of written language and that of oral speech were made. Educationists characterised reading as a combination of aural and visual processes so teachers were trained to teach beginning reading through phonics and whole-word instruction. Skill teaching predominated: the sounds of the language were delineated into hierarchies of instruction and words were classified into gradually increasing levels of difficulty. Emphasis was on measures of perception that could be taught, practised, observed and tested (Pearson and Stephens, p. 23, 1992). Dyslexia was seen as an unexpected reading failure that manifested as poor test performance. The failure was considered to be "unexpected" because it represented a discrepancy between IQ and reading ability, a theory which excluded the dyslexia of the less able. Focus was on the failure rather than on its underlying causes (Frith, in Hulme and Snowling, pp.1-2, 1997).

Today, reading encompasses a broad range of perspectives and research techniques in a variety of disciplines. Research has been particularly rigorous within the field of psychology. The arrival of computer technology in the mid 1950's instigated a shift from the stimulus-response theory of behaviourism to the development of cognitive theory. Computer programmers using different operations to process data interested psychologists in identifying the different stages of human information processing and how these influenced performance (Eysenck and Keane, pp.7-9, 1990). As the field of cognitive psychology developed and findings in the field of neuropsychology began to influence theory, researchers began to see behaviour as a reflection of mental processes about which inferences could be drawn. Reading came to be seen as a process far more complex than basic perception and was no longer the exclusive realm of educationists (Pearson and Stephens, p.30, 1992).

2.3 Influences from Psycholinguistics

A paradigm shift in the field of linguistics meant that linguists also took an interest in reading, including it in studies of language that had already incorporated listening, speaking and writing. In Syntactic Structures (1957) and Aspects of the Theory of Syntax (1965) Noam Chomsky challenged behaviourist theories of language and did away with the traditional view of language acquisition and comprehension which had dominated the fields of linguistics and psychology since the beginning of the century. Chomsky argued that meaning was imbedded in the "deep structure" of language and that understanding went beyond the interpretation of a sequence of words. His attacks on behaviourist language assumptions led educationists to question traditional theories of reading skill acquisition. Similarities between oral and written language acquisition were recognised and the association between early reading problems and specific language deficits was established (Garnham, pp. 17-22, 1985).

Chomsky also introduced the idea that children acquire language naturally, in spite of its complexities, learning with ease the language of the communities into which they are born. The field of psycholinguistics evolved and, in its early stages, "devoted itself to determining whether the views of linguistic competence and language acquisition that had been set forth by Chomsky and his colleagues could serve as psychological models of language performance," (Pearson and Stephens, p. 25, 1994). The psycholinguists Kenneth Goodman and Frank Smith focused on reading as part of the total language picture and adapted Chomsky's theory on language acquisition to the acquisition of beginning reading skills, relegating visual and phonological aspects to the realm of the incidental. Their work is discussed in Chapter 6.

2.4 Information-Processing Theory

A summary of developments in the field of cognitive psychology is useful in understanding the context in which current reading theory has developed. Behaviourism dominated the field of psychology from the 1920s to the mid-1950s. In order to promote psychology as a serious field of study, behaviourism emphasised the need for scientific rigour in its experiments and for psychologists to observe repeatable human behaviours. B F Skinner, its most influential proponent, developed the theory of operant conditioning, one with such widespread impact that its influence is clearly apparent in the 1950s view of reading as a mechanical translation of symbols into words.

Behaviourists steered clear of the issue of consciousness, however, and so their predominance in the field of psychology was bound to be limited. The eventual arrival of the modern digital computer with its resultant influence on information-processing theory brought about the collapse of behaviourism. The Behaviourists are credited with having brought the study of psychology into the academic arena and with establishing a tradition of scientific rigour through controlled experimental procedures (Kellogg, p.12, 1995).

The next decades were to see a revolution within the field of psychology as psychologists moved beyond the simply observable to the complications of cognition.

As cognition became a legitimate field for scientific research, the shift toward information-processing theory gained momentum. "The input, output, storage and processing capabilities of the digital computer provided an explicit analogy for understanding the human mind," (Kellogg, p.14, 1995). Miller (1956) published his classic paper on short-term memory, establishing a clear definition for one of the processing stages. Broadbent's filter model soon followed, based on an analysis of information-processing which elucidated a theory of auditory attention (1958). Miller, Galanter and Pribram put forth the concept of operating plans in *Plans and the Structure of Behaviour* (1960). Sperling's studies of perception and memory resulted in a model of information-processing for visual recognition (1963).

The development of the information-processing framework was fundamental to many of the changes. Mental processes were interpreted as a flow of information with distinct stages, comparable to the operation of computers. Essentially, the information-processing approach assumes the ability to represent events in the external environment symbolically and to manipulate the symbolic representations, to process them. "A few relatively basic symbolic computational operations, such as encoding, comparing, locating, storing and the like, may ultimately account for human intelligence and the capacity to create knowledge, novelty, and perhaps expectations about the future," (Lachman, Lachman and Butterfield, p.349, 1979). By the early 1970's, the demise of behaviourism was complete, and the establishment of an information-processing framework was stable; revolution gave way to further evolution and elucidation of the theory.

Sternberg's 1983 classic work then introduced the idea of "process independence," based on the assumption that the mental activities underlying human performance can be delineated into separate and independent cognitive processes. He distinguished five different components into which intelligence could be analysed: metacomponents, performance components, acquisition components, retention components and transfer components. "A component is an elementary information process that operates upon internal representations of objects or symbols. . . . The basic idea is that components represent latent abilities of some kind that give rise to individual differences in measured intelligence and in real-world performance, and to individual factor scores as well," (Sternberg, p. 3, 1983).

Sternberg believed that these processes were responsible for individual differences in intelligence and analysed them by measuring the reaction times needed by subjects in solving items on traditional intelligence tests. He found that individual differences related to intelligence were most evident in the metacomponent processes--the filter and receptor of all information processed through the other components.

Finding the strictly cognitive view to be limiting, Sternberg extended his componential theory to a "triarchic one" in 1985. In this theory responsibility for planning was rooted

in the metacomponent processes, the highest level in the triarchy. The second level of cognitive functioning encompassed the performance components. Acquisition of knowledge is at the lowest cognitive level in Sternberg's theory (Anderson, p. 36, 1992).

2.5 The Luria-Das Model

The Luria-Das model delineates four elements of information processing, namely, planning, arousal/attention, and simultaneous and successive processing (PASS) (Das, Kirby and Jarman, 1975). It is the principal theory upon which this study is based and is described in Chapter 4. Its publication in 1975 was cause for debate amongst cognitive psychologists.

On a theoretical level, Paivio (1975) claimed that "Das et al had failed to recognise that the simultaneous-successive processing distinction had already been theoretically co-ordinated with the verbal-nonverbal dichotomy in Pavio's own dual coding theory. This distinguished between imaginal processing assumed to be specialised for handling nonverbal information stored in the form of images, and verbal processing which deals with discrete units of sequentially ordered linguistic information," (Pavio cited in Klich, p. 329 - 330,1987). Das and Kirby (1978) countered that Luria's original research showed right brain/left brain assignations to be an oversimplification. Instead, emphasis was placed on the type of information to be coded and the necessary operations. "Luria had illustrated how, for example, simultaneous processing in verbal and nonverbal contexts could be impaired by lesions in both the left and right hemispheres of the brain, and similarly, how successive processing was involved in the syntactic structure of narrative speech while the decoding of logico-grammatical relationships in language use depended on simultaneous synthesis," (Klich, p. 1330, 1987).

On the basis of design, Humphreys (1978) criticised research done by Kirby and Das which studied the relationships between reading achievement, IQ, and simultaneous-successive processing (Kirby and Das, 1977). Humphreys queried the validity of the research findings, contesting that they were based on use of the median split technique. According to Humphreys, the weight of the statistical evidence is reduced when a measure is delineated into a small number of categories. Das and Kirby (1978) countered this argument by pointing out that "the analysis of variance technique gave a conservative test of (the) data, thereby showing the 'real' effect to be even stronger" (p. 877) and that the conclusions drawn were not changed by the application of the technique. They further defended their research by citing examples of the validity and usefulness of median splits in the research of fellow psychologists.

The PASS model is useful from a practitioner's point of view. With its stress on a production system, it focuses on the processes underlying behaviours and deals with educational problems; the bulk of the research supporting the PASS model has dealt with reading disability. As such, its applications are useful in a school setting. For the practitioner, it links poor performance to insufficiently developed strategies and allows

for changes that successfully promote learning. As these processes are said to take place against the background of knowledge base, the model is adaptable to different cultures. Further support for the PASS model, in the form of processing studies, is discussed in Chapter Four.

2.6 Cognitive Psychology and Assessment

Until recently, psychologists viewed human intelligence as an immutable and measurable ability, one assessable through traditional intelligence testing. The development of intelligence tests by Binet in the 1920's established a foundation for using standard scores, based on the assumption that human ability is incremental with age. The results of these tests ". . . . is a numerical value which reveals how productively a person can think in a well-defined test situation and this enables us to compare the person's performance with the performance of other persons in the same well-defined test situation," (Jordaan and Jordaan , p. 442, 1984). Traditional measures of intelligence have excluded factors relative to culture, language, social class, and an almost immeasurable range of other variables.

Attitudes toward intelligence began to change with the shift to information-processing and the development of cognitive theories in the 1950's. With regard to assessment, attention eventually moved to measurement of processes rather than the results of their application. It has taken some time for practice to reflect theory, however and changing views of intelligence did not immediately impact on testing practice. Even now, traditional instruments continue to dominate the field and the paths of psychology and psychometrics continue to diverge. On the one hand, psychologists are taught cognitive theory but, on the other, trained in using tests which do not sufficiently credit new developments. Psychologists involved in testing continue along traditional pathways because design, testing and validation of new instruments is a slow and costly process and because of natural resistance of well-entrenched habits to change.

However, cognitive psychologists have eschewed traditional testing as they have come to reject its underlying principles and to query its social value. Feuerstein was among the first. The Learning Potential Assessment Device (LPAD) measures learning potential by promoting cognitive change during testing (Feuerstein, Rand and Hoffman, 1979). With a focus on process rather than product, Feuerstein defined intelligence as "the capacity of the individual to use previously acquired experiences to adjust to new situations," (Feuerstein, p. 764, 1980). The LPAD goes beyond measurement of performance levels to provide specific information about cognitive processes as well as suggestions for modifying those processes. In keeping with information-processing theory, Feuerstein's Instrumental Enrichment programme is one of the most widely known approaches to the enhancement of cognitive performance.

With the 1983 publication of the Kaufman Assessment Battery for Children (K-ABC), its authors identified as a goal the separation of measures of acquired knowledge from those that measure problem-solving ability. "How children process information relates to their problem-solving ability, regardless of the content (factual knowledge) they process," (Kaufman and Kaufman, p. 6). It includes measures of sequential and simultaneous processing along with a more traditional set of achievement tests, but does not include measures of executive function, i.e., planning. Das et al acknowledge that while the PASS theory influenced the development of the K-ABC, the test itself reflects a conglomeration of information-processing theory and "was not designed to reflect any particular model," (Das, Naglieri and Kirby, p. 124).

The (1997) Cognitive Assessment System (CAS) *does* reflect a particular theoretical model, the PASS. As such, it integrates "theoretical and applied areas of psychological knowledge using a theory of cognitive processing and tests designed to measure those processes," (Naglieri and Das, 1997, p. 1). With its view of intelligence as the sum of the four cognitive activities of planning, attention, and simultaneous and successive processing, the CAS goes beyond traditional definitions and measures of intelligence to address the complexities of human thought and action. It is discussed further in Chapter Seven.

2.7 Summary

This chapter has linked contemporary views of the reading process with developments in the fields of cognitive psychology and linguistics. It included a broad overview of the development of information-processing theory, with a closer look at the Luria-Das model of information processing. It included comment on current methods of assessment in the field of psychology and the shift of emphasis from measurement of acquired knowledge to that of cognitive processes. The chapter concluded with the introduction of the CAS, a measure for cognitive processes representative of one way forward in psychological assessment.

Chapter Three
Effects of the "Cognitive Revolution" in the Field of Reading

3.1 Introduction

This chapter takes a closer look at the impact of developments in cognitive psychology on the field of reading. It links the development of information-processing theory to developments in the field of reading before providing a definition of reading reflecting that link. The new perspective on the reading process also meant changes in the view of reading disability and its link to phonological processes which are also discussed. The chapter concludes with an introduction of the PASS Reading Enhancement Program (PREP), a remediation programme reflecting the developments in reading theory and with roots in cognitive psychology.

3.2 Information-Processing and Reading Theory

As the influence of information-processing theory in the field of cognitive psychology took hold, the recognition of the link between cognitive processes and reading ability allowed researchers to go beyond simple observations and to design task analyses linking these processes with reading. LaBerge and Samuels (1974) were the first to apply an information-processing model to an analysis of reading behaviour. Their model of automatic information-processing demonstrated that poor readers needed to allocate cognitive resources to tasks in word recognition, allowing fewer resources for the higher level processes related to reading comprehension. Their work provided a means of studying the acquisition of beginning reading skills in a new context and was paralleled by studies in the acquisition of basic reading skills (Krywaniuk and Das, 1976; Kaufman and Kaufman, 1979).

Anderson and Pearson (1984) developed schema theory to explain how knowledge base is represented in memory. They posited that comprehension of written text occurs when the elements of a story can be associated with pre-existing mental categories or the "schemata" of the reader. The theory had wide-ranging implications for the teaching of reading comprehension. Previously, methodology had concerned itself with teachers finding ways to transmit information to students. With the influence of schema theory, teachers were encouraged to credit the cultural backgrounds and existing knowledge of their students in finding ways to establish connections between texts and the schemata of their students.

3.3 Reading - Current Definitions

Current definitions of the reading process generally include a distinction between decoding and comprehension. The definition of decoding has in itself been controversial, some relating it to the "sounding out" of words and others, to word recognition. Gough and Tunmer (1986) characterise the sounding out of words as "a primitive form of decoding," and although they admit to a reader's need for knowledge of English letter-sound correspondence, they prefer to define decoding as "(context-free) word recognition" (p. 7). They "believe that the skilled decoder is exactly the reader who can read isolated words quickly, accurately, and silently" (p. 7). In *Beginning to Read* Adams (1990) reviewed the research of the previous decade and concluded that "students must appreciate the alphabetic principle to become proficient readers. They must acquire a sense of the correspondence between letters and sounds upon which it is based," (p. 29). In contrast to the Gough and Tunmer definition, Adams' review found a preference for a phonological definition of decoding.

Goulandris (1996) resolves the debate by separating decoding, the application of phonological principles, from the skill of word recognition with the simple assertion that reading "consists of three quite different components or subskills: decoding, word recognition and comprehension," (in Snowling and Stackhouse, p. 83). Decoding is insufficient in itself for readers of English because of the abnormalities of English spelling (dough, bough, through) and it is here that word recognition can be seen as a separate, and essential reading component.

The Das, Naglieri and Kirby (1994) definition of decoding deals with both phonetic analysis and word recognition:

> A printed word has visual characteristics that are perceived and received by the eye. Proceeding from this stage, the word is either visually coded as a pattern or phonologically coded as speech sounds. Travelling through one of these routes, the word reaches the next stage, which is pronunciation of the word. Once the required pronunciation is available, the final stage, oral reading of the word, is reached (p. 134).

Simultaneous processing predominates in the coding of visual information and successive processing does so in the coding of phonological information, as the sequencing of sounds is obviously crucial to word pronunciation. "Pronunciation of the word is assembled by organising speech sounds corresponding to the printed word; this is predominantly a successive process requiring the motor programme (articulation of the sounds) for oral reading," (Das, Naglieri and Kirby, 1994, p. 134). A cognitive perspective on decoding is illustrated in Figure 3-1 on the following page, showing the relationship between speech processes and access to print.

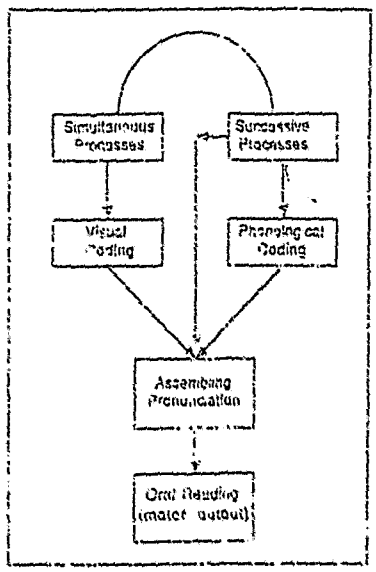


Figure 3-1: Cognitive Processes in Decoding
from Das, Naglieri and Kirby (1994) p.136

3.4 New Perspectives on Reading Disability

Definitions of reading as a cognitive function necessitated new definitions for reading disability. Poor performance on reading tests came to be seen not as a problem in itself but as a reflection of underlying problems. Frith (1986) characterised developmental dyslexia as the failure to acquire alphabetic strategies. "It seems that the subtle and near-spontaneous phonological analysis that is demanded by the alphabetic strategy cannot be attained by otherwise intelligent children," (p. 79).

In 1986 Gough and Tunmer first referred to reading difficulties which are more general in nature as "garden variety reading disability." They identified as dyslexic those children who had a "deficiency in reading alongside normal or superior achievement in other areas," (p. 8). They used the term "hyperlexia" to refer to those children who, in spite of superior skill in decoding, demonstrated average or below average comprehension of texts. Children with the inability to acquire decoding skill as well as the inability to comprehend were said to be "garden variety" poor readers. These are the children whose

difficulties in acquiring beginning reading skills are rooted in any number of extrinsic factors, physical and educational deprivation to mention only two.

Stanovich (1988) made a case for adopting a model which "distinguishes dyslexics by considering an arbitrary cut-off point in phonological-core variable. [The model] posits that all poor readers have a phonological deficit, but that other processing deficits emerge as one drifts in the multidimensional space from 'pure' dyslexics toward garden-variety poor readers," (p. 601). Behaviourists had viewed dyslexia as an exceptional condition beyond the realm of normal development but cognitive psychologists redefined it as an extreme condition within developmental boundaries.

With the advent of neuroscience, research into the causes of dyslexia was no longer limited to behavioural observations. Siegel's 1989 research findings put the discrepancy theory to rest; he found commonality of phonological deficit in the reading disabled, irrespective of IQ. Dyslexia is now viewed as an extreme condition on the continuum of reading development, its single most common characteristic, a phonological coding deficit or, as Samuels and Miller (1985) phrased it, "the absence of automaticity in decoding," (cited in Das, Kirby and Naglieri, 1994, p. 158).

Investigations into the links between cognitive dysfunction and reading disability continue, with most recent contributions coming from the field of neuroscience where brain-imaging techniques allow researchers simultaneous study of cognitive concepts and brain function. "During scanning blood flow is made visible by means of a radioactive tracer. Blood flow indirectly measures increases in neural activity at particular locations in the brain," (Frith, 1997, p.12). Consensus now exists that dyslexia is a lifelong developmental disorder, biological in origin. "There is some evidence for a brain basis, although . . . . the work is only just beginning. There may be many different kinds of genes and different kinds of brain conditions interacting with environmental influences that are ultimately responsible for dyslexia," (Frith, 1997, p.17).

3.5 Phonological Processing and the Acquisition of Reading Skills

Evidence for phonological ability as the single most specific mechanism in the acquisition of early reading ability abounds (Bradley and Bryant, 1978, 1983 1985; Perfetti, Beck and Hughes, 1981; Wagner and Torgesen, 1987). Citing seventeen studies on the acquisition of beginning reading skills, Stanovich (1992) states that the "...variation in phonological processing ability is the primary specific mechanism that determines early reading success. Although general indicators of cognitive functioning such as intelligence, vocabulary, and listening comprehension all predict the ease of initial reading acquisition, phonological abilities stand out as the most potent predictor," (p. 316). The central goal of reading--the acquisition of meaning--relies on phonological abilities. "The comprehension failures of poor readers are derived from their limitations in phonological processing," (Shankweiler, Crain, Brady and Marcuso, 1992, p.280).

"Phonological abilities" is an umbrella term for a range of processes which include phonological awareness, phonological memory, and rate of access for phonological information. "Phonological awareness is generally defined as one's sensitivity to, or explicit awareness of, the phonological structure of the words in one's language. It is measured by tasks that require children to identify, isolate, or blend the individual phonemes in words," (Torgesen, Wagner, and Rashotte, 1994, p.276). It begins with the phonological awareness of early language acquisition which becomes more complex and extensive when children learn to read. It is essential to, but not sufficient for reading.

Phonological memory refers to the ability to hold verbal information in working memory. Deficits in phonological memory characterise poor readers. "Typically, they retain fewer items from a set of fixed size than age-matched good readers," (Liberman and Shankweiler, 1985, p. 9). The problem is specific to phonology and language; when testing tasks involve nonsense shapes or unfamiliar faces, performance among good and poor readers is much the same (Katz, Shankweiler and Liberman, 1981). Brady, Mann and Schmidt (1987) found that "examination of the nature of errors on verbal memory tasks revealed that both good and poor readers use phonetic coding in preference to some other strategy, but poor readers do so less accurately," (cited in Shankweiler, p. 279). Torgesen, Wagner and Rashotte (1994) found that "the representations, or codes, used to store verbal material (such as digits, letters, words, or pronounceable non-words) on memory span tasks requiring immediate, verbatim, and ordered recall are composed primarily of the phonological features of the stimuli. Difficulty with this type of task is one of the most frequently reported cognitive characteristics of children with severe reading disabilities," (p. 277).

Rate of access to phonological information is the third aspect of phonological awareness under discussion. Rapid automatic naming tasks, as used in this study, are the traditional measure of the ability to access phonological information stored in long-term memory. Decoding ability is related to the efficiency with which children are able to access phonological information. As mentioned earlier, phonological deficit impacts on reading comprehension since an overload at a lower level of processing, phonological coding, interferes with the higher level cognitive demands of comprehension. Longitudinal research by Torgesen, Wagner and Rashotte (1994) tracked the development of phonological awareness, phonological coding in working memory and the retrieval of phonological codes from long-term storage by following a group of children through their first three years of formal schooling. They concluded that individual differences in phonological processing abilities are remarkably stable. As these processes are difficult to alter, it follows that remediation programmes must involve children in developing their own strategies for acquiring phonological skills and for the transfer of those skills to reading tasks.

The inability to apply alphabetic strategy, then, is a defining characteristic of dyslexics. "Most dyslexics are assumed to show a breakdown in the phonological coding route. They use direct visual access. As they advance through elementary school, word reading becomes increasingly dependent on the meaning of the word and the context in which it appears. Even when they have become adults, they make many mistakes in recognising

words, especially when nonwords such as plit, culk, bipe, etc., are given for reading," (Das, Naglieri and Kirby, 1994, p. 135). "A failure to acquire the alphabetic strategy would manifest itself as problems in using a grapheme-phoneme translation strategy, and thus would give rise to poor reading of nonwords," (Frith, 1986, p. 75). Snowling and Stackhouse (1996) succinctly define dyslexia as a "phonological processing deficit," (p. 11).

Although dyslexia has been linked with cognitive dysfunctions related to phonological processing, a definitive explanation for its causes remains the focus of research in the field. Frith (1997) summarises the current situation:

> The precise nature of the phonological deficit remains tantalisingly elusive. One possibility is that a single component in the phonological system is faulty; another is that crucial connections between the various components do not work. The issue is even more complicated when we try to disentangle associated deficits in other brain functions. Thus a faulty pathway may affect different parts of the brain and may result in additional difficulties that may or may not influence language-related processes (p. 11).

3.6 The PREP and Current Practice

As the debate over distinctions between dyslexics and poor readers continues, new perspectives on reading have not yet completely impacted on the development of remediation programmes. Das, Naglieri and Kirby (1994) suggest that most remedial programmes are "not supported by either hard or consistent evidence in regard to their efficacy, and the majority of them are based on no theory at all or on poorly conceived theories," (p. 155).

As research findings have elucidated the causes for dyslexia new methods that result in children learning how to manipulate, segment and blend phonemes have been devised. The PASS Reading Enhancement Programme (PREP), is among the first of these remediation programmes to be based on a theoretical model. It has as its aim to improve the processing strategies needed to acquire phonological skills, without the direct teaching of splinter skills such as phoneme segmentation or blending that characterises other remediation programmes. As such, PREP addresses phonological processing deficits through promoting the application of tacitly acquired strategies to appropriate reading tasks.

Early studies of structure and control processes in coding in memory in the late 1960's had led to research on improving rehearsal. When it was found that rehearsal training did not lead to transfer, attention was then given to the development of programmes for teaching general learning skills. These provided a foundation for PREP (Das and Abbott, 1995). Das and his colleagues incorporated information-processing theory when they developed PREP and defined two goals for the programme: maximising transfer of learning through the teaching of global principles and promoting their application to academic tasks.

Feuerstein's work with disadvantaged children had resulted in the finding that intellectual performance could be enhanced through cognitive training, a further stimulus for the development of PREP. Vygotskian principles provided a third influence on PREP from the field of psychology--its spirit of teacher-child interaction is one that encourages the child to internalise what is learnt through the use of inner speech. A more complete discussion of the PREP follows in a later chapter, Chapter 5.

3.7 Summary

Developments in the field of psychology and their impact on reading theory have radically changed educational perspectives on the reading process and on those who struggle to master it. New insights into the link between phonological processes and reading acquisition have led to the recognition of the need for remediation programmes based on theory and relevant to current developments in the reading field. The PREP is such a programme but before it is profiled, a study of its theoretical foundations in the PASS information-processing model is presented in Chapter 4.

Chapter Four
The PASS Information Processing Model: Functional Systems

4.1 Introduction

The PASS Information-Processing Model provided the theoretical foundations upon which this study was based. The model describes three functional units, each said to be responsible for certain cognitive functions. Its three functions are, briefly, Planning, Arousal/Attention, and Simultaneous and Successive processing. These are said to operate against the background of Knowledge Base. This chapter discusses the PASS model which provides the theoretical basis for the PASS Reading Enhancement Program used in this study.

4.2 Foundations in Luria's Work

The PASS information processing model, illustrated below in Figure 4-1, is based on A. R. Luria's neuropsychological view of intelligence, and is an acronym for the three units of the theory.

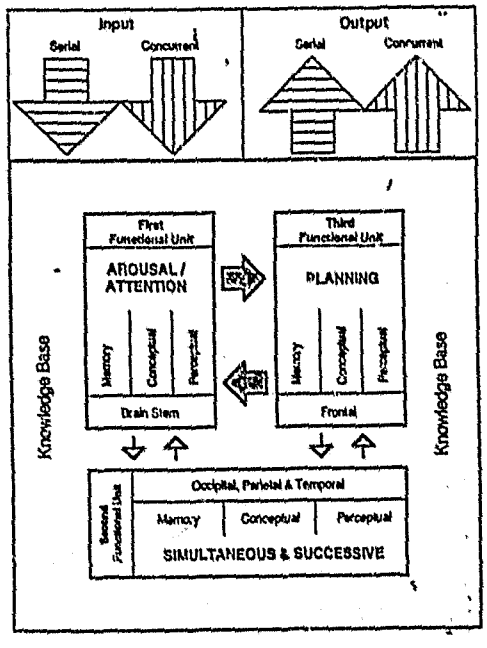


Figure 4-1: The PASS Model of Ability
from Das, Naglieri and Kirby, 1994
(Page 21)

Luria's 1973 examination of the mental abilities of brain-damaged patients and research on the cerebral bases of psychological processes led to the theory that the brain can be divided into three functional units, each characterised by specific cognitive activity. "These cognitive processes are complex functional systems localised in broad, functional areas of the brain, that take place through the interaction of brain structures working in concert," (Das, 1992, p.140). The PASS model focuses on the cognitive processing components themselves rather than on their specific location within the brain and includes knowledge base as the context within which these operations are performed.

Although this research specifically deals with one component of the PASS system, namely processing (successive) the three units are interactive in cognition and warrant description here. "The three functional units are dynamic in that they respond to the experiences of the individual, are subject to developmental changes, and form an interrelated system," (Das, Naglieri and Kirby, 1994, p.19).

The first unit, arousal/attention deals with tone or waking, the second unit is responsible for receiving, processing and storing information, and the third unit, planning, regulates mental activity. As illustrated in Figure 4-1 the three functions interact while maintaining their own distinct functions.

4.3 Arousal/Attention

Arousal encompasses the basic behaviours of the orienting reflex, the source of cortical tone and wakefulness. It is concerned with general levels of activity in both the body and the mind and, according to Luria, is influenced by metabolic processes, by the orienting response, and by internal sources of stimuli, the latter two being most directly related to attention. As a general rather than a specific state of alertness, arousal differs from, but is necessary for, attention; a certain degree of arousal is necessary for learning to take place. "Although it is not easy to separate arousal from attention, it is safe to say that arousal is subcortical whereas attention is also partly controlled by the cortex, especially by the frontal lobe," (Das, Naglieri and Kirby, 1994, p.33). In human beings, arousal manifests itself through attention.

Attention is more specific than arousal and implies selectivity and directedness. It is said to be sustained or selective and, in the latter case, divided or focused. In instances of divided attention, the individual simultaneously attends to two or more sources of information. Focused attention sees the individual attending to a single source of information, to the exclusion of all others. Attention, as the act of directing one's responses to a stimulus through the exclusion of other competing stimuli, is fundamental to the other functional units of coding and planning. ". . .attention interacts with learning and memory, which are included in coding, in the acquisition of information, its analyses, syntheses, storage and retrieval," (Das, 1988a, p. 42). "Attention, through its relation to

learning and problem solving, becomes an essential component of human behaviour," (Das, Naglieri and Kirby, 1994, p.51).

4.4 Processing

The information received from the environment is analysed and coded through the processing unit, regardless of the content or modality of the sensory input. Das, Naglieri, and Kirby (1994) identify level, content and type of coding as being relevant to an understanding of how children think and learn.

4.4.1 Levels of Coding

Tasks require different levels of coding, depending on their complexity. Lower levels of coding can be automatic but as the levels become more complex, more organisation is required and a greater store of information can be represented by a single code. In an example related to reading, Kirby (1988) identified letter features as the lowest level of coding, followed in the hierarchy by letters, syllables, words and phrases, on into comprehension of abstract concepts which require high levels of analysis and coding.

4.4.2 Code Content

Content is relevant with regard to coding but Das, Naglieri, and Kirby (1994) warn against oversimplification of code content into a "left brain/right brain" view of verbal and non-verbal abilities. Code content most relevant to school experience is verbal and/or spatial;
it is the underlying processing of the information, however, rather than the content, that needs to be analysed in ascertaining the source of learning problems.

4.4.3 Type of Coding: Simultaneous and Successive Processes

The PASS model identifies two major types of coding, simultaneous and successive. Simultaneous processing is illustrated in Figure 4-2 below.

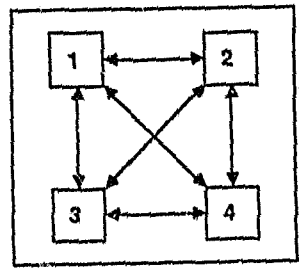


Figure 4-2 :Simultaneous Processing
From Das, Naglieri and Kirby, 1994
(Page 16)

Simultaneous processing is applied to stimuli that can be grouped and provides the basis upon which we perceive relationship systems. As the stimuli must be interrelated for simultaneous processing, they are said to be "surveyable," that is, they can be studied either through direct examination of the stimuli or through recall. "In order for the human organism to grasp systems of relationships, it is necessary that the components of the system be represented simultaneously. In this fashion, the relationships among components can be explored and determined. Luria notes that the use of spatial presentation of the components is an aid in this process for when a unitary representation of components is formed, the system is readily surveyable," (Das, 1988a, p. 41).

The relationship among the units of information is recognisable, because it already exists in the long-term memory of the individual or because a basis for discovering the relatedness of the information exists. The coding of this information becomes a single unit for use in working memory. Sequencing is irrelevant as simultaneous processing focuses on forming links among items of information, regardless of their temporal order. Some of the original pieces of information may be lost, if superfluous to the eventual coding, once the simultaneous coding has taken place Classification of items into groups is an example of simultaneous processing. Another, related to reading, would be the integration of a set of individual letters into a single word; at a higher level, it would be the recognition that several subtopics in a paragraph were all related to a single, main idea.

Successive processing is the other major coding unit in the PASS model and is illustrated in Figure 4-3 below.

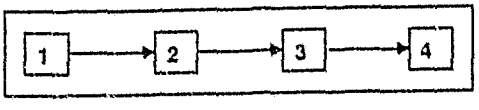


Figure 4-3: Successive Processing
from Das, Naglieri and Kirby, 1994
(Page 16)

Successive processing relies on the sequencing of the incoming information as the only basis for the relationship of the information. As such, it is without surveyability, and so is distinct from simultaneous processing. Initially, the successive code occupies as much space in working memory as there are units within the code, but practice reduces the load on working memory; the first link in the chain of information then serves as a cue to those that follow. As the sequence becomes automatic, it requires less space. The

those that follow. As the sequence becomes automatic, it requires less space. The sequencing of the information is critical. Successive processing is involved, for example, in remembering telephone numbers, in spelling, and in word analysis. Luria identified human speech as an example of complex successive processing whereby sequential grammatical structures require successive synthesis (Das, 1992).

Das, Naglieri and Kirby view simultaneous and successive processing as complementary; "the units that are part of a successive code are themselves simultaneous codes at a lower level, and the successively coded units are the basis for the next higher level of simultaneous coding. Neither type of coding is in this sense superior to the other, as both are required at various levels," (Das, Naglieri and Kirby, 1994, p.59). Kirby characterised processing in reading as an increasingly complex task which can be delineated into eight levels (1988). Figure 4-4 shows how both simultaneous and successive processing are needed at every level of reading.

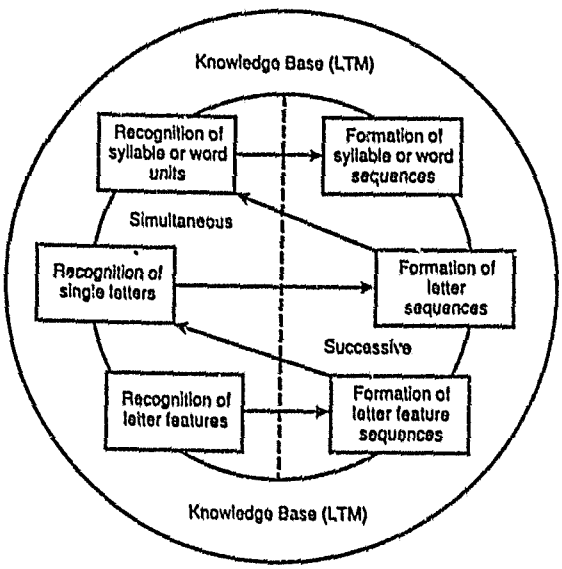


Figure 4-4: Cyclical Hierarchy in Reading
from Das, Naglieri and Kirby, 1994 (page 60)

"The reading process may begin with the encoding of a number of primitive units (e.g. letter features), which are held in some sort of order (successive coding) so that relationships among them may be recognised and encoded (simultaneous processing); these newly encoded units (letters) can also be held in order (successive processing) so that higher level units (words) can be encoded (simultaneous processing) and so on," (Das, Mensinck and Mishra, 1990, pp. 425-6). As is discussed later, successive processing has consistently been shown to have the greatest correlation with reading at the word level.

Das, Naglieri and Kirby emphasise that coding is neither an ability, a strategy nor a style but that all three are aspects of the process (1994). Ability is competency with a task and involves both knowledge and skill. One needs knowledge of a particular category, for instance, in order to apply it to a group of objects. Skill has to do with the application of that knowledge, for example, facility in remembering a sequence of numbers based on number patterns. Strategy, on the other hand, relates to choice of coding, i.e., which type of coding is to be applied to incoming information. It too has both knowledge and skill aspects: an individual must be aware of a particular strategy for remembering the incoming information and can have varying degrees of skill in its application. Style refers to habit, individual preference for one type of coding over the other, determined by genetic as well as socio-cultural factors.

"To the extent that individuals vary in their facility in using the two types of processing, in required knowledge, and in willingness to employ certain strategies, it may be possible to characterize some students as preferring simultaneous processes and others as preferring successive processes, though the status of such a characterisation is unclear," (Das, Naglieri and Kirby, 1994, p.63). Both types of coding are reliant upon the two other aspects of the PASS model, attention and planning.

4.5 Early Studies: Successive Processing

As information-processing theory took hold in the field of psychology, cognitive psychologists devised methods of investigating information processing. The shift in emphasis from content to process provided the foundation for a challenge to traditional learning theory. Research on simultaneous and successive processing provides the greatest part of the support for the PASS model and for the PREP, and is reviewed here.

4.5.1 Pask and Scott, 1972

As early as 1972, Pask and Scott classified the presentation of new material to students as being either "serial" or "holistic." In their study, subjects were classified as having one or the other preference for learning before being presented with new material in ways that were either mostly serial or mostly holistic. When there was a match between learning style and method of presentation, subjects demonstrated mastery close to 100%. Students whose processing preference did not match the method of presentation produced much lower performance scores (Pask and Scott, 1972). Further research was obviously needed to delineate the extent of the impact of processing preference on learning.

4.5.2 Krywaniuk, 1974; Krywaniuk and Das, 1976

These studies trained processing tasks that were primarily successive in nature (Krywaniuk, 1974; Krywaniuk and Das, 1976). Both studies used eleven training tasks that were unrelated to any academic subject areas. Tasks included sequence story boards (arranging twelve pictures in sequence to tell a story), parquetry boards (using shapes to

matrices (recalling numbers within a matrix) and five filmstrips which trained visual discrimination, spatial orientation, visual-motor co-ordination, visual memory, figure ground discrimination and visualisation.

The tasks were administered to eighteen poor readers in Grades 3 and 4 on a Canadian Indian Reservation during fifteen hours of training. The control group numbered twenty in each study and received three hours of training. The encouragement of children to verbalise the strategies they applied to the training tasks was an important feature of the training.

A comparison of post-testing results for the two groups showed significantly improved performance on two successive processing tasks (serial learning and visual short term memory) as well as on the Schonell Word Recognition Test. "The results of the study indicated that both near transfer to other non-taught examples of successive processing and far transfer to word recognition had been produced. In comparison to other studies claiming transfer the results obtained by Krywaniuk represented strong examples of transfer," (Crawford and Das, 1992, p.82).

4.5.3 Kaufman and Kaufman, 1979

Kaufman and Kaufman hypothesised that non-academic tasks and special instructional procedures could be used to enhance problem-solving and therefore to improve successive processing. In their study a group of thirty-four readers, half of whom demonstrated above average reading ability and the other half, below average ability, were randomly assigned to two groups. Although some simultaneous tasks were included the intervention was predominantly in the area of successive processing.

The training consisted of ten hours of individual training to members of the experimental group. The training was free of reading content and took the form of nine tasks and seven filmstrips used to train the experimental group. These included five visual training filmstrips from the Krywaniuk studies as well as People Puzzle (building faces), Matrix Letters (remembering letters in a top to bottom and left to right sequence), Serial Recall (increasingly longer sequences of pictures), Free Recall (pictures to be remembered in any order), Follow the Arrow (matching pictures with arrows to depict a string of events) and Numbers and Pictures (recalling numbers/pictures as in Krywaniuk's Matrix Serialization).

There was significant improvement when comparisons between pre- and post tests were made. The authors allowed that this could be due to maturation or to practice effect but found that "there was a significant experimental/control x pretest/postest interaction on every test, with the exception of Raven's Coloured Progressive Matrices. This would indicate that while some pretest/posttest improvement may have been attributed to maturation and/or practice effect, a major portion of the improvement was attributed to experimental intervention," (Kaufman and Kaufman, 1979, p. 418).

A finding which was to have influence on further research was the result that training in successive skills had transferred to the domain of reading in the form of enhanced word

attack skills as reflected by gains on the Schonell Graded Word List. The link between "a consistent left-to-right search pattern followed by successive phonetic recall in blending," (Kaufman and Kaufman, 1979, p. 418) was to be a foundation in many of the studies of phonological awareness discussed in Chapter 2. The study also highlighted the need for further research into simultaneous processing since the procedures using non-academic tasks were shown to improve academic performance in word recognition and in mathematics through enhanced simultaneous processing.

4.6 Studies Including Simultaneous Processing

4.6.1 Brailsford, 1981; Brailsford, Snart and Das, 1984

Studies were therefore extended to include investigation into simultaneous processing as well (Brailsford, 1981a; Brailsford, Snart and Das, 1984). In these studies, experimental and control groups numbered twenty-two each. Training was completed individually and was fifteen hours in duration. Pre-intervention and testing procedures included a battery of measures of successive as well as simultaneous processing and the Gates-MacGinitie reading comprehension subtest.

The training involved twelve simultaneous processing tasks as well as six successive processing strategy tasks including Matrix Letters and Numbers, Picture Story Sequencing, Serial Recall and Associated Pairing. Two tracking tasks and Joining Shapes were also included. As in the earlier studies, training tasks were free of reading content and subjects were encouraged to verbalise the strategies they used to complete the tasks.

The 1974 Krywaniuk study and the 1978 Kaufman study had led to the expectation that the experimental group would outperform the control group on the tests of cognitive synthesis. Post-testing showed that "the experimental group scores indicated significantly greater improvement than the control group scores on four of the cognitive tests," (Brailsford, Snart and Das, 1984, p. 289). A comparison of posttest scores on the Gates-MacGinitie comprehension subtest showed no significant interaction; the authors suggested that this could have been due to the multiple-choice design of the test. The Standard Reading Inventory, which requires the child to participate actively in the testing, was then used and results were compared; the experimental group achieved significantly higher results. It was suggested that "the remediation program taught the child to use active strategies for the organization, coding, memorization and retrieval of information and that these cognitive strategies are necessary in the reconstruction of meaning from print" (Brailsford, Snart and Das, 1984, p. 290).

4.6.2 Naglieri and Das, 1987

The Naglieri and Das study then explored differences in simultaneous and successive processing across age ranges, administering six different processing tasks to children in grades two, six and ten. The simultaneous processing tasks were figure recognition (drawing a figure on a figure amidst geometric patterns), tokens (positioning tokens into a pattern), and matrices (identifying figures to complete a matrix). The successive

(drawing a figure on a figure amidst geometric patterns), tokens (positioning tokens into a pattern), and matrices (identifying figures to complete a matrix). The successive processing tasks were word recall (repeating a list of words), successive ordering (retelling an event in the correct sequence) and hand gestures (repeating a series of hand movements).

Results indicated that children's performance in both types of processing improves with age, evidence cited by the authors of construct validity. Results indicated that coding was more important to reading at the grade two level than was a combination of coding and planning. "The increased correlation between simultaneous processing and reading is consistent with findings [which] suggested that simultaneous coding may be more important at advanced stages of reading when decoding, which involves successive processing, is mastered," (Naglieri and Das, 1987, p. 359).

The studies thus far cited all demonstrated near transfer to measures of successive processing as well as far transfer to reading. "Unlike many studies of transfer, the near transfer tasks are clearly different from the training tasks. Far transfer tasks require the application of strategies, learned in context-free tasks, to context-specific tasks of reading and mathematics, a far more substantial degree of transfer than has been demonstrated in other cognitive training programmes. In addition, the studies have demonstrated the viability of teaching context-free processing strategies to low achievers and the reading disabled," (Das Naglieri and Kirby, 1994, p. 176).

4.7 Planning

Luria (1973) provided neurophysiological evidence for planning with his research on the role of the frontal lobes. The most complex of the three functional units, planning accounts for organising, regulating and verifying activity and is a uniquely human function. Planning can be considered separate from attention and processing because of the role played by metacognition, the individual's knowledge of cognitive processes. Planning entails an awareness of task demands, consideration of potential strategies, assessment of feedback, and decision-making about the application of new strategies.

The planning function is closely linked to inner speech which is the means used by the individual to analyse situations and to regulate behaviour. "It is on the basis of speech that complex processes of regulation of one's own actions are formed. This complex form of brain activity that is consciousness entails the analysis of incoming information, the evaluation and selection of its significant elements, the use of memory traces, control over the course of goal activity, and, finally, the evaluation of the consequences of its own activity," (Das, Naglieri and Kirby, 1994, pp.77-8). Das suggests that planning is "the essence of human intelligence as it involves the aptitude for asking new questions, solving problems, and self-monitoring as well as the application of information coding processes," (Das, Naglieri and Kirby, 1994, p. 17).

knowledge base. An example of the interrelatedness of the three units is the need for appropriate levels of arousal and attention for planning to take place, as well as the coding of information that is relevant to the planning task.

4.8 Memory and the Role of Knowledge Base

Coded information is stored in memory; that which is current and limited to no more than seven codes, in working memory, and that which is permanent, in long-term memory. Working memory is temporary and relies on automaticity since the more information that can be recognised and coded as a single unit, the greater the capacity of working memory. Long-term memory is that which constitutes knowledge base, the context in which incoming information is analysed. As incoming information is received through the processing system, it is "combined with prior knowledge in the knowledge base, changed according to prior knowledge and to the operating plan and stored for later use," (Das, Naglieri and Kirby, 1994, p. 19). Knowledge base exerts influence on attention/arousal, on the coding of information, and on planning behaviour. It encompasses all that has been learnt by the individual, whether through formal instruction or through experience. The extent of knowledge base can limit or enhance the coding of incoming information; its role is fundamental in the information-processing model. The three functions then operate within the context of knowledge base which "includes everything the individual has learned--values as well as facts that have been organized by the concepts, images or relations that have been acquired," (Das, Naglieri and Kirby, 1994, p. 81).

4.9 Summary

PREP is the PASS operationalised. It is based on the PASS theory outlined in this chapter and its purpose is to improve the information-processing strategies which underlie reading ability. Its principles are discussed and its format described in Chapter 5 which also reviews support for both the PASS and the PREP, in the form of processing studies.

Chapter Five
Principles and Nature of PREP

5.1 Introduction

The purpose of this chapter is to describe the PASS Reading Enhancement Programme (PREP) as an alternative to traditional remediation programmes. The PREP avoids the direct teaching of word reading skills, in contrast to traditional programmes which, on the whole, offer children who have not benefited from mainstream teaching the opportunity to experience more of the same in different contexts. As an alternative to direct teaching, the PREP addresses the information processing strategies which underlie--and sometimes interfere with--reading.

This chapter, then, looks at the PREP as the PASS theory of intelligence operationalised. After a discussion of the need for new programmes and the basic principles underlying the PREP, it describes the PREP tasks in detail. Studies relating to the PREP are discussed before an overview of programmes for at risk readers is given.

5.2 The Need for New Programmes

Although it has been established that reading disability is rooted in a phonological processing deficit, traditional remediation programmes have long focused on using skills training to address the processing deficit, thus ignoring the earlier failures of direct teaching with reading disabled children. In their review of treatment programmes for dyslexic children, Lovett, Ransby, Hardwick, Johns and Donaldson (1989) found few studies with sufficient design to validate any specific form of remediation. Programmes based on traditional methodology have yet to show widespread efficacy with the reading disabled population. " . . .teachers are all too often being provided with an instructional procedure that directs them specifically not to trouble the child with details of how orthography works. The procedure encourages beginners to memorise the appearance of words as visual patterns by whatever means they can muster and to use the known words as a basis for guessing the rest of the message from picture cues and context," (Liberman and Shankweiler, 1991, p. 13 - 14).

For those who do not understand that language can be segmented, who do not discover for themselves that written symbols represent spoken words, reading training is insufficient. It follows that a remediation programme that offers training in the application of successive processing to phonemic principles would be of much greater benefit to children who do not automatically acquire the alphabetic principle. The PREP provides such training, with the goal of improving the information processing strategies that underlie reading.

5.3 Vygotskian Roots

With a primary aim of transfer of principles to academic tasks, the PREP reflects the Vygotskian concepts of internalisation and mediation. Internalisation refers to the learner's ability to transfer instruction from the external world to his or her own internal world. Whatever the input—from teacher, parent or peer, from books, tapes or visuals--the learner moves through the stages of familiarity, understanding and, eventually, "ownership" of the information, transforming external codes to internal ones. "Internal speech is an excellent example of the process of internalisation. It has its own code, it is a language system unique to an individual, and it is not isomorphic to external speech. The quality of internal speech--or, in common language, ideas—determines competence in thinking," (Das, Naglieri and Kirby, 1994, p. 162).

Mediation refers to the learner's sociocultural context. "Every function in the child's cultural development appears twice: first, on the social level, and later on, at the individual level; first between people, and then inside the child," (Vygotsky, 1978, p. 57). Mediation is "a special quality of mediated interaction between the child and the environmental stimuli. This quality is achieved by the interposition of an initiated and intentioned adult between the stimuli of the environment and the child," (Feuerstein, 1980).

Internalisation and mediation facilitate transfer and as such, are fundamental to PREP. As a child's competence with a particular task may not reflect his potential, the role of teacher as mediator is key to the success of the programme. "What children can do with assistance of others might be in some sense even more indicative of their mental development than what they can do alone," (Vygotsky, 1978, p. 85). The emphasis must be on instruction and mediation. "Instruction may take place in formal or informal settings; the mediators can be peers or adults. But the central point is that learned skills have a social origin and, even more broadly stated, cognitive processes have a sociohistorical origin, especially as these depend on a system of signs, which is commonly called language," (Das, Naglieri and Kirby, 1994, p. 161).

In the PREP, non-verbal global processing training opportunities are presented for learners who then interact with the materials, through the mediation of a teacher. The process encourages learners to acquire and to recognise processing strategies inductively. Learners internalise these strategies in their own way, using inner speech, transforming external information into internal codes. In the process, the original information is adapted to the unique cognitive needs of the learner, facilitating transfer to academic tasks. "This remediation programme provides 'bridges,' that is, training in strategies that have been shown to be relevant for the academic skills of reading and spelling. These two parts of PREP, global training and content-related training, encourage the application of the strategies to academic tasks through verbal mediation and internalisation processes," (Das and Abbot, 1995, p.177).

5.4 Links between Processing Strategies and Reading Disability

It has been established that dyslexic children demonstrate a verbal deficit and that the deficit is specific rather than general. Children characterised as "learning disabled" may have average or above average ability with spoken language and listening comprehension but their specific difficulty is rooted in the inability to process information successively and to decode written information. Das, Bisanz and Mancini (1984) state that "Verbal deficits associated with reading disability are found in lexical access to phonology and semantics as well as in the knowledge of linguistic rules. But the deficits are not restricted to processing verbal material; they also appear in non-verbal tasks," (p. 552). The relationship between reading disability and information processing strategies has been investigated through a number of processing studies.

In contrast to direct teaching, PREP relies on induction for strategy acquisition, allowing learners to process and retain sequentially presented information in ways best suited to their own needs. As stated earlier, phonological processing is essential to, but not sufficient for, reading. As PREP offers training in successive processing and in the transfer of the principle to phonological processing, it is consistent with the theory that successive-processing relates to word level reading and that the automatisation of word level reading contributes to fluency (Kirby, 1991).

5.5 The PREP Described

In comparing the PREP to traditional remediation programmes that rely on direct teaching, Das, Naglieri and Kirby describe PREP materials as engaging and attractive to children. For most children, the approach and appearance of the materials are novel, making PREP a success in leading children "to applying appropriate successive and, to a lesser extent, simultaneous processing skills in word reading while their planning and attention improve." (Das, Naglieri and Kirby, 1994, p. 183).

5.5.1 Process Training

The PREP consists of ten tasks, each beginning with non-academic global processing training which uses familiar materials. The training is later bridged to an academic task. Although the processing demands of each task cannot be categorised as strictly successive or strictly simultaneous, the tasks are identified as involving primarily one or the other forms of processing. Six of these, then, are said to be successive in their training emphasis and four are said to be simultaneous. The six PREP tasks used in this study were those dealing with successive processing. Their descriptions follow, each task consisting of a global component followed by one which bridges the processing training to a reading task.

There are three levels of difficulty for each of the global and bridging tasks. Using the materials, and through the mediation of the instructor, learners infer that a strategy is effective when successful in a number of tasks requiring a common processing strategy.

There are three levels of difficulty for each of the global and bridging tasks. Using the materials, and through the mediation of the instructor, learners infer that a strategy is effective when successful in a number of tasks requiring a common processing strategy. These tasks can involve prediction, internal rehearsal, categorisation, sound and sound blending. Moving through the tasks, children learn how to apply these procedures, how to monitor their personal approaches to the tasks and, through discussion with the instructor, are encouraged to apply strategies to academic ones such as decoding unfamiliar words. Over the course of the programme, children develop awareness of strategies and of opportunities for their application.

5.5.2 Successive Processing Tasks

The six PREP tasks in which successive processing training predominates are:

Transportation Matrices

Global

Focus: Successive processing, visual scanning, sequential rehearsal, verbalisation, prediction, categorisation and discrimination

The child views a series of pictures of cars, motorbikes, buses, planes, and other forms of transport in a single line matrix divided into sections. The child sees the complete series and is then shown the pictures individually and in sequence from left to right. Given a collection of the same pictures, along with several foils, the child is asked to represent the original line of pictures.

There are three levels of difficulty which range from a series of four pictures up to a series of eight. In this task, as well as in all tasks throughout the PREP, the teacher provides feedback on performance and then elicits from the child a description of how the task was performed and what particular strategies were used. If the child has not successfully completed the task, it is presented again, with a prompt such as a reminder of strategies that can be used (e.g., rehearsal, sequencing, verbalisation, etc.). An alternate form is available for each task to assure that the child eventually completes it successfully.

Bridging

Focus: Successive processing, visual scanning, sequential rehearsal, sounding, sound blending, letter discrimination

The child views a series of letters, individually, on a card divided into single boxes to accommodate each of the letters, through a "window" in a card. Given a number of plastic letters, along with several foils, the child is asked to form and to read the word made by the letters. There are three levels of difficulty, each containing fifteen words at increasingly complex levels of phonemic difficulty.

Joining Shapes

Global
Focus: Successive processing, visual scanning, rehearsal, verbalisation, and working sequential memory for instructions

A series of triangles, squares and hexagons are presented, alternating with rows of circles, for the child to join with a marker, listening to verbal instructions from the teacher and following a set of rules which involve only moving diagonally and from left to right. There are three levels of difficulty, varying according to the number of instructions the child must follow.

Bridging
Focus: Successive processing, visual scanning, rehearsal, sound blending, prediction, working memory for letters

The child is asked to join up letters on a page from among displaced rows, joining the letters from the top row to the bottom row, in a diagonal direction from left to right and following a set of verbal instructions, in order to construct a word. The last letter of each word is the first letter of the following word. The child reads the words as they are found. There are three levels of difficulty, of increasing word length.

Window Sequencing

Global
Focus: successive processing, rehearsal, verbalisation, discrimination of colour and shape, attention to pattern

The child sees a series of different coloured and shaped chips which are shown one at a time through a small window, in a left to right progression. The child is then given chips of a similar shape and colour and asked to represent what was seen, verbalising the colour of the chips. The levels of difficulty move from sequences of the same colour but different shapes, to sequences of the same shape but of different colours, to sequences in which both colour and shape vary.

Bridging
Focus: Successive processing, verbalisation, rehearsal, sound-symbol, blending, and prediction

The child sees letters moving through the window and then says the word formed. The letters are presented singly or in vowel or consonant clusters. The levels become increasingly difficult in word length and phonemic complexity.

Number and Letter Matrices

Global
Focus: Successive processing, visual search patterns, verbalisation, rehearsal.

The child memorises a random selection of letters or numbers within a matrix of five divisions arranged in a crosslike formation. The model is removed and the child is given a blank matrix in which to write as the teacher points to each block in order. Prompts are available which allow the child to see each symbol individually in its position within the larger matrix.

Bridging
Focus: Successive and simultaneous processing

The matrix is the same as in the global task but the child needs to memorise the position and sequence of a series of words. There are ten series of words, the first five being at a reading level slightly lower than the second five. In each matrix, four of the words are semantically linked while the fifth is not. For the first series, the child simply recalls the words in the proper position and sequence. In the second series, the child recalls the four words which are related and explains why the fifth word does not belong to the group.

Connecting Letters

Global
Focus: Successive processing, visual tracking

The child is given a page with two columns of random letters connected by intertwining lines and asked to identify which letter on the right is connected to each letter on the left. Each page has five letters on each side. At the beginning level, each line is coloured differently to assist the child in scanning. The intermediate level uses solid black lines to connect the letters and the most difficult level uses solid black lines as well as distracter lines.

Bridging
Focus: Successive processing, visual scanning, sounds, sound blending

The bridging component is similar to the global with the addition of letters along each of the lines. Letters are presented individually on the lines or in clusters. The child is asked to read along the line to find the letters that form a word. All levels are colour coded and the degree of difficulty relies on the phonemic complexity of the words.

Related Memory

Global
Focus: Successive processing, visual scanning, making predictions

The child is given a series of animal pictures, the front halves drawn in a column of three on a page and the back of an animal drawn on a card. The child is asked to identify which of the animal fronts matches the back drawn on the card. He then moves the card to the page, to check his response, changing his prediction as needed. There are three levels of difficulty corresponding to the degrees of discrimination required. As with the other tasks, there is an alternative set of cards for each difficulty level.

Bridging
Focus: Successive processing, scanning alternatives, sounding, sound blending, discriminating letter sounds

The task is similar to the global with the child choosing from three alternative word beginnings to match with correct endings and then pronouncing the word. There are three levels of difficulty, growing in complexity with word length.

5.5.3 PREP and Reading Comprehension

As discussed earlier, decoding is only the first tier of the multi-layered reading process which results in comprehension of text. The PREP also includes four tasks specifically designed to promote strategies in simultaneous processing which have been shown to predict reading comprehension. Das, Naglieri and Kirby (1994) cite four studies (Das, Mensinck and Janzen, 1990; Das, Snart and Mulcahy, 1982; Kirby and Gordon, 1988; Naglieri and Das, 1988) to confirm "the importance of both simultaneous and successive processing, as well as planning in (reading) comprehension," (p. 73). In all the studies, measures of simultaneous processing with no reading components proved to be good predictors of reading comprehension achievement.

5.5.4 Simultaneous Processing Tasks

Although the simultaneous tasks were not used in this study, their descriptions are included here to illustrate the training of simultaneous processing and the inclusion of reading comprehension enhancement as an aim of the PREP.

Sentence Verification

Global
Focus: Simultaneous processing, attention to visual detail, visual discrimination, understanding semantic concepts and relationships, semantic discrimination, synthesising semantic information

The child is shown sets of photographs that are in groups of two, three, or four and thematically linked. A printed passage is provided for each set, to be read by the child. The task is to study the set of photographs and to select the one which best illustrates the passage. As in all PREP tasks, there are three levels of difficulty and an alternate form.

Bridging
Focus: Simultaneous processing, attention to visual detail, visual discrimination, understanding semantic concepts and relationships, semantic discrimination, synthesising semantic information

The global task is then reversed, with the child being presented with a single photograph and a set of paragraphs. The task is to select the passage which most accurately describes the photograph. There are three items for each session, the first including two passages, the second, three, and the third containing four passages.

Tracking

Global
Focus: Simultaneous processing, verbalisation of the stages of a task, organised visual scanning, use of visual clues and shape discrimination

The child is given a map of a village and tracking cards that show the outlines of the intersections in the village that lead to either a numbered house or a lettered tree. The child studies individual cards and the map and then uses the path illustrated on the card to find either a particular house or a tree on the map. The second phase of the task involves a similar procedure, using a different map.

Bridging
Focus: Simultaneous processing, verbalisation of the stages in the task, organised visual scanning, and use of visual cues

The child is shown a map of a large mall and encouraged to familiarise himself with landmarks He then reads a short passage from a card which presents a situation starting from a particular place, moving through two or more places in the mall. The child is asked to read the passage, to identify the places he needs to visit, and to plan the most efficient route that includes the requirements. Passages become increasingly complex in their requirements but the child is able to ask for assistance in the reading of the passages.

Shape Design

Global
Focus: Simultaneous processing, associative strategies, spatial relationships

The child is presented with a design composed of various rectangles, squares, circles and triangles, in an assortment of three colours. The stimulus card is shown for ten seconds and the child is asked to remember what is seen. There are then similar shapes in the three colours which the child arranges to reproduce the stimulus pattern. There are three levels of difficulty (varying in complexity from three shapes of different colours to six shapes of different sizes and colour) and six items at each level. An alternate form is available.

Bridging
Focus: Simultaneous processing, visualisation, spatial relationships

The child reads a description of how animals are arranged in relation to one another and is encouraged to visualise the scene. The reading card is then taken away and the child is asked to arrange plastic figures as described in the printed passage. There are three levels of difficulty (ranging from two to five animals in increasingly complex relationships to one another) and alternate sets for Levels 1 and 2.

Shapes and Objects

Global
Focus: Simultaneous processing, categorisation, classification, visual scanning

There are two levels of difficulty for this task, each with a separate activity. For Level 1, the child is presented with three abstract shapes and asked to classify fifteen line drawings of common objects according to their proximity to the abstract shape. At Level 2, twenty-four coloured chips are matched to one of four geometrical shapes illustrated on a card. This level is completed twice and timed. The second trial is provided so that the child has an opportunity to reflect on performance and to devise strategies for improvement.

Bridging
Focus: Simultaneous processing, categorisation, classification

The child is given sets of cards on which thematically-related phrases or sentences of increasing levels of difficulty are printed. The child is given a set of cards that include titles for the categories described along with one foil. The child is asked to read the phrases/sentences aloud and to sort them into categories, identifying the title that is a foil.

5.6 Processing Studies in Relation to PREP

This section deals with support for the PREP in the form of processing studies related to reading disability.

5.6.1 Effects of PREP in Improving Phonological Skills and Word Decoding

Although activities from PREP had been used in processing studies from 1976, the most extensive study using the complete form of PREP was completed by Carlson and Das in 1992 with underachieving children in Southern California, USA. PREP was used for four months with children with reading disabilities. These were then compared with children who had had similar reading profiles. Improvement was noted when comparing pre- and post-testing results and significant interaction effects were found. "That is, the treated children who received remediation gained almost one year in word-decoding ability within sixteen weeks of training. This was significantly more than the control group of reading-disabled children who were receiving the regular remedial instruction from their teachers," (Das and Abbott, 1995, p. 178).

The efficacy of the PREP in improving successive processing depends on the nature of the successive processing deficit. If readers' inability to read is simply due to a weakness in applying successive processing strategies when reading, training does not result in a significant difference between experimental and control groups. When reading disability is rooted in a successive processing deficit, reading improves in the experimental group.

The 1995 Das, Mishra and Pool study had as its purpose the demonstration of far transfer in the form of improvement in word decoding rather than in completion of the PREP training tasks. It involved the participation of fifty-one underachieving students in Grade 4, with children in the experimental group receiving small group instruction using the PREP twice weekly for fifteen sessions. The control group received regular classroom in-put. Here, too, children in the PREP group made gains in word attack skills and in word identification that were significantly greater than those made by children in the control group.

Follow-up studies were made with the same group of children, with those from the control group being given either the global or the bridging tasks from PREP for the same period of time as in the first phase of the study. Results indicated no significant gains in word attack skills nor in word identification for these groups; it can therefore be concluded that normal PREP training (which includes bridging and global components) is more effective than training in only one of the components.

These studies also addressed the issue of intervention-control often used in criticism of such studies. If the success of the remediation were more influenced by the fact that children were receiving attention through additional input than by the quality of the remediation, there would not have been a significant distinction between the groups that completed the global and the bridging tasks and those that completed either one or the other.

Also in 1995, Boden and Kirby used a version of PREP modified for children in Grades 5 and 6 to study the effects of successive processing training and phonological coding on a small group of children who had been identified as underachieving in reading. The PREP group received approximately fourteen hours of instruction while the control group received regular classroom input.

Successive skills did not show a significant improvement in the experimental group when compared with the control. The ANCOVAs showed significant difference only on word level reading. This "is consistent with the hypothesis that these poor readers do not have a major successive processing deficit per se, but rather a difficulty in applying their successive processing skills to reading," (Boden and Kirby, 1995, p. 27). Although the study involved a small sample, the results indicate that PREP is also successful as a means of intervention with poor readers who have difficulty in applying ·· ·sive processes to reading.

5.6.2 Effects of PREP on Learners with Special Educational Needs

In 1996 Carlson and Das used a small group version of the PREP with 135 underachieving Grade 3 students. Sessions were twice weekly, for fifty minutes in duration and lasted for three months. The PREP group and the control group continued to participate in a government-funded reading remediation programme for socially disadvantaged children at the same time. Those children who participated in the PREP made significant gains in word attack skills and in word identification. "The results showed significant improvement following training in PREP, as well as significant Group x Time interaction effects," (Das, Parrila, Kendrick & Kirby, 1997, p. 10). Replication studies were then completed in the same school district, reproducing the original results with children from Grades 3, 4, 5, and 6, and with both bilingual (Spanish-English) and monolingual (English) children (Carlson, 1996).

Das, Parrila, Kendrick and Kirby (1996). used the PREP in an early intervention programme for at-risk students. Fifty-eight Grade 1 children were divided into two groups, each participating in one of two remediation programmes, twice a week for twenty minutes over a nine week period. One group worked in PREP while the other received "meaning-based reading intervention." The Woodcock Tests of Reading Mastery - Revised subtests, *Word Attack* and *Word Identification* were used for pre- and post-testing. "Separate independent samples t tests showed that the pre-test scores did not differ significantly for either measure, whereas the post-t·· scores for *Word Attack* were significantly different," (Das, Parrila, Kendrick and Kirby, 1997, p. 20). In the experimental group, gains in word attack skills were approximately double to those made by the meaning-based group. Gains in word identification were more limited for both groups but slightly greater for those in the PREP group.

5.7 Remediation Programmes for At-Risk Children

The studies discussed in this chapter profile the development of information-processing theory in relation to reading disability and give evidence for the effectiveness of a remedial programme based on its principles. There is an abundance of research on the positive effects of phonological awareness training programmes on the acquisition of beginning reading skills, as described in Chapter 3. The vast majority of these studies, however, have dealt with improving reading programmes for mainstream children. The research on programmes that have been used with at-risk children has not been extensive. Some of these are described here.

Mantzicopoulos, Morrison, Stone, and Setrakian, (1992) used a screening instrument, SEARCH, to identify two experimental groups and a control, and the Kaufman Assessment Battery for Children to identify cognitive matches. Children in the experimental groups were divided into moderately and severely at-risk groups. Intervention involved one-to-one teaching using a perceptual remediation programme, TEACH, and a phonic tutoring programme for a total of twenty-five hours per child. Results reflected improvements in the moderately at-risk group on Word Attack and minimal changes for the severely at-risk group.

A computer-assisted learning programme (Barker and Torgesen, 1995) involved the random assignment of fifty-four at-risk Grade 1 students to one of three groups: computerised phonological awareness training, computerised training in alphabetic decoding, and a control group whose time was divided among several computer programmes in basic maths. Training was for eight hours and results reflected significant improvements on three of the four measures of phonological awareness for the group involved in phonological training. There was no significant difference in the fourth task, phoneme blending, an indication that the programme is successful at the very beginning stages of phonological awareness (sound acquisition) but inconclusive as regards its application to more complex reading tasks such as decoding unfamiliar, phonetically regular words.

The Hurford, Johnston, Nepote, Hampton, Moore, Neal, Mueller, McGeorge, Huff, Awad, Tatro, Julianoo and Huffman study (1994) involved a total of ninety-nine Grade 1 children identified as being at-risk for reading disability. The experimental groups received ten to thirteen hours of training in phonemic discrimination, blending and segmentation, with results reflecting improved performance in these three skill areas for the experimental group. As in the previous study, however, there was no indication of significant gains in word attack skills.

In a 1994 follow-up study to an earlier study of disadvantaged (as opposed to at-risk) children, Blachman selected those Grade 1 children from the initial study whose cognitive profiles put them at risk for beginning reading. The intervention programme was based on developing phonological awareness skills and lasted for the entire Grade 1 year. Results indicated significant improvements in phoneme awareness, sound-symbol knowledge, word recognition and spelling. "In addition, fewer treatment children were

recommended for retention in first grade and fewer treatment children were referred for remedial reading instruction from Chapter 1 reading teachers," (Blachman, 1994, p. 289).

Of the studies discussed, only the Blachman (1994) study reflects significant maintainable gains for children who are genuinely at risk for early reading failure. It should be noted that the Blachman study involved intervention of a year's length and adoption of such a programme would represent a costly investment. The study that follows deals with a much smaller sample and the intervention is considerably shorter in duration. Its purpose is to demonstrate the efficacy of PREP in addressing the needs of children genuinely at risk for accessing and maintaining beginning reading skills. Its use is compared with that of a meaning-based programme, as described in the next chapter.

5.8 Summary

This chapter described the need for remediation programmes which address underlying cognitive dysfunctions as an alternative to traditional remediation programmes which involve direct teaching. The individual tasks of the PREP were described in some detail, as well as studies that supported its development. An overview of other programmes available for at-risk readers was also given.

Chapter Six
A Remedial Programme Based on Whole Language

6.1 Introduction

This chapter describes the theory underlying whole language teaching, the development of the Whole Language Movement, and the prospects of its methodology for at-risk children. The programme based on Whole Language principles which was used in this study is then discussed, as well as reasons for the selection of children for the programme.

6.2 Theoretical Foundations

Prior to the dawn of psycholinguistics, the teaching of reading was based on the belief that children learned language in a hierarchical fashion and that language learning could be delineated into orderly, skills-based curricula. Chomsky's research into early language acquisition challenged these beliefs. His argument that language is innate and therefore inevitable for children had widespread influence in the fields of psycholinguistics and education. This ultimately resulted in what came to be known as the Whole Language philosophy.

Chomsky's work had particular impact on the thinking of the American psycholinguist Kenneth Goodman who is referred to in the literature as a "founding father" and leading writer in the Whole Language movement (Liberman and Liberman, 1990, p. 52). When he studied children's reading miscues in the mid 1960s, his research led him to believe that children used context to find meaning and that reading miscues were not simply errors for correction but "windows on language processes at work," (Goodman, 1965, p. 643). Goodman believed that even before entering school children had expectations that print should make sense and that in all contact with print, the reader's singular aim is to find meaning, just as it is with the spoken word.

Goodman's miscue analysis studies provided the foundations for the theory that learning to read is as natural as learning to speak. "An array of methods are possible in a whole language classroom and consistent with whole language philosophy, with all such methods promoting natural learning. Natural learning, according to whole language enthusiasts, does not involve explicit decoding instruction, controlled vocabulary, or any form of decontextualized instruction," (Pressley and Rankin, 1994, p. 158). As the pyscholinguistic approach to reading took hold, educationists in America began to view with suspicion traditional reading programmes built upon skill hierarchies.

Frank Smith's influential work, *Understanding Reading* (1971), argued that reading required no unique abilities but was simply the result of the child's need to make sense of the kind of information commonly found in literate environments. He extended Chomsky's theory of natural language acquisition to the development of literacy skills that he saw as a natural consequence of immersion in a literate world. Smith influenced

reading teaching throughout America with his assertion that "the function of teachers is not so much to teach reading as to help children read," (Smith, 1971, p. 3). As the whole language philosophy began to prevail in American schools, its definition and applications provoked considerable debate among theorists and practitioners. Disagreement was such that some proponents viewed Whole Language as a methodology while others defined it as a philosophy. Proponents of teaching reading through phonics found fault with the fundamental assumption of Whole Language that direct teaching is unnecessary for the acquisition of literacy skills:

> We take it as given that in teaching children to read and write, our aim must be to transfer the wonders of phonology from speech to script. In our view, this can be done only if the child comes to understand the alphabetic principle, the insight that words are distinguished from each other by the phonological structure that the alphabet represents. Surely this is the principle that links the less natural mode of written communication to its natural, spoken base, and so makes available to the reader-writer the ready-made phonological system that gives to speech the incalculable advantages it enjoys, (Liberman and Liberman, 1990, p. 358).

In a 1991 retrospective of the debate, Froese summarised the confusion over the meaning of Whole Language: "The role of direct instruction is unclear; some advocate it, others discourage it. Some characterise it as a political activity: it shifts power away from the teacher toward the student. Still others believe that it means that all instruction should be individual rather than in small groups. And others have extended it to be inclusive of professional development, " (p.2).

Froese found consensus on three issues:

> First, it is agreed that language is a naturally developing human activity and, as a result it is a social phenomena used for communication purposes.
>
> Second, it is generally accepted that language learning and teaching must be personalised in order to respect the uniqueness and interest of the learner.
>
> Third, language learning is considered to be a part of making sense of the world; language need not be learned separately first. Language is learned holistically in context rather than in bits and pieces in isolation, (Froese, 1991, p.2).

The debate came to an end in the 1990s with renewed interest in Vygotsky's work on language. "With the renaissance of Vygotskian thinking, there is a growing evidentiary base substantiating the role of instructional scaffolding in the development of language competence. Even a number of scholars traditionally identified with psycholinguistics and language acquisition as specialities now recognise the explicit teachability of language," (Pressley and Rankin, 1994, p. 161). As direct teaching came to be recognised as an effective means of language development in the field of psycholinguistics, "Code Emphasis" --the teaching of phonics in beginning reading-- found its way back into the classrooms that had previously been described as Whole Language classrooms.

Citing evidence from research on the perceptual and neurolinguistic mechanisms for reading, Pressley and Rankin conclude that skilled reading and writing depend on instruction. "There is substantial contemporary evidence documenting the efficacy of explicit, systematic instruction of important reading skills--that is, support for practices explicitly inconsistent with Whole Language. Although Whole Language theorists may not agree, a strong case can be made on the basis of both theory and data that such instruction may be absolutely necessary for certain types of students to achieve in primary literacy," (1994, p. 161).

6.3 Whole Language and At-Risk Students

These "certain types" are the children who are at risk. Westby and Costlow (1991) described the prospects of whole language teaching for learning disabled children:

> Whole language methodology can provide language learning-disabled students with enriched language contexts, meaningful reasons for communicating, and contextual cues to support learning. Whole language philosophy, however, does not provide a simple answer to meeting the developmental needs of learning handicapped children. If language learning-disabled children learned language by the usual interactions in their environment, they would not be learning disabled, (p. 71).

Although spoken language is a natural ability as old as mankind, reading is not. The written form, a product of cultural rather than of biological evolution, manifests in numerous ways across cultures and almost always demands instruction in order to be read. Liberman and Liberman (1990) acknowledge that a large proportion of children are able to discover the alphabetic principle independent of adult instruction but rule out the possibility for at-risk children. "What they need to know, and what their experience with language has not taught them, is no more and no less than the alphabetic principle," (p. 361).

Weaver (1991) regretted the lack of formal research on the effects of whole language teaching on learning disabled students and relied on anecdotal evidence in suggesting that it had potential for work with students in specialised education programmes. In "Whole Language Reading Instruction for Students with Learning Disabilities: Caught in the Crossfire," Mather (1992) cited the failure of empirical research to support the tenet that whole language is the most certain route to reading achievement and argued for more explicit code-based instruction for at-risk children. Citing studies by Pennington, Groisser and Welsch (1993) and by Stanovich (1986), Pressley and Rankin state categorically that "the evidence is overwhelming that when children fail to develop phonemic awareness they are at long-term risk for reading failure," (1994, p. 160).

It is now recognised that all reading programmes need to incorporate instruction in phonemic awareness and that such a component is essential to programmes for at-risk children. As such, the Whole Language remediation programme used in this study incorporated phonemic awareness teaching. The phonics instruction in the remediation programme differs from the kind of phonics teaching that preceded the Whole Language movement. Pressley and Rankin summarise the impact of the Whole Language movement on the teaching of phonics: "When phonics instruction and instruction designed to stimulate phonemic awareness occurs in the 1990s, it is different because of whole language. In a positive sense, phonics instruction and letter-level training, even when it is extensive, systematic, and explicit, is now more likely to be integrated with reading of whole, authentic texts and student writing of texts, a component of meaningful, primary literacy instruction rather than being synonymous with primary reading instruction," (Pressley and Rankin, 1994, p.160.)

6.4 Whole Language Programme Described

Pressley and Rankin (1994) identified two characteristics essential to whole language teaching: the belief that learning to read is a natural process which does not necessitate direct instruction and that reading instruction should utilise real examples of language. The meaning-based remediation programme used in this study was therefore both child-centred and literature-based.

Children read stories from a variety of children's books from the writer's personal collection. In selecting books for the programme, priority was given to those that were rich in language. Children chose books for their own reading, and to read to one another. A primary teaching aim was to encourage the children to derive meaning from print through personal experiences with the stories. Children listened to stories read to them by the writer and by other children. Discussions focused on the events of the stories and how they related to the children's own experiences. The books and stories were also used as language models for the children to use in making their own books, both individually and in groups.

The phonemic component sprang from the stories read. When a particular sound or pattern recurred in a story, discussion would include the sound, along with games and activities to encourage the children to think of and to use words with similar sounds. Sentences were then constructed, using the language generated by the children. Typical of instruction in phonemic awareness in the 1990s, the teaching was done within a wider literary context, integrated with the language found in the stories and in the children's own retelling of stories read. As such, it could be characterised as Whole Language teaching.

6.5 Choice of Remedial Programme

This study used two remedial programmes, PREP for the experimental group and a programme based on Whole Language principles for the control group. The expectation was that children whose inability to access print was rooted in a cognitive processing deficit would best be served by participation in the PREP. A further expectation was that children who did not demonstrate a specific successive processing deficit but who still had not acquired beginning reading skills in the regular classroom reading programme would benefit from the Whole Language remediation programme. In an effort to match specific needs with suitable programmes, children with successive processing problems were identified using tests modelled on the Naglieri-Das Cognitive Assessment System subtests. This instrument is discussed in the chapter that follows.

6.6 Summary

This chapter gave an overview of the development of Whole Language theory and what came to be known as the "Whole Language Movement." It touched on the feasibility of using Whole Language programmes for children at risk in acquiring beginning reading skills and addressed the inclusion of the teaching of phonics in a Whole Language context. A description of the selection of children for the meaning-based programme used in this study concluded the chapter.

Chapter Seven
The Cognitive Assessment System

7.1 Introduction

The Naglieri-Das Cognitive Assessment System (CAS) is described here for two reasons. As the assessment instrument based on the PASS Theory of Intelligence, it represents a further extension of theory into practice. The intent to link theory to practice establishes the CAS as a "non-traditional" measure (Naglieri and Das, 1997, p.1), and reflects the changing view of assessment discussed in this chapter. The CAS is also described here because it provides the basis upon which tests of successive processing were modelled for this study. Its theoretical foundations are outlined and its usefulness in predicting reading achievement is discussed before samples of the tests used in this study are presented.

7.2 Changing View of Assessment

The tradition of focusing on learning abilities as being verbal and non-verbal and on modalities as being visual and auditory no longer suffices in the light of contemporary learning theory. As described in Chapter 4, the PASS model emphasises coding of input over the content and modality of that information. "Both simultaneous and successive processing may be applied to information that is verbal or spatial, episodic or semantic," (Das, Naglieri and Kirby, 1994, p.59). The CAS, based on the PASS, differs from most existing psychometric tests of intelligence in that it explores cognitive processes and identifies dysfunctions which interfere with learning. In addition to its contribution to a changing view of the assessment of intelligence, it casts a new light on measures of reading assessment. Word decoding problems may sometimes be attributed to instructional and motivational deficits, but "the major deficit seems to be an inefficiency in phonological decoding which itself can be related to a basic cognitive process," (Das, Mishra and Pool, 1995, p. 66).

As discussed in Chapter 3, the link between cognitive processes and the acquisition of beginning reading skills has been established. Reading practitioners now look to better ways of diagnosing the causes of reading disability, in order to provide better means of remediation. The cognitive measures used in this study were based on CAS subtests which link speech rate to reading proficiency. A profile of the research showing the parallels between the development of reading and that of speech rate follows.

7.3 Theoretical Foundations

7.3.1 Research into Memory and Recall

As early as 1967, researchers were investigating the link between reading ability and the retention of temporal sequences. In Temporal Order, Meaningfulness and Reading Ability, Bakker established that poorer readers made significantly more errors than better readers in remembering temporal sequences. In 1975 Baddely and Hitch introduced the concept of working memory with its three components: central executive, articulatory loop, and visuo-spatial scratchpad. Their description of the articulatory loop as a store for speech-based, phonological information gave impetus to further research into the role of inner speech in reading.

Baddely, Thomson and Buchanan (1975) found a "linear relationship between the number of words recalled in a serial recall task and the time taken to articulate those words," (Hulme, Tomson, Muir and Lawrencel, 1984, p. 250). In other words, the capacity of the articulatory loop is defined in terms of time--the number of items fitted on the loop depends on the time taken to articulate them. Vellutino (1978) suggested that "poor readers have difficulty on short-term memory tasks because they lack implicit coding devices which will facilitate efficient storage and retrieval of stimulus input," (p. 96).

Shankweiler, Liberman, Mark, Fowler and Fischer (1979) theorised that the extent to which children rely on speech-related processes in short-term memory impacts on reading ability. They studied the role of phonetic representation in linguistic storage and found that "good and poor readers differ in their use of phonetic coding in working memory, whatever the sensory route of access, and (the findings) suggest that individual variation in coding efficiency may be a relevant factor in learning to read," (p. 531). The suggestion that the memory-related problems of poor readers may reflect phonetic coding deficiencies led to further research into the relationship between phonological coding and short-term memory.

The relationship between word recall and speed of articulation suggested by Baddely et al (1975) had led to the assumption that speech rate could be used as an estimate of rehearsal time. Hulme et al (1984) investigated this assumption, studying the effects of word duration on memory span and found that "all subjects recall as much as they can say in a fixed time interval, which is roughly 1.5 seconds. Or put another way, the observed increases in memory span during development seem perfectly well explained in terms of a corresponding increase in speech rate. Speech rate might in the present context be viewed as a measure of the maximum rate of rehearsal of which an individual is capable," (Hulme et al, 1984, p. 251). They attributed the increase in speech rate during development to two factors: speed of articulation increases with age (as motor skills develop) and words in continuous speech are packed more closely together by older children.

7.3.2 Memory and the Alphabetic Principle

Research began to confirm that the development of reading runs parallel to the development of speech rate. An understanding of the function of the articulatory loop in short-term memory led to the assumption that an efficient verbal memory is needed in order to grasp the alphabetic principle essential to the acquisition of beginning reading skills. Further investigations supported this assumption. Shankweiler et al (1979) noted the consistent findings that working memory prefers phonetic coding of information for both listening and reading. Their own research explored the possibility that children who do not relate print to the phonology of the spoken word are those most likely to struggle with beginning reading. Their findings supported the hypothesis that "good and poor readers differ in their use of speech coding, whatever the route of access, and [suggested] that individual variation in coding efficiency places limits on reading acquisition," (p.541).

Liberman and Shankweiler (1991) noted that reading disability is due to material-specific problems with memory. "Memory difficulties arise where the items to be retained are words or nameable objects. When the test materials do not lend themselves to verbal encoding (as in memory for nonsense shapes or unfamiliar faces), the results of memory testing do not find poor readers at a disadvantage," (p. 9).

For children at risk for failure at beginning reading, the link to material-specific serial order was an important one. "Evidence from several laboratories finds that poor readers are inferior to their age-matched peers on memory tests that require them to retain the order of a series of words or objects that can be named (Shankweiler, Liberman, Mark, Fowler and Fischer, 1979; and Wagner and Torgesen, 1987)," (Shankweiler, Crain, Brady and Marcuso, 1992). The inability to hold sounds sequentially in memory is an obvious deterrent to an understanding of the phonological structure of language essential to the acquisition of beginning reading skills. Measures using serial order could therefore be used to identify those children most likely to be at risk for failure at beginning reading.

7.3.3 Naming Speed and Reading

Difficulty with naming and labelling has also been linked to early reading failure. Rapid word reading can be a measure of successive processing because words need to be decoded sequentially and with a degree of automaticity to maintain the rhythm necessary for adequate performance. Denckla and Rudel (1974) compared dyslexic, nondyslexic learning disabled, and a control group of children of average reading ability on rapid naming tasks. They found that "tests of rapid automatized naming of colors, objects, numbers and letters differentiate the dyslexic learning disabled from the non-dyslexic learning disabled child and not just dyslexic from normal readers," (p. 186). Naming errors were infrequent for all of the groups but the dyslexic group demonstrated significantly longer latencies on all tasks.

In a subsequent series of five experiments, Perfetti , Finger and Hogaboam (1978) found no differences between skilled and less able readers for naming colours, numbers and pictures but significant differences for naming words. They explained the contrast to the Denckla and Rudel study by acknowledging that although "there may be differences in general name retrieval processes between normal readers and the extreme dyslexic," (p. 738), the reading disability most often found in regular classrooms is linked to coding processes rather than name retrieval.

Stanovich (1981) conducted a similar study and found that "less skilled first grade readers do not appear to be characterised by a general deficit in their ability to rapidly retrieve the names of stimuli. Rather, they appear to be deficient in their word knowledge and their ability to rapidly decode words that are known," (p. 814). As no difference between the experimental and the control groups in letter naming was found, Stanovich's results supported findings of earlier studies that identified automaticity, coding and phonological analysis as fundamental to early reading.

Blachman (1984b) also incorporated naming time measures in research on language analysis tasks such as segmentation and rhyming and stated categorically that "rapid naming of words has been found to differentiate between good and poor readers, regardless of paradigm used," (p.612). Stanovich's landmark 1988 study which conceptualized the differences between dyslexic and garden-variety poor readers included an articulation speed test to differentiate the two groups. He hypothesized that " . . .articulation speed taps into the (phonological) module in a way that would make it act as a marker variable for phonological problems at deeper levels," (p.596).

Das and Siu (1989) used a naming time test in their investigation into the differences between good and less able readers' information processing. The naming time tasks included reading of one- two- and three-syllable words. "Overall, naming time was shorter for good readers in all three word categories than it was for poor readers," (p. 107). In addition, naming time for three syllable words was found to be a predictor of both visual and auditory memory span. Naming speed tests are now in common usage among psychologists, speech therapists, and reading teachers.

7.4 The CAS as Predictor of Reading Achievement

Traditional assessments " . . . provide limited information with regard to how the child is approaching reading or what may be the most effective instructional method to use with the child," (Lovett, Benson and Olds, 1990, p. 289). Traditional reading tests have not specifically and exclusively identified the deficit in phonological coding that characterises dyslexic children. As the purpose of this study included the identification of children with the phonological coding deficit so that appropriate remediation could be provided, specific screening measures were needed. The subtests of the CAS upon which the measures in this study were modelled were tests of successive processing based on the principles of speech rate and automaticity. They were chosen for their ability to

differentiate readers with successive processing deficits. "All the successive tests require the individual to deal with information that is presented in a specific order and for which the order drives the meaning," (Naglieri and Das, 1997, p. 23).

The two CAS subtests used as models in this study were *Word Series* and *Speech Rate* and are described in the final section of this chapter. The third test, *Naming Time*, is not included in the current edition of the CAS but was used in the study as a result of its inclusion in trial editions and in the work of other researchers discussed earlier in this chapter.

7.5 CAS Tests Described

7.5.1 *Word Series*

Digit Span, as used in the Weschler Intelligence Scale for Children - III, is perhaps the most well known measure of successive coding. The Word Series test is similar to Digit Span in design, the most important difference being the substitution of words for numbers. The list words are not related and follow no pattern, to ensure that the subject does not detect links that might allow for simultaneous processing. A series of single syllable words, taken from a word bank of eight, are repeated in lists that range from two to seven words, the only link between them being their order. The list words were all familiar nouns of one syllable. In choosing them, care was taken that they were easily pronounced, varied in sound, and did not rhyme.

Children were asked to listen to and repeat the word sequences that were read at the rate of one word per second. A practice trial was allowed. Scoring was either correct (the whole sequence) or incorrect. Testing was terminated after four consecutive errors. A copy of the words used in this study follows.

WORD SERIES - Instructions: "Listen to the words I am going to say; after I finish, say them in the same way, one after another, as I did."

1. sock egg	_____
2. ball key	_____
3. cat pin	_____
4. boy gate	_____
5. sock cat ball	_____
6. key boy cat	_____
7. ball key gate	_____
8. boy cat egg	_____
9. key sock boy ball	_____
10. egg gate sock pin	_____
11. sock ball egg boy	_____

12. ball pin cat gate _____
13. sock boy egg cat _____
14. egg ball gate key boy _____
15. sock cat boy gate egg _____
16. ball boy egg cat gate _____
17. boy pin egg ball gate _____
18. pin cat egg sock boy _____
19 sock pin boy egg cat ball _____
20.gate ball cat pin sock boy _____
21.egg sock ball boy cat gate _____
22.pin sock gate cat ball egg _____
23.boy egg sock ball cat gate pin _____
24.gate ball sock boy egg pin cat _____
25.pin cat gate ball sock egg boy _____
26.sock egg pin boy key ball cat _____

7.5.2 *Speech Rate*

This test required the child to repeat three single syllable words as many times as possible within ten seconds, then to repeat the task using two syllable words. The single syllable words were leaf, bus, egg and the two-syllable words were tiger, rocket, and monkey. Here, too, a practice trial was given. The score was the total number of correct repetitions within the time limit, for each of the two tasks.

7.5.3 Naming *Time*

This test required the child to read thirty unrelated basic sight words from left to right as quickly as possible. Children were instructed to attempt or skip unfamiliar words. A practice trial of five words was given. The score was the time needed to complete the task. A copy of the words used follows.

NAMING WORDS.

land	eye	wall	cow	bee
jar	food	doll	kite	fork
moon	boy	tree	key	hill
hen	salt	bus	house	lamp
two	she	wood	pig	cent
jet	man	cloth	pad	eat

7.6 Summary

The identification of children with specific learning disabilities is now known to be essential to providing appropriate remediation for children with reading disabilities. Traditional reading tests do not provide sufficient information about children's abilities to read nor do they address the cognitive processes underlying reading. The use of the CAS, based on theory and principles tested by a number of researchers over the years, gives practitioners the opportunity for greater understanding---and hence, enhancement---of children's reading abilities.

This chapter described the CAS tests related to this study, along with its theoretical foundations and its usefulness as a tool in predicting reading ability. The specific tests used in this study and modelled on CAS tests were then detailed.

Chapter Eight
The Study

8.1 Rationale

8.1.1 Introduction

The social and educational history of South Africa has led to a myriad of problems for school-age children in accessing basic literacy skills. Given the need to differentiate between children whose reading problems are specific and intrinsic and children whose problems are due to extrinsic factors, measures based on sound theoretical foundations are needed. Simple and reliable measures for identifying children with specific learning disabilities would mean that appropriate matches between children's learning needs and their remediation programmes could be made. The provision of these remediation programmes then lends meaning to the process of identification.

The purpose of this study was to address these issues, using the PASS Theory of Intelligence and its applications in a South African context. As the field of reading moves on from being the exclusive realm of educationists, it benefits from the work of cognitive psychologists and the resulting cognitive perspective on reading described in earlier chapters. These benefits can be realised when instruments rooted in cognitive theory are applied in the diagnosis of reading problems. Based on the PASS Theory of Intelligence described here, the Cognitive Assessment System provides such instruments.

The programmes which address the identified reading deficits must also be based on sound theoretical principles. The two programmes described for use in this study meet this criteria. The PASS Reading Enhancement Program (PREP) is a remedial solution based on the PASS theory. The results of previous studies using the PREP led to the expectation that children in this study whose test scores reflected successive processing deficits would also manifest problems with phonology. The link between phonology and access to basic reading skills, as discussed in Chapter 3, is evidenced in the benefits of successive processing training provided by the PREP.

The meaning-based programme used in this study was built on the previously described Whole Language theory. It was expected that children who did not demonstrate successive processing deficits but whose reading performance reflected a considerable lag would benefit from a meaning-based remedial programme. The focus of the remediation was to address the language needs fundamental to the acquisition of reading skills, as demonstrated in the application of Whole Language theory.

The appropriateness of the two intervention programmes was a further focus of the study. The rationale for the use of remediation programmes is that identification of learning problems is only meaningful when appropriate interventions follow. If the intervention is to be successful, it should be suited to the needs of the children tested and consistent with their cultural world. Both programmes used in this study were chosen because of their

suitability to the South African context and because the first addresses the needs of children with intrinsic learning problems while the second provides solutions for children whose reading problems are more general in nature.

8.1.2 Aims of the Study

The general aims of the study, then, were to differentiate between children whose inability to acquire basic reading skills was due to intrinsic factors and those whose reading difficulties were more general in nature, and to provide appropriate intervention programmes. Intrinsic factors which interfere with learning to read are those which are based in cognitive dysfunction. For the majority of dyslexic children, this means a deficit in phonological coding, (Das, Naglieri and Kirby, 1994, p. 134). The others are children whose difficulty in accessing beginning reading skills is said to be more general in nature--Gough and Tunmer's (1986) "garden variety reading disabilities" discussed in Chapter 3.

Specifically, the study aimed to:

(a) test the usefulness of screening instruments modelled on subtests of the Naglieri-Das Cognitive Assessment System in identifying South African children with specific learning disabilities

(b) study the effects of the PASS Remedial Programme in addressing the needs of children whose reading problems were attributed to deficits in successive processing

(c) study the effects of a programme based on Whole Language principles in addressing the needs of children whose reading problems were not rooted in specific learning disabilities but were more general in nature, that is, due to extrinsic factors.

8.1.3 Expectations

Expectations for this study were as follows:

(1) Children who take part in a remediation programme designed to improve successive processing would show greater gains in successive processing than children who take part in a Whole Language remedial programme.

(2) Children with successive processing problems would manifest lower levels of ability in word attack and word identification skills than children without successive processing problems.

(3) A programme designed to improve successive processing (i.e. PREP) would result in corresponding improvements in successive processing and corresponding improvements in reading ability.

(4) A programme designed to improve reading ability in children who do not manifest successive processing problems and aimed at improving language abilities and phonics skills would result in improvements in reading ability.

8.2 Method

8.2.1 Subjects

The experimental group came from the 1996 Grade III class of Thuthuka School in Braamfontein, Johannesburg and the control group came from the 1997 Grade III class from the same school. In August 1996, all children in the experimental group were tested using the three tests of successive processing and the two Woodcock Tests of Reading Mastery-Revised (WTRM-R) subtests. First using the results of the tests of successive processing, the children in the lowest quartile of the class were identified as having a specific cognitive dysfunction, i.e. a deficit in successive processing. This deficit was reflected in their performance on the WTRM-R subtests as well, confirming the link between reading disability and difficulties in successive processing. These children were selected for the PREP experimental group.

The WTRM-R results of the remaining children in the class were then studied to identify those who had average scores on the tests of successive processing but whose reading performance placed them in the next lowest quartile of the class. These children were selected for the Whole Language experimental group. In January the procedure was repeated with the control group, the 1997 Grade III class, resulting in the identification of a PREP control group and a Whole Language control group.

The experimental group, then, was composed of eighteen male and fifteen female students from the 1996 Grade III class. Ages ranged from eight years, one month to ten years, seven months. The class was a fairly heterogeneous one, with children from distant centres such as Soweto, Katlehong and Boksburg, as well as from the city, Braamfontein, Hillbrow and Joubert Park. Socio-economic class was mixed, although the majority could be said to be in the lower economic range. Thuthuka is a fee-paying school and as such, the subjects came from families where at least one parent was employed. Most parents reported having had a Grade 9 education or higher. Home languages included Zulu, Tswana, Xhosa, French, Afrikaans and Northern Sotho.

The control group consisted of fourteen male and sixteen female students from the 1997 Grade III class of Thuthuka School. The class was well matched with the experimental group for socio-economic status and the children came from the same general areas as had the 1996 class. The age range and languages represented were similar to those of the

experimental group. For purposes of comparison, children scoring in the lowest quartile of the 1997 class in the measures of successive processing were identified as a PREP control group and those children whose performance on the WRMT-R was weak but who did not exhibit difficulties in successive processing were identified as a Whole Language control group. Both groups are profiled in Table 1, below.

Table 8.1
Characteristics of the Sample

	Experimental	Control
Grade	Grade III	Grade III
Gender		
Males	18	14
Females	15	16
HomeLanguages		
Zulu	14	12
N. Sotho	11	8
S. Sotho	0	1
Tswana	3	6
Xhosa	3	1
Afrikaans	1	1
French	1	0
Portuguese	0	1
Age Range	96 - 127 mos.	93 - 129 mos.

8.2.2 Measures

Poor readers were selected from the experimental group based on their performance on the tests that had been modelled on the Cognitive Assessment System (CAS) subtests and on the Woodcock Tests of Reading Mastery-Revised (WTRM-R) which are detailed here.

8.2.2 1.Tests of Successive Processing

(a) The *Word Series* subtests, modelled on the CAS, consisted of eight single-syllable words: sock, egg, ball, key, cat, pin, boy, gate. Frequency of word use and position was balanced across the test. The test consisted of twenty-six word series items to be read aloud to the child by the examiner at the rate of one word per second, with word series length ranging from two to eight words. The child repeated the sequence, in the same order as it had been given.

Scoring was either correct or incorrect, with a single point being given for a total correct sequence and no points scored if item of sequence or omitted. Credit was given for items not administered level. The raw score was the total

number of items correctly repeated. Word Series items were presented until the child erred on four consecutive items.

(b) There were six items on the *Speech Rate* subtest. Children were timed while repeating a set of words and stopped when ten repetitions had been made. All children were asked to complete the *Speech Rate* subtest for repetitions of three single-syllable words and for three double-syllable words. The test was scored using the total amount of time required to complete each of the sequences ten times.

(c) Although it is not included in the current edition of the CAS, *Naming Time* was used in experimental versions. The use of *Naming Time* in a number of research projects was discussed in Chapter 7. The test is comprised of thirty high frequency and phonetically regular words. The child is asked to read the words as quickly and accurately as possible and the score is the number of seconds it takes to complete the task.

8.2.2.2 Reliability and Validity of the CAS

Reliability coefficients demonstrated that the Standard Full Scale Battery and the PASS scales have high internal reliability, with full-scale coefficients ranging from .95 to .97. The average reliabilities for the tests of successive processing (including others, not used in this study) are .93. For the Basic Battery, the reliability coefficients for the Full Scale ranges from .85 to .90. The average reliabilities for tests of successive processing are .90. Test-retest reliability on a sample of 215 children from the standardisation sample yielded median stability coefficients of .73 on the CAS subtests and .82 for the Basic and Standard Battery.

Confirmatory factor analyses were performed on four age groups within the standardisation sample (5-7 years, 8-10 years, 11-13 years and 14-17 years.) The goodness-of-fit index (gfi) and the adjusted goodness-of-fit index (agfi) indices yielded results above .90 and .80 respectively, demonstrating a good fit between the PASS scales and data from the four age groups. In addition, the maximum-likelihood factor analysis demonstrated appropriate loadings for each subtest on the factor to which they were assigned.

Criterion-related validity was achieved through investigation of the CAS with both individual (Woodcock-Johnson Revised Test of Achievement) and group administered measures (Scholastic Aptitude Test). All information cited is from the Cognitive Assessment System Interpretive Handbook (Naglieri and Das, 1997).

8.2.2.3 Tests of Reading Performance

Subjects' pre- and post-intervention reading performances were assessed using two subtests from the Woodcock Reading Mastery Tests-Revised (Richard Woodcock, 1987) [WTRM-R], the *Word Attack* and the *Word Identification* subtests.

The *Word Attack* test is composed of simple consonant-vowel combinations (e.g., "ap," "ift," and "raff") and measures the ability to apply basic phonological skill. Subjects begin with two sample items and then proceed to the first test item. If the child fails to pronounce a sample item, the examiner is allowed to model the correct pronunciation until the child is able to correctly complete a sample item. The child is then given five seconds to give a correct reading for each nonsense word and items are presented in order of increasing difficulty. Responses are recorded and allowances are made "for mispronunciations resulting from speech defects, dialects, or regional speech patterns," (WTRM- R Manual, 1987, p. 25).

The *Word Identification* test is composed of a list of high frequency words ("is," "you," and "and," etc.) to be read aloud. Here, too, five seconds is the time allotted for responses, which are recorded. Testing stops at six consecutive errors that come at the end of a page. For both the Word Attack and the Word Identification subtests, scoring involves totalling the number of correct responses. For the purposes of this research, raw scores were used in making comparisons.

Reliability data are provided for the internal-consistency reliability of the WTRM-R. Data are listed separately for Grades 1, 3, 5, 8 and 11 and for college and adult groups. Reliabilities for the *Word Attack* subtest range from .84 to .94 and for the *Word Identification* subtest, from .86 to .98. Evidence is also given for concurrent validity. "Correlations among subtests measuring similar behaviours are high. There is good evidence for the convergent validity of the scale; that is, performance on specific tests correlates more highly with performance on other measures of similar reading behaviours than with performance on measures of different reading behaviours," (Salvia and Ysseldyke, 1995, p. 485).

8.2.3 Intervention Programmes

Subjects whose performance on the tests of cognitive processing fell in the lowest quartile of the class and whose scores on the WTRM-R subtests reflected weaknesses in reading were identified for participation in the PREP group. Children whose performance on the tests of successive processing fell within the average range for the class but whose reading performance on the WTRM-R subtests was poor were identified for participation in the Whole Language programme. These programmes, introduced in Chapters 5 and 6 respectively, are now described in more detail.

Sessions with the PREP group were between thirty-five and forty-five minutes in duration. The programme is prescriptive in that it provides text that defines each task and expectations for its completion. It also offers guidelines as to when and how prompts should be given. In this study, children worked through the PREP successive processing

materials, completing a global task followed by a task which bridged the strategy to a reading task. If children demonstrated mastery at the beginning level, they then moved ahead to the next set of tasks. If further work was still needed, an alternate form was available for each of the tasks until mastery was demonstrated.

The Whole Language sessions were of similar duration. Sessions alternated between one which focused on the introduction and discussion of a book and one which consisted of follow up activities. The first began with discussion of a particular book. Children's attention was drawn to the book's title, author, illustrator and illustrations. Based on the book preview, children were invited to make predictions about the story before it was read aloud by the teacher. The books that were used generally featured repetitive language or followed a particular language pattern. Children therefore found it relatively easy to join in as the books were read aloud and they were encouraged to do so. Words from the story were then shown in isolation and used to reconstruct the story, the teacher guiding the children through questioning as they retold the story.

Follow up sessions began with a word study, using the word cards from the previous session. Language features for discussion included letter-sound relationships as well as the rhyming words in poetic texts. Words were grouped according to letter sounds and patterns and children were encouraged to discuss patterns they observed and to arrange word cards according to sound and pattern.

Language patterns from the text under study were then used as models for children to write their own stories. For example, one of the stories used details the progress of naughty bear cubs who leave the safety of their own home for an exploration of the local wood; it relies on prepositions for the telling of the tale, "out the window, down the tree, around the rock, across the bridge." When children in the whole language group wrote their own books, they used prepositions from the story to describe their own personal journeys. The writing and sharing time freed the teacher to listen to individual children reading and to provide strategy support in each child's attempts at decoding unfamiliar words. Book-making sessions were always followed by individuals reading their own stories aloud to the group.

8.2.4 Procedure

Pre-testing took place in August 1996 for the experimental group and in January 1997 for the control group. It included the three successive processing tasks, *Speech Rate*, *Word Series* and *Naming Time*, and the *Word Attack* and *Word Identification* tests of the WRMT-R, Form G. Students were tested individually, by the writer, within the context of the normal school day. The remediation programmes began in September 1996 and consisted of 24 sessions, with three sessions per week, between the beginning of September and mid-November. Children in the PREP programme were seen in groups of two, three or four, depending on their levels of attainment within the programmes. When a child did not attain a sufficient level of mastery of a PREP task, an alternate from of the task was completed. This meant that group composition was flexible to ensure that all of

the seven children in the PREP programme eventually met with success on each task while completing the PREP.

Children in the Whole Language programme also participated in 24 sessions. They were seen in two groups, one of three children and the other, of four. The writer taught all the sessions for both the groups, as well as completing the post-testing for the experimental and control groups. This used the *Word Identification* and *Word Attack* subtests of the WTRM-R from an alternative form, Form H, and *Speech Rate*, *Word Series* and *Naming Time* for the two experimental groups. It was completed during the last two weeks of November 1996, after the remediation programmes had been completed. The post-testing for the control group was completed in April 1997, after a period of regular classroom input directly comparable to the duration of the intervention programmes completed with the experimental group. A summary of the timetable for the study is presented in Table 2 below.

Table 2
Testing and Intervention Timetable for Experimental & Control Groups

August 1996	Pre-testing of Grade 3 class using WTRM-R, Form G and tests modelled on *Naming Time* and on *Word Series* and *Speech Rate* from the CAS. Children identified for two different remediation programmes.
September-November 1996	PREP group receives 24 sessions of intervention. Whole language group receives 24 sessions of intervention.
November 1996	Post-testing of PREP and Whole language groups using the WTRM-R, Form H.
January 1997	Pre-testing of Grade 3 class using WTRM-R Form G and tests modelled on the CAS. Children identified as candidates for the PREP and for the Whole language programme.
February - April 1997	Both control groups receive regular classroom input for reading progamme.
April 1997	Post-testing of PREP & Whole language groups using WTRM-R Form H.

NOTE: WTRM-R = Woodcock Reading Mastery Tests, Revised and CAS = Cognitive Assessment System

8.3 Research Design

8.3.1 Introduction

The study used a pre-post experimental control design, in which the pre- and post test results for each of the experimental groups were compared with their respective control groups and with those of each other.

8.3.2 Statement of Hypotheses

The hypotheses for this study were as follows:

1. Improvements in successive processing will be greater for the children in the PREP experimental group than for those in the Whole Language experimental group.

2. Children with successive processing problems will manifest lower levels of ability in word attack and word identification skills than those without successive processing problems.

3. A programme designed to improve successive processing (PREP) will result in corresponding improvements in successive processing and in reading ability (i.e., word attack and word identification).

4. A programme designed to improve reading ability in children who do not manifest successive processing problems and aimed at improving language abilities and phonics skills will result in improvements in reading, that is, word attack and word identification skills.

8.3.2 Statistical Analysis Applied

T-tests and correlational studies were used to test each of these five hypotheses in the following ways:

Hypothesis 1

The hypothesis that children in the PREP programme would show greater improvements in successive processing than the children who participated in the Whole Language programme was tested by two sample t-tests for *Speech Rate* and *Naming Time*. The normality assumption was violated in the case of *Word Series* since in some cases the child could not do the test and the time taken was effectively infinite. For those observations, the arbitrary large value of eighty seconds was assigned as the time taken. The data was thus skewed and the usual t-tests not suitable. The Mann-Whitney nonparametric test was used to test whether the samples had equal medians.

Hypothesis 2

Scores on the CAS-modelled tests were calculated for the control group and the experimental group, and, on this basis, two groups were identified: a low performing group for successive processing (a combination of children identified for the PREP in the experimental group and in the control group) and a group with average or above successive processing ability (all the other children in both the experimental and the control groups).

The pre-test results of the Woodcock Tests of Reading Mastery-Revised (WTRM-R) scores were calculated for each of these groups and compared. The tests were performed for the WTRM-R *Word Identification* and *Word Attack* subtests. A two sample t-test was used for equality of means.

Hypothesis 3

The efficacy of the PREP in promoting the development of (a) successive processing and (b) reading (word identification) was evaluated by a comparison between the experimental PREP group and the control group for the pre- and post-test results for (a) the successive processing measures and (b) Woodcock Tests of Reading Mastery-R, respectively.

Results for *Speech Rate* were reported as the total time taken for the repetitions of one- and two-syllable words; for *Word Series* results were the total time taken to repeat the series; for *Naming Time*, results were reported as the total time taken to read the thirty words. Results for the WTRM-R tests of *Word Identification* and *Word Attack* were compared using raw scores. T-tests were used to evaluate and compare the testing results.

Hypothesis 4

The efficacy of the Whole Language programme in promoting the development of reading (word identification) was evaluated by a comparison between the experimental Whole Language group and the control group using the pre- and post-test results for the Woodcock Tests of Reading Mastery-R

8.4 Summary

The rationale for the study, the details of its subjects, measures and intervention programmes, as well as its research design and hypotheses have been outlined in this chapter. The results of these studies, with statistical support, are presented in the chapter that follows.

Chapter Nine
Results - Hypotheses with Tables of Statistical Data

9.1 Introduction

This chapter provides the results of the studies used to test the hypotheses that formed its basis. All pre- and post-tests were scored according to the procedure described in the Measure section (8.2.2) of Chapter 8. Raw scores were used for the *Word Identification* and *Word Attack* subtests of the Woodcock Tests of Reading Mastery-Revised (WTRM-R).

9.2 Results

9.2.1 Hypothesis 1

Successive processing ability was measured using *Speech Rate* and *Word Series*. Comparisons of successive processing ability prior to intervention (the PREP experimental group and the Whole Language experimental group) are depicted in Tables 1 and 2, below.

Table 9.1

Comparison of the PREP and Whole Language Experimental Groups on *Speech Rate* Prior to Intervention

GROUP	NUMBER	MEAN	STD. DEVIATION
PREP Experimental	7	22.5	5.57
Whole Language Experimental	7	15.5	2.34

There was a highly significant difference in successive processing between children chosen for the PREP group and children chosen for the Whole Language programme, with $t = 3.19$ and $p < 0.008$.

Table 9.2

Comparison of the PREP and Whole Language Experimental Groups on *Word Series* Prior to Intervention

GROUP	NUMBER	AVERAGE RANKS
PREP Experimental	7	7.18
Whole Language Experimental	7	3.45

Here, too, there was a highly significant difference in successive processing between children chosen for the PREP group and children chosen for the Whole Language programme for *Word Series* where $p < 0.009$.

Tables 3 and 4 below present the results of testing the hypothesis that children who participate in the PREP programme will show greater improvements in successive processing than the children who participate in the Whole Language programme. It compares the post-test minus pre-test scores on *Word Series* and *Speech Rate* for the two groups, with each other. The test was not performed for *Naming Time* since neither the PREP group nor the Whole Language group exhibited a significant improvement in *Naming Time*, as is shown in relation to Hypotheses 2 and 3.

Table 9.3

Mean Rate of Change of the PREP and Whole Language Experimental Groups on *Speech Rate* Following Intervention

GROUP	NUMBER	MEAN	STD. DEVIATION
PREP Experimental	7	9.00	6.50
Whole Language Experimental	7	4.00	1.52

The PREP group outperformed the Whole Language experimental group for *Speech Rate*, with $t = 2.60$ and $p < .02$, showing greater improvement in successive processing.

Table 9.4

Mean Rate of Change of the PREP and Whole Language Experimental Groups on *Word Series* Following Intervention

GROUP	NUMBER	AVERAGE RANKS
PREP Experimental	7	9.85
Whole Language Experimental	7	5.14

The PREP group also outperformed the Whole Language group on *Word Series*, with $p < 0.04$, showing significance of gain.

9.2.2 Hypothesis 2

Table 5 shows the results of testing the hypothesis that children with successive processing problems will manifest lower levels of ability in word attack and word identification skills than those without successive processing problems. Two groups were identified, using the scores of the tests of successive processing: children with successive processing problems (a combination of those identified for PREP in the experimental and control groups) and a group with average or above average successive processing ability, i.e., all the other children in both the classes.

The pre-test performances of the two groups on the WTRM-R *Word Attack* and *Word Identification* tests were then compared. The results assumed equality of variance of the samples for the *Word Identification* subtests but the variances for the *Word Attack* subtest proved to be unequal and an adjusted t-test was used. The mean performance and standard deviations for both groups are shown in Table 5 below:

Table 9.5

Comparison of Pre-test Word Decoding Scores for PREP and Non-PREP Groups

GROUP	MEASURE	NUMBER	MEAN	STANDARD DEVIATION
	WTRM-R* Subtest			
PREP	*Word Ident.*	14	30	10.67
Non-PREP	*Word Ident.*	49	50	16.15
PREP	*Word Attack*	14	8	4.09
Non-PREP	*Word Attack*	49	19	10.17

WTRM-R = Woodcock Tests of Reading Mastery - Revised

Results reflected a significantly lower performance in both of the WTRM-R subtests for the PREP group. Separate independent sample t-tests showed a significant difference between the pre-test scores of children identified as having successive processing problems and those who did not. On the *Word Identification* test, $t = -2.40$ and $p < .01$. On the *Word Attack* test, $t = -5.75$ with $p < .001$.

9.2.3 Hypothesis 3

Table 6 shows the results of testing the hypothesis that participation in the PREP will result in corresponding improvements in successive processing and in reading ability (i.e., in word attack and word identification). Performances compared were those of the children identified for PREP in the experimental group with those of the children identified as the PREP control group.

The usual t-tests were used for *Speech Rate, Naming Time* and *Word Attack* in which the normality assumption was acceptable. The *Word Series* tests presented problems, however, as described in the previous chapter, and the usual t-tests could not be used. The Mann-Whitney nonparametric test was used to measure whether or not the medians of the samples were equal for the *Word Series* test results.

The results reported in Table 6 below reflect differences, that is, the improvement in each of the tests for the children identified for the PREP groups. For the tests of successive processing, scores were calculated as pre-test performance minus post-test score as improvements were reflected by *decreases* in the time taken to complete the test items. For the WTRM-R, the difference was calculated as the post-test scores minus the pre-test scores, to reflect the increases in the number of items children were able to complete on these tests.

Table 9.6

Comparison of Test Results for PREP Groups
Control and Experimental

MEASURE	GROUP	NUMBER	MEAN	STD. DEVIATION
Subtests Modelled On the CAS*				
Speech Rate	Control	7	1	7.84
	Experimental	7	9	6.50
Naming Time	Control	7	5	15.19
	Experimental	7	38	23.5
				AVERAGE RANK
Word Series	Control	7		4
	Experimental	7		11
WTRM-R* Subtests				STD. DEVIATION
Word Identification	Control	7	2	1.57
	Experimental	7	9	3.95
Word Attack	Control	7	0	2.81
	Experimental	7	10	4.39

CAS = Cognitive Assessment System WTRM-R = Woodcock Tests of Reading Mastery - Revised

Results reflect success of the PREP in improving performance in two out of the three successive processing tasks as well as transfer to *Word Attack* and *Word Identification* performance where improvements were highly significant. For *Word Attach*, the t-test result was 4.71 with $p<.002$. For *Word Identification*, $t = 4.53$ with $p<.003$. The t-test results for *Speech Rate* showed significance ($t = 2.29$ and $p<.02$). For *Word Series*, there was a significant improvement, with a two-tailed probability of <.0002.

The improvement in *Naming time* was not statistically significant and there was no difference in performance in the *Naming Time* task between children completing the PREP programme and children following the normal classroom reading programme. The large standard deviations for *Naming time* prevented significance of the mean difference where $t = 1.67$ and $p<.06$.

9.2.4 Hypothesis 4

Table 7 shows the results of testing the hypothesis that a programme designed to improve reading ability to children who do not manifest successive processing problems and aimed at improving language abilities and phonics skills will result in improvements comparable to those of the PREP group.

Tests here parallel those of the third hypothesis but this time, with the performance of children in the Whole Language groups, in both the experimental and the control groups.

Table 9.7

A Comparison of the Whole Language Groups, Post-Intervention

MEASURE	GROUP	NUMBER	MEAN	STD. DEVIATION
Subtests Modelled On the CAS+				
Speech Rate	Control	7	2	6.32
	Experimental	7	4	1.52
Naming Time	Control	7	3	6.31
	Experimental	7	20	41.18
				AVERAGE RANK
Word Series	Control	7		5.71
	Experimental	7		9.28
WTRM-R* Subtests				STD. DEVIATION
Word Identification	Control	7	4	3.38
	Experimental	7	12	1.77
Word Attack	Control	7	2	2.42
	Experimental	7	7	3.98

+CAS = Cognitive Assessment System
*WTRM-R = Woodcock Tests of Reading Mastery - Revised

Results of the testing for the fourth hypothesis reflected no improvement in *Speech Rate* ($t = -0.4$ and $p < .65$) and no statistically significant improvement for *Word Series* where a two-tailed probability of equalling or exceeding $z = 0.12$. There was, however, improvement in *Naming Time* ($t=2.23$ and $p < .02$).

The Whole Language programme, however, showed significance for gains in the two reading subskills. For *Word Identification* $t = 6.72$ and $p < .001$ while for *Word Attack*, $t = 3.39$ and $p < .002$.

9.3 Summary

To summarise, this chapter presented the tables showing test results for the four hypotheses tested by this study. The relevance of the results and the implications of the study are discussed in the final chapter.

Chapter Ten
Discussion

10.1 Interpretation of Findings

10.1.1 Hypothesis 1:

Children who participate in a programme which involves successive processing (PREP) will show significantly greater improvements in successive processing than the children who participate in a meaning-based programme (Whole Language).

Performance on the *Speech Rate* and *Word Series*, two of the three measures of successive processing, showed significantly greater gains in successive processing for the PREP experimental group than for the Whole Language experimental group. Naming Time, as used in this study, did not prove to be a reliable predictor of successive processing ability, as shown in Hypotheses 2 and 3.

Improvements on the tests of successive processing for the PREP experimental group over those of the Whole Language group reflect the effectiveness of the successive processing component of the PREP. The acquisition and internalisation of successive processing strategies are aims of the PREP programme, the first step in a process with the ultimate goal of word reading.

Change in the successive processing of children in the Whole Language experimental group was not expected, as subjects in this group had not demonstrated successive processing deficits. The Whole Language remediation programme offered no remediation in information-processing strategies. Children in the PREP group, however, were well-suited to the acquisition of successive processing strategies due to the nature of their deficit.

As described in Chapter 5, the nature of the successive processing deficit is a variable in the usefulness of the PREP. If the reading disability is simply due to a weakness in applying successive processing strategies when reading, then a programme which provides children with the opportunity to discover further successive processing strategies will be of little benefit. Further training only serves to increase the store of unused strategies. In such instances, the process of applying such strategies can be mediated for the learner without the need for the type of training offered by the PREP. It is therefore important that the nature of the deficit be clear before suitable prescription can be made. As demonstrated in this study, useful measures such as *Speech Rate* and Word *Series* can provide the clarity needed for match with a suitable programme such as PREP.

10.1 .2 Hypothesis 2:

Children with successive processing problems will manifest less ability in word attack and word identification skills than those without successive processing problems.

Results reflected a significantly lower pre-test performance in both of the Woodcock Tests of Reading Mastery-Revised (WTRM-R) subtests for the PREP groups, both experimental and control, when compared with the Whole Language experimental and control groups, that is, children whose reading difficulties were of a more general nature. This demonstrates that difficulties in successive processing result in reading disability. The standard deviations for the experimental PREP group and the control PREP group were quite close on the *Word Attack* subtest. As this test uses nonsense words, completion of the items relies solely on the ability to process sounds sequentially. It would be expected then that performance on the *Word Attack* test would be reliant on the ability to apply successive processing and that children who experience a deficit in that area would consistently show poor performance on the test.

There was a slightly greater variation between the PREP control and the PREP experimental groups on the test of *Word Identification.* As this test measures sight vocabulary including both phonetically regular and phonetically irregular words, a child's performance could vary here according to the degree of previous exposure to particular words. The test is not as pure a measure of successive processing as is the *Word Attack* subtest which could offer some explanation as to the greater degree of variance between the two groups compared.

Confirmation of the hypothesis supports the use of the tests of successive processing as a screening instrument for identification of specific learning problems and the choice of the PREP as an appropriate remediation programme for the group.

10.1.3 Hypothesis 3:

A programme designed to improve successive processing (PREP) will result in corresponding improvements in successive processing and in reading ability (i.e., word attack and word identification).

Hypothesis testing confirmed the success of the PREP in improving performance in two of the three successive processing tasks and in both the measures of reading ability where improvements were found to be highly significant. *Naming Time* was not confirmed as a predictor of successive processing ability while the other two measures, *Speech Rate* and *Word Series* were, as suggested in the discussion of Hypothesis 1.

Confirmation of this hypothesis shows:

(1) the link between successive processing problems and reading disability

The link between successive processing problems and reading disability was supported by the confirmation of Hypothesis 2. The effectiveness of the remediation programme designed to address reading disability through the acquisition of successive processing strategies (PREP) provides further evidence for that link.

(2) the efficacy of tests like those modelled on the CAS in identifying successive processing problems

In the discussion of Hypothesis 1, the usefulness of measures for identifying cognitive deficits was pointed out. As discussed in Chapter 2, traditional tests overlook the underlying cognitive processes involved in reading. Tests such as *Speech Rate* and *Word Series* can be used to identify cognitive dysfunction and to assist in making appropriate matches between problems and programmes.

(3) the efficacy of the PREP in remediating reading disability which is rooted in successive processing deficits

Traditional remediation programmes address the symptoms of reading disability rather than their causes (Lovett, Ransby, Hardwick, Johns and Donaldson, 1989). The PREP represents an alternative to such programmes. The relevance of the gains demonstrated in this study is not simply with regard to the acquisition of strategies but to the fact that they were applied to reading tasks, thereby demonstrating transfer. If raw scores are converted to age scores, an inspection of individual performances shows an average gain of nine months for *Word Identification* and eight months for *Word Attack* in the PREP experimental group. For the PREP control group, average gain for *Word Identification* was one month and for *Word Attack* it was .7 month.

"Transfer of learning to a new situation may occur when the original and new situations are similar in content, similar in procedure, and share the same principle of learning," (Crawford and Das, 1992, p. 92). The PREP meets these criteria for the internalisation of strategies and for their successful application, as evidenced in the gains made by the experimental PREP group in this study.

10.1.4 Hypothesis 4:

A programme designed to improve reading ability in children who do not manifest successive processing problems and aimed at improving language abilities and phonics skills will result in improvements in reading, that is, word attack and word identification skills.

As hypothesised, the meaning-based Whole Language programme showed significant gains in the two reading subskills, support for use of such a programme with children whose difficulties with reading are extrinsic in origin. After three months of intervention work, the gains were reflected on the WTRM-R. It is useful to note that progress was measured by means of a standardised test and that gains such as these are not easily

attained after short periods of intervention. "Usually, even when gains are seen, they may not be significantly greater than those shown by the non-intervention group," (Das, Mishra and Pool, 1995, p. 74).

When raw scores are converted to age scores, the average gain for the Whole Language experimental group was eleven months for *Word Identification* and six months for *Word Attack*. For the Whole Language control group, the average gain for *Word Identification* was 1.4 months and for *Word Attack*, 1.2 months. It is interesting to note that the greater of the gains on the WTRM-R tests is reflected in *Word Identification* results, the opposite of the case for the PREP group. It could be inferred that the emphasis in the Whole Language programme on using children's books--with a range of sight vocabulary both phonetic and irregular--resulted in greater exposure to non-phonetic sight words.

Confirmation of Hypothesis 4 supports the use of the programme based on Whole Language principles with children who struggle to acquire beginning reading skills but who do not demonstrate a specific cognitive dysfunction related to successive processing.

10.2 General Implications of the Findings

The general implications of the findings are:

(a) As demonstrated in this study, tests such as *Speech Rate* and *Word Series* are useful in identifying children who experience successive processing deficit. The special needs of children with specific learning disabilities have not always been readily recognised or have come into focus only after a history of frustration and failure. The link between such a deficit and difficulty in acquiring phonology is supported by the evidence cited in Chapter 3. Tests such as *Speech Rate* and *Word Series* require little training in administration and could be helpful in selecting children who could benefit from remediation.

(b) Remedial programmes have traditionally intensified, in a smaller context, that at which the child has already failed in the classroom. It is therefore desirable to use programmes based on theoretical models that offer children new strategies for dealing with their reading disabilities.

The two programmes used in this study proved to be effective. The focus for their choice was their suitability to specific learning profiles. There is no evidence from this study that other programmes may not have been as effective as those used nor is there any proof that the benefits of the PREP programme might have been the same for the Whole Language group as they were for the PREP group and vice versa. There is support, however, for the use of a programme that addresses successive processing deficits with children who demonstrate the need. There is also support for using a programme based

on Whole Language principles with children whose reading problems are of an extrinsic nature. The concept that programmes should fit the children they are meant to teach is not a new one. The results of this study provide support for the concept of matching needs to programmes.

(c) In designing such programmes, attention needs to be given to the acquisition of strategies rather than skills. The concept of skill training, sometimes called "overlearning," does not go to the heart of the dysfunction, the underlying cognitive problems. These problems can be addressed through the presentation of opportunities for their resolution and through the availability of a suitable mediator to act as a guide through the process.

This was an underlying principle in both the Whole Language and the PREP intervention programmes used in this study. Lessons focused on interaction, on discussion of basic principles and of their applications. No attempt was made to train a particular word list or sound pattern as that kind of specificity could be a deterrent to transfer. Focus, instead, was on the understanding of principles transferable to beginning reading tasks.

"Students are commonly taught content (knowledge, particularly declarative knowledge) and how to do things (skills and strategies, or procedural knowledge); what they often fail to acquire is an understanding of why that knowledge is important, how it should be employed, and when. In short, they lack the metacognitive awareness to use their knowledge effectively, and thus they are unlikely to see the value of that knowledge or be able to retain it," (Das, Naglieri and Kirby, 1994, p.83). Metacognition was a guiding principle in the teaching of both remedial programmes in this study. Assessment was on-going, in the context of the instruction, and children were guided to reflect and to comment upon their own mental processes.

(d) As outlined in Chapter 3, there is an abundance of research supporting the link between phonics teaching and the acquisition of beginning reading skills. It was for this reason that the remediation programme based on Whole Language principles also included the teaching of phonics. In *Beginning to Read* Adams (1990) reviewed the research of the previous decade and concluded that children must "acquire a sense of the correspondence between letters and sounds upon which [the alphabetic principle] is based, " (p. 29) if they are to become proficient readers. The extent of support for including a phonological component in remediation programmes is such that modelling a programme along strict Whole Language lines and excluding the teaching of phonics would have been irresponsible.

As discussed in Chapter 6, the 1980's debate about the inclusion of phonics in Whole Language programmes was followed by the integration of phonics teaching with the reading of texts. The effectiveness of the Whole Language programme used in this study is at least in part due to the inclusion of phonics teaching. The progress made by the children in the Whole Language experimental group, particularly on the WTRM-R *Word Attack* subtest supports the inclusion of phonics teaching in the remediation programme.

The teaching of phonics could be particularly relevant to the training of new teachers and to the design of new programmes. Although English is not phonetically regular, the support for a phonological component in remediation programmes is widespread. Phonics instruction therefore seems particularly relevant when done in languages which are phonetically more regular than English, as many African languages are.

Teacher training in reading instruction has varied over the years. Background in phonology now appears to be a necessary component in teacher education, for mainstream classroom teachers and for remedial teachers. In *Phonology and Beginning Reading*, Liberman and Shankweiler state that "...until phonological instruction has been fully integrated into the method of reading instruction, we should be wary of explanations that attribute reading failure to non-language factors like differences in the visual or auditory learning style of the children or the motivational or cultural shortcomings of their families," (1991, p. 14). This seems particularly relevant in a South African context where problems are varied and widespread. Research into phonology has now established that the teaching of phonics is a significant factor in beginning reading. The quality of phonics teaching needs to be a prime consideration in the evaluation of existing programmes and in the design of new ones. Although learning style, motivation and culture also need consideration, they should follow on phonology.

(e) The PREP and the Whole Language remedial programme used in this study are relevant to the South African context as they have been shown to address the needs of children who struggle to acquire beginning reading skills.

The PREP was used with small groups in this study and the materials have since been adapted to allow for groups of a slightly larger size to work through the programme together. This is useful in South Africa where the education system continues to suffer from financial constraints while the need for remedial programmes exerts increasing pressure on the system. The PREP can provide more cost effective remedial solutions than traditional remedial programmes that often involve one to one tuition.

The Whole Language remedial programme is also an effective means of addressing remedial needs within the group context. In South Africa, where settings can very considerably from small and rural to large urban schools, it can be flexible in its use of materials and adapted to suit the varying needs of children in need of remediation. As used in this study, the Whole Language programme allowed time for children to experiment with language patterns and to construct their own small books. This provided time for the teacher to work with individuals and pairs, when necessary, to develop specific strategies. The phonic component, as used in this study, is well suited to group teaching.

The PREP further demonstrated its usefulness in South Africa through the nature of its materials that need not be grounded in a particular culture. Hence the use of the materials

and the application of strategies are adaptable to a variety of contexts. Its flexibility is well suited to a country where a wide variety of cultures can be found.

10.3 Limitations of the Research

10.3.1 The Development of Reading Comprehension

The PREP, as used in this study, was not expected to have any effect upon simultaneous processing, attention or planning. As only the successive processing training tasks of the PREP were used, reading comprehension was outside the realm of this research. Measures used in this study targeted word level processes only and tested ability with word decoding (the *Word Attack* subtest) and sight vocabulary acquisition (the *Word Identification* subtest). Word level processes stand at the very beginning of the reading process and only address initial access to the complexities involved in deriving meaning from print.

This study, then, could be described as one of early intervention, that is to say, one which studies the access to beginning reading skills. Basic skills only become meaningful once automatised, thereby freeing memory and attention resources for comprehension (Laberge and Samuels, 1974). The focus on word reading, therefore, can be seen as a limitation of the research. Reading comprehension is said to involve cognitive processes which are both successive and simultaneous in nature (Kirby, 1992) and this study was limited to successive processes.

10.3.2 Planning

The study was also limited in that the underlying cognitive processes addressed by the Whole Language remedial programme were not studied. Given that the Whole Language programme was less prescriptive than the PREP and that children were given choices and activities to complete, many of the tasks involved planning. Planning was also a component of the PREP tasks but was not measured as such. Having taught both programmes, informal observations lead the writer to an interest in how planning impacts on a child's ability to make use of remedial input.

10.3.3 Sample and Timeframe

Children who participated in the study were those whose circumstances allowed for them to attend a fee-paying school. The sample--a comparison of two similar classes, 68 children in all, in an urban setting--was small and, given the range of South African society, could be considered to be relatively elite. The pre-test post-test improvements were noted after three months, a relatively short period. The impact of the two remediation programmes could be studied over longer periods of time.

The study was also limited in that the control groups received only the regular classroom input. It would be useful to have a control group of children with successive processing problems undertaking a remedial programme based on Whole Language principles as well as a control group of children with "garden variety" reading problems completing the PREP. A comparison of the benefits of the alternate remedial programmes for each of the identified experimental groups could offer further insight into the nature of remediation.

10.3.4 Extraneous Factors

As can be the case with intervention programmes, at least some of its success could be attributed to the fact that children receiving remediation enjoyed the benefits of increased attention and resulting improvements in motivation and self-esteem. To ensure that the success of the PREP and the Whole Language programmes did not rely solely on these factors, the effectiveness of programmes without phonological training and successive processing components would need to be compared to programmes used in this study. This becomes untenable, however, when consideration is given to the abundance of research (as discussed in Chapter 3 and above) confirming the need for phonics teaching if children are to acquire the alphabetic principle needed to become successful readers.

10.4 Suggestions for Further Research and Implementation

10.4.1 The Inclusion of Simultaneous Processing

As mentioned earlier, only successive processes were measured in the screening instruments for this study. None of the simultaneous PREP tasks were used with the experimental group. In order to study the full effectiveness of the PREP, further studies need to include simultaneous processes and measures of comprehension. The study described here represented access to the very beginning stage of reading only. In order to complete the process, comprehension, the purpose of any reading task, needs to be studied in order to have a complete picture of the efficacy of the PREP in improving the reading skills of South African children.

Given that the PREP comprehension tasks were written for Canadian children, stories would need to be written to adapt the PREP to an African context. The PREP is based on the PASS Information Processing Model, outlined in Chapter 4, which emphasises the importance of knowledge base as a context in information-processing. It would therefore be in keeping with the theory to replace the beavers and the moose of the existing PREP stories with African animals. The ice and snow and cold, elements outside the knowledge base of many African children, could be replaced by sun and heat and dust.

10.4.2 The Need for Further Research and South African Norms

A further shortcoming of the study was the size of the sample. Future research could involve a greater number of children with a wider range of home backgrounds. The

design for this study was completed before the publication of the Naglieri-Das Cognitive Assessment System and the analysis of its data was done internally. The norms that are now available could be applied to South African children. South African norms, however, would be more useful if these measures of successive processing were to be used to identify children for early intervention programmes and for remediation suited to the needs of children with specific learning disabilities. Such tests might be even more reliable if they were given in the mother tongue. This would of course involve the design of a number of different instruments and could perhaps be the results of a number of studies done with different language groups.

10.4.3 Intervention before the Need for Remediation

If literacy needs are to be addressed, it would be useful to use the two oral tests of successive processing--*Word Series* and *Speech Rate*--as a screening test for Grade 1 children. This would mean the identification of those most likely to struggle with any beginning reading programme and would allow teachers the opportunity to intervene at a very early stage, dispensing with the repeated failure and frustration that generally occur before a child is singled out for additional support.

As previously stated, identification is meaningful only when linked to intervention. The early identification of children with specific learning disabilities would have to be part of a programme allowing them opportunities to develop strategies for dealing with successive tasks. These would have to be non-reading tasks and could be similar to ıe non-academic global items of the PREP.

10.5 Summary

This chapter reflected on the findings of the study and their general implications. It also discussed the limitations of the study and provided some suggestions for its relevance to the pressing needs of specialised education in South Africa.

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APPENDIX: STATISTICAL DATA

RESULTS FOR HYPOTHESIS 1

SPEECH RATE – Two Sample Analysis Results

Sample 1: Exp. Syllables (Pre)-Exp. Syllables (Post)
Sample 2: Con. Syllables (Pre)-Con. Syllables (Post)

		Sample 1	Sample 2	Pooled
Sample Statistics:	No. of Observations	7	7	14
	Average	10.5714	1.71429	6.14286
	Variance	42.2857	61.5714	51.9286
	Std. Deviation	6.50275	7.84675	7.20615
	Median	9	1	4

Difference between Means = 8.85714

Conf. Interval for Diff. In Means:		95 Percent			
(Equal Vars.)	Sample 1 – Sample 2	0.462519	17.2518	12	D.F.
(Unequal Vars.)	Sample 1 – Sample 2	0.43029	17.284	11.6	D.F.

Ratio of Variances = 0.686775

Conf. Interval for ratio of variances:		95 Percent			
	Sample 1 – Sample 2	0.116111	4.06216	6	6 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = 2.29945
Vs. Alt: LT Sig. Level =0.0201187
At Alpha = 0.05 so reject HO.

Note: The variances of the two samples may be assumed equal. There is an improvement in speech rate.

WORD SERIES TEST – Comparison of Two Samples (Nonparametric)

Sample 1: Exp. Word Series Post
Sample 2: Con. Word Series Pre- Test: Unpaired

Average rank of first group = 11 based on 7 values
Average rank of second group = 4 based on 7 values
Large sample test statistic z = -3.06661
Two-tailed probability of equalling or exceeding z = 2.16516E-3

Note: 14 total observations

Only the first 7 word series are taken into account since none of the PREP group could complete *Word Series* 8 or 9. There is a significant improvement in *Word Series* time.

NAMING TIME TEST – Two Sample Analysis Results

Sample 1: Exp. Naming Time Pre. - Exp. Naming Time Post
Sample 2: Con. Naming Time Pre. – Con Naming Time Post

Sample Statistics:	No. of Observations	7	7	14
	Average	29.8571	12.1429	21
	Variance	554.476	230.814	392.643
	Std. Deviation	23.5473	15.1924	19.8152
	Median	38	5	10.5

Difference between Means = 17.7143

Conf. Interval for Diff. In Means:		95 Percent		
(Equal Vars.)	Sample 1 – Sample 2	-5.36896	40.7975	12 D.F.
(Unequal Vars.)	Sample 1 – Sample 2	-5.81164	41.2402	10.3 D.F.

Ratio of Variances = 2.40231

Conf. Interval for ratio of variances:	95 Percent			
Sample 1 – Sample 2	0.40615	14.2093	6	6 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = 1.67247
Vs. Alt: LT Sig. Level =0.0601401 so do not reject HO.
At Alpha = 0.05

Note: The variances of the two samples may be assumed equal. The improvement in *Naming Time* is not statistically significant at the 5% level.

RESULTS FOR HYPOTHESIS 2
Two Sample Analysis Results

Experimental group **Word Identification Test**

Sample 1: Exp./ PREP. /Wd. Id.
Sample 2: Exp. /Non-PREP/Wd. Id.

		Sample 1 (PREP)	Sample 2 (Non-PREP)	Pooled
Sample Statistics:	No. of Observations	7	26	33
	Average	26.4286	42.037	38.8235
	Variance	113.952	260.883	233.334
	Std. Deviation	10.6748	16.1519	15.2753
	Median	30	50	38

Difference between Means = -15.6085

Conf. Interval for Diff. In Means:		95 Percent		
(Equal Vars.)	Sample 1 – Sample 2	-28.8085	-2.40842	32 D.F.
(Unequal Vars.)	Sample 1 – Sample 2	-26.5286	-4.68837	14.1D.F.

Ratio of Variances = 0.436795

Conf. Interval for ratio of variances:	95 Percent			
Sample 1 – Sample 2	0.148331	2.22647	6	26 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = -2.490915
Vs. Alt: LT Sig. Level = 0.0109596
At Alpha = 0.05 so reject HO.

Note: The variances of the two samples may be assumed equal.

Control Group **Word Identification Test**

Sample 1: Con./ PREP. /Wd. Id.
Sample 2: Con. /Non-PREP/Wd. Id.

		Sample 1 (PREP)	Sample 2 (Non-PREP)	Pooled
Sample Statistics:	No. of Observations	7	26	33
	Average	17.2857	42	36.9118
	Variance	91.2381	105.077	102 482
	Std. Deviation	9.55186	10.2507	10.1233
	Median	18	41	39.5

Difference between Means = -15.6085

Conf. Interval for Diff. In Means:		95 Percent		
(Equal Vars.)	Sample 1 – Sample 2	-33.4623	-15.9662	32 D.F.
(Unequal Vars.)	Sample 1 – Sample 2	-33.8943	-15.5342	9.9 D.F.

Ratio of Variances = 0.868298

Conf. Interval for ratio of variances:	95 Percent			
Sample 1 – Sample 2	0.294866	4.42598	6	26 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = -5.75593
Vs. Alt: LT Sig. Level = 1.10139E-6
At Alpha = 0.05 so reject HO.

Note: The variances of the two samples may be assumed equal. The result is highly significant.

Experimental Group **Word Attack Test**

Sample 1: Exp./ PREP. /Wd. At.
Sample 2: Exp. /Non-PREP/Wd. At.

		Sample 1 (PREP)	Sample 2 (Non-PREP)	Pooled
Sample Statistics:	No. of Observations	7	26	33
	Average	6.85714	17.4815	15.2941
	Variance	16.8095	103.49	87.2374
	Std. Deviation	4.09994	10.173	9.3401
	Median	8	19	12.5

Difference between Means = -10.6243

		95 Percent		
Conf. Interval for Diff. In Means:				
(Equal Vars.)	Sample 1 – Sample 2	-18.6955	-2.55314	32 D.F.
(Unequal Vars.)	Sample 1 – Sample 2	-15.7632	-5.48551	25.5 D.F.

Ratio of Variances = 0.162427

		95 Percent			
Conf. Interval for ratio of variances:					
	Sample 1 – Sample 2	0.0551586	0.827937	6	26 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = -2.6819
Vs. Alt: LT Sig. Level = 5.74091E-31.10139E-6
At Alpha = 0.05 so reject HO.

Note: The variances cannot be assumed equal. Reject the null hypothesis.

Control Group **Word Attack Test**

Sample 1: Con./ PREP. /Wd. Id.
Sample 2: Con. /Non-PREP/Wd. Id.

		Sample 1 (PREP)	Sample 2 (Non-PREP)	Pooled
Sample Statistics:	No. of Observations	7	26	33
	Average	7.14286	17.7037	15.5294
	Variance	13.4762	75.0627	63.5152
	Std. Deviation	3.67099	8.66387	7.96964
	Median	8	18	12.5

Difference between Means = -10.5608

		95 Percent		
Conf. Interval for Diff. In Means:				
(Equal Vars.)	Sample 1 – Sample 2	-17.4478	- 3.67392	32 D.F.
(Unequal Vars.)	Sample 1 – Sample 2	-15.0369	- 6.08477	24.2 D.F.

Ratio of Variances = 0.179533

		95 Percent			
Conf. Interval for ratio of variances:					
	Sample 1 – Sample 2	0.0609676	0.915131	6	26 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = -3.12429
Vs. Alt: LT Sig. Level = 1.88615E-3
At Alpha = 0.05 so reject HO.

Note: The variances of the two samples may not be assumed equal. Reject the null hypothesis.

For the *Word Identification* test, the variances could be assumed equal and the standard t-test was used, while the adjusted t-test was used for the *Word Attack* tests, where the variances could not be assumed equal.

CONCLUSION: All the null hypotheses were rejected in favour of the alternative hypotheses. We can conclude that the PREP group and the Non-PREP group do not have equal reading ability. The reading ability of the PREP group is significantly lower than that of the average group, since their performance was significantly weaker on both Woodcock Tests of Reading Mastery-R subtests.

RESULTS FOR HYPOTHESIS 3
PREP Experimental vs. Control

WORD IDENTIFICATION TEST – Two Sample Analysis Results

Sample 1: Exp. Word Ident. Post – Exp. Word Ident. Pre-
Sample 2: Con. Word Ident. Post – Con.Word Ident. Pre-

Sample Statistics:	No. of Observations	7	7	14
	Average	942857	2.14286	5.78571
	Variance	15.619	2.47619	9.04762
	Std. Deviation	3.95209	1.57359	3.00793
	Median	9	2	4

Difference between Means = 7.28571

Conf. Interval for Diff. In Means:		95 Percent		
(Equal Vars.)	Sample 1 – Sample 2	3.78171	10.7897	12 D.F.
(Unequal Vars.)	Sample 1 – Sample 2	3.56519	11.0062	7.9 D.F.

Ratio of Variances = 6.30769

Conf. Interval for ratio of variances:		95 Percent		
	Sample 1 – Sample 2	1.06642	37.309	6 6 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = 4.53147
Vs. Alt: LT Sig. Level = 3.43977E-4 so reject HO.
At Alpha = 0.05

Note: The variances of the two samples may not be assumed equal. There is a highly significant improvement in *Word Identification*.

WORD ATTACK TEST – Two Sample Analysis Results

Sample 1: Exp. Word Attack. Post – Exp. Word Attack. Pre-
Sample 2: Con. Word Attack. Post – Con.Word Attack. Pre-

Sample Statistics:	No. of Observations	7	7	14
	Average	8.57143	-0.714286	3.92857
	Variance	19.2857	7.90476	13.5952
	Std. Deviation	4.39155	2.81154	3.68717
	Median	10	0	2.5

Difference between Means = 9.28571

Conf. Interval for Diff. In Means:		95 Percent		
(Equal Vars.)	Sample 1 – Sample 2	4.99043 13.581	12 D.F.	
(Unequal Vars.)	Sample 1 – Sample 2	4.90544 13.666	10.2 D.F.	
Ratio of Variances = 2.43976				
Conf. Interval for ratio of variances:		95 Percent		
	Sample 1 – Sample 2	0.412481 14.4308	*6*	6 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = 4.71146
Vs. Alt: GT Sig. Level = 2.52148E-4 so reject HO.
At Alpha = 0.05

Note: The variances of the two samples may be assumed equal. There is a highly significant improvement in *Word Attack*.

CONCLUSION; The null hypotheses were rejected for *Speech Rate*, *Word Series*, *Word Identification* and *Word Attack*. This means that the PREP course improves the post-testing scores in these tests more than the regular classroom reading programme. We failed to reject the null hypothesis for *Naming Time*. The PREP and regular classroom input can be considered equal in improving *Naming Time*. The PREP improves successive processing and results in far transfer to reading ability.

RESULTS FOR HYPOTHESIS 4
Whole Language Experimental vs. Control

SPEECH RATE TEST – Two Sample Analysis Results

Sample 1: Exp. Syll. Pre. – Exp. Syll. Post.
Sample 2: Con. Syll. Pre. – Con. Syll. Post.

		Sample 1	Sample 2	Pooled
Sample Statistics:	No. of Observations	7	7	14
	Average	4	5	4.5
	Variance	2.33333	40	21.1667
	Std. Deviation	1.527539	6.32456	4.60072
	Median	4	2	3.5

Difference between Means = -1

Conf. Interval for Diff. In Means:	95 Percent		
(Equal Vars.)	Sample 1 – Sample 2	-6.3595 4.3595	12 D.F.
(Unequal Vars.)	Sample 1 – Sample 2	-6.87043 4.87043	6.7 D.F.

Ratio of Variances = 0.0583333

Conf. Interval for ratio of variances:	95 Percent		
	Sample 1 – Sample 2	9.8622E-3 0.345032	6 6 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = -0.406638
Vs. Alt: GT Sig. Level =0.654284
At Alpha = 0.05 so do not reject HO.

Note: The variances of the two samples may not be assumed equal. There is no improvement in *Speech Rate.*

WORD SERIES TEST – Comparison of Two Samples (Nonparametric)

Sample 1: Exp. Word Series Pre. – Exp. Post
Sample 2: Con. Word Series Pre. – Con. Post Test: Unpaired

Average rank of first group = 9.28571 based on 7 values
Average rank of second group = 5.71429 based on 7 values
Large sample test statistic z = -1.53333
Two-tailed probability of equalling or exceeding z = 0.125201

Note: 14 total observations
All 9 word series are taken into account. Improvement is not statistically significant.

NAMING TIME TEST – Two Sample Analysis Results

Sample 1: Exp. Naming Time Pre. - Exp. Naming Time Post
Sample 2: Con. Naming Time Pre. – Con Naming Time Post

Sample Statistics:	No. of Observations	7	7	14
	Average	37.8571	2.71429	20.2857
	Variance	1696.48	39.9048	868.19
	Std. Deviation	41.1883	6.31702	29.4651
	Median	20	3	7

Difference between Means = 35.1429

Conf. Interval for Diff. In Means:		95 Percent		
(Equal Vars.)	Sample 1 – Sample 2	0.818252	69.4675	12 D.F.
(Unequal Vars.)	Sample 1 – Sample 2	-2.99112	73.2768	6.3 D.F.

Ratio of Variances = 42.5131

Conf. Interval for ratio of variances:	95 Percent		
Sample 1 – Sample 2	7.18754	251.458	6 6 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = 2.23133
Vs. Alt: GT Sig. Level = 0.0227509 so reject HO.
At Alpha = 0.05

Note: The variances of the two samples may not be assumed equal. There is no improvement in *Naming Time*.

WORD IDENTIFICATION TEST – Two Sample Analysis Results

Sample 1: Exp. Word Ident. Post – Exp. Word Ident. Pre-
Sample 2: Con. Word Ident. Post – Con Word Ident. Pre-

Sample Statistics:	No. of Observations	7	7	14
	Average	11.8571	2.14286	7
	Variance	3.14286	11.4762	7.30952
	Std. Deviation	1.77281	3.38765	2.70361
	Median	12	4	8

Difference between Means = 9.71429

Conf. Interval for Diff. In Means:		95 Percent		
(Equal Vars.)	Sample 1 – Sample 2	6.56478	12.8638	12 D.F.
(Unequal Vars.)	Sample 1 – Sample 2	6.44739	12.9812	9.1 D.F.

Ratio of Variances = 0.273859

Conf. Interval for ratio of variances:	95 Percent		
Sample 1 – Sample 2	0.0463003	1.61983	6 6 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = 6.72203
Vs. Alt: GT Sig. Level = 1.0638E-5 so reject HO.
At Alpha = 0.05

Note: The variances of the two samples may be assumed equal. There is a significant improvement in *Word Identification*.

WORD ATTACK TEST – Two Sample Analysis Results

Sample 1: Exp. Word Attack. Post – Exp. Word Attack. Pre-
Sample 2: Con. Word Attack. Post – Con.Word Attack. Pre-

Sample Statistics:	No. of Observations	7	7	14
	Average	7.28571	1.28571	4.28571
	Variance	15.9048	5.90476	10.9048
	Std. Deviation	3.98808	2.42997	3.30224
	Median	7	2	3

Difference between Means = 6

Conf. Interval for Diff. In Means:		95 Percent			
(Equal Vars.)	Sample 1 – Sample 2	2.15314	9.84686	12	D.F.
(Unequal Vars.)	Sample 1 – Sample 2	2.06146	9.93854	9.9	D.F.

Ratio of Variances = 2.69355

Conf. Interval for ratio of variances:		95 Percent			
	Sample 1 – Sample 2	0.455388	15.9319	6	6 D.F.

Hypothesis Test for HO: Diff. = 0 Computed t statistic = 3.3992
Vs. Alt: GT Sig. Level = 2.63874E-3 so reject HO.
At Alpha = 0.05

Note: The variances of the two samples may be assumed equal. There is a significant improvement in *Word Attack*.

CONCLUSION: The null hypotheses for *Word Identification* and *Word Attack* were rejected but those for *Speech Rate*, *Word Series* or *Naming Time* were not. This means that the Whole Language programme resulted in improved reading scores on the WTRM-R significantly more than the regular classroom reading programme, while the improvements in the scores of the tests of successive processing were not significantly greater.

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