AN INVESTIGATION OF THE PASS MODEL AND DEPTH OF PROCESSING IN ADOLESCENTS WITH READING DIFFICULTIES

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ABSTRACT

The comprehension of text involves a number of psychological and cognitive processes such as perception, attention, memory, and learning (Pearson & Stephens, 1994). The purpose of the study was to investigate the relationships that exist between cognitive processing (e.g., PASS model) and depth of processing (e.g., surface or deep) in reading comprehension within a sample of adolescent students who exhibited reading difficulties.

The theoretical frameworks used in this study were the PASS model (Planning, Attention, Simultaneous and Successive processing) and a depth of processing model which dichotomized processing into two categories: surface or deep. These frameworks were contextualized within the reading comprehension domain.

Students with reading difficulties in grades 9 to 11 were selected for participation based upon teacher nomination procedures (n=84). As the raw scores for a number of measures used in this study could not be converted into standard scores, a random sample of students without reading difficulties in grades 9 to 11 (n=67) served as a comparison group for the purposes of data analysis. Both groups of students were administered a series of tasks designed to measure the PASS model components (e.g, two tasks for each component) as well as two subtests of the Woodcock Reading Mastery Test - Revised (Woodcock, 1987). Students with reading difficulties were asked to complete a questionnaire designed to measure depth of processing as a general approach to learning (e.g., Learning Process Questionnaire, Biggs, 1987). They were also asked to read a series of short passages and provide oral summaries in order to determine depth of

processing within reading comprehension specifically. In addition, a randomly selected subsample of students with reading difficulties (n=14) were asked to participate in a short interview in which a Miscue Analysis was conducted and several open-ended questions were asked regarding their approaches to reading comprehension.

Results of the study suggested that students with reading difficulties differed from students without reading difficulties on all PASS model components except for successive processing. Students with reading difficulties generally used surface strategies when learning although they identified a deep level of motivation. Within the context of reading comprehension, they identified a number of deep and surface level processing strategies although they applied predominantly surface level strategies when actually reading and comprehending text.

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DEDICATION

For my nieces, Carey and Ashley -

As women of the future -
May you be inspired by the accomplishments of
The women of the past and present.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

OVERVIEW OF THE STUDY

Introduction

The comprehension of text is a complex interaction between the reader and written language. In an effort to derive meaning from text, the reader employs a number of psychological processes such as perception, attention, memory, learning, purpose and motivation (Pearson & Stephens, 1994). Researchers within the last half of this century have examined the relationship between reading comprehension and psychological and cognitive processing theories in an attempt to understand these interactions better. These relationships have also been explored within special populations; of particular interest to researchers are the differences that exist between skilled and less skilled readers in terms of the proficiency with which they utilize specific cognitive processes.

A theory of cognitive processing which has been explored regarding its applicability to reading is the PASS model. PASS is an acronym for Planning, Attention, Simultaneous and Successive processing. The PASS model has neuropsychological underpinnings; cognitive processing is viewed as "the result of the interdependent functioning of three neurological systems, those responsible for arousal (and attention), processing (or coding), and planning" (Kirby & Das, 1990, pp. 320, 321). Generally speaking, attentional systems are responsible for directing an individual toward the salient features of a task. The processing or coding system is comprised of two types of integrative activities: simultaneous

and successive processing. Simultaneous processing involves an integrative function in which information is viewed wholistically whereas successive processing involves the sequencing of information using temporal order links. Planning, as the third system, is the executive functioning component and involves setting goals, selecting strategies for task completion, and monitoring behavior (Das, Naglieri, & Kirby, 1994).

The relationships between the PASS model and the reading process have been examined in the research literature, particularly with younger readers (e.g., Boden & Kirby, 1995; Das, Mensink, & Mishra, 1990; Cummins & Das, 1977; Parrila & Papdopoulos, 1996). Word attack skills and word level reading are related to successive processing whereas the comprehension of written material is related to simultaneous processing (Kirby, Booth, & Das, 1996). Less skilled readers have been shown to demonstrate difficulties in applying their successive processing skills to reading (e.g., Boden & Kirby, 1995; Das, Mishra, & Kirby, 1994; Kirby et al., 1996). Difficulties in planning have also been evident in children with reading comprehension deficits (Das et al., 1994).

An alternative way of conceptualizing cognitive processing arises from the literature on cognitive approaches to learning. According to these theoretical models (e.g., Biggs, 1984), individuals can engage in one of two levels of processing: deep or surface. The level of processing implemented by the individual may be due to personological factors (e.g, learning style) or contextual factors (e.g., reading comprehension). Within reading, a deep level of processing

is employed when the reader attempts to extract meaning from text in a purposeful manner (e.g., focussing on main ideas; connecting new information with prior knowledge) (Kirby & Woodhouse, 1994). A surface level of processing, however, is characterized by a linear approach to understanding text in which factual recall is emphasized at the expense of more in depth understanding (Stein & Kirby, 1992).

There is also preliminary evidence that an individual's learning approach (e.g., depth of processing) is related to several PASS model components, namely, simultaneous and successive processing. For example, Biggs and Kirby (1984) found that students who differed in their cognitive abilities (as measured by simultaneous and successive processing tasks) also differed in how they approached a learning task. Students who possessed both high levels of simultaneous and successive processing also used deeper levels of processing in task completion.

Purpose of the Study

A number of studies have investigated the relationships between reading processes (e.g., reading comprehension) and PASS model components in beginning readers with reading difficulties (e.g., Beggs, Kirby, & Martinussen, 1996; Kirby, Beggs, & Martinussen, 1995; McRae, 1986). Few published research studies to date, however, have examined the PASS model in samples of adolescents or adults with reading difficulties although these individuals continue to demonstrate deficiencies in phonological awareness and/or comprehension of

written material (Bell & Perfetti, 1994; Pratt & Brady, 1988). As well, there is little, if any, information available regarding the learning approaches which adolescents with reading difficulties typically employ, particularly when attempting to comprehend text. The interrelationships among all PASS model components, deep and surface levels of processing, and text comprehension in adolescents with reading difficulties have not been explored in the research literature although these variables are important components in both the assessment and remediation of reading problems. The purpose of the present research study was to explore the relationships among these constructs.

Areas of Research Inquiry

The relationships among the PASS model components and depth of processing in reading comprehension in adolescents with reading difficulties have not been well substantiated within the theoretical and empirical research literature. As hypotheses statements generally require substantial theoretical and/or research underpinnings, a more tentative line of inquiry (e.g., non-directional research questions) was developed to guide the investigation. The formulation of questions was also considered appropriate as this study was primarily descriptive in nature (Borg & Gall, 1989).

The study was guided by the following areas of research inquiry:

1. How are planning, attention, simultaneous and successive processes manifested in adolescent learners with reading difficulties?
2. What kind(s) of cognitive approach(es) do adolescents with reading difficulties

use when reading?

3. What is the relationship between PASS Model components and cognitive approaches in adolescents with reading difficulties?

Significance of the Study

This study was designed to provide new information regarding the cognitive processes and learning approaches specific to reading comprehension which adolescents with reading difficulties employ.

The PASS model was used as the theoretical framework for describing cognitive processing. While a number of studies have provided descriptions of the manifestation of planning, attention, simultaneous and successive processing in students with reading disabilities, much of the research has sampled younger readers (e.g., elementary school age children). Also, many previous studies have employed IQ - achievement discrepancy-based diagnoses for selecting participants with reading difficulties. In this study, the adolescent sample was selected on the basis of teacher nomination rather than *a priori* diagnoses of reading disability. As such, the description of adolescents with reading difficulties encompassed a broader range of performance deficits in both reading comprehension and phonological processing.

Depth of processing (e.g., surface versus deep) was also investigated in this study. Depth of processing has been examined in previous research studies using one of two approaches: (a) a description of depth of processing as a predispositional construct (e.g., individual differences in the likelihood of using a

deep or surface approach) or (b) specific context-based strategies (e.g., deep level approach evident in integrated summary of a reading passage). This research study incorporated both approaches using (a) a norm-referenced measure to assess depth of processing as a predispositional construct and (b) a criterion-referenced measure to determine the specific strategies used in reading comprehension.

This study produced descriptions of cognitive functioning and depth of processing in adolescents with reading difficulties. These descriptions may enhance educators' understanding of the cognitive processing profiles and cognitive approaches of students with reading difficulties. As well, they may facilitate the identification of students' strengths and weaknesses in cognitive processing and depth of processing pertaining to reading comprehension.

Limitations and Delimitations of the Study

Since norms were not available for most of the PASS model tasks when the study was conducted, a group of students without reading difficulties was selected randomly to serve as a reference group for the purposes of determining the performance parameters of students with reading difficulties. The selection procedures used in the study attempted to ensure that the reference group was representative of a normal sample of students; however, the lack of norms made it difficult to ensure that these students' scores on the PASS model tasks were within the average to above average range.

The overall sample size was somewhat small (e.g., 84 students with reading difficulties; 67 students without reading difficulties) and an unequal

number of boys and girls participated in each of the two groups in the study. As gender differences were investigated in the study, caution must be exercised regarding the interpretation of results given the small and unequal group sizes.

Several of the instruments used in the study (e.g., *Learning Process Questionnaire*) lacked strong empirical support (e.g., reliability and validity data). Results of the study pertaining to student performance on these instruments must be regarded as preliminary findings.

The study was delimited to students exhibiting reading difficulties as identified by their classroom teachers using a set of selection criteria. Although several subtests of a standardized reading test were administered to the students subsequent to the initial selection procedure as an additional validity check, none of these students had previous formal diagnoses of reading disabilities (e.g., assessment results based upon IQ-achievement discrepancy scores).

CHAPTER TWO

LITERATURE REVIEW

Introduction

In order to orient the reader to the constructs which were investigated in the present study, the following conceptual models and frameworks will be described: PASS model, depth of processing models (e.g., generalized learning approaches and approaches specific to reading comprehension), and models of reading processes. The interrelationships among the constructs will also be explored; particular attention will be paid to the theoretical and empirical applications of these constructs to reading comprehension. A section on reading disabilities is included in order to provide a basis for the description of the sample of students used in this study.

The PASS Model

Historical Development

Intelligence, as an area of study within the domain of psychology, has been viewed through a number of conceptual lenses. Both atheoretical (e.g., psychometric) and theoretical descriptions of intelligence have been posited, although historically, the focus has been upon the actual measurement of the construct. Within the early part of the 20th century, both the popularity of behavioral views on intelligence and the pragmatic concerns of applied psychology (e.g., tests required for selection purposes) resulted in the development of tests based primarily upon psychometric considerations (Das et

al., 1994). Since the 1950's, new and alternative views of intelligence have been developed which are reflective of cognitive theory. The advancement of cognitively-based approaches in the study of intelligence within the last thirty years has produced a greater emphasis upon both processes and functions. Although proficiency in these processes implies intelligent functioning, the processes themselves are of interest to applied psychologists as they may provide the framework for understanding concomitant difficulties in achievement. The PASS (Planning, Attention, Simultaneous and Successive processing) model was designed to provide information regarding an individual's cognitive processes.

The development of the PASS model can be traced directly to the work of Luria (1966) and indirectly to the theoretical perspectives of Spearman (1927) and Thurstone (1947). Both Spearman and Thurstone suggested that human abilities have general physiological underpinnings. Luria, on the other hand, linked cognitive processing specifically to cortical functioning. According to Luria, two types of integrative activities - simultaneous and successive processing - are conducted by the cerebral cortex. Research findings with individuals with lesions in the left cortical hemisphere led Luria to conclude that simultaneous processing was compromised if lesions were found in the occipital-parietal area whereas successive processing was disturbed if lesions were found in the fronto-temporal area of the cortex (Luria, 1966). Simultaneous and successive processing are described by Luria as two types of analyzers responsible for the synthesis of information into a variety of forms. Simultaneous processing involves the

"synthesis of separate elements into groups, these groups often taking on spatial overtones" (Das, Kirby, & Jarman, 1975, p. 89). The interrelatedness of the elements makes simultaneously processed information surveyable and "accessible to inspection either through examination of the actual stimuli during the activity [direct perception] . . . or through memory of the stimuli [mnestic processes]" (Das et al., 1994, p. 15). Simultaneous syntheses also occur within complex cognitive processes; the systems of relationships are represented simultaneously in order to facilitate surveyance. Successive processing, on the other hand, involves the sequential processing of information as the system of relationships is not completely surveyable at any time. Successive processing also involves perceptual, conceptual, and mnestic processes (Das et al., 1975; Mishra, 1983). The demands of the task determine the way in which information is processed (e.g., simultaneous or successive) rather than the modality, task content or method of presentation (Das et al., 1994).

According to Luria's conceptualization of cortical functioning, the brain has three major functional units which are linked to simultaneous and successive processing. Each unit is controlled by three hierarchically arranged cortical zones (primary, secondary, and tertiary). Primary zones are those in which information is received, secondary zones are responsible for processing information, and tertiary zones involve the most complex forms of thinking and "require the concerted participation of many cortical areas" (Das et al., 1979, p. 37). The first functional unit is comprised of arousal and attention. The arousal component is

"important because it provides the opportunity for the voluntary action of attention" (Das, et al., 1994, p. 13). Attention, as a voluntary act, can be classified within two hierarchical categories. Firstly, it can defined as selective or sustained. Selective attention, which is of particular relevance to the PASS model, can be further divided into two categories: divided or focussed. Focussed attention is considered to be the ability to focus on stimuli which are relevant and to ignore stimuli which are irrelevant. Alternatively, divided attention refers to the ability to perform several tasks without losing efficiency (Das et al., 1994). The second functional unit is that of input, recoding, and storing information. Both simultaneous and successive processing are intricately linked with this unit as most of cognitive processing occurs here (Das et al., 1994; Mishra, 1983). The third unit is dependent upon the first two functional units and is responsible for the development, implementation, and monitoring of action plans and programs of behavior (Das et al., 1994).

Das et al. (1975) extended Luria's work by developing a cognitive model that incorporates the four basic components of information processing: input, sensory register, central processing unit, and output (see Figure 1).

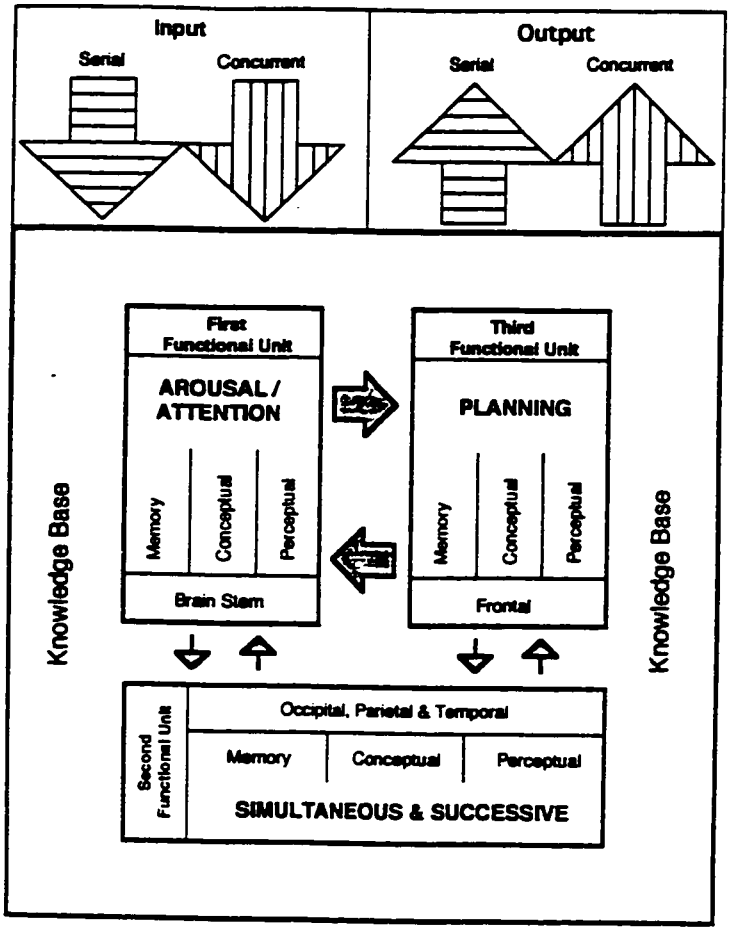

Figure 1

PASS Model Components

Note: Taken from *Assessment of Cognitive Processes: The PASS Theory of Intelligence* by J.P. Das, J.A. Naglieri, & J.R. Kirby, 1994, Needham Heights, Mass: Allyn & Bacon.

According to Das et al. (1975), stimuli may be presented to any of the receptors: exteroreceptors, interoceptors, and proprioceptors. Within the exteroreceptors, one or several sensory modalities may be used. As well, input may be either simultaneous or successive. Once the input is registered, it is transmitted to the central processing unit. Similar to Luria's conceptualization of cortical functioning, the central processing unit is comprised of three components: (a) simultaneous processing, (b) successive processing, and (c) planning and decision-making.[1] Each of these components involve the mental processes of memory, perception, and understanding of conceptual relationships. The output component is involved in determining and organizing performance according to task requirements. Both simultaneous and successive processing may be involved in performance output.

All cognitive processes function within the context of, and are mediated by, an individual's knowledge base. Knowledge can be acquired either formally or informally; "[f]ormal knowledge is that acquired through instruction or reading; informal knowledge is that obtained by one's experiences" (Das et al., 1994, p. 19).

[1]Subsequent descriptions of the model (e.g., Das et al., 1994; Naglieri & Das, 1988) have included attention/arousal as a functional unit which is more closely aligned with Luria's work.

Four Components - Planning, Attention, Simultaneous and Successive Processing

The PASS model, the cognitive processing derivative of Luria's neuropsychologically-based model, has been researched extensively within the last few decades. Numerous experimental tasks have been used to assess each of the components - planning, attention, simultaneous and successive processing. Initially, research efforts were focussed primarily on simultaneous and successive processing; subsequent studies have addressed the planning (and to a lesser extent, attention) components.

Planning

The construct of planning has been researched extensively within the areas of cognitive and neuropsychology; however, different definitions have been used to understand the construct thus making it difficult to compare results across studies (Parrila, Aysto, & Das, 1994). Within the PASS model, planning has been defined within a functional rather than ability-oriented framework. Planning is viewed as "a process, a system of functions which arises in response to a need, and can change as the situation demands" (Das, 1980, p. 142). Planning involves a series of executive functions such as task analysis which may involve attentional, simultaneous, and successive processes, the determination of the need for a plan, the construction of a plan, the revision of the plan (if necessary), and the implementation of the plan. The plan is continually monitored (e.g., modification of the plan) until the task is completed (Das et al., 1994). For example, commerically produced games such as Master Mind require the

development, implementation, and monitoring of strategies and plans in order for successful completion (Das, 1984).

As an extension of the PASS model definition, planning may be conceptualized as a composition of three levels of analysis: activity, action, and operation (Parrila et al., 1994). Within the activity level, planning may be used to explain an individual's general behavior as it pertains to the attainment of life goals and motives (e.g., education; self-improvement). As an action, planning may be viewed as problem-solving behavior, in particular, the realization of a specific goal or solution to a particular problem. The operation level of planning involves the development of strategies and tactics within task-imposed constraints. Both the action and operation levels of analysis are incorporated into the PASS model's definition of planning; both action and operation levels have been assessed most frequently when measuring the construct of planning.

Research on planning has also demonstrated that planning is a developmental construct; simple planning tasks may be demonstrated by young children whereas more complex tasks may require levels of performance that can only be evidenced by adolescents or adults (Parrila et al., 1994). Kreitler and Kreitler (1987) articulated four major developmental trends: (a) planning is initially constrained to routine actions (e.g., eating; sleeping) and then expands to include other domains (e.g., actions performed under special conditions), (b) planning is viewed initially in immediate terms (e.g., immediate future) and over time includes long-range planning (e.g., far future), (c) the beneficiaries of

planning shift from an egocentric focus to a social and societal one; and (d) simple plans are replaced by more complex plans requiring greater complexity in mental processing. The ability to mentally construct appropriate subgoals (also described as depth of search) in order to accomplish complex goals is a developmental characteristic of older children (De Lisi, 1987). These trends are in keeping with the neuropsychological view of cortical development - the frontal region in the prefrontal cortex is responsible for planning and is the last to develop physiologically (Das, 1980).

Numerous tasks have been used to assess the planning component of the PASS model. Tasks such as the *Visual Search Task, Trail-Making Test, Verbal Fluency Test, Planned Composition, Porteus Maze Test*, and *Matching Familiar Figures Test* were used in early research (e.g., Ashman, 1978) to determine whether planning was distinct from coding - simultaneous and successive processing. According to the results of the factor analyses conducted in these early research studies, planning could be differentiated from simultaneous and successive processing. Subsequent studies (e.g., Naglieri & Das, 1988; Naglieri, Prewett, & Bardos, 1989) have published similar results thus validating the use of these tasks when measuring planning. Derivatives of these tasks (e.g., *Matching Numbers, Visual Search*, and *Planned Codes*) have been developed for inclusion in the *Das-Naglieri Cognitive Assessment System - CAS* (Das & Naglieri, 1997) and have loaded on the planning factor as well (Naglieri et al., 1989).

Although planning has been measured separately from other cognitive

processes, it can be predicted by performance on simultaneous and successive processing and attention tasks. Greater proficiency and competency on attention, simultaneous and successive processing tasks will enhance the knowledge base with which to process information and will ensure that a greater number of cognitive resources will be allocated to planning (Parrila et al., 1994). Planning and self-awareness pertaining to one's knowledge base have been shown to predict student achievement (Sink, Barnett, & Hixon, 1991). High achieving students were found to use self-regulated learning strategies (comprised of planning, self-monitoring, and self-awareness) more often than low achieving students (Zimmerman & Martinez-Pons, 1988). The relationship between planning and reading disabilities has been explored within the recent research literature. For example, Kirby et al. (1996) investigated differences in PASS model performance among two groups of middle years students. One group was identified as having reading disabilities and a second group was selected as a control (n=30 students in each group). Results of the study indicated that average-IQ children with reading disabilities differed from their non-disabled peers on planning and attention, as well as both simultaneous and successive processing.

Attention

Attention and arousal are closely associated within the PASS model. According to Luria's conceptualization of cortical functioning, arousal is influenced by an individual's metabolic processes, orienting response to external stimuli and internal sources of stimuli. Attention, however, is primarily

influenced by an individual's responses to internal and external stimuli (Das et al., 1994). Within a neuropsychological framework, arousal may be construed as "subcortical whereas attention is also partly controlled by the cortex, especially by the frontal lobe" (Das et al., 1994, p. 33). Arousal is a generalized state of alertness; attention, on the other hand, is viewed as a specific state of alertness. Attention is comprised of two types: sustained and selective attention. Sustained attention (or vigilance) is defined as the "maintaining of attention to a single source of information for an unbroken period of time" (Parasuraman, 1984, p. 243). Sustained attention is influenced by the length of task and the frequency with which a signal or stimuli is presented; the longer an individual is required to attend to the periodic presentation of a signal, the less efficient an individual will become in detection accuracy and speed (Parasuraman, 1984). Selective attention is either divided or focussed. Divided attention tasks require the individual to attend to two or more sources of information as stimuli may be presented either simultaneously or successively. Focussed attention tasks are those which require the individual to focus on one information source and reject irrelevant kinds/sources of information. Selective attention may also be viewed as either expressive or receptive depending on task demands. Expressive selection occurs at the time in which a response is required whereas receptive selection occurs when stimuli are received and encoded (Das et al., 1994; Schneider, Dumais, & Shiffrin, 1984).

Developmental trends in attention have been noted in the research

literature. Lupart and Mulcahy (1984) found that, as children get older, they are able to increase their time on task and are able to focus on the most salient aspects of the task, they are able to develop and implement better and more systematic strategies for acquiring visual information (e.g., visual scanning), and they show increasing speed in the completion of visual search tasks.

Most tasks which have been used to assess attention within the PASS model paradigm have focussed upon selective attention (expressive and receptive). Selective attention tasks may require the individual to select items based on (a) memory, that is, category detection or name identification (e.g., Aa are the same; Ab are not); or (b) data, namely, physical identification (e.g., AA are the same; AB are not) (Das et al., 1994). Types of selective attention tasks which have been used in confirmatory factor analyses of the PASS model are variations of the *Stroop* test (expressive attention) and *Posner* tasks (receptive attention). These tasks assess three essential and "distinct components: selectivity, resistance to distraction, and shifting or switching strategies" (Das et al., 1994, p. 38). Sustained attention tasks suggested by Das et al. (1994) incorporate characteristics important in measuring this construct such as a prolonged length of time in which a target must be identified and the presentation of the target at irregular intervals. Selective attention, as measured by the PASS model tasks, is associated with reading. Children with reading disabilities have been shown to demonstrate deficiencies in both receptive and expressive selective attention. To illustrate, a study was conducted by Das (1993) in which the performances of two groups of

readers (70 average readers in grades 3 and 5; 15 reading disabled readers in grade 5) were compared on two attention tasks: one expressive attention task and one receptive attention task. Children with reading disabilities in grade 5 were shown to demonstrate deficiencies on both attention tasks as compared to their grade 5 non-disabled peers although their performance was comparable to the grade 3 non-disabled students.

Simultaneous and Successive Processing

Simultaneous and successive processing are regarded as two types or categories of processes in the integration of information. According to Luria's conceptualization of cortical functioning, these processes are located in the posterior cortex: simultaneous processing is located in the parieto-occipital regions whereas successive processing is a function of the frontal and frontotemporal regions (Das & Molloy, 1975; Kirby & Das, 1990). As complementary processes, simultaneous and successive processes function cyclically. For example,

> [p]rocessing may begin 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 recognized and encoded (simultaneous); these newly encoded units (letters) can also be held in order (successive) so that higher level units (words) can be encoded (simultaneous) and so on. (Kirby & Das, 1990, pp. 321-322)

Both types of processes can involve varying levels of complexity (e.g.,

sounds versus concepts) and different kinds of code content (e.g., verbal versus spatial) (Das et al., 1994; Kirby & Das, 1990). As well, they are related to different kinds of working memory operations. Information may be held in working memory through successive processing while simultaneous processing may be involved in combining and relating information units into new units (Kirby & Das, 1990). Within long term memory, information may be coded either successively (e.g., temporally ordered units) or simultaneously (e.g., meaningfully-integrated units).

According to Das et al. (1994), simultaneous and successive processing can be differentiated from each other. Simultaneous processing involves the integrative relationship among units of information (e.g., geometric pattern) whereas the only relationship among information units in successive processing (or coding) is a temporal or sequential one. Understanding relationships in simultaneous coding is dependent upon information stored in long term memory and, as a holistic unit, takes up only one space in working memory. Successive codes, on the other hand, take up the same amount of space in working memory as the units they comprise. These codes, however, can become automatized and may be executed in such a way that the demands on working memory are minimized. Information which is originally coded simultaneously may be lost or "mixed up"; however, the sequence of successive coding units must be retained in order to be executed appropriately.

Experimental simultaneous coding tasks which have been used in

numerous studies include the following: *Raven's Colored Progressive Matrices* and *Matrix Analogies Test* (conceptual level tests), *Figure Copying* (perceptual level task), and *Memory for Designs* (mnestic level task). Successive processing tasks include *Digit Span* (Wechsler subtest), *Word Recall*, and *Sentence Repetition*. All of these tasks are mnestic-type tasks (Das, 1984; Naglieri, Das, Stevens, & Ledbetter, 1991).

As simultaneous and successive processing have been studied most extensively within the PASS paradigm, a plethora of research exists to support these two constructs. Research findings have demonstrated that these processes may be developmental; for example, Das and Molloy (1975) presented findings that indicate young children demonstrate strategy ambivalence on tasks which typically load on either simultaneous or successive processes in older children and adults. Numerous studies have also been conducted in cross-cultural settings (e.g., Kirby & Robinson, 1987; Krywaniuk & Das, 1976; Leong, Cheng, & Das, 1985) and with special populations (e.g., learning disabled, hearing impaired, and mentally retarded) (Das & Malloy, 1975; Kirby, 1992). In addition, research has demonstrated that both simultaneous and successive processing are related to reading and mathematics achievement (e.g., Kirby & Das, 1977; Kirby et al., 1995; Parrila & Papdopoulos, 1996). For example, Kirby and Das (1977), in a study conducted with fourth grade boys (n=104), found that both simultaneous and successive processing abilities were related to reading achievement (vocabulary and comprehension as measured by the *Gates-MacGinite* reading

test). Within the reading domain, Kirby et al. (1996) suggested that simultaneous processing (and planning) are associated with reading comprehension and higher level skills whereas successive processing (and attention) are affiliated with word attack and decoding skills.

PASS Model Critique

The PASS model has been critiqued on both theoretical and psychometric grounds. According to its authors, the PASS model is a new theory of cognitive processing. Carroll (1993), however, identified several ways in which the PASS model may be regarded as a revisitation of several historical theories of intelligence which are based upon three hierarchical levels: a general factor, several broad factors (e.g., fluid and crystallized intelligence), and a large number of narrow factors. For example, Carroll (1993) asserted that both the simultaneous and successive processing components may be regarded as broad factors (e.g., visual perception and memory) within a three level theory.

According to the theory, the four components (planning, attention, simultaneous and successive processing) of the PASS model are regarded as distinct (albeit related) constructs which do not reflect a general ability factor or "g" (Das et al., 1994). A review of the research literature, however, provides evidence that these four components are correlated. These findings, in turn, create difficulty when interpreting these components. According to Carroll's (1995) attempts at verifying the factor structure of the PASS model, a general factor, or 'g', was evident in several of the factor models he used. In addition, the two

components of planning and attention were virtually indistinguishable and "it might be concluded that Planning and Attention as measured here [were] . . . not separate factors, even though they may indeed be separate processes that could be measured separately by appropriate tests other than those used" (Carroll, 1995, p. 401). Carroll's findings suggested that the subtests used in some of the previous research did not appear to measure the theoretical component (e.g., the theory lacked construct validity).

A critique of the PASS model can also be made regarding the *Cognitive Assessment System* (Das & Naglieri, 1997), the test designed to measure planning, attention, and simultaneous and successive processing. The test allows for the computation of a general or composite score, calling into question the theoretical premise upon which the test is based. As well, the results of the exploratory factor analysis (e.g., principal components, principal factor, and maximum-likelihood methods) conducted on the standardization sample (using four age groupings) indicated that a three factor solution was the most suitable: planning/attention, simultaneous processing, and successive processing. Alternatively, confirmatory factor analysis, conducted with the standardization sample (using four age groupings), resulted in a four factor solution (planning, attention, simultaneous processing, and successive processing).

Although the PASS model has received criticism regarding the verification of its theoretical tenets using factor analysis, it has merit as a theoretical model which attempts to describe the processes of cognition. Caution, however, must be

exercised in the interpretation of the research findings pertaining to the model given the difficulty in discriminating clearly among the components.

Gender Differences and the PASS Model

Gender differences have been examined within the cognitive processing research literature. Although the findings are varied, sex differences seem to exist in tasks involving mental rotation (e.g., males perform better than females), verbal fluency (e.g., females perform better than males), and some quantitative abilities (e.g., females perform better than males prior to adolescence; males perform better than females after adolescence) (Halpern, 1997; Neisser et al., 1996; Pressley & McCormick, 1995).

There is some preliminary evidence that gender differences exist on several of the PASS model components. Early research on simultaneous and successive processing indicated that gender differences may exist as a function of developmental and maturational considerations. For example, Randhawa and Hunt (1979) found that pre-adolescent females performed better than males on visual-verbal tasks. These differences may have been attributable to the fact "that girls show earlier and stronger lateralization of speech, motor, and sense functions compared to boys" (p. 352). McCallum and Merritt (1983) investigated differences in simultaneous and successive processing in a group of college students. They found similar simultaneous and successive processing factor solutions for both men and women. Gender differences on all PASS model components have been investigated within the last several years. Bardos,

Naglieri, and Prewett (1992) found that girls and boys performed similarly on simultaneous, successive, and attention tasks but performed differently on planning. In both samples of students (434 students in grades 2, 6, 10 and 110 students in grades 4, 5), girls in the middle school years (grades 4, 5, and 6) performed better on planning tasks (e.g., *Trails, Visual Search*, and *Matching Numbers*) than their male counterparts. A similar study examined gender differences in a sample of students in grades 3, 6, and 9 (Warrick & Naglieri, 1993). Results of this study indicated that girls in grade 3 outperformed their male counterparts on attention tasks and girls in grade 6 performed better than the boys in grade 6 on the planning tasks. No differences were found between boys and girls at any age on the simultaneous or successive processing measures.

Although tentative, the results of these studies suggest that gender differences in some of the PASS model processes may follow a developmental trend. That is, girls may develop proficiency in these processes more quickly than boys and as a result, may perform better on specific tasks at younger ages than their male counterparts. By adolescence, these gender differences may be ameliorated (Warrick & Naglieri, 1993). As well, girls' proficiency on specific tasks (e.g., planning) may be related to differences in reading performance (e.g., higher identification rate of boys than girls with reading difficulties) (Bardos et al., 1992).

Reading Comprehension Processes and the PASS Model

The Reading Comprehension Process

Numerous theoretical models of the reading process have been developed within the domain of cognitive psychology (e.g., Just & Carpenter, 1987; Carr, Brown, Vavrus, & Evans, 1990). Within each of the models, there is a recognition of the precursor skills to reading (e.g., oral language proficiency, minimal attentional capacity to attend to visual stimuli, understanding of association between oral language and written text, perceptual recognition) (Layton, 1979). Within all of the models, there is also an acknowledgment that reading comprehension is comprised of a complex interplay of reading processes. According to Just and Carpenter (1987):

> Reading comprehension consists of several levels of representation and their associated processes, including perceptual processes to encode words, lexical processes to access word meaning, syntactic and semantic processes to organize word meanings into larger units such as phrases and clauses, and processes to construct a representation of the story or text, as well as the events and objects it describes. (pp. 17-18)

These processes are strategically based; that is, they are applied by the reader in a heuristic fashion in an effort to obtain meaning from text. The application of a particular process (or strategy) is based upon text cues; successful prior applications of a particular process in similar contexts may also influence the selection of a particular process (Kintsch, 1982).

Each of the processes, or components, in reading comprehension can be regarded as hierarchically interrelated but discrete. For example, phonological processing skills are viewed as distinct from semantic processing; however, they interact to promote understanding of text (Carr et al., 1990). Some of the processes can be automatized through practice (e.g., word decoding skills) thus allowing the reader to execute these processes in parallel.

Processes which construct representations in text can be classified into three categories: (a) literal comprehension skills, (b) interpretive skills, and (c) evaluation skills (Zintz, 1980). Literal comprehension skills can be described as the categorization of words and the recognition of the sequence of ideas in a sentence. Skilled readers are able to "recognize the multiple meanings of words and readily shift to a new definition when one meaning does not fit the schematic structure" (Robeck & Wallace, 1990, p. 357). Interpretive skills refer to the reader's interpretation of the interaction in text between actions, events, and objects. These skills are involved in making predictions when reading text and drawing inferences and making generalizations. Evaluation skills are higher level skills; examples of these skills include the evaluation of text as fact versus fancy and judging author's intent or emotional response to material) (Zintz, 1980).

Relationship between Reading Processes and the PASS Model

Reading processes have been conceptualized as complex, hierarchical, and interactive, and the cognitive coding systems of simultaneous and successive processing are involved at each level of processing as "items of information are

recognized (simultaneous processing) and ordered (successive processing), so that higher-level units can be recognized (simultaneous processing)" (Das et al., 1994, p. 60). Generally speaking, simultaneous processing is more strongly associated with comprehension whereas successive processing is more strongly related to word decoding (Kirby & Das, 1990; Kirby & Williams, 1991).

Recent research focussing on early reading skills has demonstrated that all four components of the PASS model (planning, attention, and simultaneous and successive processing) are associated with the acquisition of reading skills (Kirby et al., 1996; Parrila & Papadopoulos, 1996). In young readers, the strongest association has been demonstrated between successive processing and phonological processing. In older students (e.g., middle years and high school students), "simultaneous processing . . . [is] involved in direct lexical access and semantic processing, and successive processing in graphophonic decoding and syntactic analysis" (Kirby & Robinson, 1987, p. 249). In fact, reading achievement in older students is associated with proficiency in all of the four PASS components as poor readers can be discriminated from proficient readers on planning, attention, and simultaneous and successive processing (Kirby et al., 1996).

Proficiency, or successful performance, in domains such as reading and mathematics may also be contingent upon individual characteristics. For example, the utilization of either simultaneous or successive processing is dependent upon both task demands and individual preferences (e.g., habitual

mode and competence) in problem-solving approaches (Das, 1984; Das & Molloy, 1975). In reading, proficiency is associated with high levels of simultaneous and successive processing as well as skill in the selection of appropriate task strategies and approaches (Biggs & Kirby, 1984).

The selection of particular cognitive strategies may also be characteristic of an individual's general approach; for example, an individual may use a particular approach to reading comprehension regardless of the text genre (e.g., narrative or expository) or ambiguity of the text. As a result, this general approach may be more or less effective in different contexts. Alternatively, specific strategies may be selected by individuals based upon their perceptions of task demands and may change as a function of the perceived outcome requirements (Marton & Saljo, 1976a, 1976b).

Model of Academic Performance - Levels of Processing Framework

In order to understand the relationship between cognitive processing, strategy implementation, and learning or performance outcomes (e.g., reading achievement), a model of academic performance has been posited by Biggs (1984).

The model of academic performance developed by Biggs (1984) has, as a central tenet, the construct of strategy. Strategy, according to Biggs, is defined in terms of the different procedures and operations that individuals may use to procure, remember, and recall different kinds of knowledge. As illustrated in Figure 3, strategies mediate "between personological and situational variables on

the one hand and performance on the other" (Biggs, 1984, p. 112). Different types of strategies exist and may be conceptualized as either macrostrategies, mesostrategies, or microstrategies. Macrostrategies refer to "the general way in which a student will order and relate data in the face of particular tasks" (Biggs, 1984, p. 115). They are considered to be "distant" from specific tasks and are less amenable to teaching; however they do influence the selection and implementation of both meso- and microstrategies. Examples of these types of strategies are metacognitive functions (e.g., planning). Mesostrategies are "the way in which a person goes about the task" (Biggs, 1984, p. 112). Strategies which are developed using simultaneous and successive processing serve as examples of mesostrategies.. Surface and deep level processing strategies are also exemplars of this construct and will be discussed in greater detail in the following section. Microstrategies are those strategies most closely tied to the task itself. They are highly amenable to teaching within particular contexts and are easily transferable from one task to another when the task demands are similar.

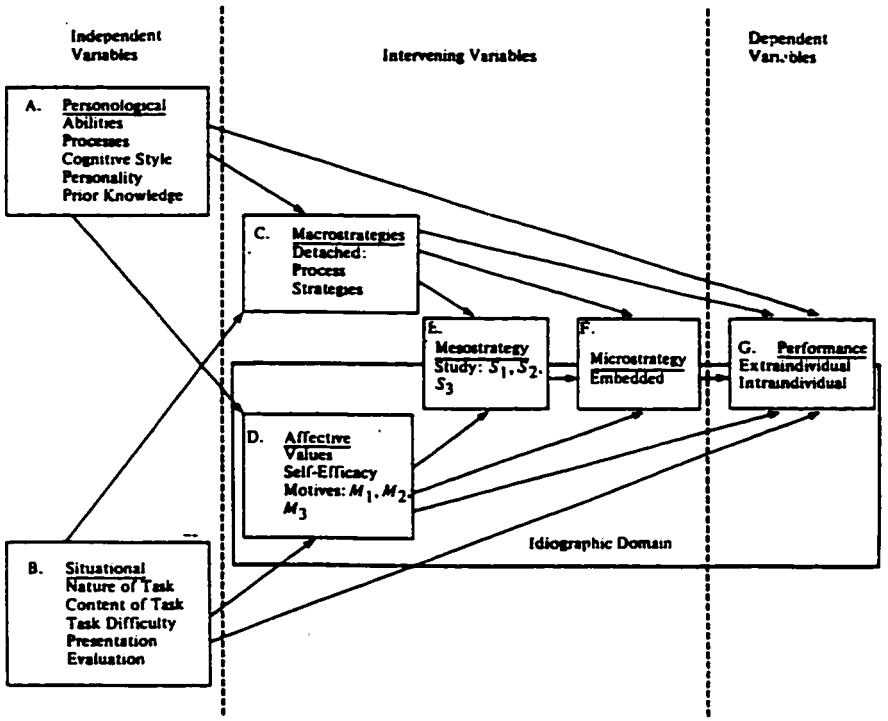

Figure 2

Model of Academic Performance - Levels of Processing Framework

Note: Taken from "Learning Strategies, Student Motivation Patterns, and Subjectively Perceived Success" by J.B. Biggs in *Cognitive Strategies and Educational Performance*, 1984, London: Academic Press.

The exogenous variables within this framework - personological and situational - influence the selection and implementation of strategies. Personological variables have been studied extensively in psychological research (e.g., personality, abilities, prior knowledge). Situational variables are task-specific and refer to the nature, content, and difficulty level of the task. In addition to influencing all three types of strategies, both personological and situational factors have an impact upon the affective component of performance; that is, an individual's motivation, feelings of self-efficacy and personal belief systems (e.g., values) (Biggs, 1984).

Mesostrategies (Depth of Processing) and the PASS Model

A research study conducted by Biggs and Kirby (1984) demonstrated the relationships among motivation, mesostrategies (depth of processing), and cognitive processing ability (simultaneous and successive processing) in a sample of grade 9 students. Results of the study indicated that "[h]igh use of a meaning strategy was aligned to achievement motivation in high simultaneous students, and high use of a reproducing strategy to achievement motivation in high successive students" (Biggs, 1984, p. 117). A meaning strategy was reflective of the individual's utilization of relevant prior knowledge in understanding text whereas a reproducing strategy was limited to the recall of information and the reproduction of text through rote learning (Biggs & Kirby, 1984).

Deep and Surface Level Processing

Surface and deep levels of processing, or mesostrategies, have been

likened to reproducing and meaning strategies respectively (Biggs, 1984; Biggs & Kirby, 1984; Biggs & Rihn, 1984). Early research investigating deep and surface approaches to learning was conducted by Marton and Saljo (1976a; 1976b) although the terms - deep and surface processing - were first posited by Craik and Lockhart (1972). For the purposes of the present research, Marton and Saljo's conceptualization of the two levels of processing will be presented.

According to Marton and Saljo (1976a), levels of processing are related to the varying aspects of the material on which the individual focusses. In surface-level processing,

> the student directs his attention towards learning the text itself *(the sign)*, i.e., he has a 'reproductive' conception of learning which means he is more or less forced to keep to a rote-learning strategy. In the case of deep-level processing, on the other hand, the student is directed towards the intentional content of the learning material *(what is signified)*, i.e., he is directed towards comprehending what the author wants to say about, for instance, a certain scientific problem or principle. (pp. 7-8)

In their research, Marton and Saljo (1976a; 1976b) rated college students' responses to a reading passage along a four level continuum in order to ascertain the students' conceptions of the intentional content of the passage. Introspective questions were also asked to try to determine the functional differences in the students' levels of processing. Research findings indicated that students' conceptions of the intent of the passage were congruent with the levels of

processing they used; that is, students using deep-level processing also performed better on the rating system regarding the intentional content of the passage. Other findings also indicated that students can be directed to either deep or surface-level processing depending on their perceptions of the anticipated task demands (e.g., factual questions versus summarization of main idea of text).

Subsequent research (e.g., Biggs, 1993; Biggs & Rihn, 1984; Kirby & Woodhouse, 1994) has expanded the constructs of deep and surface levels of processing to include individual dispositional approaches as well as task-specific behaviors. Biggs & Rihn (1984) outlined characteristics of students who generally adopt deep approaches to learning: (a) student attempts to relate information to his/her personal experience, (b) student integrates information and looks for relationships between new information and existing knowledge base; develops hypotheses; searches for meaning inherent in the task, (c) student is interested in the task and enjoys completing the task. In contrast, students who typically adopt surface level approaches to learning are characterized as: (a) relying on memorization to reproduce the task's surface aspects, (b) not making connections between prior knowledge and new information and not attempting to relate information to personal experiences, and (c) completing the minimum requirements of the task with the least amount of time expenditure. In order to measure an individual's predilection to either deep or surface level processing, Biggs developed the *Study Process Questionnaire (SPQ)* (1987). Results of research conducted with college and university students using the *SPQ* indicated

that general differences existed between college and university students in their levels of processing. College students adopted surface level approaches to learning whereas university students adopted deep level approaches (Biggs, 1982). Additional research (e.g., Biggs & Rihn, 1984) also provided evidence that intervention (e.g., strategy instruction) is facilitative in changing individuals' dispositions toward surface level processing.

Several additional factors have been identified which are related to students' predispositions to either surface or deep levels of processing: text absent summarization and poorly structured text. Kirby and Woodhouse (1994) found that students who typically reported deep levels of processing performed better when they were required to summarize text without the text being present. Students who reported surface levels of processing, however, were adversely affected by the absence of text. These results were also obtained by Stein and Kirby (1992); additional findings in their research indicated that reading ability and recall were associated with depth of processing in text absent summarization conditions as more able readers gave better (deeper) summaries of text. Poorly structured text (e.g., difficult to comprehend) also appears to have an impact upon depth of processing. According to the results of Simpson's research (as cited in Kirby & Woodhouse, 1994), students with greater working memory efficiency engaged in deeper levels of processing when reading poorly structured text. Better summaries (a measure of depth of processing) and better free recall were evidenced by these students.

Measuring Depth of Processing in Reading Comprehension

Much of the research regarding depth of processing as a mesostrategy construct has been conducted in the area of text comprehension. According to cognitive models of reading comprehension, the construction of representations of ideas, main ideas, and themes are components of text comprehension (e.g., Just & Carpenter, 1987; Kirby, 1992).

In order to measure text comprehension, numerous researchers have relied on student-generated written text summaries and text recall tasks (administered within a predetermined time interval) (e.g., Kirby & Woodhouse, 1994; Stein & Kirby, 1992). Several researchers have also advocated the use of miscue analysis of students' oral reading as a way to assess text comprehension as "the oral output reflects the underlying competence and the psychosociolinguistic processes that have generated it" (Goodman & Goodman, 1994, p. 107). Miscues are defined as the errors or deviations made from the text in oral reading (Goodman & Burke, 1972). In addition, several studies (e.g., Marton & Saljo, 1976a; 1976b) have incorporated interview questions into the examination of depth of processing in text comprehension.

Text summarization processes are comprised of three functions: selection of ideas for inclusion in the summary, linking ideas together, and constructing a response - interpretation of ideas. These summarization processes are intricately linked with and constrained by the level of comprehension (e.g., ideas, main ideas) within which an individual is operating. For example, if comprehension is

operating only at the idea level, selection is based on salience or rote rule. Linking and construction are functionally non-existent (Kirby & Woodhouse, 1994). Depth of processing may be assessed using content scores; Marton and Saljo's (1976a) four level continuum is an example of this approach. Other scoring schemes may be based upon dichotomous categories: surface level processing and deep level processing and subcategories within each (e.g., deep processing may include higher level main ideas, use of prior knowledge, and meaning-oriented strategies) (Kirby & Woodhouse, 1994). Short answer as well as multiple choice questions may also be used to assess depth of processing. Although these types of questions may inadvertently over-estimate student performance, if they are carefully constructed, they are appropriate for assessing varying levels of information (Kirby & Woodhouse, 1994).

The analysis of miscues during oral reading may also be used to assess students' reading comprehension and depth of processing. Students' miscues may be classified in several categories: graphic and phonic similarity, and semantic, syntactic and text meaning acceptability (Willich, Prior, Cumming, & Spanos, 1988). Graphic and phonic miscues may be regarded as surface miscues whereas syntactic, semantic and text meaning miscues are deemed to be language-based (or deep) miscues (Willich et al., 1988). Proficient readers will typically rely more heavily on language-based cues (e.g., semantic and text meaning cues) and will make more semantically acceptable miscues whereas poor readers will rely more heavily on graphic and phonic cues and will make more non-word

substitutions (semantically unacceptable miscues) (Goodman & Burke, 1972; Goodman & Goodman, 1994; Willich et al., 1988).

In addition, interview questions may be used to ascertain the processes that students use when reading as well as the level of understanding that students exhibit regarding the text they have read. For example, students may be asked to describe the approaches they take in learning and remembering (Marton & Saljo, 1976a). Students responses can be categorized as surface-level processing (e.g., student focusses on the text itself or the recall of it) or deep-level processing (e.g., student focusses on the significance of the text or what it is about).

Factors Influencing Depth of Processing in Reading Comprehension

The assessment of depth of processing in reading comprehension is also influenced by the personological and situational factors described earlier in the model of academic performance (Biggs, 1984). The influence of prior knowledge (a personological factor) has been well researched within the reading comprehension literature (e.g., Leslie & Cooper,1993; Pace, Marshall, Horowitz, Lipson, & Lucido, 1989). The influence of prior knowledge in text comprehension is continuing to be debated by researchers (c.f., Valencia & Stallman, 1989; Carver, 1992). However, proponents of information processing perspectives based on schema theory recognize the importance of an individual's past experiences, knowledge of language, understanding of subject matter, and familiarity of text structure in reading comprehension (Copmann & Griffith, 1994) and depth of processing (Schnotz, 1993). Prior knowledge has traditionally been

viewed as a structured set of concepts which are represented through schemata, semantic maps, or propositions. New conceptualizations of prior knowledge, however, acknowledge the important influence of direct personal experience and individual belief systems in the construction of knowledge. As a result, prior knowledge is viewed as dynamic - it is continually changing to meet the needs of the individual learner (Copmann & Griffith, 1994). Numerous ways of assessing prior knowledge have been researched. Valencia and Stallman (1989) described multiple measures of prior knowledge ranging from multiple-choice measures (e.g., students were requested to answer a series of multiple choice questions based on a selected topic) to open-ended questions (e.g., students were requested to write down ideas regarding a topic named by the researcher). Other studies have used prediction activities (e.g., students were given a topic and asked to make a prediction regarding the accompanying passage content) and free association tasks (e.g., students were asked to say 'what they think of' when given a concept) (Leslie & Cooper, 1993). Additional prior knowledge measures include short answer questions (e.g., Haenggi & Perfetti, 1994; Snider, 1989) and vocabulary tests (e.g., Callahan & Drum, 1984). Research results regarding the relationship (e.g., correlation) between type of prior knowledge measure and comprehension of text have been ambiguous - prior knowledge measures have correlated differently with types of text (e.g., narrative versus expository) and comprehension outcomes (e.g., free retelling of text versus open-ended comprehension questions).

Situational factors (e.g., type of text; text structure) also impact upon text comprehension and levels of processing. The two primary types of text which have been investigated to date are narrative and expository (Copmann & Griffith, 1994). Narrative discourse has been investigated much more extensively; research results indicate that narrative text comprehension precedes expository text comprehension developmentally (e.g., Meyer, Brandt, & Bluth, 1980). As well, some researchers suggest that narrative text is less dependent upon prior knowledge (Valencia & Stallman, 1989) and is easier to recall than expository text (Copmann & Griffith, 1994).

The relationship between personological and situational factors and text comprehension (e.g., levels of processing) are complex; however, Marton and Saljo's (1976a) idiographic conceptualization of depth of processing highlights the importance of individual characteristics (e.g., prior knowledge) in measuring how individuals process text when reading.

Reading Processes and Reading Disabilities

Research has demonstrated that comprehension deficits and phonological processing difficulties are endemic to reading disabilities and are important aspects in the assessment and remediation of reading difficulties. The relative importance of the various aspects of reading difficulties (e.g., phonological skills) is more difficult to ascertain and define. Numerous definitions exist regarding the nature and extent of learning disabilities, and by implication, reading disabilities. In order to provide a basis for the description of reading disabilities, the following

section provides an overview of the construct of learning disabilities.

Definition of Learning Disabilities

Within the realm of learning disabilities research, numerous definitions have been put forward. Common to all definitions are five basic components: "task failure, achievement-potential discrepancy, etiological factors, exclusionary factors, and dysfunctions in one or more of the psychological processes" (Hammill cited in Shaw, Cullen, McGuire, & Brinckerhoff, 1995). A definition which has received a fair amount of support and incorporates all five components is that of the National Joint Committee on Learning Disabilities (NJCLD):

> Learning disabilities is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are instrinsic to the individual and presumed to be due to central nervous system dysfunction. Problems in self-regulatory behaviors, social perception, and social interaction may exist with learning disabilities but do not by themselves constitute a learning disability. Even though a learning disability may occur concomitantly with other handicapping conditions (e.g., sensory impairment, mental retardation, social and emotional disturbance) or environmental influences (e.g., cultural differences, insufficient/inappropriate instruction, psychogenic factors), it is not the result of those conditions or influences. (National

Joint Committee on Learning Disabilities cited in Shaw et al., 1995, p. 587)

Despite the growing consensus regarding the definition of learning disabilities, controversy continues to exist regarding the operationalization of the definition. The role of cognitive processing is recognized as an important facet in the identification and description of individuals with learning and reading disabilities, however, the way in which cognitive processes are conceptualized and assessed vary. Traditionally, the focus in the measurement of cognitive functioning has been on abilities rather than processes (Das et al., 1994). Psychometric measures of ability have been used to produce IQ scores. These scores are then used to determine whether a significant discrepancy exists between reading ability and performance on measures of intelligence. Assessment practices based on discrepancy formulas continue to be criticized because they do not address specific cognitive processing deficits, use measures which are product-oriented (e.g., standardized achievement tests), discount professional clinical judgment, and rely on school failure for identification purposes (Shaw et al., 1995). Alternative ways to operationalize the definition of learning disabilities have been advocated. Researchers (e.g., Naglieri & Reardon, 1993; Stanovich, 1989; Torgesen, 1989) have adopted approaches to assessment in which the role of cognitive functioning is viewed from a process perspective. Cognitive processing approaches provide information regarding both general processes and the extent to which an individual (or subject) "can apply those

processes in a given task context (e.g., reading) and the task-specific knowledge regarding that context that the subject has attained (e.g., in reading, knowledge of phonics and of word meanings)" (Das et al., 1994, p. 10).

Conceptualizations of Reading Disabilities

Numerous research studies have attempted to ascertain the particular deficits which are associated with reading (and learning) disabilities. In order to clarify and classify the nature and extent of learning disabilities, subtypes of learning/reading difficulties have been identified using a variety of measures (Kavale, 1990). Subtypes of learning disabilities based on WISC-III and WAIS-R performances have been identified (e.g., verbal comprehension deficits/intact perceptual organization skills, and inadequate attention abilities) (Rourke, 1997; Snow, Koller, & Roberts, 1987). Other subtypes have been based on reading difficulties, arithmetic disabilities, and reading/arithmetic disabilities (Shafrir & Siegel, 1994). A way of conceptualizing differences among student performance in reading has been to define deficits according to general reading and content-specific reading problems (Espin & Deno, 1993). Numerous researchers have also differentiated between 'dyslexic' readers and 'garden-variety poor readers'. Dyslexic readers have been defined as those individuals who have relatively high IQ scores but demonstrate specific deficits in reading, particularly in phonological processing skills. Garden-variety poor readers, on the other hand, are those individuals who have lower IQ scores and exhibit more generalized reading difficulties (Stanovich, 1988). Within the term dyslexia, several different kinds of

dyslexia have been identified: dysphonetic, dyseidetic, phonological, deep or semantic (Kirby, 1991; Stanovich, 1988).

In order to manage the multiple ways of conceptualizing reading disabilities, Kirby (1991) suggested that individuals be identified generally as having a learning problem; specific disabilities could then be identified within this rubric. A specific framework for identification was outlined by Leong (1987; 1993). According to Leong, a two-stage approach may be implemented: (a) students may be screened for reading and related difficulties and, (b) students who are identified via the screening tests may then be assessed more intensively using refined instruments and techniques.

Although ways of identifying and describing individuals with reading and learning disabilities are varied, research conducted with individuals to date has resulted in several findings: (a) phonological processing deficits (e.g., segmentation, analysis) appear to be defining features in assessing learning difficulties (e.g., Stanovich, 1988), (b) comprehension deficits are evidenced independently of word-decoding skills (e.g., Stanovich, 1982), (c) working memory difficulties contribute to comprehension difficulties independently of word processing difficulties (e.g., Swanson & Berninger, 1995; Torgesen, 1988), (d) qualitative (as opposed to quantitative) differences exist between poor readers and good readers (e.g., Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996), and (e) reading difficulties exhibited during the early school years continue to exist into adolescence and adulthood (Bell & Perfetti, 1994).

Gender Differences in Reading Disabilities

Differences exist in the rate of indentification of reading disabilities in males and females as a larger percentage of males are identified as exhibiting reading disabilities (Shaywitz, Shaywitz, Fletcher, & Escobar, 1990). Although the etiology of these differences is not clear, gender differences which are evidenced in cognitive processing (e.g., females exhibit higher levels of verbal fluency) may be due to developmental and maturational differences (e.g., females mature more quickly and subsequently reach cognitive milestones more quickly than males (Halpern, 1997). Females who are identified as reading disabled may, in fact, exhibit more severe deficits in achievement (e.g., reading and mathematics) and have lower IQ scores than their reading disabled male counterparts (Vogel, 1990).

Conclusion

The PASS model is based upon the theoretical premise that cognition is comprised of three functional units: planning, attention, and simultaneous and successive processing. These units are related in that they influence each other; however, they also have discrete functions. Planning serves an executive function: it is responsible for the development, execution, monitoring, and revision of a plan. Attention is required for task completion; it enables the individual to focus upon the salient features of the task/plan. Simultaneous and successive processes function in an interrelated fashion and serve to integrate incoming information.

All components of the PASS model are required for successful task completion although the relative importance of each of the components may vary as a function of the nature of the task. For example, in reading, successive processing and attention are more closely associated with word decoding whereas simultaneous processing and planning are more closely aligned with text comprehension.

Individual differences in the proficiency with which planning, attention, and simultaneous and successive processing are executed also affect the success with which an individual is able to complete a task (e.g., reading). For example, the research evidence suggests that students with simultaneous processing deficits experience difficulties with text comprehension (Kirby et al., 1996). In addition to differences in cognitive processing, individuals also vary in how they apply particular cognitive approaches or strategies for task completion (e.g., deep or surface level processing). They may use primarily a surface approach to reading comprehension due to predispositional factors (e.g., individual preference or competency) or they may execute a particular approach due to perceived task demands (e.g., a learned strategy) (Biggs & Kirby, 1984; Marton & Saljo, 1976b). Although preliminary, research findings on gender differences in cognitive processing suggest that males and females differ in the proficiency with which they process specific information. A hypothetical pictorial representation of the conceptual relationships among cognitive processing components, reading, and cognitive approaches is shown in Figure 3.

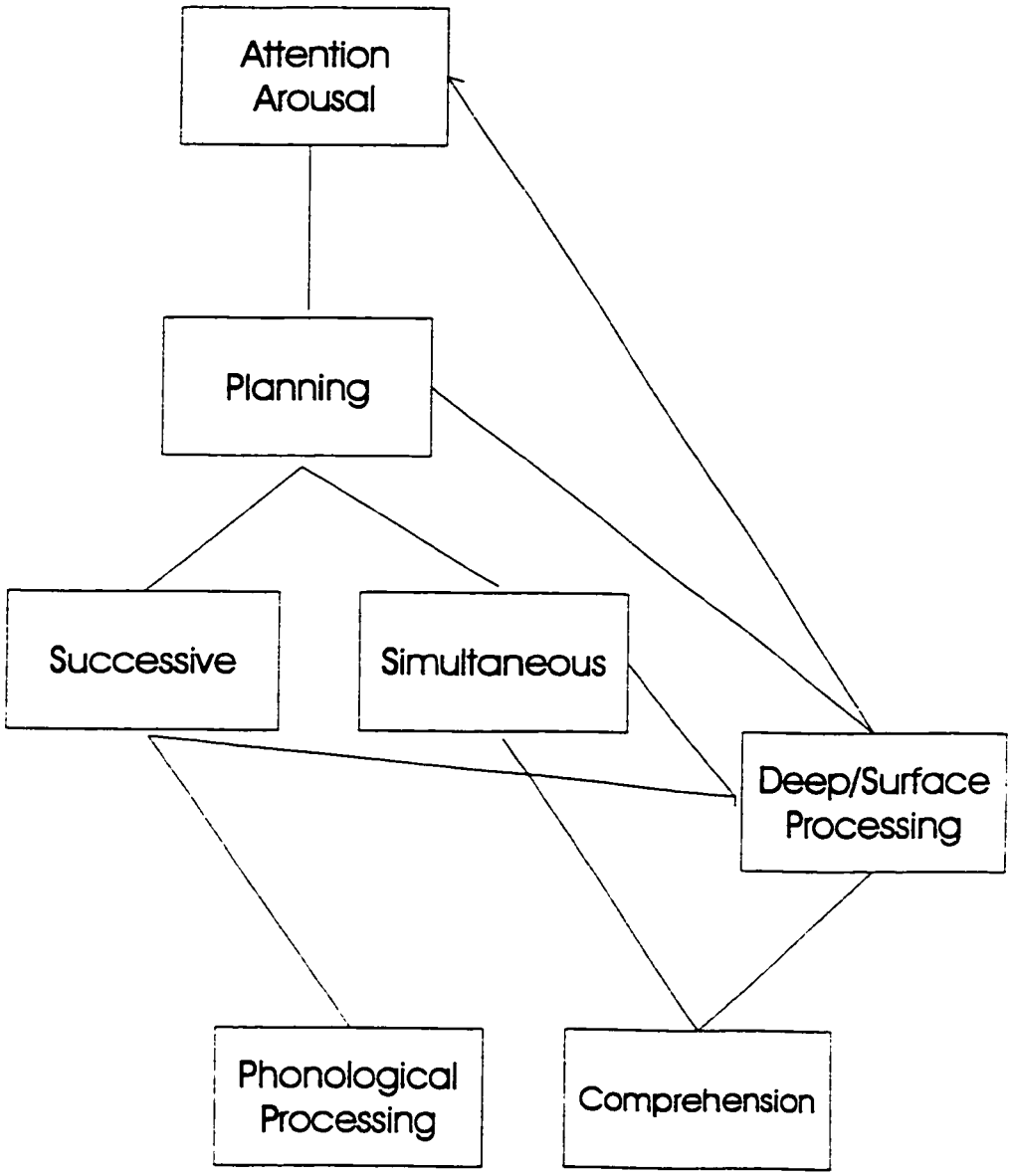

Figure 3

Conceptual Relationships among PASS Model Components, Reading, and Cognitive Approaches

Previous research has shown that students with reading comprehension difficulties demonstrate deficiencies in particular PASS model components. There is also some preliminary evidence that students who generally adopt surface level cognitive approaches may demonstrate simultaneous processing deficits. However, no research studies have investigated how adolescent students with reading difficulties perform on all aspects of cognitive processing (planning, attention, and simultaneous and successive processing) in relation to their cognitive approaches (deep and surface levels of processing) within the domain of reading comprehension.

Areas of Research Inquiry

Within the previous sections, the theoretical underpinnings and accompanying research evidence have been outlined regarding the constructs which were under investigation in this study. Although there have been a substantial number of studies published regarding the theoretical framework of the PASS model, limited research exists regarding the interplay of all four components in adolescent populations who exhibit reading difficulties. In addition, gender differences on the PASS model in learning disabled populations have received little attention within the research literature. The delineation of cognitive approaches within a levels of processing framework has also not been well articulated in the literature. Although levels of processing have been studied to some extent within the context of reading comprehension, only a few research studies have examined deep and surface processing as a predispositional construct

or general approach to learning. Given the limited number of research studies within these domains, research questions (rather than hypothesis statements) were generated for the purposes of this study.

The general areas of inquiry identified in the first chapter and expanded upon in the previous sections are outlined more specifically within this next section.

1. How are planning, attention, simultaneous and successive processes manifested in adolescent learners with reading difficulties?

In order to provide greater focus to this area of research inquiry, the following questions were generated for the purposes of data analysis:

a. Are there performance differences on Planning tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

b. Are there performance differences on Attention tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

c. Are there performance differences on Simultaneous processing tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

d. Are there performance differences on Successive processing tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

Although the intent of the study was to focus upon the performance of adolescents with reading difficulties on the PASS model components, no standardized data or norms were available for several of the tests used to measure these components. Therefore, a randomly selected group of adolescent students without reading difficulties served as a comparison group for the purposes of data analysis. The method for selecting students for participation in the comparison group is in keeping with previous research on the PASS model (e.g., Das et al., 1994; Mishra & Pirta, 1994; Parrila & Papadopoulos, 1996) and will be explained more fully in Chapter Three.

Gender differences in the performance on the PASS model components were also explored as the existing literature base is limited and research findings to date suggest that differences in gender may exist on planning and attention tasks and may follow a developmental trend.

Each of the PASS model components were considered separately as the research literature regarding the conceptual and empirical treatment of the PASS model components suggests that planning, attention, simultaneous processing, and

successive processing are separate constructs. For example, Naglieri and Das (1990) stated that the "PASS view of cognitive processes opposes general ability as a real entity and questions its value as an average or composite measure of a set of processes. This concept is limited because it does not adequately recognize that human cognitive functioning is comprised of varied cognitive processes" (p. 331).

2. What kind(s) of cognitive approach(es) do adolescents with reading difficulties use when reading?

In order to guide the investigation of this aspect of the research study, the following specific data analysis questions were generated:

a. As a general approach to learning, what kinds of cognitive approaches do adolescent learners with reading difficulties use?

b. Within the context of reading comprehension, what kinds of cognitive approaches do learners with reading difficulties use?

As outlined by Thomas and Bain (1982), learning approaches can be characterized as either "generalized styles of cognition . . . or as strategies that may be heavily influenced by such factors as the subject matter being studied and/or the method(s) of assessment anticipated" (p. 250). Within the framework of the present study, both kinds of cognitive approaches were examined.

3. What is the relationship between PASS Model components and cognitive approaches in adolescents with reading difficulties?

The following data analysis questions were generated to provide a more

specific focus to this aspect of the study:

a. Are planning and surface and/or deep levels of processing related in adolescents with reading difficulties?

b. Are attention and surface and/or deep levels of processing related in adolescents with reading difficulties?

c. Are simultaneous processing and surface and/or deep levels of processing related in adolescents with reading difficulties?

d. Are successive processing and surface and/or deep levels of processing related in adolescents with reading difficulties?

Given the conceptual relationships identified in the research literature and the limited empirical findings to date, the interplay among cognitive processing and cognitive approaches (e.g., generalized approaches to learning; strategies specific to reading comprehension) was investigated further within this research study.

CHAPTER THREE

METHOD

The primary focus of the present study was to investigate the relationships between the PASS Model components, depth of processing, and reading comprehension in a sample of adolescents with reading difficulties. This chapter outlines the sample, data collection procedures, and measures used in the study.

Sample

Subjects were drawn from a mid-sized urban school division located in western Canada. The sample of students was selected from grades 9 to 11 in all four high schools in the school division. Two groups of students were targeted: (a) Group One - students with reading difficulties, and (b) Group Two - students without reading difficulties. The selection method for group membership differed from one group to the other with one exception: all targeted students, regardless of group membership, were to be of average or above average intellectual ability. The selection criterion of average intellectual ability was of relevance to the study in order to avoid confounding reading difficulties with below average intellectual functioning. Support for the exclusion of students with below average intelligence exists in both the reading disabilities research area (e.g., Fletcher, Francis, Rourke, Shaywitz, & Shaywitz, 1992) and PASS model and disabilities research (e.g., Das et al., 1994). To control for intellectual ability, all students were (a) selected from high school university entrance English classes and (b) screened to ensure that they had not been assessed previously as performing

within the below average range (standard score <80) on intelligence tests.

Group One - Students with Reading Difficulties

Students with reading difficulties were identified by high school teachers who taught English 9, 10A and 20A (excluding French Immersion and Advanced Programs). These English classes are prerequisite courses for entry into post-secondary training institutions (e.g., university). The teachers were asked to nominate students in their classes who exhibited significant reading difficulties. Suggested criteria for identification of these students included: (a) below grade level performance on reading comprehension skills, (b) difficulties with reading comprehension regardless of content area, (c) word decoding difficulties, (d) slow and labored reading, and/or (e) reluctance to read (see Appendix A). The list of student names generated by the teachers were reviewed by school support personnel (e.g., resource teacher) in order to ensure that students with below average scores (<80) on intelligence tests (e.g., information derived from previous psychoeducational reports) were removed from the list.

Once a final list of students was obtained for each school, letters were sent via the school to the potential participants and their parents/guardians (see Appendix B). Students who wished to participate in the study were asked to return the consent forms to the school. In total, 84 students comprised Group One. The number of boys (n=61) was considerably larger than the number of girls (n=23) as a larger number of boys were identified as exhibiting reading difficulties (see Table 1). The over representation of boys is in keeping with previous

research on gender differences and reading disabilities (e.g., Shaywitz, et al., 1990). The mean age of the boys was 15.6 years (SD=1.0) and the mean age of the girls was 15.5 years (SD=1.1). The boys ranged in age from 14 years to 18 years; the girls ranged in age from 14 years to 17 years. The majority of students were in grades 9 to 11; two students were enrolled in both grade 11 and grade 12 classes. See Table 1 for information (e.g., gender and grade placement) regarding selected and actual participants in Group One.

For the purposes of the semi-structured interview, fourteen subjects in Group One were randomly selected from the four high schools. Three students from two high schools were interviewed; four students from the remaining two high schools were interviewed. Nine boys and five girls participated in the interviews.

Group Two - Students Without Reading Difficulties

Students without reading difficulties were selected for participation in the study in order to serve as a comparison group on the PASS model tasks. Normative information was not available for most of these tasks thus necessitating the formation of a reference group. Student names were randomly generated by the school district. The random list of names was reviewed by either the school principal or the English department head to ensure that none of the students were enrolled in ESL (English as a Second Language) classes, were enrolled in the French Immersion program, or were unsuitable for participation due to unsatisfactory performance in their English classes. Letters were sent to these

students and their parents/guardians via the school (see Appendix B). Students interested in participating in the study were asked to return the completed consent forms to the school.

A total of 67 students in Group Two (males=22; females=45) participated in the study. All students were enrolled in grades 9 to 11. The mean age of the boys was 15.2 years (SD=1.0) and the mean age of the girls was 15.2 years (SD=.83). Both boys and girls ranged in age from 14 years to 17 years. See Table 1 for a description of the Group Two sample.

Table 1

Description of Sample - Group One and Group Two

	Group One - Reading Difficulties				Group Two - No Reading Difficulties			
	Males		Females		Males		Females	
	Select	Participate	Select	Participate	Select	Participate	Select	Participate
Grade 9	62	19	26	7	36	8	41	11
Grade 10	60	23	23	7	37	8	48	23
Grade 11	41	19	19	9	26	6	40	11
Total n	163	61	68	23	99	22	129	45
Response Rate (%)		(37%)		(34%)		(22%)		(35%)

Additional Criteria for Group One and Group Two Membership

As part of the data collection procedure, the *Woodcock Reading Mastery Test - Revised* (Woodcock, 1987) was administered to validate the initial reading group selection method and to ensure that students in Group One did exhibit

reading deficiencies as compared to their Group Two peers. As previous research results (e.g., Stanovich, 1982; 1988) suggested that reading difficulties may be manifest in both phonological processing and text comprehension, two subtests were administered to assess phonological decoding skills (Word Attack subtest) and reading comprehension skills (Passage Comprehension subtest). Means and standard deviations were computed for both groups (Group One and Group Two) and gender (males and females) (see Table 2). Results of the statistical analysis (e.g., 2 x 2 MANOVA) indicated that the two reading groups differed significantly on the Passage Comprehension subtest but not on Word Attack (see Appendix C for MANOVA results). There were no performance differences between males and females on either of the two subtests. Several possible explanations can be generated regarding the apparent discrepancy with these data and previous research results: (1) given the placement of the students (e.g., university entrance classes), most students will have mastered word attack skills and, as a result, will not demonstrate significant difficulties in phonological decoding and (2) possible sampling error given the relatively small sample size. Although the two groups did not differ significantly on phonological processing skills (e.g., word attack), Group One did perform significantly more poorly than Group Two on text comprehension thereby validating the selection procedure for group membership (e.g., teacher nomination).

Table 2

Means and Standard Deviations of Groups One and Two on Reading Subtests

Variable	Reading Group		Gender	
	One (n=84)	Two (n=67)	Males(n=83)	Females(n=68)
Rdg WA	98.15(11.91)	100.97(11.28)	99.40(12.26)	99.41(11.03)
Rdg PC	91.95(14.07)	102.82(14.04)	95.73(15.07)	98.06(14.98)

Note: Standard Deviations are reported in brackets; Reading - Word Attack (WA); Passage Comprehension (PC)

Procedure

University of Saskatchewan Ethics Requirements

Prior to the actual implementation of the study, the researcher submitted a research proposal to and received approval from the University of Saskatchewan Advisory Committee on Ethics in Human Experimentation (see Appendix D for a copy of the Ethics application and approval). The subjects' rights to informed consent, confidentiality, anonymity, and freedom to withdraw from participation in the study were upheld. No deception or risk to subjects was involved in the study.

Data Collection

Data were collected consecutively in the four high schools during January to March, 1997. In the first high school in which data were collected, the percentage of subjects who agreed to participate in the study was relatively small (e.g., 25% response rate). As a result, sampling procedures for Groups One and Two were reinitiated in order to increase the number of subjects from that school.

These additional students were tested at the end of the data collection period.

Each of the subjects was assigned an identification number; these numbers were used for the purposes of scoring test protocols and analyzing data. A master list with student names and accompanying identification numbers was held by the researcher and was destroyed upon completion of the research project. Standard scores on one of the instruments (i.e., *Woodcock Reading Mastery Test - Revised* - Word Attack and Passage Comprehension subtests) were compiled and sent to each of the high schools for those students who stated that they wished the school to be apprised of their performances on this instrument.

Subjects in Group One (students with reading difficulties) were administered the full battery of tests; Group Two subjects (students without reading difficulties) were administered only the PASS model tasks and the *Woodcock Reading Mastery Test - Revised* Word Attack and Passage Comprehension subtests. Fourteen students in Group One also participated in a short interview designed to elicit information regarding the reading strategies they used and their prior knowledge of the content of the reading passages.

Subjects were tested individually. For each Group One subject, the testing period was approximately one and one-half hours. The total administration time was approximately one hour for each student in Group Two. Two trained research assistants administered the tests; one assistant administered all reading-related tasks and the other assistant administered all PASS model tasks. Both research assistants were trained in test administration procedures specific to the

research study. Both assistants held university degrees; the research assistant who administered the PASS model tasks had completed graduate coursework in intellectual assessment. The principal researcher conducted all individual interviews (n=14). Each individual interview lasted approximately 15 minutes.

To avoid order effects, the tests were administered in a counter-balanced fashion. Two students at a time were called from classes; one student completed the reading tests first; the other student completed the PASS model tasks first. The students then changed places and completed the other tasks.

All data were collected during school hours with the exception of one subject. That student was invited to come to the University of Saskatchewan campus to complete the testing as data collection could not be completed prior to the school holiday at the end of March.

Measures

PASS Model Tasks

The PASS Model tasks were selected to represent the four PASS components: Planning, Attention, Simultaneous Processing, and Successive Processing. Only tasks which had been well documented in the research literature were selected for inclusion in the battery. Two tasks per PASS model component were selected. Several tasks were selected from published tests: *Raven's Standard Progressive Matrices* (Raven, 1976) and *Wechsler Intelligence Scale for Children - Third Edition* (Wechsler, 1991). The remainder of the tasks were obtained from the standardization edition of the *Cognitive Assessment System* -

DN:CAS (Das & Naglieri, 1997). Normative information was not available regarding the tasks taken from the DN:CAS (1997) during the initial stages of the data analysis; thus only raw scores were computed. Raw scores were also used for the PASS model tasks taken from other sources; for example, *Raven's Standard Progressive Matrices* in order to maintain consistency in data analysis.

Subsequent to the initial analysis, the DN:CAS was published and conversion tables for raw scores to standard scores (mean=10; standard deviation=3) were made available. In order to allow for a standardized interpretation of the raw scores, standard scores were computed for those DN:CAS standardization edition tasks which were identical in item content to the final version of the test. These tasks included Planned Connections and Expressive Attention. Standard scores (mean=10; SD=3) were also computed for the *Raven's Standard Progressive Matrices* and Digit Span. One task from each of the four PASS model components were converted to standard scores.

Planning Tasks

According to Naglieri and Das (1990), "the structural analysis of a planning task indicates that such a test should require an individual to develop an approach of solving a relatively simple task" (p. 321). Both tasks used in the present study require that the individual apply planning strategies in order to successfully complete the tasks. In order to measure the efficiency of the application of these planning strategies or the realization of the specific goal/solution to the problem, the time required for task completion is recorded.

According to Naglieri and Das (1990), these tasks measure planning and not processing speed despite the fact that they are timed. Several studies (e.g., Das & Dash, 1983; Naglieri et al., 1989) have demonstrated that planning and speed could be separated using factorial analysis. For example, Naglieri et al. (1989) found that planning tasks (e.g., Trails, Planned Codes) could be distinguished from speed tasks (e.g., speed of word-reading).

Planned Connections.

The *DN:CAS* (1997) planning task, Planned Connections, was used in the study. The test is adapted from the *Trailmaking* (1960) test. The subject is required to connect numbers, as well as a series of numbers and letters, in sequential order. The score is the time required to complete the task as the "best measure of the degree of efficiency of connecting these points is the time needed to complete the sequence" (Naglieri & Das, 1990, p. 321). Previous research results have reported loadings on planning of .69 (using a grade 8 sample of students) (Ashman & Das, 1980), .53 (using a sample of grades 2, 6, and 10 students) (Naglieri & Das, 1988), and .76 (with a sample of grades 4 and 5 students) (Naglieri et al., 1989).

Planned Search.

Planned Search is included in the experimental version of the *DN:CAS* (1997). The subject is required to point to an object or letter located in a box surrounded by an array of objects or letters (Naglieri & Das, 1988). The completion times for each of the searches (16 in total) are summed to produce the

total raw score. Factor loadings similar to Planned Connections have been reported for Planned Search. Loadings on the Planning factor have ranged from .54 (Naglieri & Das, 1988), .64 (Naglieri et al., 1989) to .76 (Ashman & Das, 1980).

Attention

Receptive Attention.

The task consists of two parts which require the subject to either identify identical letters (e.g., HH or ee) or letter-name pairs (e.g., Hh or Ee). Two raw scores were computed for this task based on number of correct items for each of the two parts[1]. Only the raw score for the second search was used in this study as ceiling effects were noted on subject performance on the first search. On the first search, both reading groups had similar mean scores with little variability [e.g., Group One- 48.01 (SD=2.50); Group Two- 48.84 (SD=1.38)]. The maximum correct score on the first search was 50. Initial research results (e.g., factor loadings) of the Receptive Attention task indicated that it loaded on both an Attention factor (.39) and also on a Planning factor (.52) (Naglieri et al., 1989).

[1] Of note, is that the DN:CAS (1997) Receptive Attention subtest scoring system for both searches has been modified; completion time, number of correct responses, and number of false detections are all used to compute the raw score for each search.

As a result, the refinement of the measure was recommended. Although no specific changes to the item content of Receptive Attention have been identified in the literature, subsequent analyses (e.g., using a sample of hearing impaired students) resulted in a factor loading of .50 on the Attention factor. No factor loadings were reported for the Receptive Attention task on Planning, however (Naglieri et al., 1994). According to the *Cognitive Assessment System* Interpretive Handbook (Das & Naglieri, 1997), loadings of .65 were obtained for Receptive Attention on the Attention factor when confirmatory factor analyses were conducted on the standardization sample.

Expressive Attention.

The second attention task was taken from the standardization version of the *DN:CAS* (1997). This task is a derivative of the *Stroop* test (Golden, 1978). The test consists of color words which are printed in one of four colors (e.g., yellow, red, blue, and green). The time required to complete the task (e.g., name the color of the ink of printed color words) is used to compute the score. The Expressive Attention task has been shown to load on the Attention factor; Parrila et al. (1994) reported a factor loading of .78 (using a sample of students in grades 2, 4, and 11) and similar factor loadings (.70) were reported by Naglieri et al. (1989) with a sample of students in grades 4 and 5.

Simultaneous Processing

Matrices-type tasks are considered to be measures of simultaneous processing as they require the construction of a whole (e.g., spatial pattern) from

component parts (Das et al., 1979).

Ravens Standard Progressive Matrices.

The *Raven's Standard Progressive Matrices* (Raven, 1976) is comprised of five sets of twelve matrices-type items in each set. The subject is required to select one item (from six possible choices) which best fits the missing portion of the matrix or pattern. The test is a power test; items become progressively more difficult. The *Raven's* raw scores can be converted to percentile rank scores for an adolescent and adult population.

The *Raven's* is considered to be a measure of simultaneous processing. Numerous research studies (e.g., Das et al., 1979; Das & Molloy, 1975) have demonstrated that the *Raven's Coloured Progressive Matrices* (Raven, 1976) loads on simultaneous processing. Similar results have been obtained for the *Raven's Standard Progressive Matrices*. Das et al. (1975) reported loadings of .873 and .784 on the Simultaneous factor for the *Ravens Standard Progressive Matrices* in samples of grade four and grade one students respectively. Factor loadings reported by McCallum & Merritt (1983) were .80 and .61 in two samples of college age students.

Figure Memory.

The Figure Memory test is part of the experimental version of the *DN:CAS* (1997). The subject is required to view a geometric design and then identify the design when embedded in a more complex figure. The test is scored dichotomously (0 or 1). Previous research results have demonstrated that Figure

Memory loads on the simultaneous processing factor. Naglieri et al. (1989) reported loadings of .398 on the Simultaneous factor in a sample of grade five students. A similar loading (.463) on the Simultaneous factor was found in a sample of hearing-impaired students (Naglieri et al., 1994). Somewhat higher factor loadings (.695) were reported for Figure Memory by Parrila et al. (1994).

Successive Processing

Word Series.

Tasks which measure successive processing "require the temporal order for input items" (Das et al., 1979, p. 53). In the Word Series test, subjects are asked to repeat a series of words ranging in length from two to nine words. The score is computed based on the total number of words recalled correctly. Word Series is included in the standardization version of the *DN:CAS* (1997) and has been shown to measure successive processing in previous research. For example, Naglieri and Das (1988) found that Word Series loaded on a Successive factor (.43) for a sample of grades 2, 6, and 10 students. In a subsequent study, factor loadings reported by Naglieri et al. (1989) ranged from .687 (orthogonal principal factor analysis) to .746 (oblique principal factor analysis). Similar factor loadings (.725) were reported with a sample of hearing-impaired students (Naglieri et al., 1994).

Digit Span.

This task was first adapted from the *Wechsler* scales; most notably, the *Wechsler Intelligence Scale for Children - Revised* (Das, Kirby, & Jarman, 1979).

For the purposes of this research project, the Digit Span subtest was taken from the *Wechsler Intelligence Scale for Children - Third Edition* (Wechsler, 1991). In the subtest, subjects are required to repeat a series of digits presented orally; the number sequences range from 2 to 9 digits. The test is comprised of two parts: Digits Forward and Digits Backward. In Digits Forward, the subject repeats the digits as dictated by the examiner; in Digits Backward, the subject listens to the number sequence and then repeats it in reverse order. The raw score is calculated by adding together the number of correct number sequences in both Digits Forward and Digits Backward. Factor loadings reported for Digit Span on the Successive processing factor have included (1) both Digits Forward and Backward and (2) only Digits Forward. Despite differences in reporting, Digit Span has shown to load approximately .8 on the Successive factor (e.g., Ashman & Das, 1980; Naglieri et al., 1994).

Reading Tasks

Reading performance, that is, word attack skills and passage comprehension, was measured by selected subtests of the *Woodcock Reading Mastery Test - Revised (WRMT-R*, Woodcock, 1987*)*.

Woodcock Reading Mastery Test - Revised

There are two parallel forms of the WRMT-R: Forms G and H. For the purposes of this study, Form G was used. The WRMT-R provides norms (e.g., standard scores; mean=100; standard deviation=15) for adolescent populations. According to the manual, normative data were collected on approximately 6,000

subjects ranging in age from five years to adulthood. Subjects were selected randomly according to specified variables: age, gender, geographic region, community size, race, and occupation (for adult subjects only). Median split-half reliability coefficients reported in the manual are .87 for the Word Attack subtest and .92 for the Passage Comprehension subtest. Concurrent validity correlations reported in the manual for the WRMT-R and the *Woodcock Johnson* reading tests range from .64 to .90 for the Word Attack subtest and .55 to .71 for the Passage Comprehension subtest. These correlations may be of limited utility in assessing the validity of the test, however, as both the WRMT-R and *Woodcock Johnson Achievement Battery* were developed by Woodcock (Eaves, 1992). A more recent research study reported correlations between the WRMT-R total score and *Wechsler Individual Achievement Test* Reading Comprehension subtest (Wechsler, 1992) as r=.74 (Slate, 1996). The diagnostic accuracy of the WRMT-R in the identification of learning disabled (LD) students was examined; results indicated that the WRMT-R (in combination with cognitive and math achievement tests) was useful in classifying LD students as 70% of the students were correctly classified (Eaves, 1992).

Word Attack.

The Word Attack subtest is comprised of 45 items arranged in order of difficulty; subjects begin with item 1 and continue until they fail six consecutive items. Subjects are required to read nonsense words or very low frequency words. The test "measures the subject's ability to apply phonic and structural analysis

skills in order to pronounce words" (WRMT-R Examiner's Manual, 1987, p. 6).

Passage Comprehension.

The Passage Comprehension subtest consists of a series of short passages in which the subject is required to insert a missing key word. This is a modified cloze procedure. There are 68 items arranged in order of difficulty; item entry points for different age levels are outlined in the manual. Ceiling rules (e.g., six consecutive failed items) are also provided. According to the Examiner's Manual (1987), "to complete the item the subject must understand not only the sentence containing the blank, but the other sentence(s) in the passage as well" (p. 8).

Depth of Processing Tasks

Two types of depth of processing tasks were used in this study. Strategies specific to reading comprehension were evaluated on the basis of (1) student self-generated summaries after the completion of each of three reading passages and (2) interview data. Generalized approaches to learning were assessed via the *Learning Process Questionnaire.*

Passage Summary Depth of Processing Task

The text comprehension task was based upon an approach similar to Marton and Saljo (1976a). Subjects were asked to read and simultaneously listen to an audiotape of three short stories. The texts were provided orally in order to control for poor readers' deficits in phonological coding (Stanovich, 1982). The genre of the narrative short story was selected because students are familiar with this genre from their English classes. The stories were selected from a published

informal reading inventory (i.e., *Burns/Roe Informal Reading Inventory Third Edition*, 1989) in order to ensure that (a) the materials were age appropriate and (b) the students had not encountered the text previously. Each of the three passages was graded according to reading level: grade six, grade nine, grade ten. See Table 3 for a summary of the reading passages; see Appendix E for the complete reading passages which were used for this portion of the study.

Table 3

Synopses of Reading Passages

Reading Passage	Synopsis
Passage #1 Apollo 13	As they orbit around the moon, Apollo 13 astronauts make a last attempt to get the spaceship back on course in order to return to the Earth.
Passage #2 Lifeguards at the Beach	Lifeguards must work diligently and put their lives on the line to ensure the safety of the people at the beach.
Passage #3 Hidden Treasure	Two boys discover an oak tree on an island which appears to have a treasure buried nearby.

Students read each of the passages silently and then provided a short oral summary for each of the passages based on the research assistant's or principal researcher's request to "tell me what the story was about". The students' oral summaries were tape recorded and transcribed. Student performance on the passage summaries was analyzed according to Stein and Kirby's (1992) criteria for assessing depth of processing. These rating criteria were selected as results of Stein and Kirby's (1992) study showed that depth of processing (as assessed by

the scoring criteria) was associated with reading performance. Students' responses were scored according to the criteria outlined in Table 4. Two raters, the principal researcher and a research assistant, scored each of the summaries independently. Discrepancies in scoring were discussed between the two raters until agreement was reached for each summary. Approximately 35 summaries (14%) required clarification regarding the assignment of scores.

Table 4

Depth of Processing Criteria (adapted from Stein & Kirby, 1992)

Score	Criteria
0	verbatim descriptions of text in sequence; no integration or connectives; narrow interpretation of text; errors in recall of text
1	linear summarization in own words; reordering ideas; attempts at integration
2	self-generated summaries; order rearranged; examples of integration; global interpretations of text

Students were then asked to respond to a series of questions (ten questions per passage). These questions ranged from detail and vocabulary questions to cause and effect and inference questions. The total number of correct responses was summed for each of the three passages.

Prior knowledge was not assessed formally as the assumption was made that all students would have similar school and educational experiences (e.g., exposure to content and genre of text).

Semi-Structured Interview

A semi-structured interview was conducted with select students after they

completed the reading tasks (See Appendix F). Students were asked to read a short passage orally. The oral reading was scored according to miscue analysis guidelines (see Table 5). Initially, students were asked to summarize the text orally. They were then asked, using a series of open-ended questions, to describe what sources of information, strategies, etc. they used to understand the gist of the passage. Questions of particular relevance to the examination of depth of processing included the following: What do you think about as you read?, What kind(s) of information do you typically try to remember when you read a passage?, and What do you say to yourself when the reading becomes difficult?. The oral reading of the passage and all responses (e.g., summary of reading passage and responses to open-ended questions) were recorded on audiotape and transcribed after the interview. Themes were generated by the researcher according to the students' responses to the open-ended questions. Once thematic categories were identified and student responses were classified accordingly, a research assistant categorized each of the responses independently using the thematic categories outlined by the researcher. Any discrepancies in categorization were discussed between the two raters until agreement was reached for each response. Approximately five responses required clarification regarding classification. The students were debriefed following the interview regarding the purpose and intent of the study; students were provided with an opportunity to ask questions regarding their participation in the study.

Table 5

Miscue Analysis Guidelines

Miscues Scored and Counted	Miscues Counted But Not Scored
Mispronunciation	Spontaneous Correction
Substitution	Punctuation Omission
Refusal to Pronounce	
Word(s) Insertion	
Omission	
Repetition	
Word(s) Reversal	

The questions and format for the semi-structured interview were reviewed with a reading expert who is a professor in the Department of Curriculum Studies at the University of Saskatchewan. They were then piloted with two high school students (who were not potential participants) prior to data collection. The sequence of questions and format were altered in keeping with the feedback received from the students during the pilot phase.

Learning Process Questionnaire

The predispositional characteristics of depth of processing were assessed using the *Learning Process Questionnaire* (LPQ) developed by Biggs (1984). The questionnaire was developed to identify high school student approaches to learning: surface, deep, and achieving. *Approach to learning* is defined as a composite of both student motives and student strategies. For example, students who adopt a surface approach to learning implement both surface motives and

surface strategies. A surface approach is characterized by the reproduction of information through rote learning and minimal performance in meeting requirements. A deep approach is depicted through the exhibition of an intrinsic interest to learn and the discovery of meaning through the incorporation of relevant knowledge. An achieving approach is characterized by academic achievement, high grades, and "model student" behavior. A number of subscale scores can be generated based on the three approaches: Surface Motive, Surface Strategy, Deep Motive, Deep Strategy, Achieving Motive, and Achieving Strategy. Four scale scores (based on relevant subscale scores) can be computed: Surface Approach, Deep Approach, Achieving Approach, and Deep-Achieving Approach. See Table 6 for a description of the Surface, Deep, and Achieving Motives and Strategies. For each of the 36 items, students rate themselves on a five point scale ranging from (1) never or rarely true of me to (5) always or almost always true of me. Subscale raw scores are converted to decile scores using separate norms tables for boys and girls. Norms are provided for age 14 and year 11 (boys and girls). According to Biggs (1987), the decile scores may be interpreted using the following groupings: 1 - well below average; 2 to 3 - below average; 4 to 7 - average; 8 to 9 - above average; and 10 - well above average. High scores indicate high levels of motive, strategy, and approach. For the purposes of this study, decile scores were used in the data analysis.

Individual profiles can be generated for students based upon their scores on all subscales. For example, a student who obtains well above average scores

on the Surface subscales, and average scores on both the Deep and Achieving subscales may be regarded as having a "predominantly surface" profile.

Table 6

Descriptions of Approach, Motive and Strategy (Surface, Deep, and Achieving)

Dimension	Domain		
	Approach	Motive	Strategy
Surface	Surface approach leads to retention of factual detail at expense of structural relationships; feelings of dissatisfaction and boredom.	Surface motive is to meet requirements minimally; a balancing act between failing and working more than is necessary.	Surface strategy is to limit target to bare essentials and reproduce them through rote learning.
Deep	Deep approach leads to an understanding of the structural complexity of a task and to positive feelings about it.	Deep motive is intrinsic interest in what is being learned; to develop competence in particular academic subjects.	Deep strategy is to discover meaning by reading widely, inter-relating with previous relevant knowledge, etc.
Achieving	Achieving approach leads to good performance on exams; good academic self-concept and to feelings of satisfaction.	Achieving motive is to enhance ego and self-esteem through competition; to obtain highest grades, whether or not material is interesting.	Achieving strategy is to organize one's time and working space; to follow up all suggested readings, schedule time, behave as a 'model student'.

Note: Adapted from *Learning Process Questionnaire* Manual, by J. Biggs, 1987, Melbourne, Australia: Australian Council for Educational Research.

According to the Manual, reliability was assessed via several studies using two indices: test-retest and internal consistency. Test-retest reliability estimates ranged from .49 to .70 across scales. Internal consistency (alpha) coefficients ranged from .46 to .78. Test validity is addressed from the perspective of construct validity. The author stated that correlations between test scores and students' subjective evaluations of their performance support the construct validity of the test. For example, a surface orientation correlates approximately -.15 with student satisfaction of their performance. A deep orientation correlates around .20 and an achieving orientation correlates approximately .30 with performance satisfaction.

Summary of Measures

As a number of measures were used to used in the data collection phase of the study, the theoretical models and accompanying measures are summarized in Table 7. The next section outlines the analyses which were conducted with each of the measures; please note that all measures were subjected to statistical analyses except for the interview questions; these data were analyzed using a qualitative paradigm (e.g., themes derived from the interviewees' responses).

Table 7

Summary of Measures Used in the Research Study.

Theoretical Construct	Measure
PASS Model	
Planning	Planned Connections
	Planned Search
Attention	Receptive Attention
	Expressive Attention
Simultaneous Processing	Ravens Standard Progressive Matrices
	Figure Memory
Successive Processing	Word Series
	Digit Span
Reading	Woodcock Reading Mastery Test - Revised Word Attack subtest
	Woodcock Reading Mastery Test - Revised Passage Comprehension subtest
Depth of Processing	Passage Summaries
	Interview Questions (themes/miscue analysis)
	Learning Process Questionnaire

Treatment of Research Data

Within this next section, the data analysis procedures will be described for each area of research inquiry and accompanying data analysis questions.

1. How are planning, attention, simultaneous and successive processes manifested in adolescent learners with reading difficulties?

a. Are there performance differences on Planning tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

b. Are there performance differences on Attention tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

c. Are there performance differences on Simultaneous processing tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

d. Are there performance differences on Successive processing tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

The reading group assignment (students with reading difficulties; students without reading difficulties) and gender (male; female) constituted the independent variables and each of the PASS model components were identified as the dependent variables in the analyses.

As an initial step in the analysis, means and standard deviations on each of the reading measures were computed for both groups (students with reading difficulties and students without reading difficulties) and gender (boys and girls). A 2 x 2 MANOVA (Multivariate Analysis of Variance) was then conducted to serve as a validity check to determine whether there were reading group or gender differences on reading performance (Word Attack and Passage Comprehension) and whether there were interaction effects between reading group and gender.

A correlation matrix for all PASS model component tasks was computed to determine the relationships among the PASS components. A series of 2 x 2 MANOVAs were then conducted in order to examine reading group and gender effects on PASS model components and to determine whether reading group and gender interacted. For the purposes of this study, analyses which resulted in test statistic values having probabilities of less than .05 were ruled statistically significant.

2. What kind(s) of cognitive approach(es) do adolescents with reading difficulties use when reading?

a. As a general approach to learning, what kinds of cognitive approaches do adolescent learners with reading difficulties use?

In order to address this research question, the percentage of student responses at each decile were calculated for all of the nine subscales of the *Learning Process Questionnaire*. Decile scores were grouped according to Biggs' (1987) interpretive framework: 1 to 3 - below average; 4 to 7 - average; 8

to 10 - above average.

b. Within the context of reading comprehension, what kinds of cognitive approaches do learners with reading difficulties use?

First, student self-generated summaries on each of the three reading passages were scored according to the criteria outlined in the previous section (e.g., 0, 1, 2). The percentage of responses in each of the three categories were then calculated. The data obtained from the interviews were also analyzed according to themes generated from student responses to the interview questions. Finally, the miscues identified as a function of the miscue analysis were scored according to the guidelines identified earlier.

3. What is the relationship between PASS model components and cognitive approaches in adolescents with reading difficulties?

a. Are planning and surface and/or deep levels of processing related in adolescents with reading difficulties?

b. Are attention and surface and/or deep levels of processing related in adolescents with reading difficulties?

c. Are simultaneous processing and surface and/or deep levels of processing related in adolescents with reading difficulties?

d. Are successive processing and surface and/or deep levels of processing related in adolescents with reading difficulties?

To address each of these questions, Pearson product moment correlations were computed for all variables of relevance to the analyses: PASS model

components, levels of processing (as measured by the nine subscales of the *Learning Process Questionnaire*), and reading comprehension (as measured by the *Woodcock Reading Mastery Test - Revised* Passage Comprehension subtest). In addition, data from three individual interviews were examined to investigate the relationships between cognitive processing, cognitive approaches, and reading comprehension from a qualitative and intra-individual perspective.

CHAPTER FOUR

RESULTS OF THE STUDY

Within this chapter, both the quantitative and qualitative analyses and results will be reported for the three areas of research inquiry.

Research Inquiry Area #1

How are planning, attention, simultaneous and successive processes manifested in adolescent learners with reading difficulties?

In order to provide a preliminary description of the sample, means and standard deviations were computed for both reading groups (Group One and Group Two) and gender (males and females) on all PASS model tasks (see Table 8). A series of 2 x 2 MANOVAs were then conducted on each of the PASS model components. As stated in Chapter Three, the independent variables in each of the analyses were reading group and gender; the dependent variables were the PASS model components - Planning, Attention, Simultaneous processing and Successive processing.

Table 8

Means and Standard Deviations for PASS Model Variables and Reading Scores

Variable	Reading Group		Gender	
	One (n=84)	Two (n=67)	Males(n=83)	Females(n=68)
Planning				
Pl Search	64.86(19.84)	57.07(15.98)	65.19(19.44)	56.78(16.46)
Plan Con	166.00(46.71)	138.99(43.91)	159.63(50.44)	147.16(42.51)
Attention				
Ex Att	41.20(8.72)	36.84(8.39)	40.29(9.08)	38.01(8.39)
Rec Att	42.01(5.08)	44.04(4.46)	42.52(5.14)	43.40(4.60)
Simultaneous				
FigureMry	15.93(4.57)	18.24(4.60)	17.40(4.77)	16.41(4.61)
Ravens	39.05(7.51)	45.42(5.94)	41.87(6.88)	41.99(8.32)
Successive				
Digit Span	15.40(3.42)	16.34(4.28)	15.90(3.80)	15.72(3.92)
Wrd Series	12.31(3.29)	13.01(3.97)	12.76(3.69)	12.46(3.53)

Note: Standard Deviations are reported in brackets; Planned Connections, Planned Search, and Expressive Attention scores=time in seconds; Receptive Attention, Figure Memory, Raven's, Digit Span and Word Series scores=number of items correct.
Planning - Planned Connections (Plan Con); Planned Search (Pl Search)
Attention - Expressive Attention (Ex Att); Receptive Attention (Rec Att)
Simultaneous - Figure Memory (Figure Mry); Ravens Progressive Matrices (Ravens)
Successive - Word Series (Wrd Series); Digit Span

Standard Scores on Select Model Tasks

As stated previously, normative information on several of the PASS model tasks was published during the latter stages of the data analysis. It was then possible to convert the raw scores to standard scores (mean=10; SD=3) for one task per PASS model component. Standard scores were computed for the following tasks: Planned Connections (Planning), Expressive Attention (Attention), *Raven's Standard Progressive Matrices* (Simultaneous processing), and Digit Span (Successive processing). See Table 9 for the standard score means and standard deviations for the reading groups and gender on the PASS model tasks. The calculation of standard scores on these select PASS model tasks was undertaken in order to allow for the interpretation of student performance within a standardized framework (e.g., most norm-referenced intelligence tests use a subtest mean of 10 and a standard deviation of 3). These results will be discussed in greater detail within the context of the case studies described within the third area of research inquiry.

Table 9

Standard Score Means and Standard Deviations for Reading Group and Gender on Select PASS Model Tasks

Variable	Reading Group		Gender	
	One (n=84)	Two (n=67)	Males (n=83)	Females(n=68)
PlConnection	8.27 (2.30)	10.19(2.99)	8.77 (2.85)	9.56 (2.67)
Ex Attention	9.94 (2.65)	11.60(2.94)	10.37 (2.90)	11.04 (2.87)
Ravens	7.63 (2.27)	9.91 (2.36)	8.47 (2.52)	8.85 (2.62)
Digit Span	9.13 (2.44)	9.70 (3.19)	9.43 (2.78)	9.32 (2.85)

Note: Standard Score=10; Standard Deviation=3; Standard Deviations are reported in brackets.

Correlations Among PASS Model Tasks

Correlations were computed for all PASS model components with both groups separately and then combined to ascertain the relationships between the PASS model components and tasks. Multivariate analysis of variance (MANOVA) was then used to describe the patterns of performance on the PASS model components.

Initially, correlations for all PASS model component tasks were calculated for Groups One and Two separately (see Table 10).

Table 10

Pearson Product Moment Correlations for PASS Model Components - by Group

	PlCon	PlSrch	ExAtn	ReAtn	FMry	Raven	WS	DS
PlCon		.448	.482	-.186	-.319	-.184	-.256	-.387
PlSrch	.400		.362	-.143	-.191	-.048	-.204	-.085
ExAtn	.315	.313		-.237	-.293	-.084	-.097	-.263
ReAtn	-.123	-.134	-.262		.159	.242	.172	.222
FMry	-.434	-.197	-.366	.304		.443	.412	.346
Raven	-.333	-.114	-.266	.440	.482		.269	.288
WS	-.042	-.035	-.296	.093	.292	.192		.663
DS	-.045	.009	-.377	.272	.269	.415	.709	

Note: Group One - Correlations in Upper Half of Matrix; Group Two - Correlation in Lower Half of Matrix
Planning - Planned Connections (PlCon); Planned Search (PlSrch)
Attention - Expressive Attention (ExAtn); Receptive Attention (ReAtn)
Simultaneous - Figure Memory (Fmry); Ravens Progressive Matrices (Raven)
Successive - Word Series (WS); Digit Span (DS)

The comparability of the correlation matrices for the two groups was tested using Box's Test of Equality of Covariance Matrices. Box's Test is considered to be a sensitive test of homogeneity of variance-covariance matrices (Hair, Anderson, Tatham, & Black, 1995). The test (Box's M=42.138, F(36, 67374)=1.103, p>.05) indicated that correlations among the variables were not significantly different between the groups. Accordingly, data from both groups were then combined for further analysis. Correlations were computed for all PASS model tasks with the entire sample (n=151) (see Table 11).

Table 11

Pearson Product Moment Correlations for PASS Model Components - Combined Groups

	PlSrch	ExAtn	ReAtn	FMry	Raven	WS	DS
Pl Con	.461*	.453*	-.210*	-.412*	-.328	-.174*	-.244*
PlSrch		.376*	-.177*	-.233*	-.150	-.144	-.066
ExAtn			-.285*	.-.365*	-.238*	-.209*	-.334*
ReAtn				.258*	.364*	.151	.260*
FMry					.503*	.363*	.324*
Raven						.249*	.353*
WS							.692*

* ($p<.01$)

Note: Planning - Planned Connections (PlCon); Planned Search (PlSrch)
Attention - Expressive Attention (ExAtn); Receptive Attention (ReAtn)
Simultaneous - Figure Memory (Fmry); Ravens Progressive Matrices (Raven)
Successive - Word Series (WS); Digit Span (DS)

Within the planning component, a moderate correlation was found between planning tasks: Planned Connections and Planned Search (r=.461). The planning tasks also correlated similarly with several tasks from the other PASS Model components. For example, both Planned Connections and Planned Search were moderately correlated with Expressive Attention -Attention component (r=.453 and .376 respectively). Planned Connections was also moderately correlated with Figure Memory - Simultaneous component (r=-.412).

Within the attention component, a low albeit significant, correlation was

noted between the two attention tasks - Expressive and Receptive Attention (r=-.285). However, higher correlations were found between Expressive Attention and both planning tasks - Planned Connections and Planned Search (.453 and .376 respectively) than with Receptive Attention. As well, higher correlations were noted between Expressive Attention and Figure Memory - a simultaneous processing task (r=-.365) and Digit Span - a successive processing task (r=-.334) than between the Expressive and Receptive Attention tasks.

The two Simultaneous processing tasks - Figure Memory and *Ravens Standard Progressive Matrices* - correlated more highly with each other (r=.503) than with any of the other PASS components/tasks. Both tasks had low to moderate correlations (e.g., r=.15 to .41) with the attention, planning, and successive processing tasks.

A moderately high (r=.692) correlation was reported between the successive processing tasks (Word Series and Digit Span). As mentioned previously, the successive processing tasks were also correlated with the other components: simultaneous processing, attention, and planning. These correlations, however, were all relatively low.

The patterns of intercorrelations in Table 11 demonstrated that tasks in one domain were correlated with tasks in other domains. According to Das et al. (1994), the components or "functional units are all related while at the same time they maintain independence by having distinct functions" (p. 19). As such, the patterns of correlations should be indicative of stronger relationships within

components (e.g., higher correlations between tasks measuring the same component) than between components. These correlational patterns were found with the simultaneous and successive processing components but not with the planning and attention components. The patterns of correlations on the planning and attention tasks were in keeping with previous research findings (e.g., Naglieri & Das, 1995; Naglieri & Das, 1997). For example, on the *Cognitive Assessment System* (1997), the planning component subtests were found to correlate as highly with the attention component subtests as they did with the other planning subtests.

Data Analysis Question 1(a)

Are there performance differences on Planning tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

Results of the 2 x 2 MANOVA conducted in the first analysis indicated that there was no significant interaction between group and gender; therefore, the main effects could be interpreted directly. A significant main effect was found for reading group but not for gender. Univariate follow-up tests revealed that a significant difference existed between reading groups on Planned Connections but not for Planned Search; Group One performed more poorly (e.g., longer completion time) on Planned Connections than Group Two. See Table 12 for MANOVA results.

Table 12

F Values for 2 x 2 MANOVA Results and Univariate Tests on Planning

	Reading Group	Gender	Interaction
Wilks Lambda[a]	5.17*	2.02	.418
Univariate F Tests[b]			
Planned Connections	10.35*	.078	.175
Planned Search	2.60	3.70	.307

Note: [a] df=2,146; [b] df=1,147
*p<.05

Data Analysis Question 1(b)

Are there performance differences on Attention tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

According to the results of the 2 x 2 MANOVA, there was no interaction between group and gender. A significant main effect was found for reading group but not for gender. Follow-up tests indicated that the reading groups differed on both Attention tasks. On the Expressive Attention task, Group One performed more poorly (e.g., longer completion time) than Group Two. Group One also performed more poorly (e.g., fewer number of correct responses) than Group Two on the Receptive Attention task (see Table 13 for MANOVA results).

Table 13

F Values for 2 x 2 MANOVA Results and Univariate Tests on Attention

	Reading Group	Gender	Interaction
Wilks Lambda[a]	5.06*	.096	.321
Univariate F Tests[b]			
Expressive Attention	7.17*	.192	.112
Receptive Attention	5.47*	.022	.626

Note: [a] df=2,146; [b] df=1,147
*p<.05

Data Analysis Question 1(c)

Are there performance differences on Simultaneous processing tasks between

i. Adolescent learners with reading difficulties and adolescent learners without reading difficulties?

ii. Males and females?

According to the results of the 2 x 2 MANOVA, there was no significant reading group - gender interaction on the Simultaneous processing component. Significant main effects were found for both reading group and gender. Univariate follow-up tests revealed that differences between groups and gender existed on the Figure Memory task and the *Raven's Standard Progressive Matrices* (see Table 14 for MANOVA results). Students without reading difficulties performed better than students with reading difficulties on both Figure Memory and the *Raven's Standard Progressive Matrices*. As well, boys performed better than girls on both Simultaneous processing tasks.

Table 14

F Values for 2 x 2 MANOVA Results and Univariate Tests on Simultaneous Processing

	Reading Group	Gender	Interaction
Wilks Lambda[a]	20.49*	4.46	1.09
Univariate F Tests[b]			
Ravens	39.07*	4.85*	2.20
Figure Memory	16.17*	7.73*	.369

Note: [a] df=2,146; [b] df=1,147
*p<.05

The significant main effect for gender on the Simultaneous processing tasks must be interpreted with caution, however. For example, an examination of the mean scores on the *Raven's Progressive Matrices* for males and females (41.87 and 41.99 respectively) indicated that they were similar. In the analysis, however, differences were found between the groups. A closer inspection of the data revealed that the unequal group sizes (males with reading difficulties=61; females with reading difficulties=23; males without reading difficulties=22; females without reading difficulties=45), differences of variability within each of groups, and the susceptibility to outliers given the small group sizes, may have contributed to the apparent discrepancies.

Data Analysis Question 1(d)

Are there performance differences on Sucessive processing tasks between

i. Adolescent learners with reading difficulties and adolescent learners

without reading difficulties?

ii. Males and females?

The results of the 2 x 2 MANOVA indicated that there was no significant interaction for group and gender. As well, there were no significant main effects for reading group or gender. No significant differences existed between groups or males and females on either of the Successive processing tasks: Word Series or Digit Span (see Table 15 for MANOVA results).

Table 15

F Values for 2 x 2 MANOVA Results and Univariate Tests on Successive Processing

	Reading Group	Gender	Interaction
Wilks Lambda[a]	1.66	.599	.510
Univariate F Tests[b]			
Digit Span	3.16	.84	.598
Word Series	2.32	1.14	.003

Note: [a] df=2,146; [b] df=1,147
*p<.05

An additional analysis was conducted with Digit Span - Digits Forward as this portion of the subtest may provide a purer measure of Successive processing (J. Naglieri, personal communication, June 13, 1997). No differences between reading groups and gender were found on this portion of the Digit Span subtest.

Additional Analyses on the PASS Model Tasks

Although no differences were expected in the patterns of performance on

the PASS model tasks using standard scores rather than raw scores, an additional computation using the technique of Analysis of Variance (ANOVA) was performed on each of the four PASS model task standard scores to check that these results were in keeping with previous analyses. The results of the four ANOVAs were comparable to the results of the MANOVAs (see Table 16).

Table 16

Analysis of Variance for Select PASS Model Tasks

Source	df	F			
		Pl Connect	Ex Atn	Ravens	Digit Span
Rdg Group	1, 149	16.33*	10.86*	37.82*	2.18
Gender	1, 149	.005	.001	2.14	.57
RG x G	1, 149	.012	.020	.351	.46

*p<.01

Research Inquiry Area #1 Summary

On the PASS model components of Planning, Attention, and Simultaneous processing, students with reading difficulties demonstrated poorer performance than students without reading difficulties. These students performed more poorly on the Planned Connections task but not on Planned Search suggesting that the nature of the Planning task (e.g., complexity or difficulty level) may be a factor in discriminating between reading groups. Students with reading difficulties performed more poorly on both Attention tasks; attentional deficiencies were evident in both Expressive and Receptive Attention. As well, students with reading difficulties performed more poorly on both Simultaneous processing

tasks. Performance differences between groups on Successive processing tasks were not evident, however. These results suggest that students with reading difficulties may have had comparable capabilities and skills in sequencing information (Successive processing) relative to students without reading difficulties, but did not demonstrate adequate skills in processing information wholistically (Simultaneous processing).

No significant differences existed between the performances of males and females on the Planning, Attention, and Successive processing tasks; however, males performed better than females on both Simultaneous processing tasks. As stated previously, these performance differences must be interpreted with caution as a variety of factors (e.g., unequal group sizes) may have influenced the outcome of the statistical analysis.

Research Inquiry Area #2

What kind(s) of learning approach(es) do adolescents with reading difficulties (Group One) use when reading?

Data Analysis Question 2(a)

As a general approach to learning, what kinds of cognitive approaches do adolescent learners with reading difficulties use?

In order to address the research question, data from the *Learning Process Questionnaire* were analyzed using descriptive statistics. Decile scores were calculated from the raw scores for each of the nine subscales using separate norms tables in the *Learning Process Questionnaire* for boys and girls. The decile

scores were then combined to reflect Biggs' (1987) interpretive framework: 1 to 3 - below average; 4 to 7 - average; 8 to 10 - above average. See Table 17 for the percentage of students performing within each of the three ranges: below average, average, and above average on the nine subscales.

Table 17

Percentage of Respondents Below Average (1-3), Average (4-7) and Above Average (8-10) on LPQ Subscales (n=84)

Dimension	Domain		
	Approach	Motive	Strategy
Surface			
1-3	31	39	23
4-7	31	38	32
8-10	38	24	46
Deep			
1-3	31	33	33
4-7	40	28	42
8-10	30	40	24
Achieving			
1-3	43	47	44
4-7	41	39	30
8-10	16	14	26

Note: Each dimension (Surface, Deep, Achieving) x domain (Approach, Motive, Strategy) represents 100% of the students.

In order to assess the learning approaches identified by the students on the *Learning Process Questionnaire*, the percentage of responses at each decile can be examined within each dimension (Surface, Deep, or Achieving) or within each domain (Approach, Motive, and Strategy). For the purposes of analysis in this study, student responses will be examined along the Surface, Deep, and Achieving dimensions.

An examination of the percentages of scores on the Surface dimension subscales (Approach, Strategy, and Motive) revealed that 38% of Group One performed in the above average range on the Surface Approach subscale. Forty-six percent of the group obtained scores within the above average range on the Surface Strategy scale whereas only 24% of the students adopted a Surface Motive (i.e., performed within the above average range). These results indicated that almost half the students in Group One demonstrated a surface strategy profile (e.g., reliance on rote learning) whereas less than one quarter demonstrated a surface motive profile (e.g., were motivated to meet expectations and requirements minimally).

On the Deep dimension subscales, that is, Deep Approach, Deep Motive, and Deep Strategy, 30% of the students obtained scores within the above average range on Deep Approach. Twenty-four percent of the students obtained scores within the above average range on Deep Strategy; 40% of the students obtained above average scores on the Deep Motive subscale. These results indicated that only one quarter of the students demonstrated a deep strategy profile (e.g., relating new information to previous knowledge) although almost half of the students demonstrated a deep motive profile (e.g., were intrinsically motivated to learn).

Smaller percentages of students obtained above average scores on the Achieving dimension subscales. Only 16% of the students obtained above average scores on the Achieving Approach subscale (e.g., good academic self-concept); a similar percentage of students (14%) obtained above average scores on

the Achieving Motive subscale (e.g., motivated to achieve highest grades). Approximately one quarter of the students (26%) demonstrated an achieving strategy profile (e.g., scheduling study time; organizing work space).

Summary

Overall, students with reading difficulties were represented within all score ranges (below average, average, above average) across all dimensions (Surface, Deep, and Achieving).

Almost half of the students obtained high average scores on the Surface Strategy subscale (e.g., rote learning) whereas only approximately one quarter of the students obtained high average scores on the Deep Strategy subscale (e.g., use of prior knowledge in learning) and the Achieving Strategy subscale (e.g., use of organizational skills and study strategies).

The largest percentage (40%) of students in Group One obtained high average scores on the Deep Motive subscale (e.g., demonstration of intrinsic interest). A much smaller percentage of students (24%) scored within the high average range on the Surface Motive subscale (e.g., motivated to minimally meet requirements) and only 14% of the students performed within the high average range on the Achieving Motive subscale (e.g., motivation to obtain highest grades in class).

More than one third (38%) of the students obtained high average scores on the Surface Approach subscale (e.g., retention of factual detail at the expense of the underlying structural relationships). A slightly smaller percentage of students

(30%) obtained above average scores on the Deep Approach subscale (e.g., understanding structural complexities of tasks) whereas less than 20% of the students obtained high average scores on the Achieving Approach subscale (e.g., good performance on examinations; positive academic self-concept).

Generally, students with reading difficulties were characterized as demonstrating a Surface Strategy profile (e.g., rote learning) although their orientation was reflective of a Deep Motive (e.g., intrinsic interest in learning).

The analysis of the group's performance on each of the nine subscales did not allow for indepth individual profile descriptions as outlined by Biggs (1987). As a result, one cannot ascertain the similarities and differences between individual profiles across all nine subscales. In fact, the *Learning Process Questionnaire* appears to have greater utility in applied settings (e.g., use of individual profiles for educational decision-making) than in research (e.g., descriptions of group performance).

The results of the *Learning Process Questionnaire* provided an indication of the general approaches to learning which students self-reported. In order to investigate the approaches to learning which students took specifically within the domain of reading (e.g., comprehension of text), the following question was generated for the purposes of further data analysis.

Data Analysis Question 2(b)

Within the context of reading comprehension, what kinds of cognitive approaches do learners with reading difficulties use?

In order to address this aspect of the research inquiry, data were obtained from two sources: (1) oral summaries of reading passages and (2) interview data.

Reading Summary Scores

As outlined in Chapter Three, students were asked to generate summaries at the end of each of three reading passages. Summaries were scored using the criteria (e.g., 0,1,2) in Table 4. Two raters scored the summaries separately; any discrepancies in scoring were resolved (approximately 14% of the summaries required clarification). For each summary, the frequencies and percentages of responses in each category are outlined in Table 18.

Table 18

Student Reading Passage Summaries - Frequencies and Percentages

Scoring Criteria	Passage #1(n=83)	Passage #2(n=84)	Passage #3(n=79)
0	33 (40%)	17 (20%)	28 (35%)
1	36 (43%)	55 (66%)	49 (62%)
2	14 (17%)	12 (14%)	2 (3%)

Note: Scoring Criteria of 0=Verbatim descriptions of text; 1=Linear summarization in own words; 2=Self-generated integrated summaries.

As is evident from an examination of Table 18 most of the students produced oral summaries which were rated as either 0 or 1. According to the descriptors provided earlier, these summaries were indicative of surface level processing: verbatim descriptions of text, linear summarizations, and few, if any, attempts at integration.

Oral summaries which were given a score of 0 were characterized by

sentence fragments, erroneous or missing information, or verbatim descriptions of text. Examples of summaries which were given a score of 0 include the following:

Paragraph #1

Subject #1: They were taking about launching a rocket ship into space or whatever, and they went 5,4,3,2,1 and it went off, and it didn't really leave the ground or whatever. And then they were worried the rocket was going to end up in water and they didn't know where it would end up but they were hoping it would land in water. Done.

Subject #2: Um, let's see, they start the mission, Apollo 13, and land on the moon. And I remember Lovell, Texas, and I remember they were on the computer, and blowing off the rocket or something, and, that's it. They had a four minute explosion.

Subject #3: It's about a spaceship out in space, and, uh, I don't know.

Paragraph #2

Subject #1: A lifeguard sits around and is watching people. And there's about 3000 people. His name is Lee Anderson. He sits around.

Subject #2: Saving people. Because there's people that are drowning don't have no time to yell 'cause they gasp, panic, and stuff.

Subject #3: Basically about lifeguards, why they sit on those large chairs and all that.

Paragraph #3

Subject #1: I guess you could say that they wanted to get back to Nova Scotia. Daniel McInnis. Men. They found gold.

Subject #2: They were digging by some oaken barriers or something like that.

Subject #3: These three kids in Nova Scotia were digging and they find these oak treasure chests.

A score of 1 was assigned to summaries in which students provided a

linear summarization of the passage in their own words and attempted to reorder ideas. The following are examples of summaries which warranted a score of 1:

Paragraph #1

Subject #1: It was about the crew of the Apollo 13. One day they had trouble with their engines and they need to use a rocket blast to get them back in line with the earth.

Subject #2: It was about Apollo 13 in space and they were trying to get back to earth without making any mistakes and they had to, like, push this button to get back to earth, but if they didn't push it at the exact right time they might miss the earth, and they might die, or whatever.

Paragraph #2

Subject #1: The lifeguards telling the young kids that the job isn't as easy as they think it is. It's hard to keep track of all the people on the beach.

Subject #2: This story is about a lifeguard and telling little kids what his job is and how hard it is to look and find a person drowning. Sometimes there is 3000 people and it's hard to concentrate when there's that many people.

Paragraph #3

Subject #1: Uh, it's, three youths are canoeing and the canoe stopped at one place in Nova Scotia and they saw, saw a limb of oak or something, and, and they came back another day and, and they started digging and they saw another one, and then they kept on doing that and then they got tired from exhaustion. And they had to postpone their digging for awhile, and then they went back to Nova Scotia and they talked to people there about that, about the planks.

Subject #2: Three youths got out of the canoe - Jack, Tony, and Daniel. And they seen this spot on the earth that was sort of dark and everything, and they noticed that some excavation was done there. So they started to dig and every couple of feet they hit an oaken barrier and they just kept doing this day after day, and finally they had to give up because of exhaustion.

Summaries which were given a score of 2 were representative of students' self-generated summaries in which information was integrated; story sequence

may or may not have been reordered. Examples of summaries with 2 point scores include the following:

Paragraph #1

There's a group of guys, and they were flying through space and something went wrong with their space shuttle, and they had to use the gravitation of the moon to swing themselves around so they could go back to earth. And then they turned on the rockets which fired them towards the earth, into the Pacific Ocean.

Paragraph #2

Little girl or boy or teenager came up to the lifeguard and asked him what he really does all day and stuff. It just kinda seems like he sits around and does nothing. And he more or less said that lifeguards have to like concentrate on the water and find drowning people because when someone is drowning they don't have the energy to like yell for help or anything, so they have to watch all the time. And like when they're saving somebody in the water it's not their life at risk it's both of theirs.

Paragraph #3

It's about three young boys who were just like looking for adventure and they happened to stumble across an old oak, with packed ground under it, and so it gave them reason to wonder if there was anything underneath because, say someone was doing some touching up the ground before they came. They went back the next day and started digging and they went back frequently to dig some more and they found like these oak, like these oak wood planks, uh, they weren't too sure what was underneath them or, but they were, but due to exhaustion they stopped to rest and so they went back to Nova Scotia and they were asking like, sort of, subtle questions about the island and what the people knew about it.

Summary.

Most of the students with reading difficulties (Group One) provided oral summaries which were indicative of surface level processing within the context of reading comprehension. Caution must be exercised in the interpretation of these

results as the method for ascertaining levels of processing was based, in part, upon the students' expressive language skills (e.g., verbal fluency). Therefore, the students' performance on the oral summaries may have been constrained by their oral language proficiency. If another method (e.g., multiple choice questions) had been used to assess depth of processing, the students may have provided evidence of deep levels of processing. According to Kirby and Woodhouse (1994), verbal ability may be important antecedent variable for deep processing. Task demands which minimize the importance of verbal ability may enable the student to apply deep processing strategies or approaches.

Interview Data

A total of 14 students with reading difficulties were randomly selected from each of the four high schools for the purposes of the semi-structured interview. In order to determine if they were representative of students with reading difficulties (as a whole), means and standard deviations for the PASS model tasks and decile ranges on the LPQ were computed (see Table 19 for interviewees' performance on the PASS model tasks and reading and Table 20 for LPQ deciles). A cursory inspection of Tables 19 and 20 revealed that the interviewees performed comparably to Group One on most PASS model tasks although their mean scores on Planned Connections was slightly higher (e.g., score of 188.29 (52.29) versus the score of 166.00 (46.71) for Group One). Similar trends in the distribution of decile scores were noted on the Strategy domain for both the interviewees and Group One as a whole. For example, the

majority of interviewees (73%) obtained average to above average decile scores on the Surface Strategy as did the majority of Group One (78%). However, on the Motive Domain, a slightly smaller percentage of interviewees gave average to above average ratings on all three dimensions (Surface, Deep, and Achieving) than did Group One. To illustrate, a Deep Motive was identified by 50% of the interviewees whereas 68% of Group One scored within the average to above average ranges on this subscale.

Table 19

Means and Standard Deviations for Interviewees on PASS Model Tasks and Reading Scores

Variable	Mean Score	Standard Deviation
Planning		
Planned Search	69.429	20.49
Planned Connections	188.29	52.29
Attention		
Expressive Attention	40.57	10.96
Receptive Attention	41.71	5.41
Simultaneous processing		
Figure Memory	15.71	5.78
Ravens	42.79	6.29
Successive processing		
Digit Span	15.36	2.53
Word Series	12.50	3.25
WRMT-R		
Word Attack	94.14	13.47
Passage Comprehension	90.50	13.75
IRI Summary Total	18.75	4.55

Note: Planned Connections, Planned Search, and Expressive Attention scores=time in seconds; Receptive Attention, Figure Memory, Raven's, Digit Span and Word Series scores=number of items correct; IRI=possible total score of 30.

Table 20

Learning Process Questionnaire Interviewee Frequencies (n=14)

Dimension	Domain		
	Approach	Motive	Strategy
Surface			
1-3	3	7	1
4-7	7	5	6
8-10	4	2	7
Deep			
1-3	7	7	6
4-7	5	4	6
8-10	2	3	2
Achieving			
1-3	7	9	8
4-7	6	4	5
8-10	1	1	1

Student Responses to Interview Questions.

As outlined in the Method section, the interviewees were asked to respond to a series of questions pertaining to their approaches to reading. Of relevance to the examination of this data analysis question are the following interview questions: (1) What do you think about as you read?, (2) What kind(s) of information do you typically try to remember when you read a passage?, and (3) What do you say to yourself when the reading becomes difficult? Each of the questions will be considered sequentially. A framework for the categorization and

description of the responses for each of the three questions was determined according to the themes which were generated as a function of student responses.

What do you think about as you read?

When asked by the researcher "what do you think about as you read?", the interviewees provided a range of responses which could be grouped according to four categories.

The first type of response was reflective of the reader's disengagement from text. Comments such as "I don't think of anything when I read, I don't think" and "I don't know . . . just whatever's on my mind" were cited by four interviewees. These students did not appear to be engaged with the text and did not appear to be invested in deriving meaning from the material they were reading.

The second type of response was more purposeful. Students who were oriented to a purposeful approach made statements such as "I read it so I can learn something", "I think about information in the article", and "I take away clues and try to memorize it". Five of the interviewees provided responses which were indicative of a purposeful acquisition of information which was primarily oriented toward learning facts or details.

Responses indicative of student's active involvement in the prediction of events were classified within the third category. Statements such as "I like to try and picture, like from what the information is telling me, I try and picture a picture in my head and stuff", "I usually try to get a sense of what's going on in

it", or "I think about what's going to happen next" were reflective of the students' attempts at understanding the plot (storyline) or characters and creating visual images while reading text. Eight students provided responses which could be included within this category.

The fourth category was related, in part, to the third type of response; students within this category not only visualized the sequence of events within text but also actively related their own personal experiences to the information presented in text. Three students provided responses indicative of an overt application of prior knowledge; these responses included statements such as "I kinda think, like I put myself in the main character so it's more understandable", "I think about, like, something that happened to me like that", and "I think about what it would be like if I was actually there, if I was part of the story".

The four categories of responses can be conceptualized within the levels of processing framework. Responses that were indicative of disengagement or disinterest in text may be categorized as surface level processing. Students' responses which were more purposeful - although still focussing on factual recall - may be viewed as a surface approach to processing information. Responses which were indicative of the prediction of upcoming events, developing hypotheses and the integration of information with personal experience may be viewed as deep approaches to reading comprehension.

What kind(s) of information do you typically try to remember?

Within the framework of the question, "What kind(s) of information do

you typically try to remember?", student responses were indicative of varying approaches to reading comprehension. In keeping with the categories of responses arising from the first question, four categories of responses were evident within this area.

Similar to the first question, two students provided responses that suggested that they were disengaged from the text; no active involvement on the part of the reader was evident. Student responses included statements such as, "I try to remember something other than the book" or "I don't know".

Two students stated that they tried to remember information that appeared to be important because of some externally imposed expectation; for example, "What the teacher says is important" or "I just remember it 'cause they (teachers) said it twice".

A number of students (n=8) indicated that they tried to remember the plot and characters of the story. These students appeared to be non-selective in their recall of information but recognized that details, the sequence of events, and character development were important aspects of the comprehension of text. Students made statements such as, "I try to remember basically what happened - like everything that happened, main events, minor events, pretty much the whole thing"; "characters' personality, characters' feelings towards other characters"; and "just all around knowledge - like fixing, riding, stuff like that".

The fourth group of students was more selective in terms of recall of information. Three students stated that they tried to remember information

pertaining to the story line and characters but were more specific or selective in the kind of information they tried to recall. These students stated that they tried to remember "important stuff - big turn around point", "things that seem like they're going to foreshadow some other thing", and "I try to remember the more important stuff, like if, the stuff that seems it doesn't matter but it does matter in the end, like if, somebody dropped something you might remember that 'cause it might be a clue to where they went or something".

The categories of student responses to the second question can also be conceptualized within a deep and surface levels of processing framework. For example, students who were disengaged from the text or tried to recall information in an indiscriminating fashion could be classified as engaging in surface level processing. Students who were engaged in reading specifically to obtain meaning (e.g., understanding the plot, characters, main idea) and were selective in what they tried to remember could be identified as engaging in deep level processing.

What do you say to yourself when the reading becomes difficult?

Responses to the third question pertained primarily to the word identification aspect of reading comprehension. Each of the interviewees identified a number of strategies that they used to assist them in overcoming difficulties when encountering difficult text (e.g., unknown words). Four types of responses were generated by the students.

The first type of response was in keeping with the category identified in

the first two interview questions: disengagement from text. Statements such as "Sometimes I just keep going because I don't care . . . well, if it's a boring part, then I'll just keep going"; "I just don't do it [stop reading]" and "I just keep reading" were illustrative of this response category. Six students identified this strategy within the context of the interview question.

The second category of responses was reflective of an extrinsic orientation. Similar to the category generated for the second interview question, these students made statements that indicated that they were reliant upon an external source for assistance (e.g., parent, teacher, friend, Coles notes, dictionary). Most of the interviewees (n=10) stated that they relied on parent, teacher, or peer assistance for identifying difficult words and clarifying terminology.

The third set of responses was indicative of strategies that were phonemic in nature. For example, students stated that "I look at a word and see if there are words that sound like it, or words in it that you know"; "I don't ask anybody, but sometimes I'll, like, sound something out"; and "say it a couple of times till it sounds right". Phonetic decoding strategies were identified by three students.

The last category of responses to the interview question was one in which students identified strategies pertaining to semantic and syntactic analysis. These strategies appeared to be contextually oriented as students relied more heavily upon the surrounding sentence structure to determine the meaning of the word/sentence. To illustrate, students made statements such as "I actually read it

and I look over the paragraph or whatever and I get it better", "I just read it over until I can understand", "sometimes I just go on and gradually I'll get it as the story goes on", and "I just read it and then use the sentence and make up the word".

From a deep versus surface levels of processing framework, strategies in which students kept reading and did not self-monitor could be identified as surface strategies. Asking for external assistance (e.g., parent) could also be construed as a surface strategy as the students did not initiate the problem-solving strategy themselves. Deep strategies, on the other hand, are reflective of active self-monitoring (e.g., skipping a difficult word and rereading the sentence if the meaning was lost). Categorization of these strategies must be made cautiously, however, as a seemingly surface strategy (e.g., "keep reading") might be appropriate when reading content (e.g., details) peripheral to the reader's intent or purpose (e.g., reading for main idea or theme). In fact, relying upon the context too heavily for obtaining word meanings (e.g., trying to infer a word's meaning by reading "around" the word) may be a surface strategy if the text structure is not rich enough to provide the necessary clues for ascertaining the meaning of the word (Adams, 1995).

Miscue Analysis.

Within the context of the interview, students were also provided with an opportunity to read a short passage orally (taken from the *Burns/Roe Informal Reading Inventory - Third Edition*). A miscue analysis was conducted on each

interviewee's oral reading passages. The information derived from the miscue analysis provided another opportunity to examine students' cognitive approaches to reading when difficulties were encountered.

Most of the students' strategies could be categorized as either phonemic or semantic/syntactic. Seven of the students attempted to decode difficult words phonetically, but typically substituted a visually similar word (e.g., scores for sores, expanded for expended) and did not self-monitor for meaning. All students made numerous spontaneous miscues which were graphically similar to the target words (e.g., faucet for fact; tornado for torrential). These graphically similar substitutions did not make sense in the context of the sentence and invariably compromised the meaning and intent of the narrative text. Omissions of words or portions of words (e.g., suffixes) were evident in eleven of the fourteen oral reading passages. Typically, these miscues compromised the syntax of the reading passage and often resulted in the alteration of the meaning of text. For example, one student omitted the word "not" from the text "Even when it was not raining waves would send water crashing over us . . .". Seven of the students also inserted words into the text when reading; these miscues varied regarding the degree to which they compromised the syntax of the text. To illustrate, one student inserted the word "the" into the sentence "Even when it was not raining waves would send *the* water crashing over us . . ."; this miscue had minimal impact on changing the syntactic structure and meaning of the text. However, the word "the" was inserted in the following text by another student: "*The* rest had

been a luxury that we had both forgotten". In this case, the meaning of the sentence was altered. Repetitions of words were also indicative of semantic and syntactic analysis. For example, students would repeat portions of a sentence that preceded a difficult term. These repetitions appeared to reflect the attempt to analyze the difficult word (in an anticipatory sense) within the syntactic and semantic structure of the sentence.

The largest number of student miscues were the substitutions of graphophonically similar words. As these substitutions compromised the meaning of the text, they were indicative of a surface approach to processing. Students did not actively self-monitor when reading (e.g., they did not skip difficult portions of text and return to it when meaning was compromised). As well, they did not change strategies (e.g., phonetic decoding) if they were unsuccessful at decoding a word.

Summary

The analysis of the interview data suggests that students with reading difficulties identify and demonstrate a variety of cognitive approaches within the context of reading comprehension. Students articulated a number of cognitive approaches which were indicative of a surface level approach. For example, several students appeared to be completely disengaged from the text when reading while others attempted to remember facts or details according to an externally imposed expectation (e.g., teacher's statement). Students also used a number of decoding strategies which appeared to be phonetically driven rather than

semantically oriented. On the other hand, the interviewees were also able to articulate cognitive approaches which were reflective of deep levels of processing. These students were actively engaged in the comprehension process; they thought about plot and character development, they attempted to relate new information to previous experience, and they were selective in determining the relative importance of the information presented (e.g., focussed upon specific events; skipped words which did not appear to be important to the gist of the story).

Research Inquiry Area #2 Summary

Three sources of data analysis were used in order to ascertain the kinds of approaches that students with reading difficulties use when reading: student responses to the *Learning Process Questionnaire*, student-generated summaries, and student semi-structured interviews.

As a general approach to learning, students with reading difficulties exhibited cognitive strategies which were primarily indicative of a surface level approach as the majority of students obtained scores within the average to above average range on the Surface Strategy dimension of the *Learning Process Questionnaire*. Most of the student-generated story summaries were rated within the 0 to 1 range, indicating the adoption of a surface level approach to reading comprehension. These findings were somewhat corroborated by the interview data. The majority of students demonstrated surface strategies when reading (e.g., factual recall, low self-monitoring when reading) as assessed by the miscue analysis; however they were able to articulate numerous strategies which were

illustrative of both surface and deep levels of processing.

The analyses of the students' responses within the framework of deep and surface levels of processing must be interpreted with caution as there are a number of factors which may have mediated the quality of responses, and subsequently, the depth of analysis which was possible. For example, motivational factors (e.g., level of student interest in the interview), the ability of the students to provide descriptive oral responses to the questions, and the nature of the questions themselves may have influenced the degree to which the student responses reflected their actual level of processing.

Research Inquiry Area #3

What is the relationship between the PASS model components and the learning approaches used by students with reading difficulties?

The purpose of this area of research inquiry was to investigate the relationship between cognitive processing (as defined by the PASS model) and the approaches to learning (described as either deep or surface) used by students with reading difficulties. The exact nature of the relationship between cognitive processing and learning strategies/approaches has not been well substantiated within the theoretical and research literature; therefore, all investigations within this portion of the study were preliminary. Given the relatively small sample size (n=84) and lack of variability within the sample, caution must be exercised in the interpretation of the analyses.

In order to address the questions developed for the purposes of data

analysis, Pearson product moment correlations were computed for all variables of relevance to the analyses: PASS model components, learning approaches and strategies (Deep, Surface, and Achieving), and reading comprehension (as measured by the *Woodcock Reading Mastery Test-Revised* Passage Comprehension subtest). See Table 21 for the intercorrelations.

Table 21

Pearson Product Moment Correlations for PASS Model, LPQ, and Passage Comprehension

	AS	DA	DS	SA	SS	PC	PS	EA	RA	FM	RM	DS	WS	WC
AA	89*	54*	53*	26*	09	03	06	-11	07	-02	-17	-03	-24	-07
AS		52*	53*	24*	02	-02	10	-09	06	-05	-10	00	-24	01
DA			84*	21	-02	09	01	03	19	05	-05	-14	-12	-05
DS				22*	02	-01	03	-11	19	15	00	04	-05	08
SA					82*	-04	-02	-13	06	-01	-13	01	-10	-02
SS						-06	-09	-13	08	06	01	05	-05	00
PC							45*	48*	-19*	-32*	-18*	-39*	-26*	-09
PS								36*	-14	-19	-05	-09	-20	-04
EA									-24*	-29*	-08	-26*	-10	-22*
RA										16	24*	22*	17	39*
FM											44*	35*	41*	18
RM												29*	27*	32*
DS													66*	31*
WS														33*

*p<.05

Note: Decimals have been omitted. AA=Achieving Approach, AS=Achieving Strategy, DA=Deep Approach, DS=Deep Strategy, SA=Surface Approach, SS=Surface Strategy, PC=Planned Connections, PS=Planned Search, EA=Expressive Attention, RA=Receptive Attention, FM=Figure Memory, RM=Raven's, DS=Digit Span, WS=Word Series, WC=*Woodcock Reading Mastery Test - Revised* Passage Comprehension Subtest.

An examination of Table 21 revealed that the deep, surface, and achieving dimensions of learning approaches and strategies were virtually uncorrelated with the PASS model components (e.g., correlations ranged from r=.00 to r=.24). Given the results of the statistical analysis, each of the following data analysis questions will not be considered separately; rather, the relationships among the PASS model components and deep/surface levels of processing will be discussed more generally:

a. Are planning and surface and/or deep levels of processing related in adolescents with reading difficulties?

b. Are attention and surface and/or deep levels of processing related in adolescents with reading difficulties?

c. Are simultaneous processing and surface and/or deep levels of processing related in adolescents with reading difficulties?

d. Are successive processing and surface and/or deep levels of processing related in adolescents with reading difficulties?

As previously stated, the results of the statistical analysis did not produce any statistically significant findings regarding the relationships between the PASS model components and the deep, surface, and achieving dimensions of learning approaches. All correlations were less than .20 with the exception of the two low, albeit insignificant, negative correlations between Word Series (Successive Processing task) and Achieving Approach (r=-.239) and Word Series and Achieving Strategy (r=-.242). As well, reading comprehension (as measured by

the WRMT-R Passage Comprehension subtest) was uncorrelated with learning approaches and strategies (e.g., correlations were all less than .10).

Reading comprehension, on the other hand, had low to moderate statistically significant correlations with all of the PASS model components except for the planning component and one simultaneous processing task. Reading comprehension and both planning tasks were uncorrelated. Moderately low correlations were found between reading comprehension and attention (Expressive Attention r=-.218; Receptive Attention r=.385). One simultaneous task and both successive processing tasks had moderately low correlations with reading comprehension (e.g., *Raven's Progressive Matrices* r=.316*; Successive -- Word Series r=.324, Digit Span r=.309). The two coding processes: simultaneous and successive processing appeared to correlate similarly with reading comprehension. The results of these analyses must be interpreted with caution, however, as the correlations may have been constrained due to the restricted variability in the sample.

Given the low correlations among the variables: PASS model components and learning strategies and approaches, no further statistical analyses (e.g., multiple regression analysis) were conducted. However, data from the semi-structured interviews were examined to investigate the relationships between cognitive processing, learning approaches and reading comprehension from a qualitative and intra-individual perspective. Three randomly selected case studies will be presented to highlight the differing profiles of these students. A summary

of the students' performance on the PASS model tasks which could be converted to standard scores, *Learning Process Questionnaire*, and *Woodcock Reading Mastery Test - Revised* is provided in Table 22.

Table 22

Case Studies Standard and Decile Scores on PASS Model Tasks, LPQ, and Woodcock Reading Mastery Test - Revised

Case Study	#1	#2	#3
Gender	Female	Male	Female
Grade	11	9	11
Age	17	14	17
PASS Model*			
Planned Connections (Planning)	6	7	7
Receptive Attention (Attention)	9	10	12
Ravens Matrices (Simultaneous processing)	9	11	10
Digit Span (Successive processing)	10	10	9
Woodcock Reading Mastery Test - Revised**			
Word Attack	101	93	114
Passage Comprehension	83	95	105
Learning Process Questionnaire***			
Surface Strategy	9	10	7
Surface Approach	7	9	3
Deep Strategy	1	10	4
Deep Approach	1	10	2
Achieving Strategy	3	8	1
Achieving Approach	1	8	1
Informal Rdg Inventory Summary Score****	11	18	16

* Standard Score=10; Standard Deviation=3
** Standard Score=100; Standard Deviation=15
***Decile Score
****Total Possible Score=30

Case Studies

Case Study #1

The first case was a 17 year old female enrolled in Grade 11. An examination of her PASS model standard scores revealed that she performed within the average range in the areas of attention, simultaneous processing, and successive processing. She performed below average, however, on planning. Despite her average performance on the simultaneous processing task, she performed within the below average range in reading comprehension. The below average performance on WRMT-R Passage Comprehension was in keeping with her performance on the open-ended questions presented at the end of each of the three reading passages she read; for example, she obtained the right answer on 11/30 questions (10 questions per reading passage). A review of the Miscue Analysis conducted on the reading passage revealed that she made few word recognition miscues (e.g., graphophonic miscues) although the miscues that were made compromised the meaning of text (e.g., faucet for facet; wide for with). Her performance on the oral reading passage was congruent with her average score on the WRMT-R Word Attack subtest. An analysis of her self-reported learning approaches (LPQ scores) revealed that she used primarily a surface strategy and surface approach. Both Deep and Achieving subscale scores were well below average (e.g., decile scores of 1). Interview data regarding her level of processing (e.g., deep versus surface) when reading text provided additional evidence of the application of surface strategies. For example, she stated that she tries "to think

about something other than the book" and "I don't really pay attention to what I'm reading, I just keep reading along". She also mentioned that she uses Coles notes, views videotaped productions of novels, and requests notes from friends in order to obtain information about the reading material in class. The comprehension strategies which she stated that she utilized most frequently were the "skip it" strategy and repeated reading of words or phrases. She was unable to identify any experiences or information she had acquired previously that would facilitate her understanding of the story she read orally during the interview. All of the oral summaries she provided for the reading passages were given a rating of 0.

The relationships between the student's self-ratings on the *Learning Process Questionnaire*, her approach to reading (e.g., surface strategies), and her performance on reading comprehension were congruent; that is, she used primarily a surface level approach to learning and reading. Of interest, is that her stated comprehension strategies (e.g., skipping words) could be reflective of a deep level of processing; however, her performance on the oral miscue analysis was not consistent with her self-identified strategies. Her performance on the PASS model tasks indicated that her cognitive processing skills were within the average range, except for planning, which was below average. Although speculative, a relationship may exist between her poor performance on reading comprehension and her lack of planning skills: ineffective strategies for task completion, inefficient problem solving skills, and low self-monitoring.

Case Study #2

The second student profiled in this series of case studies was a 14 year old male in Grade 9. According to his performance on the PASS model component tasks, he was functioning within the average range in all areas: planning, attention, simultaneous and successive processing. His performance on planning was somewhat lower than his other PASS model scores although it was still within the average range. This student's performances on both Word Attack and Passage Comprehension were within the average range; these scores were in keeping with his average performance on the simultaneous and successive processing tasks. Analysis of the interview data, however, revealed that he made numerous miscues in word decoding when reading orally (e.g., graphophonically similar miscues). The miscues he made compromised the meaning of the text (e.g., sucked for scudded; finishing for fishing). He also made frequent omissions and repetitions. Although numerous decoding miscues were made, he was still able to provide a coherent summary of the text. The oral summaries he provided for the three reading passages were given ratings of 1; all of summaries included details of the reading passages. When asked what he thought about as he read text, he stated that he tries "to remember the more important stuff, like if, the stuff that seems it doesn't matter but it does matter in the end". He also stated that he thinks "about what's going to happen next". These statements were also indicative of the application of his previous experiences to facilitate his understanding of text; for example, he said "I think about, like, something that happened to me, like that".

When reading silently, he stated that he uses a variety of strategies: "skip it", "just ask somebody", or "sounding out the words"; these strategies were primarily indicative of surface level strategies. This student rated himself above average on all dimensions: Deep, Surface, and Achieving strategies and approaches.

Despite his average performance on the WRMT-R Word Attack subtest, this student appeared to have difficulty with phonological processing skills. As a result, his reading comprehension scores were constrained despite the fact that he appeared to employ deep level strategies when reading (e.g., anticipation of upcoming events; connection with his own personal experiences). The average and above average ratings on all subscales of the *Learning Process Questionnaire* may have reflected the ineffective application of these deep, surface, and achieving approaches. According to Biggs (1987), students who exhibit this profile may have difficulty with language skills. No specific cognitive processing deficits were apparent despite his difficulties with successive-related tasks (e.g., word decoding).

Case Study #3

The third case was a 16 year old female who was enrolled in Grade 11. An examination of Table 22 revealed that her cognitive processing skills (as measured by the PASS model component tasks) were all within the average range. These results were corroborated by her reading comprehension and word attack scores as both were within the average range. A review of the results of the reading passage Miscue Analysis indicated that she made few, if any, errors in

decoding. She read smoothly and proficiently; however, she did not perform well on the open-ended questions at the end of the passage. In fact, she obtained a score of only 17/30 on the questions presented at the end of the three reading passages. Her oral reading summary scores ranged from 0 to 1. During the interview, she stated that she "keep(s) going because I don't care" when reading text. She also stated that she dislikes her English classes and she doesn't "pay attention to my teacher 'cause he's so boring." Her self-reported learning approaches on the *Learning Process Questionnaire* were in keeping with her apparent surface reading strategies. For example, she obtained a decile score of 7 on the Surface Strategy subscale. All of the other subscale decile scores were below average. Of interest, however, is that during the interview, she identified several stories that she had read and enjoyed. When questioned regarding the approaches she took when reading these materials, she identified a number of reading strategies that were indicative of deep levels of processing . For example, she stated that when she read the novel *Roots*, she thought about "what it would be like if I was actually there, if I was part of the story". She was able to identify previous knowledge of subject matter (e.g., goat herding) that facilitated her understanding of the story. Although the student demonstrated a relatively average profile of cognitive processing skills and obtained average scores on passage comprehension and word attack skills, she was still experiencing difficulties with reading at school. Several explanations may be postulated regarding her variable performance: (1) despite her ability to articulate seemingly

deep reading strategies, she may not be able to apply these effectively when reading text in her English class, and/or (2) the contextual demands within the school setting may be such that she perceives the task to require the application of surface level strategies rather than deep level strategies.

Research Inquiry Area #3 Summary

The statistical analyses employed to address the third research question resulted in few, if any, quantitatively meaningful findings. None of the learning approaches (Surface, Deep, and Achieving) were correlated substantially with the PASS model components or reading comprehension. Low to moderate correlations were obtained between the PASS model components and reading comprehension. Three case studies were evaluated qualitatively to determine if relationships existed among cognitive processing, depth of processing, and reading comprehension which could not be substantiated statistically. The results of the case studies indicated that cognitive and learning profiles could be constructed that were generally congruent with the relationships that one would expect among these constructs.

CHAPTER FIVE

DISCUSSION

The intent of the present study was to investigate the relationships among cognitive processing, approaches to learning, and reading comprehension in a sample of adolescents who exhibited reading difficulties. Within this chapter, the findings of the study will be discussed within the context of the three main research areas: (1) manifestation of the PASS model components in a sample of adolescents with reading difficulties, (2) cognitive approaches to learning and reading comprehension exhibited by students with reading difficulties, and (3) examination of the relationship among the constructs investigated in each of the first two research questions.

Research Inquiry Area #1

How are planning, attention, simultaneous, and successive processes manifested in adolescent learners with reading difficulties?

Given the theoretical premise and the empirical evidence that the PASS model components are distinct but related cognitive processes, each of the components will be addressed separately for the purposes of this discussion. The examination of each individual component will also allow for a more thorough description of the cognitive profiles of students with reading difficulties.

Planning

Planning, according to theoretical tenets of the PASS model, is related to all other components: attention, simultaneous and successive processing. At the

same time, however, planning can be regarded as a distinct component for both cognitively- and neuropsychologically-based reasons (Das et al., 1994). For example, planning is involved in higher level cognitive processing (e.g., problem solving behaviour); as well, any "disturbance of planning functions is uniquely associated with damage to the frontal lobes" (p. 75). Planning, as a distinct component and process within the PASS model framework, is characterized by purpose. It is self-generated; it directs, regulates and evaluates behaviour (Das et al., 1994).

Results of the present study indicated that students with reading difficulties exhibited poorer planning skills than their peers (e.g., students without reading difficulties). These results corroborated previous research findings (e.g., Kirby et al., 1996; Parrila & Papadopoulos, 1996). Although many of the previous research studies were conducted with younger readers (e.g., elementary school children), this study's results suggested that older readers (e.g., adolescents) continued to demonstrate deficits in planning. According to Parrila et al. (1994), planning is a developmental process in which children develop skill (e.g., ability to develop complex strategies) and proficiency (e.g., automaticity in the application of planning skills) over time. As both of the planning measures used in this study were scored on the basis of completion time, it is difficult to ascertain whether the poor performance of students with reading difficulties was due to the application of ineffective or simplistic planning strategies, lack of automaticity, or the inefficient use of time. Although the two planning tasks were

moderately correlated (r=.461), students with reading difficulties performed more poorly than students without reading difficulties on Planned Connections but not on Planned Search. In previous research studies (e.g., Kirby et al., 1996; Parrila et al., 1994; Parrila & Papadopoulos, 1996), Planned Connections differentiated most consistently between students with and without reading difficulties. Differences in performance on the two planning tasks may have been a function of the composition of the sample (Groups One and Two) and the nature of the tasks themselves. For example, on Planned Search, the subject is only required to scan the page to find a target number or letter whereas on Planned Connections, the subject must scan the page to find the target number and/or letter in sequence and must then look back to determine which letter or number comes next. According to De Lisi (1987), depth of planning, as it pertains to the representation of mental moves and anticipation, is associated with proficiency in cognitive processing. Students with reading difficulties may have used immediate or surface search strategies and as a result, performed more poorly than their counterparts who did not exhibit reading difficulties.

There were no gender differences on the planning tasks for either of the readings groups. These results are in keeping with previous research findings which suggest that gender differences, if any, are of a developmental nature and will have been ameliorated by the time students reach adolescence. For example, previous studies' results indicated that gender differences were found in middle years students (e.g., grades 4, 5, 6) but not in older students (e.g,. Grade 9)

(Bardos et al., 1992; Warrick & Naglieri, 1993).

Attention

Attention, as a component within the PASS model, is generally described within a sustained and selective attention framework. Tasks used in PASS model research have typically addressed selective attention which can be defined as either focussed or divided. In focussed attention, "the individual is required to attend to one source or kind of information and exclude the others, whereas in divided attention the individual shares time between two or more sources or kinds of information or mental operations" (Das et al., 1994, p. 37). Selective attention may also be viewed as either expressive (e.g., response is required on the part of the individual) or receptive (e.g., stimuli are received and encoded) (Das et al., 1994).

In this study, both expressive selective attention and receptive selective attention (as measured by the Expressive Attention and Receptive Attention tasks) were assessed. As the results of the MANOVA showed, students with reading difficulties performed more poorly than students without reading difficulties on both the Expressive and Receptive Attention tasks. These results are in keeping with previous research findings: Elementary school students with reading difficulties were found to perform more poorly on both receptive and expressive attention tasks (Das et al., 1990; Parrila & Papadopoulos, 1996). These studies' results also indicated that Expressive Attention was a particularly good discriminator between good and poor elementary school readers.

As stated in Chapter Four, correlations between attention and planning tasks in the present study indicated that Expressive Attention correlated more highly with both planning tasks than with Receptive Attention. These results are in keeping with the intercorrelations reported in the *Cognitive Assessment System* Interpretive Handbook (Das & Naglieri, 1997). For example, for ages 15 to 17, the handbook reported a scaled score intercorrelation of r=.50 between Expressive Attention and Planned Connections (a correlation of r=.45 was computed in this study) and a somewhat lower correlation (r=.39) between Expressive Attention and Receptive Attention (a correlation of r=.29 was calculated in this study). Given the consistency in correlational patterns between planning and attention, limited empirical support was provided for the theoretical interrelationships between planning and attention. However, as planning (Planned Search and Planned Connections) and Expressive Attention correlated more highly than did the two attention tasks, the underlying constructs measured by the attention tasks are called into question (e.g., possible confounded tasks). As a result, it is not surprising that students with reading difficulties performed more poorly than the students without reading difficulties on both PASS model components given the moderate relationship (as demonstrated by the correlational matrices) between the planning and attention tasks.

Trends in the development of attention have been identified within the literature; as children get older they demonstrate better and more systematic strategies for acquiring visual information, they are able to demonstrate an

increasing focus on the most salient aspects of a task, and they show increasing speed in the completion of visual search tasks (Lupart & Mulcahy, 1984). Despite the changes that occur in the development of attention, the students with reading difficulties in this study still performed less well (as compared to students without reading difficulties) in selective attention (as defined by the PASS model). These students were not able to complete the attention tasks (e.g., visual search) as proficiently as their peers without reading difficulties.

Gender differences were not noted on the attention tasks for either reading groups. Although previous research results have provided some support for female superiority on attention tasks in the primary grades (e.g., grade 3), these differences in performance have not been noted for older students (Bardos et al., 1992; Warrick & Naglieri, 1993). The results of this study were in keeping with these previous research findings.

Simultaneous and Successive Processing

The two components of the PASS model which have been most widely researched are simultaneous and successive processing. As joint patterns of performance on the two components are typically addressed within the theoretical and empirical literature, these components will be considered together for the purposes of this discussion.

Simultaneous and successive processing are defined within the PASS model as the mechanisms through which information is coded, or "incoming information is received, combined with prior knowledge in the knowledge base,

transformed according to prior knowledge and to the operating plan, and stored for later usage" (Das et al., & Kirby, 1994, p. 52). Information can be coded either (1) simultaneously - a single or integrated code is produced from pieces of information or (2) successively - information is coded sequentially (Das et al., 1994).

The students with reading difficulties in this study demonstrated significantly poorer performance on the simultaneous processing component than students without reading difficulties. No differences between the groups were found on successive processing, however. A number of previous studies (e.g., Cummins & Das, 1977; Kirby et al., 1996) suggested that simultaneous processing (and planning) are primarily involved in reading comprehension and successive processing (and attention) are required for word attack and phonological processing. As students with reading difficulties did not exhibit Word Attack skill deficits but did perform more poorly than students without reading difficulties on Passage Comprehension, limited conceptual support for the relationships between (a) simultaneous processing and reading comprehension and (b) successive processing and word attack (phonological processing) was provided in this study. Successive processing and attention have been associated with word decoding. These associations have been identified because the tasks typically used to assess attention require some degree of phonological processing (e.g., Expressive Attention requires reading of words; Receptive Attention requires letter matching) (Das et al., 1994). In this study, students with reading

difficulties did not exhibit Word Attack skill deficits nor did they differ significantly from students without reading difficulties on successive processing. They did, however, exhibit deficits in both Expressive and Receptive Attention. These results suggest that the attentional deficits may not be related to phonological processing in this group of students with reading difficulties. As described previously, the attentional deficits may be more closely associated with difficulties in planning.

The results of the data analysis in this study suggested that gender differences exist on simultaneous processing tasks but not on successive processing tasks. As stated in Chapter Four, gender differences reported for simultaneous processing may be a function of unequal and/or small group sizes and differences in variability between groups rather than representing true diversity in performance. Previous research studies (e.g., Bardos et al., 1992; Merritt & McCallum, 1983; Warrick & Naglieri, 1993) found no differences between males and females at a variety of age ranges (e.g., grades 3, 6, 9, and college students) in either simultaneous or successive processing. This study's results were somewhat comparable to these previous research findings.

Summary

According to the results of this study, students with reading difficulties demonstrated poorer planning, attention, and simultaneous processing skills relative to their peers (students without reading difficulties). These students, however, did not demonstrate difficulties with successive processing. According

to Das et al. (1994), "[d]eficits in various combinations of PASS processes can be the underlying determinants of different types of academic underachievement" (p. 140). How, then, can these PASS processes deficits be described in relation to reading achievement in this group of students? The poor planning and attention skills demonstrated by the students may be indicative of their inability to utilize self-regulatory attentional strategies. In contrast to proficient readers who "can flexibly apply [their] . . . attention to the visual information on the page, to the interpretation of the author's meaning, to the [readers'] . . . own reflective or background knowledge, or to an overriding macrogoal that can be self-regulated or other imposed" (Lupart & Mulcahy, 1984, pp. 233,234), these students may demonstrate a limited repertoire of skills or inflexibility in applying these skills. As a result, these students are not as likely to demonstrate proficiency in reading comprehension (e.g., self-monitoring) or flexibility in meeting task demands (e.g., selecting appropriate strategies for self- or externally-imposed outcomes).

Difficulties in reading comprehension are also related to simultaneous processing skills. Within this study, students with reading difficulties demonstrated poorer simultaneous processing skills than the students without reading difficulties. However, they did evidence similar successive processing skills. Cummins and Das (1977) suggested that both simultaneous and successive processing are necessary at lower level competencies in reading (e.g., vocabulary acquisition), however, at advanced comprehension levels, proficiency in simultaneous processing is required. Therefore, although the students with

reading difficulties in this study were able to demonstrate adequate successive processing skills, they may have been constrained in terms of reading comprehension performance due to their poor simultaneous processing skills. As "successive processing accounts for more variance in reading scores than does simultaneous processing" (Cummins & Das, 1977, p. 254) in less fluent readers, the students with reading difficulties in this study may have demonstrated an over-reliance on successive processing skills (e.g., sequence of plot) which may also have impacted negatively upon higher order comprehension skills (e.g., understanding themes; main ideas) (Kirby, 1992). Caution must be exercised in the comparisons made between the findings of this study and previous research results. An examination of the research literature revealed that different methodologies were employed for identifying students with reading difficulties. The identification of students with reading difficulties ranged from *a priori* diagnoses of reading disabilities based on IQ - achievement discrepancies to deficits in phonological coding. In this study, students selected for participation did not have an *a priori* diagnosis of reading disability. As well, their performance on the WRMT-R Word Attack and Passage Comprehension subtests was not significantly below average (e.g., below a standard score of 80). As a result, these students, as a group, did not exhibit the severe reading difficulties (e.g., phonological processing and reading comprehension deficits) which are generally characteristic of students with reading disabilities. Of interest, however, is that despite the relatively minimal reading difficulties these students

demonstrated, they still performed more poorly on the planning, attention, and simultaneous processing components of the PASS model.

Research Inquiry Area #2

What kind(s) of learning approach(es) do adolesents with reading difficulties (Group One) use when reading?

In this study, learning approaches (e.g., depth of processing) were investigated using several means: *Learning Process Questionnaire*, oral reading summaries, and interview data.

Depth of processing has been defined, and subsequently examined, as both generalized styles of cognition or as strategies specific to subject matter or assessment methods (Thomas & Bain, 1982). Despite the various ways in which depth of processing is measured, two levels of processing are identified: surface and deep. A student may take a surface approach to learning which involves rote memorization of material and the attempt at learning/recalling as much of the material as possible. Alternatively, a deep approach to learning may be utilized which involves the attempt to understand the meaning of what is learned, to examine all evidence before drawing a conclusion, and to extract the principal ideas from the reading material. In this study, generalized styles of cognition (e.g., learning approaches) were assessed using student self-reports on the *Learning Process Questionnaire*. Approaches specific to reading comprehension were investigated using student self-generated story summaries, interview data, and miscue analysis results. Each of the approaches will be discussed separately

within the next sections.

Generalized Learning Approach

According to the patterns of student responses identified on the *Learning Process Questionnaire*, students with reading difficulties (Group One) obtained decile scores within all score ranges (below average, average, above average) on all dimensions (Surface, Deep, and Achieving). Generally, however, Group One students identified the Surface Strategy (e.g., rote learning) and the Deep Motive (e.g., intrinsic interest in learning) as most commonly used. The majority (46%) of students with reading difficulties identified themselves as selecting surface strategies for task completion. These included learning only facts rather than trying to understand material, memorizing material, completing work only to obtain a marginal pass, and studying the minimum amount of material required. Although these surface strategies were identified by the majority of students, a Deep Motive was also articulated. Examples of Deep Motive included feelings of satisfaction regarding one's school work, intrinsic interest in subject material, and feelings of excitement regarding the study of particular topics. These results are in keeping with previous research findings regarding low achieving students. According to Biggs (1984), most students will choose congruent motives and strategies; for example, students who are intrinsically motivated (Deep Motive) will choose the corresponding strategy (Deep Strategy). Low achieving students, however, will "make effective use of strategies that are irrelevant to, or incongruent with, prevailing motives" (p. 128). A number of reasons may account

for the inconsistency between motive and strategy. For example, low achieving students may have inaccurate perceptions of task demands or expectations (e.g., students' anticipation of how they will be evaluated on a test). They may select strategies in response to previous experiences which may be limited in range. The limitations of previous experience may then influence the overuse of one particular strategy because students lack an adequate repertoire of options (Biggs, 1984; Kirby & Woodhouse, 1994; Ramsden, 1979; Robeck & Wallace, 1990). In this study, the interview and miscue analysis data provided some insight regarding student choice of particular strategies (within the context of reading). According to students' responses to the interview questions and their scores on the miscue analysis, a number of students attempted to recall all information presented in text and were non-selective in the kind of information they focussed upon. As well, when reading, students were inflexible regarding the kind of strategy they used when encountering difficult text (e.g., students continued to use the same strategy rather than changing tactics if they were unsuccessful).

As exemplified in the preceding section, students' approaches to learning may be described within specific contexts (e.g., reading comprehension). Although there is some research evidence that demonstrates that student approaches to learning are consistent across situations or contexts (Thomas & Bain, 1982), there is also evidence to show that these strategies can be taught and are dependent upon externally imposed expectations within specific contexts (Biggs & Rihn, 1984; Marton & Saljo, 1976b). Within the next section, students'

learning approaches specific to reading comprehension will be examined.

Learning Approaches within Reading Comprehension

In order to ascertain the kinds of learning approaches students with reading difficulties used when attempting to comprehend reading material, both student oral summaries and interview information were investigated. Student oral summary scores were given predominantly surface level ratings. Most of the student responses were either verbatim descriptions of portions of text or linear summarizations of the passage. A number of the summaries contained incomplete or erroneous information. Little or no attempt was made to identify themes or integrate the information presented in text. Interestingly, the Surface Strategy identified by the students as characteristic of their general approach to learning was demonstrated within the context of these reading passage summaries. Congruency was noted between students' responses regarding "what they usually did, or what they were predisposed to do, which is one step removed from what they actually do when engaging a given task in a particular context" (Biggs, 1993, p. 5).

A number of hypotheses may be generated regarding the provision of predominantly surface level oral summaries. As stated in Chapter Four, students may have provided seemingly surface descriptions of text because of constraints regarding verbal fluency and lack of reading proficiency (Stein & Kirby, 1992). As well, the purpose for which the text was read may have influenced the type of strategy used (Marton & Saljo, 1976b; Thomas & Bain, 1982). For example,

students in this study may have selected to use primarily surface levels of processing when reading the short passages because of the perceived task demand (e.g., recall of text). Those students who provided verbatim descriptions or linear summarizations of text may have perceived that accuracy in recall constituted the successful completion of the task rather than an integrated summary of the reading passage. According to Marton and Saljo (1976b), "students adopt an approach determined by their expectations of what is required of them. While many students are apparently capable of using 'deep' or 'surface' strategies, it may be that the current demands . . . at school level are interpreted by them as requiring mainly the recall of factual information to the detriment of a deeper level of understanding" (p. 125). Thus, the production of surface level reading summaries may not necessarily reflect the inability of the students to engage in deep level processing; in fact, the interview data and miscue analysis support the notion that students have a number of deep level strategies available to them.

The qualitative analysis of the data derived from the fourteen interviews and miscue analyses provided information regarding the breadth and depth of student approaches to reading comprehension. In response to each of the three questions, "What do you think about as you read?", "What kind(s) of information do you typically try to remember?", and "What do you say to yourself when the reading becomes difficult?", the interviewees provided a range of responses indicative of both surface and deep levels of processing. A number of responses were provided which could be classified within a deep level approach: focussing

on main ideas and salient aspects of the story, connecting new information with previously learned material, relating the information in the story to their personal experiences, searching for meaning in text, and self-monitoring when reading. On the other hand, a number of responses were generated which were indicative of surface level processing: attempting to memorize the text, learning material due to some externally imposed criteria, and relying on outside assistance to understand material.

The results of the miscue analysis were in keeping with student responses to the interview questions. The students' miscues ranged from high-level miscues (e.g., substitutions of syntactically and semantically acceptable words) which retained the meaning of the text to low-level miscues (e.g., substitutions of graphically similar words or omissions of words) which compromised the meaning and intent of the reading passage. These high-level miscues can be regarded as indicators of deep level processing whereas the low-level miscues reflect surface level processing. As found in this study, the majority of miscues made by the students were of a low-level nature (surface level of processing).

The oral summaries, interview responses, and miscue analysis data suggest that the critical discriminator between surface and deep level processing within reading comprehension is the students' active attempt at deriving meaning from text. Meaning-making is characterized by purpose, intent, and the flexible use of strategies. The meaning-making aspect of the comprehension process also distinguishes the effective reader from the ineffective one (Goodman, 1996).

Effective readers demonstrate a number of characteristics: they possess a large repertoire of knowledge of written text (e.g., language syntax and semantics), they generate predictions of upcoming text, they can automatically decode words and visually fixate on words which are longer and less familiar, they rely on context to facilitate meaning after they have identified a word - both semantically and visually, and they combine their understanding of words, phrases and sentences with their overall interpretation of text as it relates to previous knowledge and experience (Adams, 1995; Just & Carpenter, 1987; Stanovich, 1981). Effective readers will also typically make semantically acceptable miscues and will selectively correct those which compromise the meaning of text (Goodman, 1973). Ineffective readers, on the other hand, possess a partial or inaccurate understanding of the syntax and semantics of language in written text, they have a smaller repertoire of sight words and have a limited knowledge of vocabulary, and they are also more dependent upon context to facilitate word identification (Adams, 1995; Perfetti, 1985). Miscues produced by ineffective readers are characterized by high graphic similarity of word substitutions even at the expense of meaning-making, frequent correction of miscues which do not affect the meaning of text, and the concentration on pronunciation of words which have minimal impact on the understanding of the story (e.g, proper names) (Goodman, 1973).

Summary

In this study, the learning approaches identified by students with reading

difficulties were investigated within a predispositional framework or general approach to learning as well as within a specific context (e.g, reading comprehension).

Students with reading difficulties can be characterized as possessing a variety of deep and surface approaches both generally and within the reading comprehension domain. According to the students' self-identified learning approaches, they used a variety of surface, deep, and achieving strategies and motives. Within the context of the interview, students described both deep and surface level strategies in approaching the reading task. Their responses were corroborated by their application of both surface level and deep level miscues when reading the text passage. However, despite the apparent eclectic repertoire of surface and deep level approaches, students with reading difficulties demonstrated incongruities in their responses. For example, the strategy most frequently used by the students when approaching learning (e.g., Surface Strategy) was inconsistent with the motive most frequently identified (e.g., Deep Motive). As well, during the interview, students identified a number of deep level reading comprehension strategies (e.g,. self-monitoring for meaning) although when actually reading the passage, they used primarily surface level miscues (e.g., substituting graphically similar words at the expense of the meaning of text). The inappropriate application of surface level strategies appeared to compromise their reading performance and more specifically, the meaning they were able to derive from written text. Perhaps these students lacked sensitivity and inflexibility in the

selection of appropriate strategies. According to Biggs and Kirby (1984), the effectiveness of the strategy may not be the determinant in its selection; rather, it may be dependent upon "the extent to which the student differentiates comfortable options in his learning repertoire" (p. 30). Although the students may have been capable of adopting a variety of strategies, they may have selected one 'most comfortable' option and subsequently only utilized one strategy or approach.

Research Inquiry Area #3

What is the relationship between the PASS model components and the learning approaches used by students with reading difficulties?

The purpose of the third area of research inquiry was to investigate the relationships among cognitive processing and learning approaches (e.g., general learning approaches and specific approaches within the reading comprehension domain). In order to facilitate a clearer description of the results of this portion of the study, the relationships between the PASS model and general learning approaches (e.g, depth of processing) will be examined separately from the relationships between the PASS model and reading comprehension.

PASS Model and General Learning Approaches

According to the results of the statistical analysis (e.g., correlations among constructs), there was virtually no relationship between the PASS model components and depth of processing (as measured by the *Learning Process Questionnaire*). These findings are in keeping with previous research results. For example, Biggs and Kirby's (1984) found that the subscales of the *Learning*

Process Questionnaire were uncorrelated with simultaneous and successive processing.

Possible hypotheses can be generated to account for the uncorrelated nature of these constructs. According to Biggs' (1984) model of academic performance (see Figure 2), cognitive processes are only indirectly related to mesostrategies (e.g., deep and surface levels of processing). As is evident from the model, a number of other variables may also influence the adoption of particular levels of processing such as the situational aspects of task completion (e.g., task content) as well as the students' purposes and intentions (Biggs & Rihn, 1984). None of these variables were measured directly within the context of this study. Another consideration in the interpretation of these results pertains to the description and measurement of the constructs themselves. An examination of the theoretical interrelationships among the PASS model components reveals the complexity of the model. In an effort to operationalize the theory, the tasks developed to assess each of the components may lack sensitivity in the measurement of these constructs (e.g,. difficulties in discriminating between the planning and attention tasks). As a result, possible relationships between the PASS model and general approaches to learning may not be evident using particular research methodologies and/or statistical analyses (e.g., correlations) despite the fact that these relationships may, in fact, exist. Biggs and Kirby's (1984) research results provide some support in this regard.

As stated previously, the results of the initial correlations computed in

Biggs and Kirby's (1984) study were comparable to the correlations calculated in this study. However, when Biggs and Kirby (1984) subdivided the sample of grade 9 students (using median splits) into information processing ability groups (e.g., high successive, high simultaneous; high successive, low simultaneous; high simultaneous, low successive; low simultaneous, low successive), and then factor analysed the *Learning Process Questionnaire* results for each group, specific trends emerged. Of interest, within the context of this study, is the description of the Low Simultaneous - High Successive group's learning processes. These students perceived "achievement motivation as involved in utilising [a surface strategy], while the appropriate achievement strategy (organizing) . . . [was] related to both utilising and internalising [a deep strategy]. In other words, the road to high marks . . . [was] seen as involving a reproducing approach" (Biggs & Kirby, 1984, p. 33). Although the composition of the sample (e.g., small sample size, low variability) in this study precluded the replication of Biggs and Kirby's methodology, tentative comparisons may be made regarding the samples of students used in both studies. To illustrate, in this study, students with reading difficulties could also be characterized as demonstrating low simultaneous-high successive processing profiles. In keeping with Biggs and Kirby's (1984) findings, these students' approaches to learning were also demonstrative of a predominantly surface or reproducing approach.

An examination of the case studies described within the qualitative framework in Chapter Four also provides support for the argument that the

complex and idiographic nature of the interplay between the PASS model components and general learning approaches may not be amenable to analyses of a strictly quantitative design. According to the descriptions of the case studies, student performance on the *Learning Process Questionnaire* was variable as each of the students displayed differing profiles of Deep, Surface, and Achieving strategies. All of the students, however, were functioning primarily within the low average to average range (e.g., standard scores between 7 and 12) on the PASS model tasks which could be scored using the *Cognitive Assessment System* (Das & Naglieri, 1997) norms.

A closer inspection of the cases demonstrates the idiographic nature of these students' profiles. For example, the first student presented a predominantly Surface profile on the *Learning Process Questionnaire*. According to the LPQ Manual (1987), "high surface students are usually not very competent metalearners. They frequently have little insight into the 'how and 'why' of their learning activities" (p. 15). This description is in keeping with the student's below average score on the planning component as planning involves the development and adoption of strategies to solve problems or reach a goal (Das et al., 1994). An examination of the third student's profile indicated that she also presented a predominantly Surface profile on the *Learning Process Questionnaire*; however, all of her PASS model standard scores were within the average range. In this particular instance, her planning skills were not deficient (as compared to her peers). Although speculative, the first student may have

adopted a Surface strategy due to the lack of specific prerequisite planning skills whereas the other student may have demonstrated inefficiencies in the application of these skills within the context of her school work. These results, of course, must be interpreted with caution as only one task per PASS model component was used and the interviews did not provide the opportunity for the thorough examination of the interrelationships among cognitive processing and learning approaches.

PASS Model, Learning Approaches and Reading Comprehension

In keeping with the descriptions provided in the previous section regarding the relationships between the PASS model and general learning approaches, marginal relationships existed between the PASS model components, learning approaches, and reading comprehension. For example, planning was virtually uncorrelated with reading comprehension (as measured by the *Woodcock Reading Mastery Test - Revised*). Low to moderate correlations (e.g., r=.2 to .4) existed between the attention tasks and reading comprehension. Low moderate correlations were obtained between reading comprehension and one simultaneous processing task (Ravens r=.32) and reading comprehension and successive processing (Digit Span r=.31 and Word Series=.33). These results are somewhat congruent with the theoretical and conceptual linkages made between the PASS model and reading comprehension. In the research literature, reading comprehension has been associated most strongly with both simultaneous and successive processing. Simultaneous processing, however, is regarded as more

closely aligned with higher order comprehension skills than successive processing (e.g., Das, 1984; Das et al., 1994; Kirby & Das, 1977). As the students in this study were representative of students with reading difficulties, the comparable correlations between reading comprehension and both simultaneous and successive processing are in keeping with the notion that these students rely as heavily upon their successive processing skills as they do their simultaneous processing skills (Cummins & Das, 1977).

In contrast to the present study's results, the *Cognitive Assessment System* Interpretive Handbook (Das & Naglieri, 1997) reported moderate correlations (e.g., r=.4 to .5) between the PASS planning and attention components and reading comprehension (as measured by the *Woodcock Johnson Achievement Battery -Revised*, 1987) and moderately high correlations between the PASS simultaneous and successive processing components and reading comprehension. Of note, however, is that these correlations were computed for the entire standardization sample and not a select subgroup (e.g., students with reading difficulties). The restricted variability within the sample used in this study may have had a constraining effect upon the degree to which the PASS model and reading comprehension variables were correlated.

The patterns of intercorrelations reported between the LPQ subscales and the Passage Comprehension subtest indicated that student learning approaches and reading comprehension were unrelated in students with reading difficulties. Although there was no statistical support for the complementarity between

learning approaches and reading comprehension, the results of the three case studies appear to provided limited conceptual support for the existence of these relationships. For example, two of the students adopted surface level strategies when reading and also indicated on the *Learning Process Questionnaire* that they favored Surface Strategies when approaching a learning task. Again, these descriptions are largely speculative and require further investigation in order to determine more conclusively the nature and strength of these relationships.

Summary

The interrelationships among the PASS model components, learning approaches and reading comprehension were examined within the last section. Although the statistical analyses provided limited support for the presence of statistically significant relationships among the constructs, the qualitative descriptions of the profiles of the three students provided some insight regarding the interplay among the constructs from an intra-individual perspective. For example, although two of the students identified themselves as adopting a primarily Surface approach to learning, their cognitive processing profiles were dissimilar (e.g., PASS model standard scores).

Perhaps the most salient aspect of this area of research inquiry pertains to the difficulty in providing an indepth and comprehensive description of the nature of the interrelationships among the constructs. For example, each of these models (e.g., PASS model, learning approaches or mesotrategies, and reading comprehension) contain complex and interrelated theoretical and conceptual

constructs. The interactions among the PASS model components are bi-directional and are subject to the influence of one's existing knowledge base. Learning approaches can be characterized as both stable (e.g, general cognitive style) or variable (e.g, approach is dependent upon task demands). As well, reading comprehension is comprised of a number of processes which are hierarchical in nature. Multiple influences may also be exerted upon each of these constructs (e.g., learning approaches are influenced by motivational factors). As a result, the complexity of these constructs may preclude the use of singular research methodologies or simplistic measurement tools in investigating their interrelationships. Although multiple methods were used within the context of this study, further investigations are required.

Conclusions

The purpose of the study was to examine the relationships among several constructs: cognitive processing (as measured by the PASS model), depth of processing (as measured from a learning and reading framework) and reading comprehension. Of interest was the manifestation of these constructs in adolescent students with reading difficulties. Although the sample sizes, methodology, and selection of measures restricted the application of particular statistical analyses, the results of the qualitative analyses provided additional information regarding the relationships investigated in the study.

The study's research findings indicated that students with reading difficulties displayed a profile of cognitive processing which was discrepant from

their peers (e.g., students who do not exhibit reading difficulties). Their skills in planning, ability to selectively attend to particular stimuli, and their competence in processing information integratively were less well developed than those of average achieving students. These students' learning approaches were characterized by inconsistency and incongruities. Although these students adopted primarily surface level strategies in learning, they identified a deep level of motivation. Within the context of reading comprehension, these students also identified a number of deep and surface level processing strategies although their actual performance on the oral summaries and miscue analysis demonstrated the application of predominantly surface level processing strategies.

Implications for Educational Practice and Future Research

Within the present study, a description of students with reading difficulties was provided with respect to their cognitive processing and depth of processing profiles within the context of reading comprehension. In the research literature, a number of intervention plans and programs have been advocated to remediate deficiencies in the PASS model processes (e.g., PASS Remedial Program or PREP, Das et al., 1994) and facilitate deeper levels of processing in reading comprehension (e.g., instruction on deep processing in text summarization) (Kirby & Woodhouse, 1994). As these programs have been successful at improving student performance in a variety of groups (e.g., learning disabled students), perhaps the implementation of these kinds of programs with students who exhibit reading difficulties will result in performance gains. A caveat should be provided,

however, regarding the development of intervention programs. Any remedial program should incorporate the ongoing assessment of student performance in an effort to ensure that accurate appraisals are being made regarding the nature of the processes that the student is using (e.g., deep versus surface strategies). The description of the case studies and the interview data within this study attest to the fact that these processes must be examined carefully to avoid making overly simplistic diagnoses.

The results of this study have implications for future research in this area. For example, the method for identifying students with reading difficulties was somewhat different from previous research methodologies. The selection of students through teacher nomination procedures was indicative of a more common place selection procedure (e.g., students were performing poorly within the context of their schoolwork) in identifying students with reading difficulties within school systems. As a result, a broader range of difficulties may have been represented within this group in contrast to previous research samples which have been identified as reading disabled based upon discrepancy formulas (e.g., IQ-achievement). Future research studies need to replicate this selection procedure with larger samples of students.

A number of the research instruments in this study were experimental in nature (e.g., PASS model tasks) or were not well validated within the empirical research literature (e.g, *Learning Process Questionnaire*). Although the *Cognitive Assessment System* (Das & Naglieri, 1997) has subsequently been published,

additional research is required to investigate the utility of these instruments in measuring these constructs.

Reading comprehension and accompanying depth of processing strategies were investigated primarily through descriptive frameworks. Additional and/or alternative approaches to conceptualizing and assessing these constructs are warranted in order to provide better and more thorough descriptions of these processes. For example, the recent conceptualization of reading comprehension from a social and cultural perspective (e.g., intertextuality or relationships among texts; reader stance or how the reader defines the reading event through the delineation of goals and approaches to text; and reader identity or the reader's social position as a student within the classroom) may provide an alternative framework for understanding depth of processing. As a research tool, the technique of Miscue Analysis has applicability within a social cultural paradigm; however, the interpretation of student miscues is viewed within a socially contextualized framework rather than just the individual reader's unexpected responses to text (Bloome & King Dail, 1997).

As stated previously in the Results and Discussion sections, future research studies of this kind which rely primarily on quantitative research methodologies require larger sample sizes in order to avoid the preclusion of particular statistical techniques.

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APPENDIX A

Criteria for Group One Selection

January 9, 1997

Dear Teachers of English 9, 10A & B, and 20A &B:

As part of my PhD program in Educational Psychology at the University of Saskatchewan, I am planning to research high school students' comprehension strategies and information processing capabilities. In particular, I wish to examine how students with reading difficulties process text (e.g., using either surface level processing - literal recall or deep level processing - integration of information). The relationship between students' comprehension strategies and information processing skills (e.g., how they attend to stimuli, plan, and process information simultaneously or sequentially) is another focus of the study. Research results will provide information regrading the nature of students' difficulties and may be facilitative in addressing these students' difficulties within the school context (e.g., development of compensatory or intervention strategies).

I would like your assistance in selecting suitable participants for the study. Please identify students in your classes who are experiencing significant reading difficulties (e.g., bottom 10% of students). To determine who these students are, please evaluate these students' reading comprehension skills according to the general level of performance you would expect for students at this grade level. These students may be characterized by word decoding difficulties, difficulties with reading comprehension regardless of content area, slow and laboured reading, and/or reluctance to read.

In the space(s) provided, please list the student's name, age, gender, grade placement, and school. These students will be contacted via the school and will be asked to participate in the study. Each participant will be asked to complete a series of information processing tasks, read several text passages, and answer comprehension questions. A small number of students will be interviewed regarding their text processing strategies. One of the research tasks will include the Passage Comprehension and Word Attack subtests of the *Woodcock Reading Mastery Tests - Revised.* As normative information is available regarding student achievement in these areas, these results will be made available to you if the student/parent or guardian agrees to release this information. Total time required for each participant will be approximately 1 to 1½ hours.

Please complete the form and return to _____ as soon as possible. If you have any questions or concerns regarding the study, please contact me at 966-7616 or my thesis supervisors, Dr. Alan Yackulic (966-7723) or Dr. Don Saklofske (966-7727).

Thank you for your assistance!

Sincerely,

Denise Hildebrand, M.Ed.

APPENDIX B

Participant Consent Form

STUDENT AND PARENT/GUARDIAN CONSENT FORM

Title of Research: An Investigation of the PASS Model and Depth of Processing in Adolescents

We, _____ (parent/guardian) and _____ (student) have read the information about this study and give consent for _____ (name of student) to participate in the study.

We understand that withdrawal from participation in the study is acceptable at any time during the research project.

Results of the reading tasks may be made available to the teacher (Check one):

Yes_____ No _____

Date: Parent/Guardian Signature:

Date: Student Signature:

PLEASE RETURN THE WHITE COPY AND
RETAIN THE BLUE COPY FOR YOUR RECORDS

APPENDIX C

MANOVA Results on Reading

F Values for 2 x 2 MANOVA Results and Univariate Tests on Reading

	Reading Group	Gender	Interaction
Wilks Lambda[a]	11.347*	0.427	0.366
Univariate F Tests[b]			
Word Attack	2.64	0.334	0.667
Passage Comprehension	21.99*	0.845	0.038

Note: [a] df=2,146; [b] df=1,147
*=<.01

APPENDIX D

Ethics Application and Approval

APPLICATION FOR APPROVAL OF RESEARCH PROTOCOL

1. **Name of Student Researcher:** Denise Hildebrand
   Department: Educational Psychology
   Type of Study: Ph.D.
   Faculty Co-Supervisors: Dr. R.A. Yackulic and Dr. Don Saklofske
   Date: November 15, 1996

2. **Title of Study:** An Investigation of the PASS Model and Depth of Processing in Adolescents with Reading Difficulties

3. **Abstract:**

The purpose of the present study is to explore the relationships between the PASS (Planning, Attention, Simultaneous and Successive Processing) Model of cognitive processing (Das, Naglieri, & Kirby, 1994) and reading comprehension strategies (e.g., depth of processing). A sample of high school students with reading difficulties (n≈150) will be selected for participation in the study. Relationships among PASS Model tasks, reading tasks (word attack and reading comprehension), and depth of processing (surface versus deep levels) will be examined. PASS Model performance profiles of students with reading difficulties will be compared to students without reading problems (n≈100). Students without reading difficulties will be selected randomly from the high schools participating in the study. The project will be guided by three general areas of inquiry:

1. How are planning, attention, successive, and simultaneous processes exhibited in adolescent learners with reading difficulties?
2. What level of processing (surface vs deep) strategy do adolescents with reading difficulties use when reading text?
3. What is the relationship between PASS Model components and processing strategies in adolescents with reading difficulties?

4. **Funding:** none.

5. **Participants:** Participants will be drawn from a large urban school division. High school students who exhibit reading difficulties in grades 9 to 11 will be asked to participate in the study (n≈150). A random sample of high school students without reading difficulties (n≈100) will also be asked to participate in the study and will serve as a comparison group.

6. **Methods/Procedures:**

The following procedure will be used to obtain research data:

A. High school teachers who teach English 9, 10A, and 20A (excluding French Immersion and Advanced programs) will be asked to nominate students in their classes who are exhibiting significant reading difficulties (see Appendix A). The following information will be requested: name, age, sex, name of high school, grade placement. The list of students

will then be compiled and reviewed by School Support Service personnel to ensure that students with below average scores on intelligence tests (information may be derived from previous psychoeducational reports) are removed from the list as these students are inappropriate for inclusion in the study.

B. Potential subjects and their parents will be contacted (via the school) to request permission for participation in the study (Appendix B). A master list with student names and accompanying identification numbers will be held by the researcher. Only identification numbers will be used for the purposes of scoring test protocols and analyzing data. Upon completion of the research project, the master list will be destroyed.

As the *Woodcock Reading Mastery test* is a commonly used test within the school system (e.g., provides information regarding reading level of student), test results may be reported to teachers (if permission has been granted by the participant).

C. Once consent forms have been obtained, participants will be administered the following tasks: PASS Model tasks, 2 subtests of the *Woodcock Reading Mastery Test-Revised*, and the *Learning Process Questionnaire* (see Appendix C). Several tasks are amenable to group administration; however, the majority of tasks will be administered individually. Total administration time for each participant will take approximately 1 1/4 hours.

D. A randomly selected subsample of these students ($n \approx 100$) will be asked to complete further testing; these students will read three short text passages and respond to 10 objective-type questions designed to measure depth of processing. Students who have difficulty with word attack skills (as measured by the Woodcock Reading Mastery Test-Revised) will listen to an audiotape recording of the passages. This portion of the data collection will take approximately 20 minutes per student.

E. From this subsample, fifteen students will be interviewed regarding the reading strategies they employed and their prior knowledge of the topics. Each interview will last approximately 15 minutes.

F. In order to compare the performance of students with reading difficulties (re: PASS model) with a group of students with average reading achievement, a sample of students of average achievement ($n \approx 100$) will be asked to complete the six PASS model tasks. These students will be selected randomly from the high schools by school board personnel.

7. **Risk or Deception:** There is no deception involved. A potential risk involves the reporting of reading subtest scores to teachers which may subsequently influence their assessment of student performance. However, the *Woodcock Reading Mastery Test - Revised* is a commonly used test within the school system, and scores such as these are frequently used to ascertain student performance on reading tasks. Scores will only be provided with parental and student informed consent.

APPENDIX A

November, 1996

Dear Teachers of English 9, 10A, and 20A:

As part of my PhD program in Educational Psychology at the University of Saskatchewan, I am planning to research high school students' comprehension strategies and information processing capabilities. In particular, I wish to examine how students with reading difficulties process text (e.g., using either surface level processing - literal recall or deep level processing - integration of information). The relationship between students' comprehension strategies and information processing skills (e.g., how they attend to stimuli, plan, and process information simultaneously or sequentially) is an another focus of the study . Research results will provide information regarding the nature of students' difficulties and may be facilitative in addressing these students' difficulties within the school context (e.g., development of compensatory or intervention strategies).

I would like your assistance in selecting suitable participants for the study. Please identify students in your classes who are experiencing significant reading difficulties (e.g., bottom 10% of students). To determine who these students are, please evaluate these students' reading comprehension skills according to the general level of performance you would expect for students at this grade level. These students may be characterized by word decoding difficulties, difficulties with reading comprehension regardless of content area, slow and labored reading, and/or reluctance to read.

In the space(s) provided, please list the student's name, age, gender, grade placement, and school. These students will be contacted via the school and will be asked to participate in the study. Each participant will be asked to complete a series of information processing tasks, read several text passages, and answer comprehension questions. A small number of students will be interviewed regarding their text processing strategies. One of the research tasks will include the Passage Comprehension and Word Attack subtests of the *Woodcock Reading Mastery Test - Revised.* As normative information is available regarding student achievement in these areas, these results will be made available to you if the student/parent or guardian agrees to release this information. Total time required for each participant will be approximately 1 1/2 hours.

Please complete the form and return to ——— (school board personnel) as soon as possible. If you have any questions or concerns regarding the study, please contact me at 966-7716 or my thesis supervisors, Dr. Alan Yackulic (966-7723) or Dr. Don Saklofske (966-7727).

Thank-you for your assistance!

Sincerely,

APPENDIX B

November, 1996

Dear _____:

My name is Denise Hildebrand and I am completing my Ph.D. in Educational Psychology at the University of Saskatchewan. I am researching high school students' information processing skills and reading comprehension strategies. Previous research suggests that there may be a connection between the way students understand text and the way they apply their information processing skills.

_____was selected for possible participation in the study. All participants will be asked to complete a series of tasks such as copying designs, completing puzzles, and reading short text passages and answering questions. Some participants may be asked to participate in a short interview regarding the strategies they use when reading text. The research participants will also be asked to complete two short subtests on the *Woodcock Reading Mastery Test - Revised* (e.g., Word Attack and Passage Comprehension subtests). The total time for participation in the study will require approximately 1 to 2 hours of school time. _____ may withdraw from participation in the study at any time without penalty.

As the *Woodcock Reading Mastery Test - Revised* is a commonly used reading achievement test, these results will be made available to teachers with your permission. All other information will be kept strictly confidential. Summary (group) information will be made available to you, teachers, and school board personnel once the study is complete. All identifying personal information (e.g., student name, age, grade) will be kept confidential during data collection and will be destroyed after completion of the project.

Your cooperation is requested in completing the following consent form and returning it to the school principal by --------.

If you have any questions or concerns regarding the study, please contact me (966-7716) or my thesis supervisors, Dr. Alan Yackulic (966-7723) or Dr. Don Saklofske (966-7727).

Thank-you.

Denise Hildebrand, M.Ed.

STUDENT AND PARENT/GUARDIAN CONSENT FORM

Title of Research: An Investigation of the PASS Model and Depth of Processing in Adolescents

We, _____ (parent/guardian) and _____ (student) have read the information about this study and give consent for _____ (name of student) to participate in the study.

We understand that withdrawal from participation in the study is acceptable at any time during the research project.

Results of the reading tasks may be made available to the teacher (Check one):

Yes_____ No _____

Date: Parent/Guardian Signature:

Date: Student Signature:

PLEASE RETURN THE WHITE COPY AND
RETAIN THE BLUE COPY FOR YOUR RECORDS

APPENDIX C

Descriptions of Instruments Used in the Study

PASS MODEL TASKS

-have used a combination of tasks from the experimental version of the *Das-Naglieri Cognitive Assessment System* and tasks from other measures which have shown to load on the four PASS model components.

Planning - (tasks taken from the *Cognitive Assessment System*)

Planned Connections

-student is required to connect a series of boxes containing numbers or letters in correct sequence; scoring is the time taken to complete the task

Planned Search

-student is asked to match the target object in the center box with an object in the visual field; the student's score is the total time taken to complete the searches

Attention - (tasks taken from the *Cognitive Assessment System*)

Receptive Attention

-student is required to find and underline pairs of pictures/letters that are the same on the basis of physical match or category match.

-scoring is based on completion time

Expressive Attention

-student is required to complete three separate tasks: read the names of colors printed in different colors; identify the name of colors with no reading, and identify the colors in which different names of colors are presented

-time required for completion is the basis for scoring

Simultaneous

Ravens Standard Progressive Matrices

-uses figural stimuli to assess simultaneous processing

-raw scores can be converted to standard scores/percentile ranks

Figure Memory (taken from the *Cognitive Assessment System*)

-Student is required to locate and trace a geometric figure that is embedded within a more complex design; after 5 sec exposure, the student must reproduce the same figure within a more complex design

-student responses are scored dichotomously (0-fail; 1-pass)

Successive

Word Series (taken from the *Cognitive Assessment System)*
-student's task is to repeat a series of words in the same order in which they are presented
-scoring: Pass for perfect recall; Fail otherwise

Digit Span (taken from the *Wechsler Intelligence Scale for Children - Third Edition*)
-students are required to repeat a series of digits; scored similarly to Word Series

READING TASKS

Woodcock Reading Mastery Tests - Revised (Word Attack and Passage Comprehension)
-published in 1987 - norms are provided for individuals up to adulthood
-Word Attack - students are required to pronounce words phonetically
-scores are assigned for correct pronunciations
-Passage Comprehension - short passages have been selected from various reading materials and students are asked to identify key words missing from each passage.

DEPTH OF PROCESSING TASKS

Informal Reading Inventory
-several reading passages will be selected based on grade level appropriateness
-student will be asked to summarize the passage or "tell what the passage was about"
-multiple choice format of questions

Learning Process Questionnaire
-self-report questionnaire - 36 items in total (6 subscales); examinees rate statements according to a 5 point scale
-scale scores are available for both motive and strategy within each of 3 basic approaches: surface, deep, and achieving

UNIVERSITY ADVISORY COMMITTEE
ON ETHICS IN HUMAN EXPERIMENTATION

(Behavioral Sciences)

NAME AND EC #: A. Yackulic (D. Hildebrand)
Educational Psychology

For Reference: 96-129

DATE: December 19, 1996

The University Advisory Committee on Ethics in Human Experimentation (Behavioral Sciences) has reviewed your study, "An Investigation of the PASS Model and Depth of Processing in Adolescents with Reading Difficulties" (96-129).

1. Your study has been APPROVED.

2. Any significant changes to your protocol should be reported to the Director of Research Services for Committee consideration in advance of its implementation.

3. The term of this approval is for 3 years.

Michael Owen, Secretary
for the University Advisory Committee
on Ethics in Human Experimentation, Behavioral Science

Please direct all correspondence to:

Michael Owen, Secretary
UACEHE, Behavioral Science
Office of Research Services
University of Saskatchewan
Room 210 Kirk Hall, 117 Science Place
Saskatoon, SK S7N 5C8

APPENDIX E

Reading Passages

•6 PASSAGE — FORM C — TEACHER 6

MOTIVATIONAL STATEMENT: Read this story to find out about something that happened on a trip in space.

Apollo 13, its crew huddled in one end, hurtled on through space. The ship curved around the back side of the moon, out of sight of the Earth. The gray lunar surface, pocked with craters, unrolled beneath the ship at about ten times the speed of a fast jet plane on Earth. Then Earth, a blue-green ball, appeared again. It was time to see whether the small rocket on Aquarius could blast the whole ship into a good course back home to Earth. If the course adjustment failed, Apollo could miss Earth completely. The crew wouldn't survive long, and the ship would carry their bodies on an endless trip through space.

"Mark!" said a man in Texas, telling Lovell he had forty seconds to go before firing. Lovell put his hand on the firing button. "Five . . . four . . . three . . . two . . . one." At exactly the right time, the rocket began to fire, pushing the whole ship into line. It fired on, a four-minute explosion. Then a computer took over to turn the rocket off at precisely the right instant.

The astronauts in space and the mission control on the ground anxiously checked the course. The rocket had done its job. The ship was aimed for a landing in the Pacific Ocean, a quarter of a million miles away. At least the ship was headed in the right direction. Whether it would splash down safely, no one knew.

Source: "Lifeboat in Space," by Gurney Williams, in William K. Durr and others, *Celebrations* (Boston: Houghton Mifflin Company, 1989), pp. 509-510.

COMPREHENSION QUESTIONS

____ main idea	1. What is the main idea of this story? (Astronauts are getting ready to try to return to Earth.)
____ vocabulary	2. What does the word "hurtled" mean in the phrase "hurtled on through space"? (moved fast)
____ inference	3. What did the surface of the moon look like? (It was gray and had pits (or craters) in it.)
____ inference	4. How fast was Apollo 13 moving past the moon? (about ten times the speed of a fast jet plane on Earth)
____ cause and effect/ inference	5. What caused Earth to appear again to the astronauts? (The ship came out from behind the moon.)
____ detail	6. What would happen if the course adjustment failed? (Apollo could miss Earth completely. The crew wouldn't survive long. The ship would keep on carrying them through space endlessly.) [Accept any one of these answers.]
____ sequence	7. What did Lovell do immediately after the man in Texas said, "Mark"? (He put his hand on the firing button; he had the countdown.)
____ sequence	8. What happened immediately after the rocket fired? (The ship was pushed into line; a computer took over to turn the rocket off.)
____ vocabulary	9. What is an astronaut? (a person trained to fly or participate in the flight of a spacecraft)
____ detail	10. Where was the ship aimed for a landing? (the Pacific Ocean)

SCORING AID

WORD RECOGNITION

%-MISCUES

99-3
95-13
90-24
85-36

COMPREHENSION %-ERRORS

100-0
90-1
80-2
70-3
60-4
50-5
40-6
30-7
20-8
10-9
0-10

234 WORDS (for Word Recognition)

234 WORDS (for Rate)

_____ WPM

/ 14014

MOTIVATIONAL STATEMENT: Read this story to learn about a special job.

Surveying the scene from high wooden stands set fifty feet apart were Nauset's lifeguards.

The lifeguards, youthful, muscular, and deeply tanned, are used to being surrounded by a horde of admiring youngsters and teased by jokes such as, "You mean to tell me you guys actually get paid just to sit up there all day and watch . . .?"

"That's the way it looks," admitted guard Lee Anderson, "but on a busy day when there are 3,000 people on this beach, we concentrate so hard we wind up practically cross-eyed. On this job, you don't sit around and wait for somebody to yell for help. People who are drowning actually haven't got an ounce of breath left to call out. They're choking, gasping, and paralyzed by fear and exhaustion. You watch for them and you keep an eye on the ocean, trying to anticipate trouble. You take a special interest because when you're in the water with a panic-stricken, drowning person, it's your life as well as his that's on the line."

[Note: Do not count as a miscue mispronunciation of the name Nauset. You may pronounce this word for the student if necessary.]

COMPREHENSION QUESTIONS

____ main idea	1. What is the main idea of this story? (A lifeguard's job is dangerous; rescuing drowning people is dangerous.)
____ vocabulary	2. What is the meaning of the word "surveying" in the phrase "surveying the scene"? (looking over, viewing closely)
____ detail	3. Who sat in the high wooden stands? (lifeguards)
____ detail	4. What were the lifeguards like? (youthful, muscular, deeply tanned) [Accept any two of the three for full credit; accept one for half credit.]
____ vocabulary	5. What is the meaning of the word "horde" in the phrase "horde of admiring youngsters"? (throng; large group)
____ detail	6. How many people visit the beach on a busy day? (3,000)
____ cause and effect/ detail	7. What happens when the guards concentrate very hard on the beach? (They become practically cross-eyed.)
____ cause and effect/ detail	8. According to the story, why aren't drowning people able to call out? (lack of breath due to choking and gasping, fear, exhaustion) [Two of the reasons earn full credit; one earns half credit.]
____ vocabulary	9. What is the meaning of the word "anticipate" in the phrase "anticipate trouble"? (foresee, expect)
____ inference	10. Could lifeguards die trying to rescue a drowning person? (yes) What did the story say that gave you this idea? (It said your life is also on the line.)

SCORING AID

WORD RECOGNITION

%- MISCUES

99-2
95-9
90-17
85-26

COMPREHENSION

%- ERRORS

100-0
90-1
80-2
70-3
60-4
50-5
40-6
30-7
20-8
10-9
0-10

169 WORDS (for Word Recognition)

170 WORDS (for Rate)

WPM
/ 10200

10 PASSAGE — FORM B — TEACHER 10

MOTIVATIONAL STATEMENT: Read this story to learn about an adventure three youths had almost two hundred years ago.

First to discover what must stand as one of the greatest engineering achievements of its time were Jack Smith, Tony Vaughn, and Daniel McGinnis, three youths from nearby Lunenberg on Nova Scotia.

This trio landed from their canoe one day in 1795 and soon noticed, about four hundred feet from shore, a majestic oak from which a long lower limb projected over a depressed square of earth. The limb showed signs of block-and-tackle pressure; the depressed ground indicated that there had once been an excavation.

Next day the three returned to Oak Island equipped with shovels, axes, and picks. They began to dig. Ten feet down they hit something hard. It turned out to be a platform of six-inch-thick oak planks. Why was it there? To protect a golden treasure? The boys' imaginations were fired. Ten feet farther they hit another oaken barrier. Thirty feet down, a similar platform halted their progress.

The youths returned week after week to probe deeper into the pit until exhaustion forced them to postpone further digging. Back in Nova Scotia, they began asking guarded questions about the isle.

Source: Adapted from Ralph H. Major, Jr., "The Buried Treasure of Oak Island," *Coronet*, July 1954. Adapted from "The Mystery of Oak Island" by Ron Rosenbaum. First published in *Esquire* Magazine.

COMPREHENSION QUESTIONS

___ main idea	1. What is the main idea of this story? (Three boys dig for a treasure; three boys hope to find treasure on Oak Island.)
___ detail	2. Where did the three youths live? (Nova Scotia)
___ vocabulary	3. What does the word "depressed" mean in the phrase "the depressed ground"? (pressed down; sunken)
___ vocabulary	4. What does the word "excavation" mean? (dug out or hollowed out area; an area from which dirt had been removed)
___ detail	5. What kinds of equipment did the youths use? (shovels, axes, picks) [Accept two of the three for full credit; accept one of the three for half credit.]
___ cause and effect/ detail	6. What caused the boys to think they might have found a buried treasure? (They hit oaken barriers or platforms of oak planks.)
___ detail	7. How many feet down did the boys hit the third platform? (thirty feet)
___ sequence	8. What was the last thing the boys did in this story? (began asking questions about the isle)
___ vocabulary	9. What does the word "guarded" mean in the term "guarded questions"? (watchful; careful; cautious)
___ inference	10. Did the boys seem to be planning to return to the island? (yes) What facts in the story caused you to answer that way? (They asked questions about the island. They only postponed further digging, which indicates they hadn't given up.)

SCORING AID

WORD RECOGNITION

%-MISCUES
99-2
95-10
90-19
85-28

COMPREHENSION

%-ERRORS
100-0
90-1
80-2
70-3
60-4
50-5
40-6
30-7
20-8
10-9
0-10

184 WORDS (for Word Recognition)

184 WORDS (for Rate)

WPM

/ 11040

APPENDIX F

Semi-structured Interview Schedule

DISSERTATION INTERVIEW SCHEDULE

1. What was this story about?
2. Can you provide any additional information? Elaborate.
3. What information did you recall from other readings that helped you understand the story?
4. What do you think about as you read?
5. Are there any parts you didn't understand? Give specifics.
6. What do you say to yourself when the reading becomes difficult?
7. What kind(s) of information do you typically try to remember when you read a passage?
8. How often do you read in your spare time? What kinds of material do you like to read?

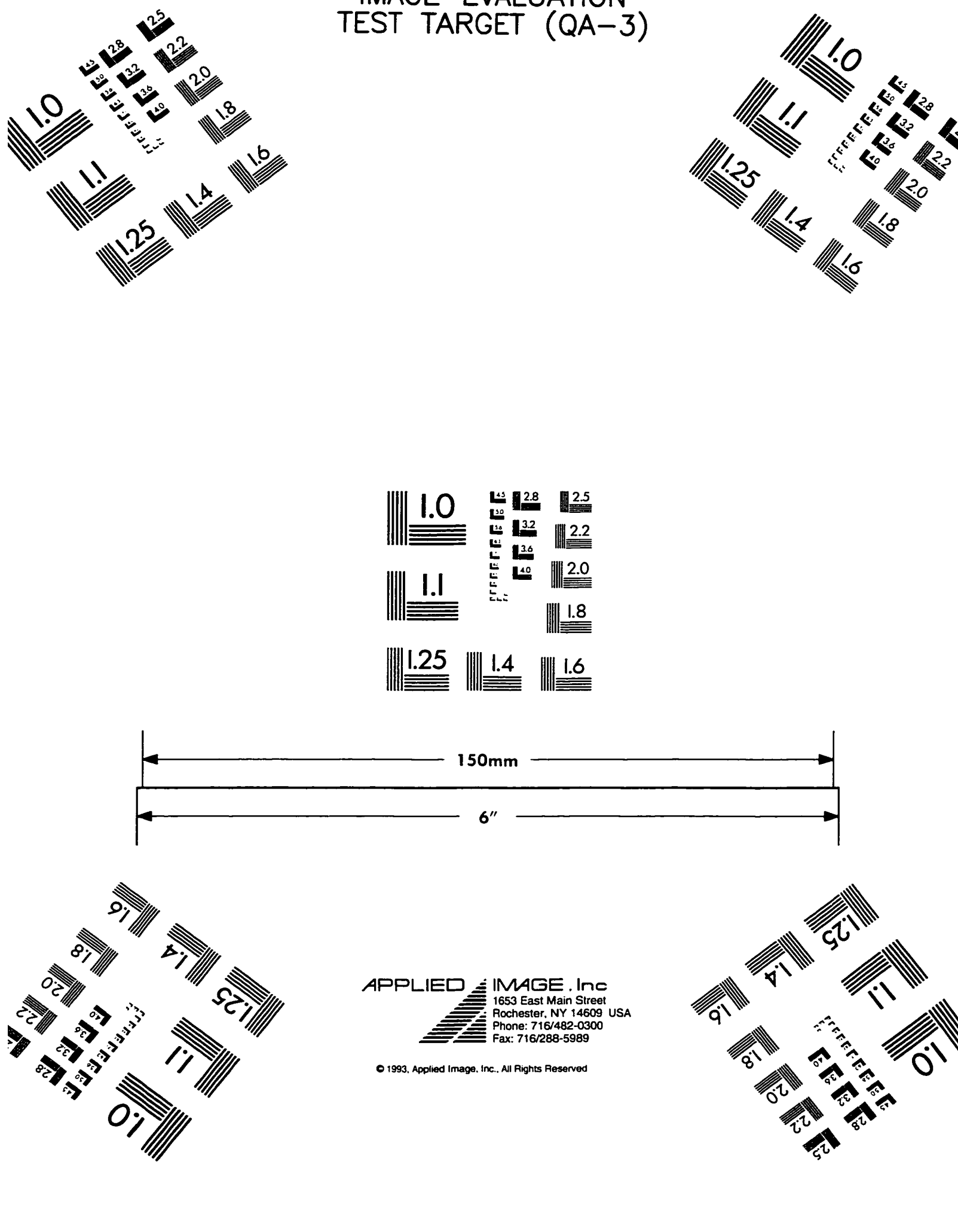
IMAGE EVALUATION
TEST TARGET (QA-3)
1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8
150mm
6"
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