1998

Investigation of Two Treatment Approaches for Improving College Students' Comprehension of Science Text.

Nancy L. Martino
Louisiana State University and Agricultural & Mechanical College

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor MI 48106-1346 USA
313/761-4700 800/521-0600

INVESTIGATION OF TWO TREATMENT APPROACHES FOR IMPROVING COLLEGE STUDENTS' COMPREHENSION OF SCIENCE TEXT

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfullment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Communication Sciences and Disorders

by
Nancy L. Martino
B.S. Pennsylvania State University, 1978
M.A., University of Tennessee, 1985
December, 1998

ACKNOWLEDGEMENTS

I could not have undertaken and completed a work of this magnitude without the help of some very special people. I wish to acknowledge my mentor and major professor, Jan Norris, for her ever-present patience and assistance, always scaffolding me at the upper limits of my ZPD, and causing disequilibrium at just the right times. To the other members of my doctoral committee, I extend a special thank you. For Paul Hoffman, with his willingness to assist me at the seeming drop of a hat, I appreciate his knowledge of statistics which he generously shared with me throughout my study. For Janna Oetting, a friend as well as an outstanding researcher, I am grateful for her expertise in writing and research, and as an ear for those times when I was unsure of my direction. And for Hugh Buckingham, who helped me to remember that there is more to life than graduate school.

I would also like to thank my family and dear friends who all supported me in this endeavor. To my husband, Greg Baber, who gave me encouragement every day, sometimes more than once a day, I acknowledge, for I know I would not have done this without him. For my parents, Robert and Dorothy Martino, who always encouraged me to pursue excellence, I am grateful for their love and support. I thank my extended family, Donna Musarra and David Mervis, for their understanding and patience when I could think and talk of nothing else but this work. And to my graduate school colleagues, Janice Del Toro, Janice Horohov, Kathy Dekemel, and Sara Reichmuth, thank you for all the support and encouragement.

I literally could not have completed this study without the instructors and students from the Biology Department at Xavier University. I acknowledge the full support that the department gave me to work with the students, especially Bob Fulginiti and the rest of the 1230 faculty, and I acknowledge the students for coming to work with me regularly.

TABLE OF CONTENTS

ABSTRACT

Many college freshmen are unable to read expository material at a level of proficiency necessary for understanding and integrating information from their textbooks. Providing intervention that addresses these deficits and results in rapid improvements is critical if these students are going to pass their current courses and remain in college. This study examined whether an instructional approach termed Communicative Reading Strategies (CRS) would result in improvement in the ability to comprehend expository text. CRS uses interactive strategies that teach students to comprehend a text as it is read. The CRS approach was compared to a skills approach that addressed similar skills taught individually.

Subjects were 8 college freshmen reading at or below a 10th grade level and enrolled in an introductory biology course. Four subjects participated in an 8 week intervention program using CRS and four in the comparison condition. Pretest-posttest results of a standardized measure of reading comprehension, and weekly probes measuring literal and inferential comprehension of the biology text were used to compare gains.

Results revealed that both groups improved following intervention for comprehension of inferential questions on the standardized measure. While group differences were not statistically different, qualitative differences were accrued to the CRS group, including higher gains, a college reading level at posttest, and better performance on literal comprehension.

Analysis of weekly probes revealed reliably better performance for inferential questions for the CRS condition. Not only did the CRS group perform better for inferential questions, but the improvements occurred more rapidly. After the first week of intervention, the CRS group outperformed the skills group by over 2 points. Rapid improvements are important because by mid-semester a student may have already failed a course. While both instructional approaches result in gains, CRS has the advantages of achieving a college reading level and effecting these changes faster than the skills approach.

CHAPTER 1 INTRODUCTION

College freshmen with low literacy skills are underprepared to meet the challenges presented to them in the area of reading comprehension. According to Applebee, Langer, and Mullis (1985), beginning undergraduate students have the basic reading skills needed to understand a newspaper, but many of them have difficulty reading and studying college textbooks due to the complexity of the written language and text structure. An approach to reading intervention that addresses the complexities of language processing is Communicative Reading Strategies (CRS) (Norris, 1988; 1989; 1991; Norris & Hoffman, 1993). CRS treats reading as an integrated language process and is designed to facilitate the integration of multiple aspects of language by helping the reader organize textual elements into a coherent whole. CRS has been used successfully with school-aged children with reading problems and adults in basic adult education programs utilizing non-expository text (Hernandez, 1989; Michaelson, 1995; Reichmuth, 1996). The purpose of this study was to examine the effectiveness of CRS on low average college freshmen using expository text such as that found in science textbooks.

The remainder of this chapter begins with a discussion about college students with reading difficulties. A discussion of the three types of reading models follows. Connectionism is discussed next, with an in-depth view of a connectionist's model of word recognition. The various processing components of CRS are then presented. Finally, the social aspect of learning, social mediation, is discussed.

Comprehension Deficits Among College Students

By the time most poor readers enter college, their ability to decode words has become automated. What they have difficulty with is understanding the complex nature of expository prose because of the complexity of the written language and the inability to successfully organize and integrate the material (Norris & Hoffman, 1993). Additionally, these individuals have few strategies and poor flexibility when it comes to reading and comprehending expository text. For example, Baker (1985) found that adult poor readers were less likely than adult good readers to evaluate text for inconsistencies and relate textual information to prior knowledge. In a study of ninth graders' use of reading strategies, Meyer, Brandt, and Bluth (1980) found that poor reading comprehenders were less likely to use organizational strategies than good comprehenders.

The number of college students experiencing poor reading comprehension is surprisingly high. The National Assessment of Educational Progress (NAEP) reading test results for 17 year-old beginning college freshmen indicate that only 39.2% demonstrate adept comprehension strategies (able to find, understand, summarize, and explain relatively complicated information) (Applebee, Langer, & Mullis, 1985). Flippo, Hanes and Cashen (1991) estimated that one-third to one-half of incoming freshmen and reentering students in postsecondary institutions are in need of reading assistance and it is expected that more students will be requiring assistance as colleges increase recruitment of disadvantaged students. The number of learning disabled students attending postsecondary institutions is also on the rise. According to

Henderson (1995), college students with learning disabilities accounted for 3 percent of all college freshmen, and between 1988 and 1994 the percentage of freshmen with disabilities who reported a learning disability more than doubled, increasing from 15.3 percent to 32.2 percent.

The vast amount of expository text required of college students consumes the majority of their class preparation time. Nowhere is expository text more important, nor more demanding, than at this level (Hiebert, Englert, & Brennan, 1983). In addition to unknown vocabulary, college texts contain words that have erudite meanings and are highly specialized to a particular field of study. Syntax is often of a complex nature, with references that may or may not be signaled by words in the text. Concepts are often abstract and present difficulty to poor readers because meaning must be derived from unfamiliar information. The abstractness requires readers to rely less on direct experience and more on background knowledge acquired through previous academic instruction or through word definitions (Norris & Hoffman, 1993). If a reader doesn't have adequate background knowledge or has difficulty accessing it, comprehension will suffer.

Other types of problems are directly related to text structure. The reader may not be familiar with various types of expository prose (e.g., problem/solution, cause/effect). She may also be unaware of the purpose of chapter titles, headings, paragraph structure and the importance of identifying a text's macrostructure. If she is new to college, she may not have learned what to do with a syllabus or know that the instructor expects her to read and comprehend textual information not discussed in

class. Any combination of these deficits leads the poor reader to struggle with reading and class assignments.

Models of Reading

Theoretical models explaining the processes involved in reading are generally divided into three categories: bottom-up, top-down, and interactive. Bottom-up models emphasize word recognition before comprehension. While the bottom-up model may help beginning readers perceive phonemic and orthographic processes, it does not account for the entire reading process. Top-down models focus on cognitive aspects of the reading process by emphasizing the use of context and meaning in predicting upcoming words. Since neither model fully explains the complex nature of reading; the interactive model has been proposed that incorporates elements of both the bottom-up and top-down models.

Bottom-Up Models

According to bottom-up theory, before a reader can comprehend the text, she must first translate the printed word (Gough, 1984). Thus, lower-level perceptual and word recognition information must be acquired before meaning can be gleaned from the text. Graphemic information entering the visual system is associated with phonemic knowledge about the sounds of language. This sensory input is then converted to orthographic knowledge, or spelling patterns, then words. After words are recognized, their meanings are accessed. This is viewed as a step-by-step, part-to-whole process. From this perspective, orthographic knowledge must be mastered before word recognition, and word meaning precedes comprehension of sentences (Adams, 1990).

Instructionally, a bottom-up approach would focus on practicing the skills in each step of the process until they become automatic. Worksheets and other materials are used at each level to teach discrete skills. For example, at the word recognition level, skills taught include: identifying prefixes, suffixes, and roots. Skills are generally taught in isolation and mastery must be demonstrated before another skill is presented.

Many secondary and postsecondary schools adhere to the bottom-up theory in the teaching of reading (McLaughlin, Price, & Shoultz, 1992). The focus is on teaching higher level skills thought to underlie comprehension, since at this level, word recognition is often mastered. A common approach to helping poor readers at the college level has been to teach specific comprehension skills, such as finding the main idea, developing critical thinking, and learning new vocabulary words (Flippo & Caverly, 1991). Students often use structured texts which simulate a standardized examination format. Objective questions dealing with skills such as vocabulary, specific detail, inference and reading rate follow short reading selections (McLaughlin et al., 1992).

Many college reading textbooks reflect bottom-up theory. In a survey of twenty current reading textbooks copyrighted between 1993 and 1997, Wood (1997) found that eight fell into the traditional category. This category was characterized by the teaching of discrete skills in a workbook format with short and easy practice reading passages. Each exercise was followed by multiple choice, true-false, or fill-in-the-blank questions. Four books fell into the middle category, which included those having both traditional and features they referred to as "modern".

These books taught both skills and strategies that included open-ended and multiple choice questions. Each section provides suggestions for students to make mental connections among readings on the same topic, to activate existing background knowledge and to relate old knowledge with new. These practices are more consistent with top-down models of reading.

Top-Down Models

While the bottom-up theory of reading emphasizes mastery and automaticity of decoding and word retrieval, the top-down theory stresses the importance of using prior knowledge about concepts and language structures to aid in recognizing words and their meanings (Bransford & Johnson, 1972; Smith, 1988). As the child reads, she makes predictions about upcoming words and sentences. The text confirms her predictions as she uses recognized words in the text and her knowledge of language structures to predict unknown words.

During the last 15 years, reading research has focused on a schema-related theory of top-down reading. According to schema theory, a reader comprehends a message when he is able to bring to mind a schema that gives a good account of the objects, concepts and/or events described in the passage (Anderson, 1985). Schema are internal representations or structures that represent, store, and are used to retrieve world knowledge or background knowledge (Bransford & Johnson, 1972). Schemes are formed at many levels, from individual concepts to complex events that maintain a prototypical structure, such as an eating or clothes washing scheme.

For comprehension to occur, the words must do more than activate the sum total of the concepts within a passage. Rather an analysis of the relationships among the elements must be performed. According to Halford (1993), schema are flexible in that a variety of phenomena or situations within a category are represented. Two uses of the same word in different contexts will elicit two different meanings, both represented within the same conceptual schema. Halford also suggested that schema were generative in that inferences can be drawn from them. One's schema enables comprehension to occur because it provides a coherent explanation of some of the elements within the text and acts as a frame of reference within which new information can be processed (Anderson, 1985).

The existing domain-specific knowledge aids the reader in identifying relevant elements of the text and provides a bridge to new information. In this top-down view, knowledge at higher levels assists the reader in the processing of text. Smith (1988) contends that what is most important in reading is not phonics but one's background experience. The reader brings to the text a storehouse of information which helps the reader make inferences and retrieve critical information from the text (Anderson & Pearson, 1984). This knowledge guides the word recognition process so that the reader "uses the eyes as little as possible" (Smith, 1988). Word recognition is rapid and automatic because word recognition decisions are made on the basis of words that fit the context as much as on the letters that fit the word. Thus, in a top-down model, prior knowledge is very important.

Interactive Models

Many theorists view reading as simultaneous occurrences of bottom-up and top-down processing. The interactive model incorporates elements of each (Rummelhart, 1977; Stanovich, 1980). According to this model, reading consists of parallel processes, both top-down and bottom-up, that provide information simultaneously at various levels of analysis. It is assumed that, as in the bottom-up model, graphemic information enters the system as print is encountered. However, from the first eye fixation on print, associations are made with higher level representations. These include syntactic knowledge, semantic knowledge, orthographic knowledge, and lexical knowledge.

Support for models for interactive processes has been demonstrated in research that shows syntax and semantics play a part in the reading process. Evidence for syntactic effects in reading come from studies of oral reading errors. Stevens and Rummelhart (1975) found that in an oral reading task, adult readers made substitutions in the same syntactic class as the target word 80 percent of the time. The researchers concluded that grammatical knowledge helped to select the word read. Semantics also has been shown to be involved in the reading process. Results of lexical decision studies on word pairs have demonstrated that a decision is made much faster when the pair of words are semantically related than when they are unrelated (Balota, 1983; Meyer, Schvaneveldt, & Ruddy, 1974). That is, subjects are faster to recognize the word **dog** when it follows **cat** than when it follows **pen**.

According to Rummelhart (1977), the following are the specific levels of knowledge that can be operating in an interactive model:

featural, letter, letter-cluster, lexical, syntactic, and semantic. Information from all of the levels is used to produce the most probable interpretation of the graphemic input. Comprehension is achieved through the processing of both visual input and internal representations (Smith, 1988). The processes are interactive such that interpretations can be generated at any level.

For example, if the reader sees a feature that suggests a "t" as the first letter of the first word in a sentence, she postulates a "t" in the first position and continues processing. If the reader thinks that the sentence begins with a pronoun, then she postulates a pronoun and looks for evidence. As these hypotheses are being entered into the system, the reader may postulate that the first word may be **these**, **this**, **they** or **their** because all of these words are pronouns and begin with the letter "t". She may expect a "th" combination at the letter-cluster level. At the syntactic level, she will be looking for one of two types of words. She may expect the next word to be a noun (as in **Their car**), or she may expect a verb (as in **They are**). When she sees that the second word in the sentence is a verb, some pronoun choices will be eliminated and she will narrow down her guess of the first word to either **they** or **these**. Depending on previous context, one of those words may be eliminated because of cohesion. If the preceding sentence read **The girls were walking quickly**, the pronoun **they** would maintain cohesion and fit the context.

Similar processes occur simultaneously throughout the system so that what is read is a consolidation of all input to the system. Skilled readers develop this interactive processing system over time and with

considerable exposure to written information. In the beginning stage of reading, the child focuses on one aspect at a time (Sulzby, 1985). She may decode a word letter-by-letter while the next word may be predicted from context or accompanying picture. As the child gains more experience with the reading process, interactive patterns are established and strengthened and she moves onto the second stage, reading with strategies imbalanced. At this stage, she integrates different patterns but exhibits incomplete comprehension and word substitutions, omissions or additions due to insufficient information within the system. By third or fourth grade, most children use an interactive process to read text (Juel, 1983; Stanovich, 1980). At this age, children demonstrate patterns of simultaneous processing at all levels.

Summary

Each of the three models of reading views the reading process differently. According to Adams, young novice readers, lacking knowledge of letters, sounds, and grapheme-phoneme correspondences, must learn the code first before anything else (1990). However, claiming that reading is far more than a decoding-only process, other theorists view reading as a constructive activity in which the reader brings her knowledge of the world to the text. According to the interactive theory, the reader uses both her schema for semantic and syntactical information as well as her decoding strategies to determine the meaning of a passage (Perfetti, 1985).

Connectionism

Some contemporary interactive models of reading have been described according to a connectionist or parallel distributed processing

(PDP) model (Patterson, Seidenberg, & McClelland, 1989; Seidenberg & McClelland, 1989). Originating in the fields of artificial intelligence and cognitive science (Tierson, 1990), connectionism is a model of cognitive functioning that attempts to explain how complex human behaviors emerge from the combining of simple processing units. PDP models are types of connectionist models that demonstrate the large number of processing interactions that occur as a result of the large quantity of processing units (McClelland, 1989).

From a connectionist's viewpoint, reading involves connecting a multiple array of concepts that include orthographic, phonological, semantic, syntactic, and contextual codes. A model of the framework is shown in Figure 1-1 (Seidenberg & McClelland, 1989). A connectionist system consists of a network of nodes or units that make direct connections with each other, sending and receiving bits of information.

Each of the codes comprises a distributed, rather than local, representation. In a distributed representation, a perceptual entity (i.e., a letter, word or object) is not stored in a particular place in memory, as in a dictionary where it can be accessed in the course of processing, but rather is represented as patterns of activation distributed over a number of primitive representational units. It is not a feature system with a perceptual characteristic either being present or absent. Rather, units are activated in different degrees (Seidenberg, 1990) and take on activation values based on a weighted sum of their inputs. Input information comes from both the environment and from other units. The total input of a node determines its state of activation. Weights are determined as a function of experience. That is, a commonly used word such as **happy**,

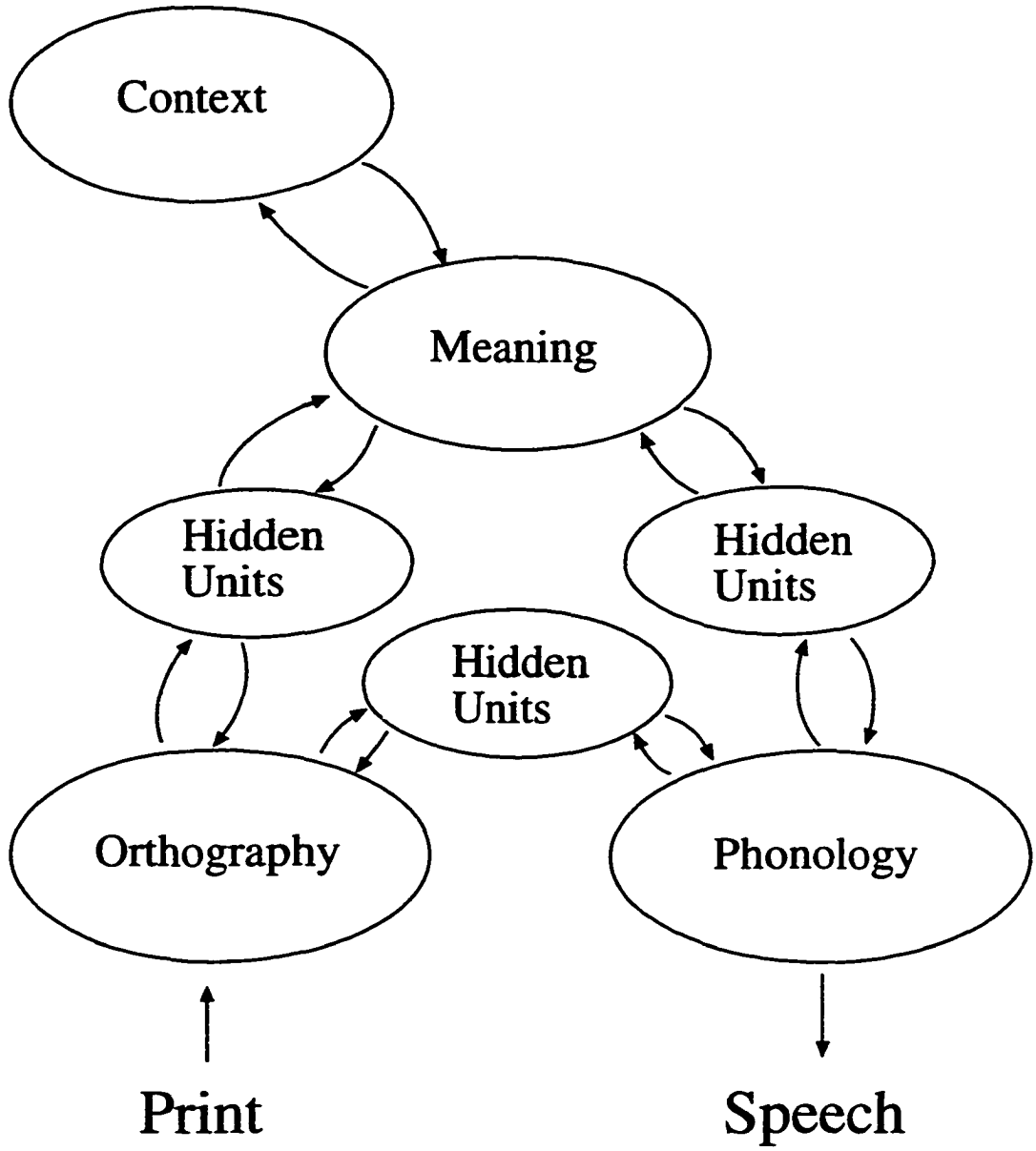


Figure 1-1
General Framework for Lexical Processing (Seidenberg & McClelland, 1989)

will carry a heavier weight and thus become activated more quickly than a less commonly used word that has a similar meaning, like **joyful**.

Because there are no entries corresponding to individual words or meanings (i.e., no lexicon), words and word meanings are computed each time they are encountered (Seidenberg, 1990). The pattern of activation depends on the information entering the system from the orthographic, phonological, semantic, syntactic, and contextual units. Processing is achieved as the activation is spread between units.

It has been demonstrated that different features are activated depending on the context. For example, Merrill, Sperber and McCauley (1981) showed that the sentence **He petted the cat** activated the word **fur** more strongly than the sentence **He was scratched by the cat**. The researchers concluded that the meaning of a sentence as a whole determines the manner in which individual words and word concepts are encoded. Information about specific properties of words that is irrelevant to the entire sentence is not activated. Hence, in the second sentence, **fur** was not activated because one does not need to think of that property of a cat to understand being scratched by one while it is highly relevant to petting a cat in sentence one.

Seidenberg and McClelland's Model

A comprehensive model of text processing would require a complex and interactive architecture involving many components that would include orthographic, phonological, semantic, syntactic, and contextual information. However, models have been used for purposes of experimentation which are simplifications of the larger processing system. Seidenberg and McClelland (1989) built such a computational

model. Their model, which eliminated the semantic, syntactic, and contextual levels, is illustrated in Figure 1-2. The model, consisting of an orthographic level, a phonological level and a third level of hidden units between the two, was designed to perform the limited task of identifying monosyllabic words and nonwords. In this simplified model, there is no feedback property between the phonological and orthographic levels. The bidirectionality of the arrows between the other units indicates the assumption of interaction between levels. That is, it is assumed that the process of building a representation of knowledge at each level influences and is influenced by the representation at each of the other levels.

Letters are encoded into a pattern of activation over the orthographic units from the visual stimuli. Activation of the hidden units are then computed on the basis of the pattern of activation at the orthographic level. Once simultaneous activations over the hidden units have been computed, they are used to compute activations for the phonological units and new activations for the orthographic units based on feedback from the hidden units. During the training phase, the model is given feedback about the correct orthographic and phonological codes for words. Repeated exposure to correct strings of letters strengthens the connection weights and learning occurs.

The simulation model demonstrates that word recognition results from phonological information activated in parallel with other representations. Once children learn to associate the orthographic codes for words with both their meanings and phonological representations, processing results in activation of multiple types of information.

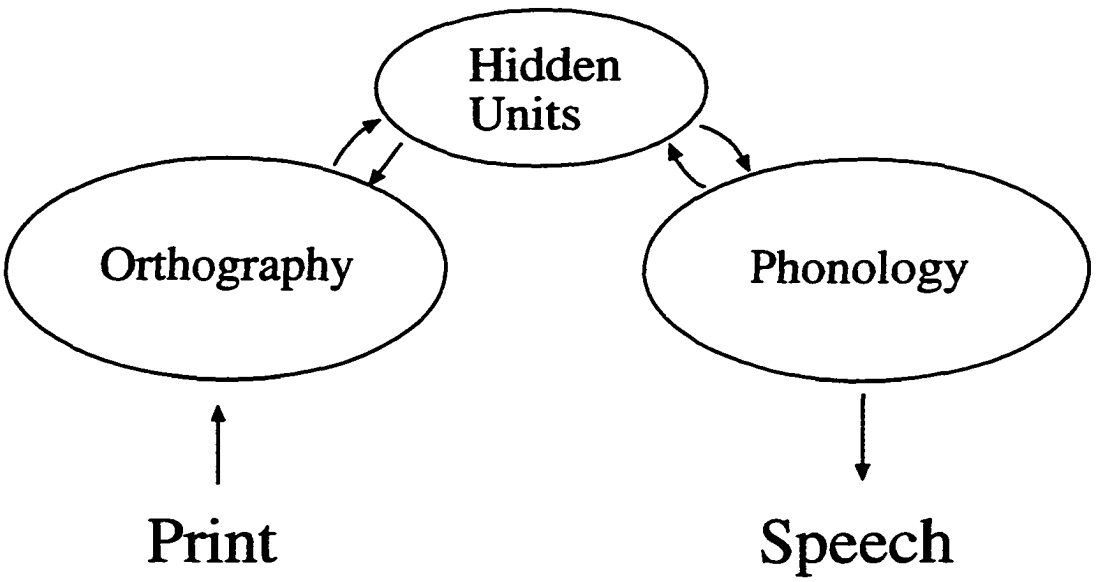


Figure 1-2
Simulated Model for Monosyllabic Word Processing (Seidenberg & McClelland, 1989)

Children do not need to generate pronunciation from the phonological processor only. They may do so by computing the meaning of the word from the orthographic processor, and then compute its pronunciation from the meaning processor. This is what happens with the pronunciation of irregular words such as **have**, **give**, and **said**. These words can only be pronounced correctly by accessing the meaning processor, for if only the phonological processor was used, these words would be pronounced incorrectly.

This is not to assume that words are accessed in a lexicon and retrieval comes about by specific rules. Rather, codes for words are computed every time they are encountered. With each encounter, different patterns of activations are computed depending on the spelling, pronunciation, meaning, and context. The model demonstrates that nonwords can be pronounced correctly, as well, through the same process. Knowledge of spelling-sound correspondences is represented by the weights on connections between units arrived from the computation between orthography and phonology instead of by rules.

Information Processing

Connectionist models have been used to explore a wide range of human behaviors and natural phenomenon. For example, some researchers have focused on developmental changes in the behavior of infants and children, while still others have focused on the biological intricacies of chemical changes at the cellular level. What these researchers have in common, however, are general assumptions about basic aspects of information processing and the development of thought.

Information processing is the way information is taken into the organism, interpreted, represented, transformed, and acted upon (Gross, 1985). Various conceptualizations of information processing have been proposed, including Piagetian theory, neo-Piagetian theory, and the information processing approach. What is similar about these conceptualizations is that the mechanisms by which information is processed is structural. A newer way of conceptualizing processing is through a connectionist framework. This section begins with a discussion of processing from a structural point of view. Following that, the aspects of representations, knowledge, and learning will be discussed from a connectionist viewpoint.

Structures

According to Piaget (1970), intellectual structures undergo a change through the organism's active involvement with the environment. Children are continuously assimilating new experiences, accommodating these experiences and reorganizing their cognitive schemata into increasingly complex mental structures. While Piagetian theory has been an important and influential theory of cognitive development, it does not specify how the structures work (Shaffer, 1985).

The same can be said of the neo-Piagetian theory. Case (1985) contended that children are born with general regulatory structures that predispose them to solve increasingly complex problems. The effectiveness of the structures depends on the individual's processing space, which is comprised of one's short term storage space and one's operating space. As the individual develops more processing space, especially short term storage space, she is able to solve more complex

problems. This view is more explicit in describing how children move from stage to stage than Piaget's; however, Case did not specify what these structures were or how they worked.

The information processing approach emphasizes particular storage structures that are important for learning, such as, short term memory, long term memory, and sensory information storage (Lindsay & Norman, 1977). According to information processing theorists, the structural components of cognition operate in a serial fashion from sensation to perception to attention to memory (Simon, 1969). It is assumed that these structures are innate and that one is born with them, and they also develop over time.

Representation

Those who study development in terms of dynamic systems or systems that change continuously over time hold that the same event can come about in many ways (Elman, Bates, Johnson, Karmiloff-Smith, Parisi, & Plunkett, 1998; Thelen & Smith, 1994). Thelen and Smith (1994) refer to all biological organisms as dynamic systems. Humans are an example of complex and heterogeneous organisms, continuously demonstrating behaviors that require complex processes. The simple act of reaching for a cup of coffee involves such processes as salivation (from thirst or caffeine dependency), visual and motor networks to search and reach for the cup, and many other physiological processes operating on many levels. What organizes the act is the coordination of the internal representations of all of the elements.

The coordinated process of reading is an example of a dynamic system. In their simulation model of word recognition, Seidenberg and

McClelland (1989) demonstrated that each bit of information is encoded as patterns of activation or units, be it the visual configuration of a letter or groups of letters, the location of the word in the sentence, or the context in which the word is being read. Each unit has the ability to receive input from and pass activation to all other connected units. Because of this connective quality of the units, representations are active in that they give rise to processing directly (McClelland, 1989). For example, in the sentence **The Smoky Mountains are in the state of Tennessee**, the reader need not know how to pronounce the word **Tennessee** nor even need to have seen the word before to understand the sentence. As long as she understands the meaning of the word **state**, she can figure out that Tennessee is a state and that the Smoky Mountains are located there. Because the units are all connected to one another, the meaning of the sentence can be formulated.

Understanding a text does not necessarily require access of phonological information (e.g., **Tennessee**). Thus a text can be read and understood by individuals who lack knowledge of orthographic-phonological correspondences (e. g., nonspeaking deaf persons). Just as a child does not need to know how to pronounce all of the words or know the meaning of all the words in the sentence to understand the sentence, an individual does not need to have thirst to take a drink of coffee. He may simply see the cup and take a drink. The outcome is the same, reaching for the cup; however, the reasons why he drank the coffee may be varied and many (e. g., thirst, caffeine addiction, visual stimulus, time of day, or aroma to name a few).

Knowledge

Connectionists discuss knowledge differently than nativists or empiricists. That is, nativists may contend that knowledge is inborn while empiricists may contend that knowledge comes from one's experiences. While it is impossible to disregard genetics and biology, and, at the same time, one's environment and upbringing in determining physiology and behavior, knowledge, to connectionists, is more than the interaction between the two. Elman and his associates (1998) discuss their opposition to using the term *innate*, because to them, it implies an "overly simplistic view of how development unfolds" (p. 357). They argue that a behavior may be said to be innate, yet, on closer inspection, could be a combination of inborn predisposition and learned behavior.

They cite the example of newborns who prefer stimuli which resemble three high-contrast blobs, similar to a defocused image of a face, over an actual face. But at two months of age, the same infants prefer stimuli that resemble real faces to the high-contrast blobs. Nativists would argue that the preference for a human face at two months is innate and it took two months to develop that inborn skill. Connectionists would argue that there is an innate predisposition that biases the newborn to faces; however, preference for faces comes about through experience at looking at faces. In other words, there is no built-in representation for a face; however, the system is primed to accept faces (Elman et al., 1998, p. 116).

Connectionists argue that while knowledge may appear as though it is hard-wired (Thelen & Smith, 1994) and stored in some place within the brain, it is not. According to McClelland (1989), knowledge is

stored in the connections among the processing units. And Elman and his associates refer to knowledge as a specific pattern of synaptic connections in the brain. In the above example, the infant's knowledge of faces is the result of interactions among neuronlike components or units.

Learning

In a connectionist framework, learning occurs as connections between units are strengthened or weighted and connections are weighted on the basis of experience (Tierson, 1990). As the neural network gradually generates a pattern of activations over specific units, those connections become more strongly weighted. In the example of the face, the infant learns and becomes familiar with her mother's face through frequent exposure to that face. A particular input, mother's face, will tend to excite the neural units because it has become positively weighted. The infant responds to the face because she has learned the face. When the infant sees a face she has never seen before, she may recognize it as a face (and not a foot, perhaps), yet the connection weights are not as strong for that face as for the mother's face.

As with face learning, word recognition emerges as a result of the way the network responds to input. It has been shown that letters are not perceived individually but in association with other letters (Seidenberg & McClelland, 1989). When children are exposed to print, they learn information about letter sequences, words, and sentences. The strength of the associations among the units is based on the frequency with which letters have been seen together.

Adams (1990) described what happens when a single, familiar word is read. A commonly encountered word, such as **the**, is recognized more quickly than less commonly encountered words, such as **nod**, because the individual letters **t**, **h** and **e** are frequently found in that order. When the letter **t** occurs in the initial position of a three letter word, it is highly probable that the next letter will be an **h** (Mayzner & Tresselt, 1965, as cited in Adams, 1990). The association between **t** and **h** becomes stronger with more exposure to words beginning with **th**.

Additionally, it has been demonstrated that letters are seen in pairs and triples (Juel & Solso, 1981), so when the reader looks at the word **the**, she sees all three letters. Each letter receives excitation from each other letter. Thus, over time when the word is presented, the reader quickly recognizes it due to the strength of the associations between and among the letters. This example has only demonstrated a small aspect of how the reader processes words. Not taken into account are the other types of information units, such as syntactical and conceptual, that are being activated at the same time. These will be discussed later.

Due to the nature of human brains, it is assumed that there are limits in its architecture. According to connectionist theory, these are referred to as prior constraints (Elman, et al. 1998; McClelland, 1989; Thelen & Smith, 1994). There are three levels of architectural prior constraints: unit, local, and global. Unit level architectural constraints correspond to the physical structure and computing properties of individual elements within a region. Local constraints correspond to the patterns of connectivity that define types of regions and the general characteristics of layering and connectivity within a region. Global

constraints correspond to the ways in which brain regions are connected to one another and to the input/output pathways connecting the brain to the rest of the body.

An area where connectionists disagree with nativists is that of neural architecture. In current connectionist models, what is innate is the neural mechanism and not the neural content (Elman et al., 1998). These researchers argue that the neural mechanism, with its architectural constraints, is independent of neural content. One cannot conclude that a specific neural content, such as language, arises from a specific neural mechanism. For example, they argue that while humans over the age of three are the only species which learn and use language, it does not follow that grammar is under genetic control.

Children are not born with prespecified neural mechanisms that are for the sole purpose of language processing. They cite the localization literature to support their argument. For example, children with left-hemisphere damage have been reported to acquire language within the normal range (Aram, 1992, as cited in Elman et al., 1998) and some agrammatic Broca's aphasics perform normally on receptive grammar tasks (Tyler, 1992, as cited in Elman et al., 1998).

Current linguistic theory attempts to show that there are specific linguistic mechanisms that generate specific linguistic rules, for example, children's learning of the past tense (Chomsky, 1957; Pinker, 1994). It has been postulated that children must first discover the rule that changes a verb from present to past tense. Then they must learn that there are exceptions to this rule because of irregular forms of past tense. There is a specific mechanism that provides the rule and another

mechanism that provides a rote look-up table. Pinker and Prince (1988) refer to this as the dual mechanism theory and they argue that these mechanisms are innately specified.

A critical finding in support of connectionism is that a specific behavior is not produced from a specific neural mechanism. Plunkett and Marchman (1991) demonstrated how a connectionist network could be used to model children's past tense verb acquisition, including both regular and irregular verbs. Their mechanism contained input units, hidden units and output units.

During training, the model was exposed to both regular and irregular verbs. Feedback was given as to the correctness or incorrectness of the past tense codes. Errors were dealt with through a backpropagation learning algorithm, that is, a computational constraint built into the network. For each error, weights on connections were adjusted so that the discrepancies between the computed codes and the correct target codes were reduced. Consistent with children's typical experience in which irregular past tense verbs are encountered with high frequency (i.e., **sat, hit, cut, has**), Plunkett and Marchman increased the frequency of the irregular verbs during the training. As a consequence, the pattern of connections of the irregular verbs was established. This caused the irregular verbs to initially improve in performance at a rate faster than regular verbs.

Plunkett and Marchman found that network performance for a verb was influenced not by the discovery of a rule, but rather by the complex interaction of several variables. These included the frequency of verb type, the number of other verbs in the same sub-class, the degree

to which a sub-class shared features with other sub-classes, and the phonological features of particular verb classes.

As with verb tense acquisition, a distributed representational theory of word recognition within a connectionist framework has emerged. In their simulation model of word recognition, Seidenberg and McClelland (1989) demonstrated that learning to recognize printed words comes from exposure to letter strings and feedback and not accessing pronunciation rules or choosing words from a mental lexicon. This feedback occurs for children as they learn letter groups and are given information from parents and teachers as to the correctness or incorrectness of a pronounced word.

In relating a connectionist framework to reading, Adams (1990) pointed out that learning to read consists of learning patterns. The patterns, including visual, auditory, motor and conceptual, are linked together each time a word is encountered. Over time, these patterns or connections are strengthened as their frequency of occurrence increases.

The perceptual aspects of print with which children must be aware include phonemes, letters, syllables, and words. There are also conceptual aspects of print, including word meanings (i. e., lexicon), concepts, syntactic structures and contexts. Children learn how to read by building links among these different elements (Adams, 1990).

Moving from learning to read to becoming a skilled reader involves overlearning the characteristics of each of these perceptual and conceptual elements. At a young age, children learn perceptual characteristics such as the names of letters and learn to recognize them in familiar words such as their names. Skilled readers automatically

process letters in words (Adams, 1990). Conceptual characteristics are also overlearned. Children learn concepts (i.e., the concept of **cat**), in many ways: by being exposed to the object, through conversations, in pictures, and in print. Over time, their knowledge about the various characteristics of the concept becomes activated quickly when the word **cat**, one of its characteristics, or something related to it is seen in print.

As skilled readers encounter segments of text (i.e., words, phrases, clauses, and sentences), they appear to read holistically. Evidence for this comes from research on eye movements and word shape. Research on eye movements has demonstrated that skilled readers perceive whole words as quickly and accurately as single letters (Cattell, 1885, as cited in Adams, 1990). Also, it has been shown that skilled readers spend more time gazing at the thematically important material than details in phrases and clauses. Word shape research has shown that skilled readers identify high frequency four-letter words such as **down**, **make** and **look** more quickly and accurately than four-letter, regularly spelled nonwords such as **fint**, **poat**, and **sust**, and with irregularly spelled nonwords such as **epkr**, **rsai**, and **tgyo**, even when the typography of the words is distorted (Adams, 1979).

Skilled readers do not need to perceptually process each letter in a word or phrase to understand its meaning. Reading becomes automatic as all aspects of text are coordinated. Skilled readers rely on conceptual aspects, including prior knowledge, syntax, and contextual information to glean meaning from a text (Smith, 1988).

The coordinated and highly integrated process of reading is somewhat like what happens in chemical reactions. Thelen and Smith

(1994) discuss the emergence of new forms from a chemical point of view. They cite a chemical reaction known as the Belousov-Zhabotinskii reaction, where bromate ions are added to a highly acidic medium. The medium does nothing for a moment. Then, suddenly, colored regions are formed that create expanding patterns of concentric, circular rings. The rings collide with other waves but never penetrate.

When the flow of the reactants is gradually increased, the ions appear to fluctuate in a random manner. The chemists concluded that the changes only looked random, however they were highly deterministic. The changes came about from the molecules interacting in nonlinear and nonhomogeneous ways. Unrelated simple, inert chemicals cooperate with one another to produce a complex pattern. Individually the chemicals show basic properties. But when they are combined, the system changes. Instead of being comprised of individual elements, the system now is described as being made up of collective variables that dominate and govern the behavior of the system (p. 55). This is referred to as self-organization and it can only occur when the system is complex, heterogeneous and open to flux with the environment. In self-organization, many choices are available. However, the system is attracted to or selects one path out of many possible paths.

According to Thelen and Smith (1994), behaviors are the result of nonlinear variables comprised of both internal and external factors which join together. For example, as a horse continuously increases its speed, its gait shifts discontinuously from a walk to a trot to a gallop with no stable intermediate pattern. Like the bromate ions, the horse does not switch gaits at certain predetermined speeds but rather uses all of the

information that is flowing into and within its system to move faster. This is referred to as a self-generating system. Self-generating systems are open systems which include many components that are free to relate to one another in nonlinear ways. According to Thelen and Smith:

> This is a science that discards simple cause-and-effect models, linearity, determinism, and reductionist analysis. Instead, it is a science for systems with a history, systems that change over time, where novelty can be created, where the end-state is not coded anywhere, and where behavior at the macrolevel can, in principle, be reconciled with behavior at the microlevel (p. 49).

According to a connectionist framework, there is no single moment or place where learning occurs. The architecture of the system and the connections between units help to determine when a single unit will fire and what will bring about changes in the weighted connections. The non-linear characteristic of the network allows learning to occur in unexpected ways. This, according to Bates and Elman (1993), challenges the "old Stimulus-Response theory" and allows learning to include sudden moments of insight and novel outputs.

The process of reading is a self-generated process. The various components, including orthography, phonology, semantics, syntax, and context, relate to one another in a dynamic, non-linear way. According to Norris (1998), the processes involved in reading:

> can be thought of as existing within an integrated system. Within the integrated system, different units simultaneously organize information into patterns that are recognized as words, syntactic structures, orthographic units, event structures, and other elements. These units are interconnected and work in

coordination to enable meaning to be derived from speech or from print.

Because of the multiple units of information that are being organized and integrated into patterns, the process of reading is complex. Due to this complexity, many individuals have difficulty with this task. These individuals may have problems with perceptual aspects of print, conceptual aspects of print, or a combination of both.

As all units are connected to one other, whatever happens in one area will have effects in all other areas (McClelland & Rummelhart, 1986). However, difficulty in one area does not necessarily mean the reader is not able to understand a segment of text. Connections among other processing units may be strong enough to activate meaning. For example, if the reader has little or no prior knowledge about cats, as in the previous example, then she would have to rely on the other aspects of print processing to help her understand the text. Perhaps she knows what all words in the text mean and she has an adequate understanding of syntactic structure. She would then be able to understand the new information about cats.

Summary

Instead of viewing cognitive processes as occurring within a specified structure, connectionist models view these processes in terms of dynamic, self-generating patterns of activations. Behaviors occur as a result of various units of activations being fired simultaneously. The same event can come about in many ways due to the interactive manner of the network.

The reading process is one such behavior that occurs as all contributing components relate to one another in a dynamic fashion. For

meaning to be derived from print, the interconnected units work together in an integrated and coordinated manner.

Communicative Reading Strategies

Those individuals who do not have strong enough connections between and among different processing units will experience difficulties in comprehension. These individuals would benefit from an intervention approach to reading that helps them strengthen connections between and among the processing units, resulting in fluent and meaningful reading (Norris, 1998). An approach to reading intervention that is consistent with a connectionist framework is known as Communicative Reading Strategies (CRS) (Norris, 1988; 1989; 1991; Norris & Hoffman, 1993). The principles underlying CRS can be understood using the theoretical work of James McClelland, David Rummelhart, and Mark Seidenberg. Within this connectionist framework, the ability to read and comprehend text does not solely depend on letter recognition, but also on meaning and context. It is believed that all aspects of language aid the reader in comprehending text. These include the following types of information: orthographic, phonologic, lexical, syntactic, semantic, and contextual. Processing units from each of these types of information are integrated into patterns of recognized words, concepts and syntactic structures (Norris, 1998; Weaver, 1994). All units of information are connected to each other unit either directly or indirectly. Meaning is derived from the text as all elements are processed simultaneously. That is, the different elements can jointly contribute to the meaning of a word or groups of words (Seidenberg, 1992).

Units are activated from both outside the network (i.e., the environment) and inside the network. Words are found virtually everywhere in the environment. From birth, a child is exposed to print every day, including labels, television, books, signs, mail, and newspapers. When she goes to school, she will be formally taught how to read and will spend the majority of her school years with print. Units are activated from within the network through multiple sources, such as prior knowledge, contextual information, and knowledge of concepts.

To demonstrate how CRS facilitates meaningful reading, Norris' elaborated redundancy model will be discussed (1998) (see Figure 1-3). Within this model, the reader processes all information simultaneously for text comprehension. Each processing unit is connected to all other units. Information is thus *redundant* or available from many sources (Weaver, 1994).

The presentation of visual stimuli (i.e., letters, words, and sentences) causes the reader to begin both perceptual and conceptual processing. Perceptual processors receive sensory input and include visual images, such as individual letters, groups of letters, and general structures of sentences, paragraphs and passages, phonological units, phonemic units, orthographic units, and word forms. Conceptual processors attach meaning to the perceptual units through the following: lexicon, concepts, prior knowledge, discourse structure and context. The following section discusses the model, using a passage from the college textbook, Biology (Solomon, Berg, Martin, & Villee, 1996) (see Appendix F).[1]

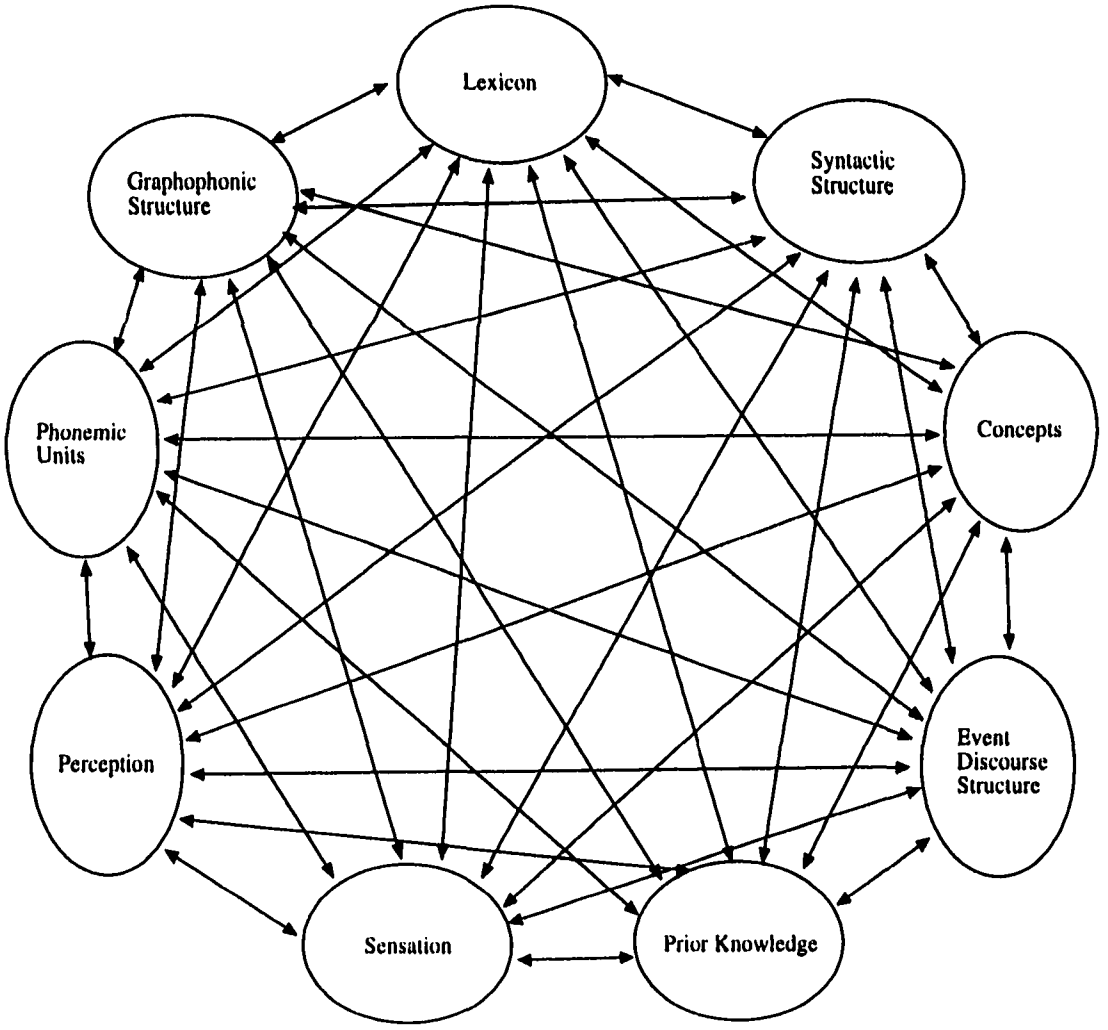


Figure 1-3
Elaborated Redundancy Model (Norris, 1998)

Graphophonic and Phonemic Processing

The term, graphophonic, refers to the aspect of reading which integrates the pronunciation or sound system (phonology) and the spelling or graphic system (orthography) within the system that relates the two (phonics) (Goodman, 1993). The term, phonemics, refers to the phonemes in speech or letters in words that occur together to make up meaningful words.

Phonology refers to the way sounds are organized within words (Owens, 1996). Individual phonemes are the sound segments and roughly compare to letters. However, some letters have more than one phoneme, such as the letter "s". It can be pronounced s, as in the word **sit**, **sh**, as in the word **sure**, or **z**, as in the word **dogs**. Phonological processing is primarily involved with auditory images of phonemes, syllables, and words (Adams, 1990). These images can be acquired from hearing someone speak and also from self generation of speech either aloud or subvocally.

The more frequently a word has been mapped onto a particular pronunciation, the stronger will be the connection and thus the faster will it be perceived and more often will it be correctly pronounced (Seidenberg & McClelland, 1989). Words with irregular spelling-sound correspondences yet high frequency of occurrence in natural language, such as **said**, **have**, and **done**, are infrequently mispronounced.

According to Seidenberg and McClelland (1989), a connectionist network will generate the correct pronunciation of words with irregular spelling-sound correspondences. This is due to the integration and coordination of the entire system. If a reader is exposed to a list of

unrelated words, she will have more difficulty correctly pronouncing the irregular words than if she were to read the same words embedded in sentences or stories (Carpenter & Just, 1981). Thus the other information, including meaning and syntax, contribute to the reader's ability to correctly identify the unknown words.

As with phonological patterns, orthographic patterns are also organized into meaningful information. Orthographic patterns are organized from an early age. By the end of first grade, most normal readers are able to associate sounds with letters (Lieberman & Shankweiler, 1979; Perfetti, 1985). During the following years, children learn the pronunciations of irregular sound-letter sequences, such as **s** in **sure**, silent **e** in **make**, and silent **gh** in **fight**. By college age, students are able to correctly identify phonemes, and can use this knowledge to help them identify unknown words effortlessly and quickly.

Frequency of words encountered plays a major role in learning word order patterns (Seidenberg & McClelland, 1989). Regular words, or words that contain spelling patterns that occur in a large number of words, are perceived faster than irregular words. The more a word or spelling pattern is encountered, the more predictable it becomes because the letters in the pattern have become linked together through their frequent association with each other (Rummelhart & McClelland, 1986). For example, words that end in **ole** become more predictable the more the reader is exposed to those words, so that when the reader sees **pole**, as in the sentence **Such a bond has two dissimilar ends, or poles**, she identifies the word quickly.

To the skilled reader, longer words with familiar patterns are perceived holistically and thus are recognized more quickly (Seidenberg, 1992). This is because specific spelling patterns have been seen more frequently than others. For example, in the pattern **ought**, individual letters are perceived as an entire group. When the skilled reader sees a word with this pattern, such as **bought**, **fought**, or **thought**, he perceives the group and combines other letters in the same syllable with it.

Additionally, skilled readers' ability to recognize long words depends on whether they can identify familiar component groups of letters (Adams, 1990). The word **electronegativities** in the following sentence is perceived quickly because it contains the frequently occurring groups: **elec**, **tro**, **neg**, **tiv** and **ties**. **In a covalent bond between two different elements, such as oxygen and hydrogen, the electronegativities of the atoms may be different**. Even if a reader has never seen this word before, she may able to read it correctly.

If the reader does not recognize the word or one or more groups of the letters, she may require help with it. In CRS intervention, a strategy such as a preparatory set may be used to facilitate the coordination of the reading process. A preparatory set is a statement provided by the facilitator given before the student reads a section of text that activates appropriate aspects of the reading process so that comprehension will be achieved. For example, the facilitator may say, "This word, (pointing to **electronegativities**), is made up of two other words that we've had before: electron and negativity. Tell me the word and see if you can figure out what it means."

By providing this information before the student reads the word, background knowledge about compound words are activated for the reader so that she not only will be able to pronounce the word, but she will also have an idea of what the word means. The meaning of the word is thus activated at the same time as the pronunciation, forming connections between meaning and pronunciation. If the word appears in the text again, the chances that the student will retrieve it accurately and more quickly are better due to the stronger connections between orthography, phonology, and meaning.

Lexical Processing

The lexicon refers to an individual's vocabulary, including both words and their meanings. If a word is not in a reader's lexicon, she must rely on the other processing units to formulate a meaning for the word. Consider the word **covalent** in our example: **In a covalent bond between two different elements, such as oxygen and hydrogen, the electronegativities of the atoms may be different**. If all other words in the sentence are in the reader's lexicon and the reader employs syntactic and conceptual processing units, she might infer what **covalent** means. If she has never seen the word in print before, her graphophonic processor may search for words, word pairs or triples, (i.e., **co**, **cov**, **ova**, **oval**, or **val**).

According to Seidenberg (1992), the system experiences errors because the different processors are not contributing the same information. Different types of information are being encoded simultaneously. If the word **covalent** is not in the system, then a word that is in the system, perhaps **coherent** or **covariant** may be generated.

The system retrieves a word that is the best fit across all of the information from the processors (Norris, 1998).

At times the author gives a meaning of a word. For example, the meaning of **cohesive** is given in the first sentence. **Water molecules have a very strong tendency to stick to each other; that is, they are cohesive**. In this example, the authors did not say they were defining a word. The reader had to use his knowledge of syntactic structures to identify that a meaning was being given. However, some students fail to recognize these subtle cues and do not become aware of the definition. In these cases, intervention strategies, such as a preparatory set, may facilitate learning to process these cues.

In CRS intervention, a preparatory set or cloze strategy may be used to help the reader retrieve the correct meaning of the word. The following is an example of preparatory sets and a cloze strategy to help students understand the meaning of covalent bonds and electronegativities. "Remember that all elements have electrons in their outer valence shells. And every element, such as oxygen or hydrogen, wants to have a filled ___ (valence shell) (cloze strategy). Right, a filled valence shell. Oxygen has 6 electrons in its ___. Right, its outer valence shell. And hydrogen has 1 electron in its ___. Right, in its outer valence shell. Water is made up of one oxygen and two hydrogens (Preparatory set). So the hydrogen loses its one ___ (electron), making it electron positive. But the oxygen gains one electron from each of the ___ (hydrogens). And we say the oxygen is ___ (electronegative). The electrons in the ___ (outer valence shell) determines what elements gets attracted to each other because of the ___ (electronegativities). So a

covalent bond is made up of ___ (elements) that have different ___ (electronegativities).

Syntactic Processing

Knowledge about syntax, or a sentence's structure, is necessary for the construction of meaning. Word order and word endings comprise syntax, which describes the acceptable combinations of elements in a sentence. In the above example, it is important that the reader understand that the type of molecules being discussed are water molecules and not some other type.

Relationships between phrases and clauses within a sentence also give the reader important information. Consider the above example. Two important pieces of information are given. First, a property of water molecules is that they stick to other water molecules. Second, the adjective used to describe this property is given (**cohesive**). If the reader had weak syntactic processing skills, she may have only understood one of those two pieces of information. The authors' use of the words **that is** signals to the reader that the information near the end of the sentence is another way of saying the information that was at the beginning of the sentence.

In CRS, it is sometimes necessary to ask graduated questions and parse or break complex sentences into smaller units to help students comprehend them. The facilitator may say, "Let's look at the beginning of the sentence and then we'll talk about the ending." (Pointing to the first clause), "Read what it says about water molecules." After the student reads the first clause, the facilitator may say, "So one property of water is what?" The student responds by saying "It is cohesive." The

facilitator then says, (pointing to the second clause), "And this is what that property is called. Read the sentence." The student reads the sentence. Then the facilitator says, "They just gave us the definition of a word. What is the definition of cohesive?"

The graduated questions and parsing strategy are utilized to help the student make connections within the text. If the facilitator did not point out that a definition was given, the student may not have made the connection. When the word **cohesive** appears in the text again, the student has a better chance of attaching meaning to it and connecting it with the characteristics of water molecules.

Conceptual Processing

The concepts in a biology course are mostly of an abstract nature. That is, they cannot be experienced perceptually but must be constructed from mental representations (Nelson, 1996). In the passage, the primary concept is that hydrogen bonds are responsible for the important properties of water molecules, such as cohesion and adhesion. The microscopic world of hydrogen bonds cannot be seen, but can only be explained and illustrated. Similarly, the concepts of cohesion and adhesion must be interpreted from their explanations.

A skilled reader will mentally identify the concept, link it to other related concepts or ideas, and organize the information into levels of conceptual subsystems. A less-skilled reader may fail to link the heading of this passage (**Hydrogen-bonding makes water cohesive and adhesive**) with the rest of the passage, and thus may miss identifying the primary concept of the passage. When this occurs, the CRS facilitator

may use the strategies of paraphrase or association to help the reader construct mental representations about the text.

After the student reads the heading, the facilitator may say, "Water is a very important molecule in nature because of its chemical properties. A hydrogen bond attaches two water molecules together. Hydrogen bonds between the water molecules are the reason for the cohesive and adhesive properties of water." This additional information combines the abstract and nonperceptual ideas of hydrogen bonds, water molecules, chemical properties, cohesion, and adhesion into an understandable concept.

The strategy of association also helps the reader link important ideas to one another. The facilitator discusses pertinent information that has previously been presented and links it to information currently being discussed. For example, the facilitator may ask, "What is the definition of a hydrogen bond?" By helping the student access this prior knowledge, the facilitator helps her create a connection between old and new information.

These connections help the student process textual information at a deeper level. The facilitator uses the whole system to accomplish this. Words are pointed to in the text (orthographic processing), meanings are discussed (lexical processing), known information is accessed (prior knowledge processing), and relations between elements are made (syntactic processing). The student gradually learns to coordinate all processes with the result being improved reading comprehension. Understanding of the text is attained as all available information is utilized.

Event and Discourse Structure Processing

Event structure refers to one's understanding of an event or routine, such as how to attend a college class (arrive on time, find a seat, take out notebook and pen, listen to the instructor). Discourse structure refers to how a narrative, story, or text is organized. Much research has been performed on narratives and non-expository texts, known as story grammars (Mandler & Johnson, 1977; Rummelhart, 1975). Story grammars involve the structure or organizational pattern of a story, including setting, initiating event, plan of action, response, and resolution.

The more children listen to and read stories, the more they are able to understand them because of their knowledge of event and discourse structures (Mandler & Johnson, 1977). These structures help organize meaning as the episodic structure of a text becomes more complex.

Those who study expository text structure also agree that knowledge of a text's format helps in comprehension (Kintsch & van Dijk, 1978; Meyer, 1984). According to Kintsch and van Dijk (1978), good readers integrate topic headers and identified topic sentences with paragraph structure to formulate the macrostructure, or gist, of a passage.

Meyer (1984) devised a classification system of expository text structures, including cause/effect, description, sequence, comparison/contrast, and problem/solution. Cause/effect is a text structure in which an event is described and one or more causes for that event is explained. Description is a text structure in which the attributes

or characteristics of an item (object, person, animal, event, etc.) are denoted. Sequence is a text structure in which a number of items are ordered and presented serially in a continuous progression as they relate to a particular topic or process. Comparison/contrast is a text structure in which the likenesses or differences between or among two or more items are denoted. Problem/solution is a text structure in which a problem is identified and one or more solutions are given.

According to Meyer, the relationships of the various expository structures are signaled to the reader by semantic and syntactic techniques. For example, the sequence structure is signaled by words such as **first**, and **then**, and the comparison structure is signaled by words such as **in contrast to**, and **like**. If signaling is not provided by the author, then the reader must infer an appropriate logical relationship among propositions.

In the passage from the biology textbook, the first sentence describes the effect (**Water molecules have a very strong tendency to stick together**) and the second sentence gives the cause (**This is due to the hydrogen bonds among the molecules.**) The words **this is due** signal to the reader that a cause is being explained. The third sentence tells another effect of the same cause (**Water molecules also stick to many other kinds of substances**), and is signaled by the word **also**. If a reader has poor discourse processing, it may be difficult for her to identify the cause and effects in this paragraph because they are not signaled by overt phrases. In CRS the facilitator may point to the specific sentences and say, "Here are two causes and here is an effect."

Prior Knowledge Processing

Authors, speakers and conversational partners assume that a certain amount of information is already known prior to discussing a topic. This is known as prior knowledge. The second paragraph of the passage assumes that the reader remembers information previously presented and links it to this new information. In the preceding section of the text was this passage:

> Water molecules are polar (Heading)
>
> Water molecules are polar, that is, one end of each molecule bears a partial positive charge and the other a partial negative charge. The water molecules in liquid water and in ice associate by hydrogen bonds. The hydrogen atom of one water molecule, with its partial positive charge, is attracted to the oxygen atom of a neighboring water molecule, with its partial negative charge, forming a hydrogen bond (Solomon, Berg, Martin, & Villee, 1996, p.38).

This passage explains how hydrogen bonds are formed. This information is imperative to understanding the cohesive and adhesive properties of water. The reader must identify that the information being discussed in the second paragraph of this passage is different from the information discussed in the first paragraph. The first paragraph discussed hydrogen bonds and how they cause cohesion and adhesion of water molecules. The second paragraph discussed what a polar covalent bond is. If the reader has not accessed or does not have prior knowledge about the chemical make-up of a water molecule (e. g., two hydrogen atoms and an oxygen atom), how hydrogen bonds are formed, and now what a covalent bond is, he will not be able to understand the passage

nor will he be able to understand why the second paragraph follows the first.

All of this previously discussed information is necessary for the reader to understand this passage. The reader's knowledge of covalent bonds helps him understand how hydrogen bonds are formed. In CRS after the student reads the first paragraph, the facilitator may give a preparatory set: "Covalent bonds are formed when the two hydrogen atoms are attracted to an oxygen atom, forming a molecule of water. Find out why this is important." This prior knowledge about covalent bonds helps the reader understand the important properties of water molecules as well as how hydrogen bonds come to be formed between water molecules.

Summary

Reading comprehension can be improved through the use of CRS, an integrated reading intervention approach that is consistent with the principles of connectionist networks. The many processes involved in reading are processed simultaneously, with each unit connected with all other units. Over time, information gets bundled together as information is processed. Poor readers have difficulty organizing and integrating the multiple units of information found within a text. The strategies used in CRS help the reader make necessary connections between and among processing units. At first, the facilitator makes the connections for the reader, then gradually reduces the amount of input to the reader until the reader coordinates and integrates information within the system on her own.

Social Mediation

Much of the way CRS instruction is presented is based on the work of Vygotsky (1978) who argued that social mediation plays a critical role in learning. Learning was conceptualized to be a social process where more knowledgeable or skilled individuals (e.g., teachers or more knowledgeable peers) guide less skilled individuals (e.g., children) in their formation of concepts and knowledge. This support enables the child to stimulate her thinking in new ways.

It has been demonstrated that input into the system is needed to establish and strengthen patterns of activation within a connectionist network (Seidenberg & McClelland, 1989). Input comes from the environment and from other units. In CRS intervention, this input is provided by the facilitator, a more proficient reader, who provides scaffolded assistance to the less proficient reader. The amount and type of scaffolding provided is determined by cues or indications that the reader is experiencing difficulty processing the text.

The facilitator determines, through miscues (i.e., words read incorrectly), pauses, and inappropriate phrasing, as well as answers of questions asked to the reader, what information to provide (see Appendix D). The facilitator may give information before the reader reads a portion of the text to activate prior knowledge (preparatory set). The facilitator may divide a sentence into clauses to give the reader the opportunity to understand information from a complex sentence (parsing). The facilitator may provide feedback to the reader after he has read a section to provide associations to other material or to expand on the information.

As the reader is given assistance from the facilitator, he learns to become a better, more independent reader and requires less assistance due to the combination of practice and input from the facilitator. Ideally, the knowledge he gains with this practice and input will help him construct meaning from other textbooks.

Summary

The complex nature of college expository prose presents difficulty for some college poor readers. A reading intervention approach, designed from a connectionist framework, helps readers integrate the multiple levels of processing needed to comprehend text. CRS is presented to less proficient readers through instruction in a socially-mediated context by more-proficient readers to assist them in meaningful reading. This study investigated the effectiveness of CRS on the reading performance of college poor readers using a freshmen-level science text.

End Notes

[1]Reprinted with permission of Saunders College Publishing Company. See Appendix H.

CHAPTER 2 LITERATURE REVIEW

Institutions of higher learning in the United States have been providing remedial (e.g., developmental), reading and learning assistance programs since the 1800's for high-risk students (Carpenter & Johnson, 1991). These students have been described as having poor entrance test scores, poor high school records, or poor records during their first term at college (Kulik, Kulik, & Shwalb, 1983). Learning assistance programs have been effective for some, but concerns remain regarding how to best provide instruction for these students.

Reading and study skills programs at the college level began in the nineteenth century with the development of land grant colleges, so named because the land in which the college was built was given by the federal government (Carpenter & Johnson, 1991). These colleges, which provided an agricultural education for underprepared students, instituted preparatory departments that offered courses in mathematics, reading, and writing because they could not find enough qualified students to attend them. During the twentieth century, many more programs grew and developed as underprepared students entered colleges as a result of World War II in the 1940's and 1950's and the admission of disadvantaged students in the 1960's and 1970's (Maxwell, 1979).

At the present time, what researchers are beginning to learn is how best to provide these underprepared students an appropriate remedial or developmental education such that they will achieve success in their academic careers. The purpose of this study was to investigate the efficacy of an integrated reading approach with college freshmen reading above their independent reading level. This literature review will discuss

what is currently known about college reading programs and students who have difficulty with comprehending and integrating complex reading material.

The chapter will begin with a discussion of college remedial reading programs and how these programs evaluate student success and failure. Next will be a discussion of college students with reading problems and what is expected in a typical college course. Areas of difficulty for readers, including prior knowledge and expository text structure, will be discussed as they relate to both college students and younger students. A summary of previous studies utilizing integrated reading approaches will conclude this chapter.

College Remedial Reading Programs

According to several nationwide surveys, most degree-granting institutions have some kind of program that provides learning assistance (Carpenter & Johnson, 1991). Sullivan (1980) surveyed 2,872 postsecondary institutions that offered at least an associate's degree and found that 50.6 percent operated at least one learning assistance program. More that 75 percent of the surveyed 4-year public institutions in the United States operate learning centers and 66 percent of all colleges and universities offer remedial or developmental reading courses, according to the National Center for Education Statistics (Wright, 1985).

Carpenter and Johnson (1991) identified four philosophical perspectives that influence the structure of remedial programs. They note, however, that each one is not completely distinct from the other, and most learning assistance programs that stress one theoretical

perspective recognize the need for additional services that may be more congruent with a different perspective. The counseling perspective takes the position that learning emerges through a heavy emphasis on personal counseling. Counseling proponents regard individual counseling and regular conferences with professional staff members as a way to help students break negative attitudes and emotional barriers toward learning. The administrative perspective facilitates students' academic growth by developing individualized programs for students based on results of pretests. Materials and center facilities are provided to assist students and progress is monitored periodically. The mechanistic perspective stresses the use of technology to help students achieve at the college level. Mechanistic programs utilize self-instruction via computer software programs that may include competency-based pretests and posttests in various skill areas. The basic skills perspective holds that deficiencies in the basic skills of reading, writing, and mathematics are the major contributors to academic difficulties. Proponents of this perspective argue that students should enroll in basic skills instruction and take part in tutoring in areas where they are having specific difficulty.

Because of the numerous philosophical influences on remedial reading programs, no two programs are identical. For example, some programs consist of classes that are structured similarly to other college classes and meet in regular classrooms, while others may be located in a designated lab or center where students visit individually or in small groups (Carpenter & Johnson, 1991). Despite the wide range of remedial models, developmental reading programs can be roughly

divided into three types: skills-based, simulation, and adjunct. The following is a discussion of these three types of programs.

Skills-Based

In many college developmental reading programs, the goal is to teach students specific reading comprehension skills that they have not yet mastered, such as recognizing the main idea (Stahl, Simpson, & Hayes, 1992). The skills-based approach to reading comprehension instruction is based on the diagnostic-prescriptive model (Stone, 1991). After students are given a reading pretest, their specific deficits are identified. Instructors then provide specific exercises to remediate those deficiencies.

Generally, reading workbooks designed to teach one discrete skill per unit are the main texts used in skills-based programs; however, supplemental materials are often used as well. Carpenter and Johnson (1991) described a program that teaches skills directly to a whole class using a range of materials, including commercial materials, magazine articles, students' regular course materials, and sustained silent reading. Dillard (1989) discussed a program in which students read and reported on material relating to their major and to works of fiction, and practiced skills such as test taking, vocabulary development, and reading rate.

Remedial reading instruction has been based on the premise that students will transfer skills to tasks in academic courses. Outcomes reported in studies of skills-based programs have demonstrated gains in reading speed and comprehension (Shaw & Shaw, 1987). However, critics have argued these gains are generally measured by improvement in answering comprehension questions that have been designed to test

specific strategies and have not measured actual generalization to academic courses.

The concerns regarding skills-based instruction have been expressed by many researchers (O'Hear, 1993; Stahl, Simpson, & Hayes, 1992; Stone, 1991). The primary criticism of this type of instruction is the lack of generalization (Stone, 1991). According to Stahl, Simpson, and Hayes (1992), many students successfully complete developmental reading courses by passing the teacher-made tests and doing well enough on the standardized tests to exit the program; however, they still are unable to function as independent learners in an academic environment. Whimby, Johnson, Williams, and Linden (as cited in Maxwell, 1995) claim that this is partly because developmental students, even after a semester of skills-based instruction, still are reading far below the grade 14 level required by college textbooks. Stahl and his associates argue that the teaching of isolated skills and strategies is not enough to teach students how to handle the complex nature of expository prose.

Simulation

The simulation reading program employs an actual course's tasks and texts; however, no grades are given and the emphasis is on learning specific reading, notetaking and study strategies (King, Stahl, & Brozo, 1984; Nist & Hynd, 1985). Videotaped lectures are shown in the semester-long course and teachers demonstrate appropriate classroom learning strategies, such as how to take notes and what to listen for during lectures. Students must purchase actual course materials and read the text as if they were enrolled in the course. Students take simulated examinations like those that would be encountered in the actual course.

The rationale behind this type of program is that transfer of knowledge and strategies occur when students have a chance to practice newly learned strategies on their own texts and in "simulated real" situations (Stahl, Simpson, & Hayes, 1992). Students do not have to worry about achieving a certain grade in addition to learning new reading and study strategies. When they take the course during a later semester, they will already have been exposed to course content, which then becomes prior knowledge, and they will have learned various strategies to help them with the course. It is also assumed that they will use their newly learned skills in other courses as well.

A limitation of the simulation experience is that, since the student only has to pass the simulated course, he may not be motivated to do as well as he possibly could. Another limitation is that it would be difficult to fashion examinations that are similar to actual examinations yet cover only the content information that was presented in the simulation course.

Adjunct

The third type of developmental reading program at the college level involves pairing the remedial reading course with a content course. In the adjunct model, students learn specific reading strategies, such as increasing reading efficiency, developing technical vocabulary, and preparing for exams, within the context of actual coursework. The content of the reading strategies instruction is paired with the content of an actual course students are taking for credit with the emphasis being on the direct application of skills to the content course.

One type of adjunct program that originated at the University of Missouri and has been adopted in many other states is Supplementary

Instruction (Blanc, DeBuhr, & Martin, 1983). In this program, learning center instructors or leaders conduct review sessions in which learning skills instruction is integrated with course content. The leaders attend the course lectures, take notes, and complete the readings. They schedule three or four supplementary instruction sessions per week to help students with reading, writing and thinking skills needed to understand course content.

Another type of adjunct program includes classes where reading and study skills labs are integrated with content area classes (Adams & Mikulecky, 1989; Balajthy, Bacon, & Hasby 1985). Usually the labs consist of computer instruction for the improvement of course vocabulary and reading comprehension. At the State University of New York in Genesco, Balajthy and others devised a program in which students who were enrolled in a developmental reading class and a biology class used their biology texts to develop lists of technical vocabulary words. Using a vocabulary drill software program, they wrote a brief definition and two sample sentences for each word. The students also utilized speed reading and comprehension drill software, programmed with text taken from their biology textbooks.

Adams and Mikulecky (1989) used computer software that was developed to help students comprehend what they read. The computer programs, which were related to a biology course and a psychology course, modeled such learning strategies as determining key concepts and comparing and contrasting key elements. The treatment group received three lessons while the control group received none. Results

indicated that, even after a week of no instruction, the treatment group outperformed the control group on the tested material.

Elliott and Fairbanks (1986) compared an adjunct reading instruction seminar that integrated lecture and text notes from a history course with a general reading instruction seminar that taught study habits. Both groups received instruction in developing technical vocabulary and increasing reading efficiency, with the adjunct group utilizing their history course materials. The first history exam served as the pretest while the third exam served as the posttest. The groups attended six sessions of instruction between the pretest and posttest. While there were no significant differences for the pretest, the adjunct group performed significantly better on the posttest than the general skills group.

Stone (1991) discussed an adjunct program that paired a remedial reading course with a required introductory course in sociology. The reading course consisted of teaching a study cycle comprised of predicting, confirming, and integrating. The instructor taught students to associate what they knew about a topic with what they didn't know and to identify new information from the text in order to integrate it with known information. Results of the study indicated that significantly more students passed the reading course than in previous semesters and 72.4% received a grade of C or better in the sociology course. Additionally, students made significant gains in the posttest reading evaluation as compared to the pretest evaluation.

Students at the University of Cincinnati who were enrolled in both the developmental reading program and an introductory psychology

course were placed in either a paired reading course or non-paired reading course (Bullock, Madden, & Harter, 1987). Students in the paired reading course received a different syllabus for the psychology course that included a description of the SQ3R study technique (Survey, Question, Read, Recite, Review) and time management information. The reading instructor attended all of the psychology lectures and took notes. The paired reading students in the remedial reading class used their psychology texts and notes to learn study strategies and vocabulary and to improve comprehension skills.

To determine differences between the two groups, the Degrees of Reading Power Test (College Board, 1983) and a student survey of reading questionnaire were administered to all subjects. Results of the reading test indicated that the paired students made significant improvement in their reading ability between the pre- and posttests, whereas the non-paired students did not. Results of the questionnaire indicated that more paired students' attitudes towards reading were positive as compared to non-paired students and that paired students rated their reading skills higher than the non-paired students.

Summary

Of the three types of reading programs, the adjunct course is currently regarded as the most effective. Lack of generalization to other areas is the main complaint of the skills-based program and the simulation experience does not motivate some students. Results of adjunct programs demonstrate a positive trend in reading comprehension instruction at the college level. Through assistance given to students, they are helped to understand associations and make inferences to

assimilate information into a coherent whole. It has been demonstrated that students immediately apply newly learned skills to authentic learning situations.

Program Evaluation Criteria

College reading programs use various standardized and nonstandardized measures to evaluate their effectiveness. Standardized measures include norm-referenced reading tests (e.g., the Nelson-Denny Reading Test), (Brown, Fishco, & Hanna, 1993) and criterion-referenced tests (e.g., the Degrees of Reading Power) (College Board, 1983), Nonstandardized measures include teacher-made objective and essay tests, grades from adjunct courses, and questionnaires (Stahl, Simpson, & Hayes, 1992). The following section describes some of the measures that have been used.

Standardized Measures

One of the most widely used evaluation measures in postsecondary institutions is the standardized reading test (Flippo, Hanes, & Cashen, 1991). It is usually used to determine those students who need remedial reading courses and to measure gains made during a semester of specific reading instruction.

The Nelson-Denny Reading Test (Brown, Fishco, & Hanna, 1993) is a norm-referenced test that yields grade level equivalencies. The timed test is comprised of two parts: vocabulary and comprehension. The vocabulary subtest consists of 80 vocabulary words, each with five choices and a time limit of 15 minutes. The comprehension subtest consists of seven reading passages and a total of 38 questions, each with five choices. The questions are of two types: literal and inferential. The

time limit for this section is 20 minutes, the first minute being used to determine reading rate. Norms can be obtained for the subtests individually or combined.

Most institutions favor mandatory over voluntary standardized tests to place students into developmental reading programs (Roueche, Baker, & Roueche, 1984). Many colleges require students who score below certain levels on various subtests of the American College Test (ACT) and Scholastic Aptitude Test (SAT) to enroll in developmental programs. After completing a developmental course, some students are retested in the area of the developmental course while others must complete all requirements of the developmental course to be able to enroll in credit-bearing courses.

Criterion-referenced tests, such as the Degrees of Reading Power (College Board, 1983), evaluate students' attempts to use context clues to obtain meaning from a passage and determine students' instructional level. The Degrees of Reading Power Test assesses students' ability to comprehend material written at sequential levels of reading difficulty. Passages are comprised of 325 words from which seven words have been deleted. Students must choose the correct deleted word from five possible alternatives using contextual clues.

Flippo, Hanes, and Cashen (1991) warn against the use of norm-referenced and criterion-referenced tests to assess achievement. They argue that students may do relatively well on these tests but still perform poorly in comprehension of course materials. A college textbook may be written at a much higher difficulty level than reading passages from the tests and involve much more material than a short test passage. Also,

students may have prior knowledge about some topics from the reading passages, but little or no prior knowledge relating to specific course material.

It should not be assumed, according to the researchers, that a grade equivalency score obtained on a test can be matched to a grade equivalency of a text as measured by a readability formula. It has been found that readability formulas overestimate the ability of high school seniors and college freshmen to comprehend material.

Nonstandardized Measures

A common method utilized to assess progress in college reading courses is students' adjunct course grades. Stone (1991) compared the distribution of sociology grades of underprepared students enrolled in the adjunct reading course with distributions of past semesters' sociology grades of underprepared students and found that significantly more students earned a grade of C or better the semester students were enrolled in the adjunct course.

Dimon (1988) reported that adjunct courses work because "they deliver what they promise in a quantifiable manner." In a comparison study spanning 12 college quarters, she found that a significantly higher percentage of grades above C were produced by students enrolled in adjunct courses, while a significantly higher percentage of grades below a C were produced by students not enrolled in adjunct courses.

Other ways researchers have assessed students' gains in college reading courses include teacher-made tests and questionnaires. Examples of teacher-made tests include literal and inferential questions (Voss & Silfies, 1996), questions relating to main ideas, details, and

vocabulary (Iovino, 1993; Spring & Prager, 1992), and questions relating to text structure (Zabrucky, 1990).

Some researchers tested overall effectiveness of treatment strategies by comparing experimental group students' written essays with those of a control group. Boyle and Peregoy (1991) scored essays on specifying main ideas and details, length of essays, and types and number of cohesive conjunctions used in the essays. They found significant differences in essay length and types and number of cohesive conjunctions used by the experimental group.

Questionnaires have been administered to determine students' opinions on adjunct courses. Adams and Mikulecky (1989) asked questions relating to usefulness of the program and desirability of use of the program. Bullock, Madden, and Harter (1987) gave students an informal survey and found that more students enrolled in an adjunct course gave positive responses concerning their reading characteristics than students in a non-adjunct course.

Summary

Wide variations in testing practices of developmental courses have been found. Many institutions use standardized reading assessments while others use results of subtests of the ACT or SAT. Still other institutions use their own criteria to determine program effectiveness. Critics argue the use of various evaluation measures because of the failure of some students to perform well in credit-bearing courses after successfully passing remedial reading course criteria such as standardized and non-standardized tests.

College Students with Reading Problems

A significant amount of research has been conducted regarding the cause of reading disorders in children. Although both word recognition (i.e., decoding) and text comprehension are necessary factors in the reading process, it is assumed that college students have achieved some success at decoding and instead have problems that are related to comprehension. While some researchers argue that young poor readers' problems are caused by phonological or auditory processing deficits (Adams, 1990; Catts, 1989), the thrust of this section is on theories relating to cognitive-linguistic deficits and is directed to individuals who are older and at a more advanced level of reading proficiency than those learning to read.

Researchers agree that remedial reading courses are a necessity at most universities; however, there is no general consensus regarding why this is so. In this section, several reasons will be offered. Some researchers suggest that college students have not reached Piaget's formal operational level of cognitive development and thus are unable to understand complex and abstract information (Blanc, DeBuhr, & Martin, 1983; Yellott, Dilks, Dick & Ware, 1985). Others suggest that high schools are not preparing students for the rigorous critical thinking that must occur at the college level (Henry, 1994). And still others suggest that students are unable to transfer strategy knowledge to novel situations (Stahl, Simpson, & Hayes, 1992; Zabrucky, 1990).

Piaget's Formal Operational Stage

Blanc, DeBuhr, and Martin (1983) argue that some students have not attained reasoning skills at the formal operational level described by

Piaget (1958) and have difficulty processing unfamiliar information when it is presented through the abstract media of lecture and text. According to Piaget, the formal operational stage generally begins around age 11 and is fully achieved by age 15. Adolescents who have reached this stage are able to reason about abstract ideas and concepts. They can understand symbols and information that may not have counterparts in the real world (Berk, 1989).

In addressing developmental changes that occur beyond childhood, Moshman (1998) argued that even college students have difficulty with logical reasoning tasks. This is because a variety of conditional relations must be thought of and coordinated, including propositions that may be true or untrue, and implications for possible conditional results. Moshman concluded that this type of reasoning is a late-developing form of thinking, occurring over the course of adolescence.

Most lectures and college texts employ abstract concepts, each of which is comprised of smaller concepts, requiring students to synthesize material from the complex backwards to the simple and from the abstract to the concrete. Because many developmental students may still be operating on a concrete level, an abstract concept may disrupt mental homeostasis and cause confusion and apprehension (Yellott, Dilks, Dick, & Ware 1985). Since much information at the college level contains abstract concepts and ideas, considerable amounts of material remain beyond the grasp of these students.

High School Preparation

The mere existence of college learning assistance programs indicates to some observers that high schools are not preparing all of

their graduates for the intense, independent learning required in college. Some critics of the United States educational system have theorized that the system is to blame for turning out so many underprepared students (Henry, 1994). According to Grant (1993) many underprepared students emerge from high school programs that have emphasized information acquisition in the form of rote memorization and answers to questions beginning with who, what, where, and when.

One of the areas in which secondary schools may be failing to prepare their students is vocabulary instruction. Students requiring learning assistance often have weak vocabularies and poor strategies for coping with unknown words (Flippo, Hanes & Cashen, 1991; Simpson & Dwyer, 1991). Verbal scores of the SAT and ACT, as well as scores from both the vocabulary and comprehension sections of the Nelson Denny Reading Test, indicate that many students have difficulty with vocabulary (Flippo et al., 1991).

The subject matter of many college courses includes discipline-specific and technical vocabulary. If a student has a good, overall general receptive vocabulary, it is likely he will be able to learn the new, technical and content-specific vocabulary efficiently (Simpson & Dwyer, 1991). However, if he does not have basic vocabulary and concepts from which to build knowledge, he will have a difficult time learning new, content-specific vocabulary.

Okolo (1990) cited the proliferation of television and video watching as well as the teaching of grammar as opposed to discourse analysis as a cause of students' difficulty with reading and composing. As linguists have shifted their attention from grammatical competence in

the 1960's and 70's with Chomsky's transformational grammar to communicative competence in the 80's and 90's with theorists such as Halliday, Hasan, van Dijk, de Beaugrande, and Brown, linguistic relationships have extended beyond the sentence level. Okolo suggested that middle- and high school teachers spend time instructing students how to read and compose cohesive texts so that they will learn to organize their thoughts and comprehend texts better.

Strategy Use

Researchers of learning disabled children have categorized those with reading problems as being inactive, inefficient or passive learners (Jenkins, Heliotis, Haynes, & Beck, 1986; Swanson, 1989; Torgessen, 1977; Wong, 1980). According to Torgessen's conceptualization, learning disabled children do not participate actively in their own learning. Inactive learners lack a general awareness of their cognitive processes and the demands of a task.

According to Jenkins et al. (1986), passive learners have difficulty focusing and sustaining attention during reading tasks. They do not spontaneously select, implement and self-monitor effective strategies for reading and other tasks (Swanson, 1989). Self monitoring activities include checking, planning, revising, and evaluating during an academic task. When competent readers' attention drifts during reading, comprehension suffers and attention generally gets refocused so that the text is comprehended. When learning disabled poor readers' attention drifts, according to Jenkins et al., these students are less likely to notice and subsequently take any corrective action.

Swanson (1989) discussed the importance of teaching strategies to learning disabled poor comprehenders to improve academic performance. These students require help to increase awareness of their own cognitive processes (i.e., metacognition). The teacher provides hints, clues and examples to encourage students to ask themselves questions or organize their thoughts.

Because of problems these children have coordinating multiple pieces of information, their problem solving approach is generally not integrated. They must be taught to identify multiple components of a task and shown how to coordinate all information to successfully solve a problem.

In addition to problems accessing appropriate strategies, some research suggests that these students may be constrained in their inability to use strategies in a flexible manner (Blachowicz, 1994; Holmes, 1985; Swanson, 1989). Some students with reading and other academic problems fixate on a particular topic early in their reading and do not use clues across the text to modify their initial impression (Blachowicz, 1994). These students tend to answer all questions from their own knowledge base, rather than using text information. When answering questions, some poor readers select one or two words from the question, perhaps ones they can decode easily, and invent the rest of the question; the end result being responses that are inappropriate and off-base (Holmes, 1985). Swanson (1989) concluded that this inefficient strategy use appears to be related to the students' preferred use of heuristics because their ability to choose from many strategies lacks flexibility.

Squire (as cited in Nelson, 1988) found that adolescents with reading problems had difficulty grasping implications of details and making correct inferences when interpreting short stories. He postulated that it was the students' familiar and stereotyped patterns of thinking and their lack of flexibility that led them to make incorrect conclusions about the stories.

Like some learning disabled students, lower ability readers at the college level have difficulty evaluating their understanding of text material (Zabrucky, 1990). These young adults tend to be overly confident of their understanding of what they read and tend to ignore signals of comprehension failure, including unfamiliar words, poor background knowledge, and inconsistencies within the discourse. In a study of college students reading passages with inconsistencies, Zabrucky found that poor readers frequently rated their understanding of passages as high regardless of whether or not they detected inconsistencies.

Strategy use among college freshmen has been studied. Stahl, Simpson, and Hayes (1992) recognized that college students must be able to control and regulate strategies to be effective independent learners by planning, monitoring and evaluating their own learning. However, studies indicate that these are the skills that poor college readers are not able to reliably perform (Grant, 1993). Grant argued that students are limited in their reading comprehension ability because they haven't learned how to use text processing strategies to synthesize information needed to understand concepts presented in course lectures.

Summary

While most researchers agree that many college students are unable to meet the challenges encountered in an academic institution, there is little agreement to the cause. A review of the literature points to students who have not reached Piaget's formal operational stage, high schools that aren't preparing students adequately, and students who cannot generalize learned strategies to novel situations.

Requirements of a College Course

If college reading programs are to serve the needs of college students with poor reading skills, it is necessary to know what the demands of a typical undergraduate course are. Unfortunately, there has been little research pertaining to actual requirements of particular college courses. Carson, Chase, Gibson, and Hargrove (1992) surveyed the literacy demands of an entry level American history course by attending course lectures, interviewing and surveying students and instructors, and completing course reading assignments. A summary of their findings is presented.

Table 2 - 1 shows a summary of literacy tasks expected. In the area of reading, it was found that students needed to organize, synthesize, and retrieve information from their readings, which were comprised of several texts, study guides, handouts from class, and maps. Additionally, students were required to place events and/or persons in the appropriate historical context as well as to retain facts as to their significance in history. They were also expected to relate old information to new information through their notes and other reading materials.

Table 2 - 1
Literacy Task Analysis for American History Course (Carson et al. 1992)

Area	Expectation
Reading Volume	Read 825 pages during course
	Read approximately 80 pages per week
Organization/Integration	Organize details to support concepts
	Organize information from multiple sources
	Determine essential from nonessential information
Vocabulary	Identify new vocabulary words
	Use context clues to determine meaning
	Use dictionary to clarify meaning
Factual Information	Retain pertinent facts
Text Structure	Understand and integrate graphic cues with written information
	Identify discourse structure (chronological, cause/effect, etc.)

Vocabulary acquisition strategies were needed, as access to text content depended on their knowledge of difficult words, such as **tariff** and **agrarian**. Words were not always defined in their text so they needed to utilize dictionary skills as well as recognize when the use of the dictionary was warranted.

Weekly amounts of reading averaged 80 pages, although the actual assignments varied considerably depending on the instructor and the topic being covered. However, readings were assigned in large increments. Texts exhibited organization that was primarily chronological and topical, with graphic cues (e.g., headings and marginal notes), maps, photos and illustrations. Examinations required integration of all course material with questions presented in an objective form.

Areas of Difficulty

Investigators have studied many aspects of reading comprehension difficulties. Aspects of expository comprehension that have been studied include prior knowledge and text structure. In this section, a review of these cognitive-linguistic aspects of comprehension will be discussed.

Prior Knowledge

It has been well documented that comprehension of a text is better if something is known about the subject (Anderson, 1985; Bransford & Johnson, 1972; Perfetti, 1985). In studies comparing children's reading comprehension of familiar and unfamiliar topics, subjects recall more information and answer more questions correctly after reading passages on familiar topics.

Poor readers depend on schema-based strategies to read, like good readers, but if they lack background knowledge about a topic they will have difficulty comprehending new elements within the text. The more one knows, the more one is able to read (Perfetti, 1985). As poor readers get older, the gap between their background knowledge and good readers' background knowledge widens due to poorer reading abilities.

Consequently, they may fall farther and farther behind their peers in reading and academic achievement (Stanovich, 1986).

There also is evidence that poor readers do not use schema appropriately or are unaware of whether the information they are reading is consistent with their existing knowledge (Bransford, 1985; Swanson, 1989). Swanson (1989) argued that poor readers had poor strategies in accessing knowledge and integrating it with what they were reading.

Wong (1980) showed that second and sixth grade learning disabled students improved comprehension and retention of implied information when given a question or prompt, demonstrating that these students had the abilities to infer and comprehend, yet were not able to do so spontaneously. Wong referred to this as a production deficiency. The students performed significantly poorer when asked to generate constructive inferences when given sentences with implied consequences. The students' better recall of sentences with cues indicated that they were capable of recalling the consequences. Their failure to recall sentences without cues to access or retrieve what they knew indicated a lack of coordination of old and new information.

Expository Text Structure

Not only do readers use schema for comprehension of a text's concepts, but many researchers agree that schema for expository text structure is necessary for comprehension of the text (Baker, 1985; Grant, 1993; Hiebert, Englert, & Brennan, 1983; Holmes, 1985; Kintsch & van Dijk, 1978; McNamara & Kintsch, 1996; Meyer, 1984; Meyer, Brandt & Bluth, 1980; Roller, 1990; Taylor & Samuels, 1983; Winograd, 1984). Text structure specifies the interrelationships among items that make up

the text, as well as indicating the subordination and coordination of this information (Meyer, 1984; Roller, 1990). In this section, research relating to expository text structure and differences between good and poor readers' use of text structure will be discussed.

Text Structure Awareness

Evidence for the importance of text structure awareness comes from studies demonstrating that instruction about text structure can improve comprehension and recall. One approach to increasing awareness of text structure is to teach students to organize ideas in the text. Berkowitz (1986) had sixth-graders construct maps to identify topics and relationships among them. After a six week instructional program, she found that students who used the map-construction strategy scored significantly higher on an immediate free-recall passage than students who used a map-study (i.e., looked at maps from their textbook), question-answering, or re-reading strategy.

Ambruster, Anderson, and Ostertag (1987) gave fifth graders instruction on recognizing and summarizing a problem/solution text structure and found that they performed better than students in a question-answer group on written summaries and a main idea essay question. In a similar study, Slater (1985) taught ninth graders to use structural organizers, including worksheets designed to help students identify type of text structure (e.g., problem/solution, cause/effect). Students were instructed to read the passage then complete the worksheets. Results indicated that students using the organizers performed better than students who read the passage and took notes on both written recall summaries and multiple choice tests.

Another approach used to increase text structure awareness is to teach students to use headings, subheadings, and paragraph structure as cues to the organization of the passage. Taylor and Beach (1984) taught seventh graders a hierarchical summary procedure. After they were instructed to make an outline of the key ideas in the passage, they generated a main statement and supporting details for each. After seven weeks of instruction and practice, students in the hierarchical summarization group performed better than a question-answer group and a control group on a free recall measure of unfamiliar material.

Garjia and Salvia (1992) taught five summarization rules to learning disabled middle school students. After the students achieved individual mastery of each of the rules, performance was measured. Findings indicated that the learning disabled students significantly improved in their ability to answer condensation questions (assessing comprehension of main ideas, cause and effect relationships, concepts, and inferences) and factual questions (assessing explicitly stated facts).

A third approach to increasing text structure awareness is to provide explicit instruction in a particular genre of expository text. Brooks and Dansereau (1983) identified a structural schema of the text organization for a scientific text. They had college students memorize the schema and organize their text notes according to the schema. After the students practiced on three passages over a two week period, they were instructed to use the schema in a test situation. Results showed that the students in the experimental group performed significantly better than students in a control group who received training in test taking skills and concentration on a free recall measure.

Differences Among School-Age Readers

Able readers approach text with schema about how texts are organized and have strategies to use text structure to comprehend material (Meyer, Brandt, & Bluth, 1980; Winograd, 1984). Poor readers, conversely, approach text without appropriate schema of the text's organization and have fewer effective strategies for using structure as an aid to comprehension. Winograd (1984) found that poor readers' written summaries of expository passages included more sentences from the beginning of paragraphs whether they were pertinent to the topic or not, as compared to good readers who synthesized the ideas of the passages into appropriate summaries. This lack of flexibility in the use of structure contributes to poor readers' decreased ability to comprehend the author's message. A number of investigations have examined the effects of text structure on good and poor readers' comprehension of passages (Baker, 1985; Hiebert, Englert, & Brennan, 1983; Meyer, Brandt, & Bluth, 1980). A discussion of some of the research follows.

Meyer, Brandt, and Bluth (1980) investigated ninth graders' use of a reading strategy that focused on following the organizational structure of text to determine what was important to remember. It was hypothesized that good readers would use a strategy of comprehension that followed the text's superordinate relational structure. These readers would look for the author's main point of the passage and patterns that tied together propositions contained in the text. It was hypothesized that poor readers would follow a list strategy, in which there would be no identification of a superordinate relation. They would merely list descriptions about the passage with no attempt to interrelate them.

Three groups of students, divided according to reading performance, were given two passages to read and then were instructed to write down all they could recall from the passages immediately after they read them and again one week later. Each student read one passage with signaling and the other passage without signaling. In the with-signaling version, the top-level structure was explicitly stated. The text type was a problem/solution, so the first sentence began with: **A problem of vital concern is**. Then three solutions were identified with underlined words: **solution, first, second, third**. In the without-signaling version, all underlined words were deleted so that relationships of the problem with the solutions were no longer explicit.

The findings supported the hypotheses. Most good readers used a top-level structure for organizing their written recalls, while most poor readers did not. Also, students who used this strategy recalled significantly more information from the passage, including major and minor details, than those who did not both immediately after reading it and one week later. For the poor readers, the with-signaling passage increased their recall on the immediate free recall test but not one week later. It is possible that poor readers need to be taught text structure and given opportunities to practice utilizing it as opposed to being exposed to it once or twice.

Differences Among College Readers

Much research on expository text structure monitoring has been conducted with elementary and secondary school children. However, others have investigated college students' use of awareness of text structure (Baker, 1985; Dee-Lucas & Larkin, 1988; Hiebert, Englert, &

Brennan, 1983; Zabrucky, 1990). The assumption that mature or older readers are proficient at comprehending expository text has been disputed and findings indicate that some adults do, in fact, have difficulty with elements of structure and general comprehension (Baker, 1985).

Hiebert et al. (1983) examined undergraduate education majors' sensitivity to four types of text structures: description, sequence, enumeration, and comparison-contrast. The researchers added the enumeration category to Meyer's (1984) text classification system because they found that many college content area textbooks included this type of structure. Enumeration is a text structure in which a series of points that relate to a specific topic are presented. Students were given two stimulus sentences and then were asked to rate statements according to their compatibility with the stimulus sentence. Four sentences followed each pair of stimulus sentences. Two of the sentences extended the ideas introduced in the first two sentences and were consistent with the original text structure. The remaining two sentences were distractors that retained some of the characteristics related to the topic in the original topic sentence, but introduced information not strongly compatible with the dominant text structure.

Findings indicated that knowledge of text structure appeared to facilitate students' performance. Although high ability students made more correct identifications of text structure targets and intrusive information (distractors) than low ability students, they performed significantly better at identifying the distractors than the targets. Of the types of text structure in which the two ability groups differed, high ability students were better in identifying enumeration and

comparison/contrast text structures than the low ability students. No significant differences were found in the groups' ability to detect sequence and description text structures.

In a study investigating the differences between high and low ability college students' identification of internal inconsistencies within text structure, Baker (1985) found that low ability students failed to identify problems within a text more often and gave fewer reasons why an item was identified as inconsistent. However, low ability students performed as well as high ability students when they were given specific instructions about the exact nature of the problems and examples of each type.

In the study, college freshmen were divided into two groups based on their SAT-Verbal scores. Those whose scores fell below 420 were placed in the low ability group and those whose scores fell above 580 were placed in the high ability group. Subjects were assigned to either a general instruction group or a specific instruction group. Reading passages were taken from college-level textbooks with topics not likely to be known or encountered by college freshmen. Students were asked to identify anything that might be confusing or that people might have trouble understanding and then explain why. Students in the specific instruction condition were given further information.

The explanations given by the students as to why words, phrases or sentences were confusing differed according to ability. The low ability students identified problems as having structural incohesiveness less often than the high ability students. Structural incohesiveness referred to one or more sentences in a paragraph that did not fit with the

topic sentence. Low ability students identified lexical inconsistencies (not knowing if an item was really a word, or not knowing a word's meaning) most often. This suggested that these students may be less sensitive to text structure than high ability students or that low ability students focus on other aspects of the reading process, such as word meanings. Low ability students identified fewer statements as being incomplete as compared to high ability students. This suggested that high ability students, but not low ability students, may be able to synthesize material in a passage and determine if enough information was given.

Identifying comprehension failure is an important part of the reading process. Zabrucky (1990), like Baker (1985), found that poor readers were less likely to detect inconsistencies in passages consisting of three paragraphs each even when informed that something was wrong with the passages. In some of the passages, the final sentence was changed to contradict the sentence immediately preceding it. Students who scored higher on standardized measures of reading comprehension were more likely to detect errors than those scoring lower on the standardized measures.

Because students are not forewarned about textual inconsistencies, Zabrucky pointed out that poor readers will have difficulty reading actual college texts, especially if the texts are not cohesive. Zabrucky's argument was that many beginning college students fail to understand text and usually cannot explain why or what is troublesome to them in the text. This causes students to miss important information or to misunderstand elements in the text.

Dee-Lucas and Larkin (1988) demonstrated that the way a sentence was written affected novice learners but not expert learners. Novice learners were defined as beginning-level physics students, in their first semester of college-level physics. Experts were defined as upper-level physics students, having more than three semesters of physics courses. The novices judged sentences presented as a definition as more important than sentences containing the same information but presented as a fact. For example the sentence **Specific gravity is defined as the ratio of a substance to the density of water** was judged to be more important than the sentence **Specific gravity is indicated by the ratio of the density of a substance to the density of water**. Sentences presented as facts were judged unimportant to novices but not to experts.

Experts did not judge sentence importance on the basis of the word **defined**, but rather according to content of the sentence. The experts' knowledge of physics helped them to look deeper than the surface structure of the sentence and determine importance based on content. Novices, however, were not able to draw upon background knowledge and thus judged importance by surface structure. The researchers argued that novices develop rules specifying what categories of information are important (e g., the category of definitions). Novices look for easily recognizable information regardless of the content.

Summary

Results from these studies on readers' ability to comprehend expository text demonstrate that good and poor readers differ in many ways. It appears that good readers have more strategies to choose from, have more flexibility in choosing strategies, use more complex strategies,

are better able to identify elements that do not belong within a particular passage, and are better able to use text structure to synthesize the material. It was shown, however, that poor readers' performance did not differ significantly from good readers when tested immediately after reading the text if they were given specific instructions along with examples on identifying text inconsistencies or given text that contained signaling (i.e., structure was explicitly stated) (Baker, 1985; Meyer, Brandt, & Bluth, 1980).

These findings might lead one to conclude that explicit instruction or explicitly structured text will lead to improved comprehension. While this may be true at times, it has not always been demonstrated. In the Meyer, Brandt, and Bluth (1980) study, the poor readers who read the text with signaling did not match the good readers' scores on the free recall test one week later, indicating that these students may need more than a signal to help them in their long-term comprehension. The previous studies focused on text comprehension measures that tapped into a person's schema for text structure only. The following section describes studies that were undertaken to determine what effects a combination of text structure awareness and prior knowledge would have on readers comprehension.

Text Structure Awareness and Prior Knowledge

Researchers have argued that readers use prior knowledge as well as awareness of text structure to process information during reading (Carr, Dewitz, & Patberg, 1983; Risko & Alvarez, 1986). Many studies have been undertaken that manipulate both variables to investigate the

relationship between the two types of approaches and to assess the specific role each plays in learning.

Carr, Dewitz, and Patberg (1983) theorized that readers of expository text use both background knowledge and text structure knowledge to construct meaning and that readers do not always spontaneously draw inferences from text. They investigated two inference training procedures with above and below average sixth graders' reading of a social studies text: one which combined background knowledge and text structure knowledge, and the other which only addressed text structure knowledge. The combination group was given a structured overview to help them access background knowledge and a cloze procedure that taught text structure.

Overall findings were inconclusive as to which procedure was better at helping children draw inferences. In some of the unit posttesting measures and transfer tests, the text structure group outperformed the combination group, while in others the combination group outperformed the text structure only group. However when the two experimental groups were compared to a control group that participated in supplemental readings and map skills, performance was found to be better in the experimental groups, indicating that teaching inferencing of expository text was useful.

Another finding of the study was that the below average readers performed better if they were administered the combination procedure. Comparing the results of the three unit posttests and transfer tests for the below average readers with the above average readers, the performance of the below average readers reached the level of the above average

readers by the third posttest and continued on the delayed transfer test. Below average readers may have more to learn in terms of inferencing or it may take below average readers longer to learn this strategy. It should be noted that the text utilized for the study was the students' actual social studies text that was written at a level that was above the below-average readers' reading level. It appears that poor readers need much support to help them read their texts. It may be necessary to combine a background knowledge-building type of instruction with text structure instruction for these readers to improve expository text inferencing ability.

In a related study, Risko and Alvarez (1986) used thematic organizers to help middle school poor readers improve comprehension and recall of social studies passages. The thematic organizers were designed to activate background knowledge and addressed organization and structure of the reading passage. The group who received thematic organizer instruction outperformed the group who received prereading questions along with a class discussion of prior knowledge on literal and inferential tests and retellings. Either the background knowledge was not activated in the class discussion or the class discussion did not contain enough structure to help poor readers learn new information. These results suggest poor readers need not only the background knowledge, but also a way to organize information so that new information can be assimilated.

In a study that investigated fourth graders' ability to answer literal comprehension questions and write summaries of expository text passages, results indicated that the group who received a schema-building strategy outperformed the group who received a structure

building strategy on the third and fourth tests but not on the first two (Spires, Gallini, & Riggsbee, 1992). This suggests that students might need a considerable amount of time to learn the strategy and use it effectively. Findings also indicated that training students on one type of structure did not facilitate comprehension of another type of structure with this age group. Students who learned a problem/solution type of discourse did not improve their ability to read and comprehend a comparison/contrast type of discourse until after they were given specific training in that text structure. It could be that students of this age have little experience reading expository text and haven't learned to generalize to the other types of texts without prior instruction.

Summary

Results of these studies indicate the importance of teaching children to use both background knowledge and text structure knowledge to understand expository text. Each factor is necessary in processing information during reading. These studies showed that children who have reading comprehension problems not only should be taught a combination of the two factors but also given adequate practice in reading with a combination of both background knowledge-building and text structure instruction. It is also important to teach young children specific types of text structure and for them to practice reading various types.

Textual Characteristics

Kintsch and his associates (McNamara & Kintsch, 1996; Voss & Silfies, 1996) examined textual characteristics to explore the relationship between background knowledge and text organization. McNamara and

Kintsch (1996) proposed that the driving factors to learning from text are prior knowledge about the topic and the building of a coherent situation model. The coherent situation model is generated from the text's microstructure and macrostructure, which is at least partially constructed by the reader's text structure knowledge. Links must be activated between the situation model that the reader has built and his prior knowledge for learning to occur. Based on the work of van Dijk and Kintsch (1983), the way a text is processed relates to the use of strategies. The reader utilizes his knowledge of grapheme identification, morphology, syntax, semantics, pragmatics and social and cultural information to form a cognitive model of the discourse's meaning. These strategies are flexible and operate at several levels simultaneously.

When individuals begin to read a text, attempts are made to form a macrostructure immediately to aid comprehension. An idea of the gist may be formed after reading the title, heading or first sentence of the paragraph. Prior knowledge strategies bring to mind the schema of the topic. At the same time, knowledge of text structure is used to assign an overall organization to the text. As the text is read, strategies that help to explain relations among words, clauses, and sentences are used. Ideas about the text's individual words or phrases are formed by bringing to mind the general topical information already known. If the discourse type is unfamiliar, that knowledge is used to help organize the text.

McNamara and Kintsch examined how characteristics of a text and characteristics of readers affect comprehension. They undertook two experiments, differing only in type of measurement, that tested the interactive effects of world knowledge and text coherence, or the extent

to which a reader is able to understand the relations between ideas in the text. They theorized that low-knowledge readers would benefit from reading a coherent text but high-knowledge readers would benefit from reading a less-coherent text. If a reader did not have sufficient background knowledge, then he would need the text structure to be organized such that it made the inferences for him. However, if a reader had adequate background knowledge, then the text should have gaps so that he could draw his own conclusions and inferences from what he already knew.

In both studies, undergraduates were divided into four groups: one group read a low-coherence text (relations between ideas were not explicit) and were provided with a short lesson about the topic; the second group read a low-coherence text and were not provided with any pretraining material; the third group read a high-coherence text (relations between ideas were explicit) and were provided the lesson; and the fourth group read a high-coherence text and were not provided the lesson. Prior to reading the texts but after reading the lesson, all subjects were given a prior knowledge questionnaire about the topic, further dividing subjects into high- and low-knowledge subjects. In the first study, the measurements were reading rate and a multiple choice recall test. In the second study, the measurements were reading rate and open-ended questions.

On the multiple choice test, results indicated that subjects who read the high-coherence text had better recall than subjects who read the low-coherence text, regardless of prior knowledge. However, on the

open-ended question test, performance depended on whether or not the subjects had prior knowledge.

For those subjects who were given no pretraining, the prediction of the researchers were confirmed for the open-ended questions. Low knowledge readers performed better with a high coherence text than with a low coherence text and high knowledge readers performed better with a low coherence text that with a high coherence text. The readers prior knowledge about the topic, not the textual organization, allowed them to answer the questions correctly.

High knowledge subjects who received the pretraining performed better than high-knowledge subjects who did not receive the pretraining. It appeared that if a reader already had prior knowledge about the topic, the pretraining helped, possibly by giving a priming effect, according to McNamara and Kintsch. The pretraining had an effect in activating whatever knowledge the subjects already possessed, so that it may have been used to understand the texts they read regardless of the text coherence. Low-knowledge subjects who were given the pretraining, on the other hand, did not perform any better than the low-knowledge subjects without pretraining on the open-ended questions. These effects suggested that the way the pretraining was presented was not effective in teaching new knowledge.

The researchers explained that differences between the multiple choice and open-ended questions occurred because multiple choice questions presented all of the information to the reader so that the reader merely needed to recognize the answer. With no prior knowledge, the reader needed a high-coherence text.

The multiple choice questions consisted of text-based questions and bridging inference questions. Text-based questions were those for which the question and answer appeared in a single sentence. Bridging inference questions were those for which the question and answer appeared in separate sentences. Open-ended questions consisted of the same types of questions as in the first experiment (text-based and bridging inference), but no choices were presented to the subjects. The researchers argued that correctly answering the open-ended questions meant that the subjects had and used their prior knowledge about the topic. With prior knowledge, subjects were better able to make inferences. Thus the subjects had a situation model level of understanding that was deeper than the text-based level.

The results of this study indicated that prior knowledge is needed for a deeper level of textual understanding and without prior knowledge, a text must be cohesive. It has already been discussed that low ability readers have less overall background knowledge than high ability readers. For these low ability readers, it is imperative to give them as much background information as possible and/or provide cohesive texts.

Voss and Silfies (1996) found similar results to McNamara and Kintsch (1996) when they tested Kintsch's (1988) theory that subject-matter knowledge is primarily related to situation-model development. College students who had background knowledge relating to history were better able to answer inferential questions after reading an unexpanded text (not containing causal factors relating to events leading to a military conflict) as compared to reading an expanded text. However, background knowledge made no difference when students

answered literal recall questions. No differences were found between students with background knowledge and students without background knowledge on the number of correct responses to literal recall questions.

Three points must be addressed regarding the work of Kintsch and his colleagues. First, it should not be assumed that all multiple choice questions rely on text-based understanding. Some multiple choice questions are completely inferential and require elaboration or evaluation of information not stated in the text. A deeper, more integrated level of understanding is often necessary to answer questions that include the correct answer in the choices (Carson, Chase, Gibson, & Hargrove, 1992).

The second point involves pretraining in the McNamara and Kintsch (1996) study. The pretraining consisted of a booklet with a map of the area being discussed and a brief text describing the elements on the map and events during the Vietnam war. (The experimental text described the war during an earlier period.) The complexity and amount of text was not discussed. The information may not have been adequate to be of help in generating inferences for some of the experimental subjects. As was demonstrated in the Risko and Alvarez (1986) study, some students may need more than what was presented to have it be of assistance. It may have been difficult for some of the students to read and comprehend the pretraining booklet due to poor reading skills, and/or lack of background knowledge. Also, information about the text's cohesion was not given so it is not known if those students who had little background knowledge would have benefited from a more highly structured text.

The third point is that the reading ability of the subjects was not taken into account. No information was provided about the students in the study except that they were all enrolled in an introductory psychology course. In other studies comparing good and poor readers, differences were found between those two groups regarding effects of text cohesion, pretraining, and background knowledge. Based on past work (Meyer, Brandt, & Bluth, 1980), it is assumed that poor readers would perform better on all measures after reading the high coherence text, regardless of prior knowledge, because the explicitly-stated structure would improve their recall.

Summary

Although there are limitations to these studies, the issues addressed regarding a situation model of reading comprehension point to the distinction made between a literal understanding of the text and an integrated understanding of not only the elements in the text, but also synthesized data that have been combined with prior knowledge. What is important in achieving a situation model of understanding is background knowledge about a topic and text cohesion. The less background knowledge readers have, the more coherent the text should be. The need for individuals to use background knowledge in constructing meaning depends on the information in the text.

When the information is not expanded or explicitly stated, there is a greater need for the reader to access and use background knowledge so that he can make inferences and have a more complete understanding of the text. When the text is expanded, there is less of a need to utilize

background knowledge in the process of understanding because more information about the topic has been made explicit.

Social Mediation

Recent research in instructional pedagogy has recognized the influence of social factors within the learning environment. This trend is evident in teaching approaches that emphasize collaborative learning, peer tutoring, and discovery learning (Stone & Reid, 1994) and stems from the work of Lev Vygotsky (1978), who argued that children internalize new information after collaborating with others in a meaningful interaction.

Underlying each of these approaches is a method for maximizing student learning known as scaffolded instruction (Wertsch, 1979; Wood, Bruner, & Ross, 1976). Scaffolding is used by mothers when teaching their young children. The adult, teacher, or one who is more knowledgeable, provides the scaffold and assists the student in tasks that he is unable to complete independently (Winn, 1994). The term, scaffold, is used because of its adjustable and temporary nature (Palinscar, 1986). As the student is able to perform more of the task on his own, the adult provides less assistance until the student is able to perform the task independently.

Scaffolding may be carried out in different ways. The adult or facilitator may provide a piece or pieces of information for the student that helps the student understand the task. Another way is for the facilitator to segment the task into smaller, clearer steps. In both instances, the adult anticipates what the student is lacking and provides it.

Supporting Research

Several studies have demonstrated the effects of scaffolded instruction on children. This section reports the findings of several studies involving the use of scaffolded instruction.

College students who tutored first grade poor readers in dyads were effective in scaffolding reading and writing for the children (Juel, 1996). Tutors helped children identify words, discuss word meanings, and sound out words twice a week for a school year. The more scaffolded interchanges the children were provided, the better they performed on the end-of-year Iowa reading and listening comprehension subtests.

Palinscar and her associates examined the effects of scaffolded instruction with middle school students (Palinscar, 1987; Palinscar & Brown, 1984). In their reciprocal teaching studies, teachers initially provided explanation coupled with modeling. The responsibility for learning gradually shifted to the learners as they were able to participate more in their own active and productive thinking. Modeling was faded out as emphasis was placed on providing feedback, encouragement, and self-evaluation. For example, the teacher may have talked about his approach to learning specific information and modeled what he was thinking. He would then summarize his understanding of the information, making predictions and raising questions as he went along.

The reciprocal teaching procedure was compared with three other interventions: modeling only, skills practice, and a combination of reciprocal teaching and skills combined. Only the reciprocal teaching

procedure resulted in significant gains in reading comprehension for the students.

An instructional approach known as POSSE (Predict, Organize, Search, Summarize, Evaluate) (Englert, Tarrant, Mariage, & Oxer, 1994) was compared with another instructional intervention known as K-W-L (what we know, what we want to find out, what we learned and still need to learn). In POSSE, students learned how to apply different reading strategies, such as predicting, organizing, summarizing, and evaluating text in the context of a dialogic interaction with a teacher and their peers. Using the principles that knowledge is socially constructed and social interactions foster learning, the researchers trained teachers in the POSSE group to carry out this approach in the eight week reading study.

The K-W-L approach was similar to the POSSE approach in that it included strategies for predicting, summarizing, and evaluating text. However, the two approaches differed in the way teachers and students interacted during reading. In the K-W-L approach, teachers, rather than students, asked the questions and confirmed or elaborated upon answers. Dialogue was unidirectional, from teacher to student, and was controlled by the teacher. Students were not encouraged to think out loud or to synthesize information in a conversation or dialogue with either the teacher or other students.

Subjects were first to eighth grade students identified as learning disabled, emotionally disturbed or mildly mentally retarded. Results indicated that the POSSE treatment was more effective than K-W-L on students' comprehension and material remembered. The POSSE group recalled significantly more ideas and chunks of information in both

instructed passages and posttest passages than the K-W-L group. Students in the POSSE group also displayed a greater knowledge of strategies than students in the K-W-L group.

This study demonstrates the importance of using social mediation as an underlying principle in instruction. POSSE and K-W-L both taught similar information. Yet one stressed active participation while the other one did not. Students in the POSSE group were encouraged to talk with one another and to the teacher in a dialogue whereas students in the K-W-L only talked to the teacher when called upon. The POSSE students' use of language and dialogue helped improve comprehension and discourse abilities.

The researchers identified the importance of using instructional scaffolds to help students in the POSSE group to comprehend and synthesize material. By guiding students' interactions, teachers helped them to work out comprehension problems and monitor their learning.

Summary

Current reading research has focused on the social aspects of reading instruction. Students improve their comprehension of instructed and new information through scaffolded instruction. Scaffolding has been shown to be an effective component in the socially mediated process of reading.

Implications for Instruction

Students who have been given instruction using social mediation have shown improvements in their generalization of strategies, summarization of main ideas, and hierarchically synthesizing new and old information (Englert, Tarrant, Mariage, & Oxer, 1994; Tierney,

1983). When using social mediation, instructors must be knowledgeable of several items.

First, the teacher or more-abled peer has the responsibility of carefully selecting the learning tasks. Tasks must be within students' zone of proximal development (ZPD) (Vygotsky, 1978), or ones that they are not yet able to complete on their own but are able to accomplish with assistance (Winn, 1994). Tasks must highlight critical features that students need to learn and the teacher must be able to guide the student in the learning of the task.

The scaffold is the second important point of which the instructor must be cognizant. It is up to the teacher to determine how much or how little support is needed for each particular student. To determine comprehension, questions may be asked of students, miscues may be counted, or a cloze procedure may be used (Stone & Reid, 1994). Scaffolds may then be adjusted according to how much or how little help the student may require with a particular aspect of the text.

A third point that must be considered is explicitness (Tierney, 1983). Teachers must point out to students relations in the text and specific strategies that can be used to make inferences and integrate elements within the text. Two ways to help students with this is the use of a think-aloud strategy (Tierney, 1983) and preparatory sets (Afflerbach, 1987; Johnston & Afflerbach, 1985). In a think-aloud strategy, the teacher may explain the relations between elements to the student in a way that sounds like she is thinking out loud. In a preparatory set, the teacher gives a general explanation of what the passage is about before the student begins to read a passage. This

enables the student to access appropriate background knowledge and link old information to new information.

Mulcahy (1987) offered several suggestions for assisting college students in the understanding of expository text. First, instructors can use scaffolded interchanges between students, asking questions that guide construction of appropriate expository text schemata and helping them use their background knowledge to verify information in the text. Second, instructors can help students construct outlines and cognitive maps that indicate text structure and arrangement of textual elements. Third, instructors can help readers make inferences by having students elaborate on ideas and helping them to connect textual information.

Summary

These items provide important information that will help students to be guided and supported in their efforts to acquire skills and knowledge. Through appropriate socially mediated interchanges, teachers guide students in the meaning-making process. While the lesson is important, the needs of the students must take precedent if learning is to occur.

Communicative Reading Strategies

CRS is an approach to reading intervention that addresses the complexities of the reading process. It is designed to aid the reader in organizing textual elements into a cohesive whole. Elements of text that may need to be organized for the reader include prior knowledge activation, text structure, and linguistic complexity. CRS is presented in a socially mediated environment where a more-abled individual guides the reader through the text, helping him with difficult aspects of text.

Past Studies Using Communicative Reading Strategies

The efficacy of this approach has been studied with individuals of various ages. Badon (1993) and Michaelson (1995) used first graders in their studies while Reichmuth (1996) used adults enrolled in a basic education program. This section will discuss findings from these studies.

In a single-subject, alternating treatment study with first grade poor readers, subjects received an hour of CRS instruction for five days (Badon, 1993). This approach was compared with a directed reading condition. Although not all subjects reached significance, findings indicated a trend in favor of the CRS intervention. Rereading under the CRS condition produced fewer miscues and an increased reading rate. Also, more story grammar components and episodes, longer retellings, and fewer mazes were observed in the CRS condition.

Michaelson (1995) studied the effects of CRS on first graders' word recognition, reading rate, and comprehension abilities on standardized and non-standardized tests immediately following treatment and four and nine months post intervention. She found significant gains were made for all three areas immediately following intervention on both standardized and informal reading measures. Results of the delayed tests indicated that, although they were not significant, gains were made for the treatment group, providing support for the effectiveness of an integrated approach in the absence of direct instruction.

Reichmuth (1996) used CRS with adults who performed below fifth grade reading levels in a 40 hour treatment program. While not all subjects achieved significance, it was found that three subjects increased comprehension approximately two grade levels, four subjects increased

at least one grade level in instructional reading level, and three subjects showed an increase in the number of words read per minute. When CRS instruction was compared to a skills-based instruction, results indicated that subjects in the CRS group scored better than subjects in the control group in the areas of word recognition and comprehension.

In the studies that have been conducted utilizing CRS instruction, reading and comprehending narrative prose was examined. In addition, all of the subjects had been identified as reading on a fifth grade reading level or below. This study investigated the efficacy of CRS on college freshmen who were reading above their ability level. The specific questions addressed were (a) will college freshmen reading above their independent reading level demonstrate significant improvement in reading comprehension of a biology text after receiving CRS instruction compared with skills-based instruction, and (b) will college freshmen reading above their independent reading level improve comprehension of other expository texts as a result of CRS instruction?

CHAPTER 3 METHOD

A pretest-posttest control group design (Hegde, 1994) was employed to investigate the effects of CRS on the reading comprehension abilities of college freshmen reading text above their independent reading levels. Experimental subjects received eight weeks of CRS instruction, while control subjects received eight weeks of skill-based comprehension instruction. Treatment efficacy was assessed through comparison of group pretest-posttest scores. Dependent measures of reading included a) reading grade level equivalency scores, b) literal comprehension, c) inferential comprehension, and d) total comprehension. Additionally, changes in the reading performance of the subjects over time were evaluated.

Subjects

Subjects for this study were 8 undergraduates recruited from five sections of a freshmen biology course. Participants were chosen from a pool of 33 students who volunteered to participate in the study. The following criteria were used to select participants. The 8 final subjects included those who:

1. Were between 18 and 20 years of age;
2. Spoke English as the native language;
3. Obtained a score of below 21 on the Reading portion of the American College Test (ACT) or below 450 on the Verbal portion of the Scholastic Aptitude Test (SAT);
4. Enrolled in Biology 1230 (BIOL 1230) at Xavier University of Louisiana (XULA);
5. Had normal vision and hearing;

6. Scored below a twelfth grade (12.0) level on the reading comprehension portion of the Nelson-Denny Reading Test (NDRT) Form G (Brown, Fishco, & Hanna, 1993)

Criteria Rationale

Some students attending their first year of college have difficulty adjusting to the rigors of academic life, especially in the area of reading comprehension (Adams & Mikulecky, 1989). To control for approximate life experiences and work experiences, participants were limited to college freshmen between 18 and 20 years of age. Upperclassmen taking the course, or those returning to school following a career or extensive work experience, were excluded.

Students who score below 21 on the Reading portion of the ACT or below 450 on the Verbal portion of the SAT may be at risk for experiencing reading difficulties at the college level. Studies show that the ACT has a strong correlation to college grade point average (GPA) (Anastasi, 1976; Bontekoe, 1992; Rowan, 1978). Students whose composite scores on the ACT are between 16 and 20 have been found to attain a GPA of 2.25- 2.30 (Bontekoe, 1992). If they do not fail or drop out of college, students whose composite scores on the ACT are lower than 16, attain a GPA of 1.9 and below (Bontekoe, 1992; Kaiser & Hawes, 1987).

BIOL 1230, a freshmen Biology course at XULA, was selected as the literacy intervention target course based on the following. 1). It is the first course required for all Xavier freshmen who are majoring in the sciences, 2). It has high undergraduate enrollment, 3) The course places strong emphasis on textbook reading and examination questions

are predominantly inferential. 4) Introductory science courses have between 30 and 40% failure rates (R. Atkinson, personal communication, September 1, 1998; Fulginiti, 1998).

Readability for the textbook that was used in the BIOL 1230 course was 14.0, based on the Fry readability formula (Fry, 1977). Readability levels are computed on sentence and word length only, with the assumption that reading difficulty is influenced by the length and grammatical complexity of sentences, and the number of syllables per word. Students who scored below a twelfth grade level on the NDRT were likely to experience difficulties comprehending their biology textbook (Brown, 1976).

The NDRT is a standardized reading test that provides assessment of student ability in three areas: vocabulary, reading comprehension, and reading rate. It was used to establish the reading comprehension level of subjects because it is normed for populations older than 16 years of age and for reading above twelfth grade. This test was used to establish a baseline reading level for each subject on an individually administered test, and to identify those students who would have difficulty reading their biology texts based on test predictions. A number of educational institutions, including community colleges, law enforcement training academies, and universities, have successfully used the NDRT as a screening instrument and as a predictor of academic success (Brown, Fishco, & Hanna, 1993).

Subject Selection

The study was conducted at Xavier University of Louisiana (XULA), where the researcher was on the faculty in the communications

department. XULA is a historically black, Catholic university, comprised of approximately 2800 undergraduate students, with approximately half majoring in the sciences. Potential subjects were drawn from two sources at XULA. The Academic Support Programs office informed students who were on academic probation and were enrolled in BIOL 1230 or who requested help in BIOL 1230 about the study. Students who gave their names and phone numbers at the office were contacted by the Researcher. In addition, instructors from the five BIOL 1230 sections read a letter to their classes of approximately 50 students each notifying them of the study (see Appendix A) and inviting them to contact their instructor if they wanted to participate. The researcher then contacted these students and set up a time to meet.

At the initial meeting, the researcher informed the students of the nature of and reason for the study. All potential subjects were asked to sign the consent forms to participate in the study (Appendix B) and to release their ACT or SAT scores from the admissions office (Appendix C). Per the consent statement, all subjects were free to withdraw at any time by stating their desire to discontinue their participation.

A total of 33 students volunteered for the study. Of those students, 6 had ACT or SAT scores that were too high; 7 had NDRT scores that were above grade 12.0; and 8 either could not be contacted or did not attend the initial interview. A total of 12 students began the study.

Two CRS groups and two skills groups were formed and class schedules were used to identify potential times for group intervention

sessions. Randomization was attempted based on ACT scores; however, it was not possible due to subjects' availability for group meetings.

Of these 12 students, 4 students from the CRS group and 4 from the control group completed the eight weeks of instruction and posttesting. Student attrition occurred for the following reasons. a) It was discovered that one student had only spoken English for two years; b) Two students dropped the biology course; c) One student withdrew from the study after three weeks of instruction. The attrition rate was 25%. Only data for the subjects who completed the posttesting were reported and analyzed.

Students were encouraged to attend all sessions; however, no requirement was made for attendance. The total number of hours of instruction for each group was 24 hours. The mean number of hours students in the CRS group attended instruction was 15.75 and the mean number of hours for students in the control group was 17.5.

Subject Description

Eight second semester college freshmen, including 4 CRS and 4 control subjects, participated in the study. Seven subjects were African-American; one subject was Caucasian. Seven subjects were female; one subject was male. Table 3-1 reflects the characteristics of the subjects and the pretreatment assessment performance for CRS and control groups. The means for subject age, semester in college, and scores from the Reading portion of the ACT and Reading Comprehension portion of the NDRT also are included. Two-tailed *t* tests revealed no significant differences between the groups on any measure prior to treatment.

Table 3-1
Age, Semester in College, and Achievement Characteristics of CRS and Control Subjects

Subject	Age	Semester in College	ACT Reading Subtest	NDRT Grade Level
		CRS		
1	18	2	19	7.1
2	18	2	15	9.3
3	18	2	20	10.1
4	18	2	20	10.9
M =	18	2	18.5	9.4
		Control		
1	19	2	20	10.1
2	18	2	16	4.5
3	18	2	20	10.1
4	19	2	16	9.3
M =	18.5	2	18	8.5

Note. ACT = American College Test; NDRT = Reading Comprehension portion of the Nelson-Denny Reading Test, Form G; M = mean.

Procedures

All testing and intervention sessions were conducted in an office on the campus at the subjects' university. Data, including weekly probes, were obtained during group sessions, collected by the researcher. CRS and control group sessions were randomly video- or audio recorded to provide a measure of intervention reliability. Procedures specific to the assessment, probe, and intervention phases of the study are detailed below.

Pretest-Posttest Assessment

In addition to determining eligibility for inclusion in the study, reading performance on the Reading Comprehension portion of the NDRT provided the scores for evaluating group treatment effects. Two forms of the NDRT, Forms G and H, were used at pretest and posttest, respectively. Four scores, comprised of grade level equivalency, literal questions correct, inferential questions correct, and total questions correct, were obtained. The grade level equivalency score was obtained by converting the raw score (i.e., the correct number of responses given by the student in a 20 minute time period) to a grade level equivalency score, in accord with standardized test procedures.

A modification of the NDRT was used because it has been found that timed tests are not appropriate for determining true reading abilities of lower achieving students (Kerstiens, 1986). After the twenty minute standard administration, students were then allowed to finish all remaining items on the test with no time limits. Number of literal responses correct, inferential responses correct, and total responses correct were computed. A literal response was one in which the answer

was given in the text. An inferential response was one in which the answer was not given in the text, requiring some background information on the part of the reader. Total responses were the sum of of literal and inferential responses.

Probes

Eight weekly probes were obtained from all subjects to measure patterns of change occurring during the course of intervention. Probes were administered at the beginning of every fourth hour of treatment and consisted of reading passages of 200 to 250 words. Passages were combined from two biology textbooks that were not being used in the students' course. Students were told to read the passages carefully because they would be given a quiz afterwards. They were allowed to take as much time as they needed to read the passages and answer the questions. After the subjects read the passage, they were given a comprehension test consisting of six questions. All subjects received the same probe, in the same order to allow for cross-subject comparisons. Subjects were not allowed to reread the passage once they began the comprehension questions nor were they allowed to request assistance with unknown words.

Intervention

Reading intervention was provided for both CRS and control subjects. Different instructional conditions were in place for each group. Similarities between the two interventions were as follows: each group was provided three hours per week of instruction; each group always had the choice of coming at two different times; and, content for each group came from students' course textbooks and workbooks. Students brought

their textbooks to intervention or were provided with copies of the text. It should be noted that during the course of the study, subjects could, at any time, attend biology tutoring sessions provided by upperclassmen, attend study skills workshops provided by the counseling center, join study groups for biology, and attend help sessions prior to biology exams provided by biology course instructors.

CRS Instruction

Intervention was provided to CRS subjects in two groups. Subjects were assigned to the groups based on their class and work schedules at the university. However, subjects were allowed to attend either CRS group at any time. Sessions lasted for one hour and met three times each week. Instruction was provided by the researcher who is a certified speech-language pathologist with over nineteen years of experience providing language and reading intervention.

Communicative Reading Strategies (CRS) (Norris, 1988; 1989; 1991; 1998; Norris & Hoffman, 1993) served as the reading approach for the CRS group. As an interactive approach to reading intervention, CRS provides assistive strategies to help the reader organize the many aspects of the text into a coherent whole. The instructor served as a facilitator between the author and the readers to help the readers understand the text. The following procedures were used by the facilitator (Norris, 1989).

Before the subjects read the text, the facilitator provided a preparatory set for the readers in order to help them access appropriate background knowledge and make interpretations about the text. The facilitator parsed many sentences for the readers due to the complex

nature of the sentences, and provided a preparatory set for each resultant segment. Parsing involves chunking the sentences into smaller units, such as phrases, to aid processing of the ideas within the sentence. See Appendix D for an example of a parsed sentence.

Following the preparatory set, subjects read the words out loud while the facilitator listened for any indications of difficulty or misunderstanding. Indicators included reading fluency and response to factual questions about the passage. The facilitator then gave feedback to the subjects. Feedback was determined by the way the text was read and the accuracy of responses to questions and clozes. If the text was read fluently and students answered factual questions correctly, the facilitator reacted by modeling inferences or providing explanations to link ideas together, associate old information with information just read, expand on the idea (expatiation), or generalize the ideas to similar situations. If the text was not read fluently or students did not answer factual questions correctly, the facilitator mentioned previously discussed related information, paraphrased the information, provided semantic cues, or parsed the sentence further. Examples are described in Appendix D.

If a student missed a session, material was not reviewed from the missed session. Students were reminded throughout the study that if they missed a session, they were to read the missed material on their own prior to coming to the next session.

Skills Instruction

As with the CRS instruction, intervention was provided to skills subjects in two groups. Subjects were assigned to the groups based on

their class and work schedules at the university. However, subjects were allowed to attend either skills group at any time. Sessions lasted for one hour and met three times each week. Instruction was provided by the same researcher who provided CRS instruction.

Skills instruction consisted of lessons from a college reading book along with exercises from the students' biology textbook developed by the instructor to accompany the lessons. Each week a new lesson was introduced, including two lessons on inferencing during weeks 7 and 8. The focus assured that the skills group was exposed to inferencing at a level comparable to the CRS group.

The format for the skills instruction was as follows. At the beginning of the first hour, the lesson from the reading book was given to students. It consisted of a discussion of the topic and exercises relating to the topic for the students to complete. After the researcher provided a brief overview of the week's topic, students worked by themselves for approximately 40 minutes. Then the instructor gave them worksheets that consisted of applying the lesson to reading passages in their textbooks. Students worked for the next 10 minutes on these, then the instructor checked their work. The instructor explained students' errors to them. At the beginning of the next two sessions for the week, the instructor reminded students of the week's topic and gave a 5 minute review. After that, students continued to complete worksheets that related the lesson to the same textbook chapter as the CRS subjects for approximately 40 minutes. During the last 15 minutes of the hour, the instructor checked work and discussed errors.

If a student missed a session, she would be given the instruction from the point where she missed. If work was not completed by the end of the week, the student was given the worksheets to take home and complete.

Materials

Materials used during the study consisted of the NDRT, college-level biology textbooks, a freshmen-level biology workbook, and a college-level reading book. Materials specific to the pretest and posttest, weekly probes, and each condition are detailed below.

Pretest/Posttest

The material used for the pretest and posttest was the Reading Comprehension subtest of the NDRT. It contains seven reading passages and a total of 38 questions, each with five possible answers. The time limit is 20 minutes. Each reading passage and questions relating to that passage are presented on one or two pages. Students were instructed in writing to go on to the next page after they completed the questions for each reading passage. A separate form, containing the item number and the five choices (i.e., either A through E or F through J), was provided for the students to mark their answers.

Probe Stimuli

Expository passages from two Biology textbooks were combined into 200 to 250 word passages used as probes conducted during the intervention. Passage topics were always related to the topic discussed in treatment and in class during the previous week; however they were never actually discussed nor seen by the students prior to their administration. Six comprehension questions followed each passage.

(See Appendix E for an example of a passage and comprehension questions.) The first three questions, numbers one, two and three, were multiple choice and required literal (factual) recall. The next two questions, numbers four and five, required inferential interpretation of the text. Question number four required inferential interpretation of information within a sentence or paragraph, while question number five required inferential interpretation of information within the entire passage. The last question, number six, required background knowledge that was related to the passage but was not included in the passage. Because the students' textbook was found to be at a readability level of 14.0, the reading level for the passages and questions was also at a readability level of 14.0 (Fry, 1977).

CRS Stimuli

Expository text from the students' Biology textbook, Biology (Solomon, Berg, Martin, & Villee, 1996) and course workbook, Basic Principles of Biology Workbook (Flickinger, Hunter, & Labat, 1978), served as stimuli for the CRS condition. The workbook, developed by biology department faculty, was divided into 12 units or modules and covered the lessons for the entire course. Each module included the following: learning goals; reading assignments ranging from 20 to 50 pages; 5 to 10 pages of homework that consisted of identifying terms, giving definitions, explanations and descriptions for key concepts, and 15 to 30 multiple choice or fill-in sample test questions. Some modules contained supplemental readings that students were required to know.

The textbook structure, which specifies the interrelationships among parts of information in the text, varied among different types as

identified by Meyer (1984), but primarily consisted of description. Other types of text structure included: cause/effect, sequence, comparison/contrast, and problem/solution. An example of a passage from the biology textbook is given in Appendix F.

Text presentation consisted of two 3 1/2 inch wide columns of text per page. Graphic design included the following. A 350 to 400 word general introduction began each chapter followed by a list of learning objectives. Headings and subheadings in bold type occurred every three to eight paragraphs. Figures, illustrations, tables and photographs occurred frequently throughout the text. Key terms were highlighted in bold type within the text and were listed at the end of each chapter along with review and critical thinking questions and a short bibliography.

The text contained information of an erudite nature, derived from academic knowledge. Concepts were abstract and many words, although familiar, had meanings that were technical and referred specifically to biological concepts (i.e., **polar**, **tension**). Although the text was at 14th grade readability level (Fry, 1977), the technical meaning of approximately 2% of the words increased the difficulty considerably.

Information in the textbook built on information previously discussed in the book, although few references were made to the previously presented material. For example, the amphipathic property (having distinct hydrophilic and hydrophobic regions) of the phospholipid bilayer of the cell membrane, which was discussed on page 116 was, in part, due to something that was already explained, cohesion, which was discussed on page 39.

Additionally, the text required the reader to rely on prior knowledge. For example, an important concept in the chapter on biological membranes was compared to something most of the students did not know. On page 114, the phospholipid bilayer was referred to as a "fluid mosaic model because the proteins are embedded in the bilayer much like a mosaic picture." When the students in the study were asked what a mosaic picture or mosaic tile was, only two of them could explain.

Skills Stimuli

Stimuli for the skills intervention came from a college reading book, Reading Skills Handbook (Wiener & Bazerman, 1978)[2], the students' Biology textbook, Biology (Solomon, Berg, Martin, & Villee, 1996), and the students' workbook, Basic Principles of Biology Workbook (Flickinger, Hunter, & Labat, 1978). (See Appendix G for an example of a lesson.) Table 3-2 shows the reading comprehension subskills that were targeted each week. Instructional materials were designed such that the students were required to read a sentence or short passage and respond to questions by answering in a word, phrase, or sentence, or choosing the best multiple choice answer. Each passage from the subjects' textbook was from the same chapter as the CRS stimuli.

Measurements

Pretest and posttest reading comprehension measures were analyzed to determine whether CRS intervention positively influenced the reading comprehension abilities of college freshmen who were

reading text above their independent reading level. Data were analyzed to determine whether intervention was effective in a) increasing the

Table 3-2
Reading Comprehension Subskills Targeted by Week for Subjects in the Skills Intervention Group.

Week	Subskills
1	Building a Strong Vocabulary
2	Prefixes, Suffixes and Roots
3	Reading for the Main Idea
4	Reading for Information
5	Signal Words and Previewing
6	Comparison and Contrast
7	Making Inferences
8	Making Inferences

overall reading comprehension of college freshmen, and b) increasing the biology reading comprehension of college freshmen. The dependent variables for group comparison of reading performance included measures of grade level scores and weekly probe comprehension scores.

Comprehension Measures

Three different tasks were completed to obtain reading comprehension measures. To measure overall reading comprehension, subjects took the NDRT to obtain a grade level equivalency score and then answered all additional questions on the NDRT with no time limits

imposed. To measure biology reading comprehension, subjects answered weekly probe questions.

NDRT Questions

Subject's correct responses on the NDRT in the twenty minute time period were counted and a grade level equivalency score was obtained from their raw scores. Additionally, responses to all NDRT questions were analyzed and the total number of correct answers was calculated.

The following measures were also obtained for each subject: correct responses, correct literal responses, and correct inferential responses. Each form of the NDRT contained 38 total responses, 16 were literal and 22 were inferential.

Weekly Probe Questions

Point values for the six questions included in each probe ranged from 1 to 2 points, depending on question difficulty. The first three questions, comprised of literal (factual) information, were worth one point each. The next two questions, inferential, were worth two points each. The last question, background knowledge, was worth two points each. Subject responses could be awarded full or partial point value. For the first three responses, subjects were assigned a 1 if they chose the correct answer or a 0 if they chose an incorrect answer. For questions four, five and six, subjects were assigned a 2 if all parts of the question was answered correctly or if the main point was included, a 1 if only some part of the question was answered correctly or if the answer pertained to something that was related to the correct answer, and a 0 if no part of the question was answered correctly.

Reliability

Reliability was completed for comprehension measures. The researcher scored all NDRT and probe questions. A speech-language pathologist, with four years of experience, served as the second scorer to establish reliability for type of question on the NDRT and comprehension for probe questions.

NDRT

Determination of literal and inferential questions on the NDRT was made by adhering to the following definitions. A literal question is one in which the answer is directly found in the reading passage. An inferential question is one in which the answer cannot be directly found in the passage but must be deduced from the information that is given in the passage. The NDRT manual listed literal and inferential questions for Forms G and H.

To establish reliability, the primary researcher independently coded all test questions. There was a 96% agreement with the NDRT test manual for question type. Two questions on Form G and one question on Form H that were listed as literal questions were determined by the researcher to be inferential questions based on the definition of an inferential question. Ten percent of all NDRT questions, including the ones in question, were independently coded by a licensed and certified speech-language pathologist who was familiar with standardized reading tests and question types. Prior to categorizing the questions, the primary researcher discussed definitions for the question types. An agreement of 100% was obtained between the researcher and the speech-language pathologist for the NDRT question type.

Probe Stimuli

Ten percent of all probe questions were independently coded by a licensed and certified speech-language pathologist. Prior to this procedure, written and verbal instructions as well as examples of correct and incorrect responses, were provided to the speech-language pathologist. Interrater agreement of 92% was obtained between the researcher and the speech-language pathologist.

Intervention Procedures

To establish reliability of the CRS intervention used in the study, three randomly selected videorecorded sessions were viewed by a speech-language pathologist with an earned Ph. D. who was familiar with CRS intervention procedures. Interrater agreement of procedures was 95%.

Data Analysis

The data obtained on the dependent variables were subjected to the following analyses. Literal, inferential, and total comprehension abilities of expository text were obtained at pretest and posttest. The difference between gain scores for CRS and control groups on these measures were compared. Analyses of variance (ANOVAs) and analyses of covariance (ANCOVAs) were employed to determine whether the differences between gain scores for the two groups reached levels of significance.

To examine if there was a significant difference between CRS and control groups on measures of literal and inferential comprehension of science text over time, repeated measures ANOVAs were employed.

Finally, descriptive statistics were used to analyze patterns of change in the comprehension abilities of subjects across time.

End Notes

[2]Reprinted with permission of Houghton Mifflin Company. See Appendix H.

CHAPTER 4 RESULTS

The present study was undertaken to determine the efficacy of Communicative Reading Strategies (CRS) on the reading ability of college freshmen reading above their independent reading level. Two questions were posed by this study: (a) will college freshmen, reading above their independent reading level, demonstrate improved overall comprehension of college-level expository texts after receiving CRS instruction compared to skills instruction? and (b) will college freshmen, reading above their independent reading level, demonstrate significant improvement in reading comprehension of a biology text after receiving CRS instruction compared to skills instruction?

Measures of reading comprehension for expository texts were obtained at pretest and posttest. Weekly probes, conducted after approximately every three hours of instruction throughout the duration of the study, provided ongoing measures of biology reading comprehension. Data were analyzed for group changes.

Comprehension of Expository Text

The first question addressed whether college freshmen, reading above their independent reading level, would demonstrate improved overall comprehension of college-level expository texts after receiving CRS instruction compared to skills instruction. This question was examined by comparing experimental and comparison groups' performance on four measures from the Nelson-Denny Reading Test (NDRT) (Brown, Fishco, & Hanna, 1993).

Grade level equivalency scores on the NDRT were obtained by counting subjects' correct responses elicited within the twenty minute

time period allowed for the standardized administration of the test. Normative tables were then used to convert these totals to grade equivalency scores. In addition, students answered all questions with no time limits imposed to obtain the number of correct literal responses (answers were found in the text), inferential responses (answers were not found in the text and required some background information), and total responses (sum of literal and inferential responses).

Grade Level Equivalency Scores

The pretest and posttest grade level equivalency scores for CRS subjects and Skills group subjects are reported in Table 4-1. Individual performance and group means are shown. Gain scores, representing the amount of change between the pretest and posttest, are also reported for each subject and for the group mean.

Examination of this table revealed differences between the groups for comprehension gains. All four of the CRS subjects made at least one grade level increase in expository text comprehension ability. The resulting mean gain for this group was three grade levels ($\underline{M} = 3.2$). Only two subjects in the skills group made more than one grade level increase, whereas one subject remained at the same level and the other gained almost a grade level. The average gain for this group was less than two grade levels ($\underline{M} = 1.9$).

To evaluate the reliability of differences between the CRS and skills group, performance on the grade level equivalency scores were analyzed using a 2 (group) by 2 (time) analysis of variance (ANOVA). The summary of the ANOVA is presented in Table 4-2.

Table 4-1

Pretest and Posttest Comparison of CRS and Skills Groups for Grade Equivalency Scores Attained from the NDRT, Forms G and H, Respectively

CRS Group			
Subject	Pretest	Posttest	Gain
1	7.1	10.1	3.0
2	9.3	14.4	5.1
3	10.1	11.5	1.4
4	10.9	14.4	3.5
M=	9.4	12.6	3.2

Skills Group			
Subject	Pretest	Posttest	Gain Score
1	10.1	12.9	2.8
2	4.5	8.3	3.8
3	10.1	10.1	0
4	9.3	10.1	.8
M=	8.5	10.4	1.9

Note. NDRT = Nelson Denny Reading Test; CRS = Communicative Reading Strategies; M = mean.

Table 4-2
Summary Table for ANOVA on Grade Level Equivalency Scores from the NDRT at Pretest and Posttest for CRS and Skills Groups

Source	SS	df	MS	F
Within Cells	8.10	6	1.35	
Time	26.01	1	26.01	19.27**
Group x Time	1.96	1	1.96	1.45

Note. SS = Sum of squares; df = Degrees of freedom; MS = Mean squares; F = F ratio.
**$p < .01$

Results indicate that a significant effect for time was demonstrated: $F(1,6) = 19.27$, $p < .01$, suggesting that both groups improved over time. A significant effect was not observed, however, for the group by time interaction ($p > .05$), suggesting that although mean gains were higher for the CRS subjects, the differences were not statistically significant.

Responses from NDRT

The pretest and posttest correct literal, inferential, and total responses from the NDRT for CRS subjects and Skills subjects are reported in Tables 4-3, 4-4, and 4-5, respectively. Individual performance and group means and standard deviations are shown. Gain scores, representing the amount of change between the pretest and posttest, are also reported for each subject and for the group means.

Literal Responses

Examination of Table 4-3 revealed that no subjects in either group performed better on the posttest than on the pretest for comprehension of literal information. Two subjects from the CRS group and one subject from the skills group remained the same while two subjects in the CRS group and three subjects in the skills group showed decreases in literal comprehension.

The total number of literal responses a subject could have answered correctly on either the pretest or the posttest was sixteen. Two subjects from each group answered all sixteen questions correctly on the pretest, while on the posttest, only one subject from the CRS group answered all sixteen questions correctly. The CRS group's number of incorrect literal questions was similar to the skills group on the pretest (three for CRS and four for skills). However, on the posttest, the CRS group answered fewer literal questions incorrectly than the skills subjects. The CRS group answered five literal questions incorrectly while the skills group answered twelve literal questions incorrectly on the posttest, demonstrating a higher mean gain score for the CRS group. The CRS group's difference between the pretest and posttest was only -.5 points, while the skills group difference was -2 points, suggesting that skills subjects had greater difficulty than CRS subjects on comprehension of literal information.

Analysis of covariance (ANCOVA) was computed to determine literal comprehension group differences. Literal comprehension pretest responses served as covariates. Results showed no significant effect for

Table 4-3

Pretest and Posttest Comparison of CRS and Skills Groups for Correct Literal Comprehension Responses from NDRT, Forms G and H, Respectively

CRS Group			
Subject	Pretest	Posttest	Gain
1	16	15	-1
2	16	16	0
3	15	14	-1
4	14	14	0
M =	15.25 (.957)	14.75 (.957)	-.5
Skills Group			
Subject	Pretest	Posttest	Gain
1	16	11	-5
2	16	15	-1
3	14	14	0
4	14	12	-2
M =	15 (1.16)	13 (1.83)	-2

Note. Values enclosed in parentheses represent standard deviations. NDRT = Nelson Denny Reading Test; CRS = Communicative Reading Strategies; M = mean.

group: $F(1,5) = 1.75$, $p > .243$. This finding suggests that although mean gains were higher for the CRS group, the differences were not statistically significant.

Inferential Responses

Examination of Table 4-4 revealed that all four CRS subjects and three of the four subjects from the skills group made gains in inferential comprehension. Comparison of gains showed that three of the CRS subjects made gains of at least three points and one made a gain of one point ($M = 3.5$), whereas two of the skills subjects showed an increase of three points, one exhibited an increase of only one point, and one exhibited a decrease of three points ($M = 1.5$).

Analysis of covariance (ANCOVA) was computed to determine inferential comprehension group differences. Inferential comprehension pretest responses served as covariates. Results showed no significant effect for group: $F(1,5) = 2.98$, $p > .145$. This finding suggests that although mean gains were higher for the CRS group, the differences were not statistically significant.

Total Responses

Examination of Table 4-5 revealed that three of the CRS subjects made gains in total comprehension while only two of the skills subjects made gains in total comprehension. Further, the three CRS subjects who made gains demonstrated gains of at least three points while only one skills subject demonstrated a gain of at least three points. Two skills subjects made decreases while no CRS subjects made decreases. The CRS subject who did not make gains in total comprehension remained at the same level.

Table 4-4

Pretest and Posttest Comparison of CRS and Skills Groups for Correct Inferential Comprehension Responses from NDRT, Forms G and H, Respectively

CRS Group			
Subject	Pretest	Posttest	Gain
1	11	17	+6
2	16	20	+4
3	12	13	+1
4	15	18	+3
M =	13.5 (2.38)	17 (2.94)	+3.5
Skills Group			
Subject	Pretest	Posttest	Gain
1	16	13	-3
2	14	17	+3
3	12	17	+5
4	13	14	+1
M =	13.75 (1.71)	15.25 (2.06)	+1.5

Note. Values enclosed in parentheses represent standard deviations. NDRT = Nelson Denny Reading Test; CRS = Communicative Reading Strategies; M = mean.

Table 4-5

Pretest and Posttest Comparison of CRS and Skills Groups for Correct Total Comprehension Responses from NDRT, Forms G and H, Respectively

CRS Group			
Subject	Pretest	Posttest	Gain
1	27	32	+5
2	32	36	+4
3	27	27	+0
4	29	32	+3
M =	28.75 (2.63)	31.75 (3.68)	+3
Skills Group			
Subject	Pretest	Posttest	Gain
1	32	24	-8
2	30	32	+2
3	26	31	+5
4	27	26	-1
M =	28.75 (2.75)	28.25 (3.86)	-.5

Note. Values enclosed in parentheses represent standard deviations. NDRT = Nelson Denny Reading Test; CRS = Communicative Reading Strategies; M = mean.

No subject in either group made gains in both literal and inferential comprehension due to the decreases in the literal comprehension responses. However, all CRS subjects made gains in total comprehension, suggesting that CRS intervention was successful for improving inferential comprehension. Only two skills subjects made gains in total comprehension, while one subject (Subject 1) in that group decreased for both literal and inferential comprehension, suggesting that skills intervention was not successful for her.

Analysis of covariance (ANCOVA) was computed to determine total comprehension group differences. Total comprehension pretest responses served as covariates. Results approached a significant effect for group: $F(1,5) = 5.10$, $p > .073$. Although the differences were not statistically significant, there was a trend in the direction of CRS.

The lower performance on literal comprehension was investigated further to determine if differences could be attributed to the differences in prior knowledge for the two NDRT topics. Thirty students, not participating in the current study, were administered the questions from both forms of the NDRT without being given the opportunity to read the passages. Means, standard deviations, and t-value are reported in Table 4-6. No significant differences were found for the two test forms, $t(29) = 1.55$, $p > .133$. These results indicate that prior knowledge was not the primary factor contributing to group differences.

Summary

The results of the comparison of college freshmen reading above their independent reading level receiving CRS instruction compared to a

condition of skill-based comprehension instruction revealed increased comprehension of college-level expository texts for both treatment

Table 4-6
Means, Standard Deviations, and t-value for NDRT Form G and NDRT Form H Attained from Students Not Reading the Passages

NDRT Form	Mean	SD	t-value	df
Form G	14.133	5.270	-1.55	29
Form H	15.700	4.372		

Note. NDRT = Nelson-Denny Reading Test; SD = Standard Deviation; df = Degrees of freedom.

groups. Following eight weeks of instruction, more subjects in the CRS condition had shown gains, and the mean gain scores for the CRS condition were greater, but the differences were not statistically significant.

When types of questions from the pretest and posttest were analyzed, no significant differences were found for either instructional condition. Types of questions included literal and inferential. Following eight weeks of instruction, the trends in the data favored the CRS treatment. More of the CRS subjects showed gains in inferential comprehension (CRS: 4 subjects, skills: 3 subjects), and mean gains were higher (CRS: 3.5 points; skills: 1.5 points). When literal and inferential comprehension gains were combined, three of the CRS subjects evidenced gains while only two skills subjects demonstrated

gains. Again, greater gains were made for the CRS group than for the skills group in total (combined) questions (CRS: 3 points, skills: -.5 points).

Comprehension of Biology Text

The second question examined the effects of CRS instruction compared to skills-based instruction on reading comprehension ability of a biology text. Weekly probes were administered to all subjects after approximately every three hours of intervention. Each weekly probe consisted of six questions. The first three questions tested literal information while the last three questions tested inferential abilities.

Means and standard deviations of weekly literal and inferential probes are reported in Tables 4-7 and 4-9, respectively, for the CRS group and the skills group. The possible weekly literal probe mean for each group was 3 and the possible weekly inferential probe mean for each group was 6. The results of the weekly literal probes are discussed next. Following those results are the results of the weekly inferential probes.

Weekly Literal Probes

Examination of the weekly literal probe means in Table 4-7 revealed that the CRS group outperformed the skills group for six of the eight weeks (during weeks 1, 2, 3, 4, 5, and 8). The CRS group tied with the skills group during weeks 6 and 7 for the literal scores. The CRS group achieved scores above 2 (of a possible 3) from the first week of treatment, suggesting that CRS intervention produced immediate positive results. The similarity in scores for weeks six, seven, and eight suggest that both types of intervention were successful by this time;

however, the CRS intervention helped students improve their literal comprehension more quickly than the skills-based intervention.

Repeated measures analyses of variance (ANOVAs) were used to examine statistical differences between groups for the outcome measures of weekly literal comprehension. A 2 (group) x 8 (time) ANOVA was

Table 4-7
Means and Standard Deviations of Weekly Literal Scores for CRS and Skills Groups.

	CRS		Skills	
Week	Mean	SD	Mean	SD
1	2.75	.500	2.25	.957
2	2.25	.957	1.75	.957
3	2.0	1.155	.75	.957
4	2.25	.500	1.75	.500
5	2.0	.000	1.75	.500
6	2.75	.500	2.75	.500
7	2.25	.500	2.25	.957
8	2.25	.957	2.0	1.155

used to examine the literal comprehension scores. The sum of squares and mean squares for the literal comprehension scores are reported in Table 4-8. Overall difference between groups was not significant, $F(1,6) = 1.59$, $p > .254$. A significant effect for time on the literal comprehension weekly probes was obtained: $F(7,42) = 2.91$, $p < .02$,

indicating that both groups changed significantly over time. A nonsignificant group by time interaction was observed for the literal comprehension weekly probes: $F(7,42) = .68$, $p > .690$, indicating that although the CRS group outperformed the skills group, instruction in the CRS condition did not differ from instruction in the skills condition on comprehension of literal questions.

Table 4-8
Sum of Squares and Mean Squares of Literal Comprehension Scores for CRS and Skills Groups

Source	SS	df	MS	F ratio
Within Ss	9.97	6	1.66	
Group	2.64	1	2.64	1.59
Within Ss	19.78	42	.47	
Time	9.61	7	1.37	2.91*
G x T	2.23	7	.32	.68

Note. SS = Sum of squares; MS = Mean squares; Ss = Subjects; G x T = Group by Time.
*$p < .05$

Weekly Inferential Probes

Examination of the weekly inferential probe means and standard deviations in Table 4-9 revealed that the CRS group outperformed the skills group for seven of the eight weeks (during weeks 1, 3, 4, 5, 6, 7, and 8), suggesting that the CRS intervention was more successful than

the intervention of the skills group for improvement of inferential. The skills group outperformed the CRS group during week 2. After the first week of treatment, the CRS group outperformed the skills group by over 2 points, suggesting that the CRS intervention produced greater gains in fewer sessions than did the skills group's intervention.

Table 4-9
Means and Standard Deviations of Weekly Inferential Scores for CRS and Skills Groups

	CRS		Skills	
Week	Mean	SD	Mean	SD
1	4.5	1.291	1.25	1.258
2	3.5	.577	3.75	2.062
3	5.0	.816	4.0	1.414
4	4.75	.957	4.25	1.500
5	4.50	.577	3.75	.957
6	4.25	1.50	3.75	.957
7	4.25	1.258	1.50	1.291
8	5.25	1.258	4.75	1.258

Note. SD = Standard Deviation.

A 2 (group) X 8 (time) repeated measures analysis of variance (ANOVA) was used to examine statistical differences between groups for the outcome measures of weekly inferential comprehension. The sum

of squares and mean squares for the inferential comprehension scores are reported in Table 4-10.

Table 4-10
Sum of Squares and Mean Squares of Inferential Comprehension Scores for CRS and Skills Groups

Source	SS	df	MS	F
Within Ss	51.50	42	1.23	
Time	33.25	7	4.75	3.87**
G x T	20.75	7	2.96	2.40*

Note. SS = Sum of squares; MS = Mean squares; Ss = Subjects; G x T = Group by Time.
*$p < .05$. **$p < .01$

Analysis of the weekly inferential comprehension questions revealed significant effect for time: $F(7,42) = 3.87$, $p < .01$, indicating that both groups improved over time, and a significant group by time interaction: $F(7,42) = 2.40$, $p < .05$, indicating that the CRS treatment condition had a greater effect on ability to answer inferential questions. These findings suggest that the differences were statistically significant.

Summary

The results of the comparison of subjects receiving CRS instruction compared to a comparison condition of skill-based instruction revealed significant differences in increased inferential comprehension of a biology text. No significant differences were found for literal comprehension of a biology text. For both literal and inferential

questions, the CRS group outperformed subjects in the skills group for at least six of the eight weeks of intervention. Further, the CRS group improved more rapidly, performing better after the first week of instruction than the skills group. By the end of the eight weeks, however, both groups performed at about the same levels for both literal and inferential comprehension, suggesting that both types of intervention help college freshmen reading above their independent reading level improve reading comprehension of biology text, but the CRS intervention helps some students improve comprehension more quickly than skills-based intervention.

CHAPTER 5 DISCUSSION

Many college freshmen are unable to read expository material at a level of proficiency necessary for understanding and integrating information from their textbooks. Providing intervention that addresses these deficits and results in rapid improvements is critical if these students are going to pass their current courses and remain in college. This study examined whether an instructional approach termed Communicative Reading Strategies (CRS) would result in improvement in the ability to comprehend expository text. The CRS approach was compared to a skills approach that addressed similar skills taught individually.

Two questions were proposed to determine the efficacy of CRS instruction. First, would college freshmen, reading above their independent reading level, demonstrate improved overall comprehension of college-level expository text after receiving CRS instruction compared to skills instruction? Second, would college freshmen, reading above their independent reading level, demonstrate significant improvement in reading comprehension of a biology text after receiving CRS instruction compared to skills instruction?

This chapter will begin with a discussion of the effects of the intervention conditions on overall comprehension on a standardized test with reading passages independent of the biology course in which students were enrolled. This will be followed by an analysis of weekly changes in comprehension of the biology text for the two groups. A discussion utilizing a connectionist paradigm will be used to integrate

and interpret the complex findings from the study. Finally, limitations and implications for future research will be offered.

Effects of CRS on Overall Comprehension

Question one examined the effects of CRS instruction on overall reading comprehension compared to a control condition of skill-based comprehension instruction. This question was examined by comparing gain scores of the CRS and skills instructional groups on four measures from the NDRT (Brown, Fischo, & Hanna, 1993). These measures included grade level equivalency, number of correct literal responses, number of correct inferential responses, and number of correct total responses (i.e., literal and inferential).

Gains in Grade Level Equivalency

Grade level equivalency is an important measure because it indicates the difficulty of the text material that a student can read and comprehend. At the beginning of the study, none of the students comprehended reading material at a freshman college level (i.e., a graded level of 13). The mean for the CRS group was a ninth grade level (i.e., 9.4) while the mean for the skills group was slightly lower but not significantly different (i.e., 8.5 grade level). This was primarily due to one student who had a very low pretest score of 4.5.

Analysis of gain scores revealed that both groups gained in grade level equivalency, resulting in a significant effect for time. The gain represented an increase in the number of questions answered and number of correct responses. This is an important finding since one grade level of change takes place in one average school year, and the intervention period for both groups was only 8 weeks. In this time, the skills group

gained an average of nearly 2 years in grade equivalency (1.9), with one subject making no change, one changing by less than a year, and the other two gaining 2.8 and 3.8 equivalency levels of change, respectively. The subject making the greatest gains in this group was the subject with the low pretest score.

The CRS average gain was over one grade higher (a gain of 3.2) and all of the subjects improved, each showing greater than one grade level improvement. The lowest gain was 1.4 while the highest gain was 5.1 grade levels in eight weeks. The other two CRS subjects made 3.0 and 3.5 equivalency levels of change, respectively, including one student with only a 7.1 reading level at pretest. Only subjects in the CRS condition improved to a grade equivalency that was at or above a college reading level, with two subjects achieving at the 14.4 equivalency level at posttest. The mean posttest score for this group of 12.6 was two grade levels higher than the mean of 10.4 for the skills group, indicating that as a group, the CRS subjects were nearer the goal of being able to read and comprehend college freshman material independently.

While the mean difference between the gain scores for the two groups was not significant, qualitative measures did reveal advantages to the CRS condition. All four CRS subjects made changes and two reached a level of reading independence for college level material in the eight weeks, while half of the skills subjects made no or minimal change and none attained college-level reading equivalency. The greatest gain of 5.1 was also found in the CRS group and three subjects gained over 3 grade equivalency levels, while only one subject in the skills condition gained over 3 levels.

These qualitative measures suggest that CRS may hold advantages by effecting changes for a broader range of students and for eliciting greater changes in the same time period. The gains made by the skills group suggest that this method of intervention has merit in improving overall reading comprehension. However, the level of gain in this condition was not enough to improve abilities to a grade equivalency required for comprehending college level textbooks. More weeks of skills instruction may help to raise the comprehension level to an appropriate level, but by this time the semester would be nearly over and the students may be failing their classes.

Thus, of the two instructional approaches examined in this study, qualitative data indicate that CRS intervention appears to be the favored approach for increasing grade level equivalency of expository text. Replications of the study with greater numbers of subjects and longer periods of intervention are needed to determine if these qualitative measures are reflecting real advantages for the CRS intervention or whether the effects were specific to this small group of students or due to random fluctuations in performance, as the nonsignificant results would indicate.

Gains in Response to Literal and Inferential Questions

Performance on the NDRT was analyzed further to determine if the two instructional conditions had different effects for comprehension of literal versus inferential information and if one instructional approach held advantages. This was examined by comparing total correct responses to literal questions, total correct responses to inferential questions, and the total score reflecting both question types combined.

The combined score for response to both literal and inferential comprehension questions neared significance in favor of the CRS condition ($p = .07$). Three CRS subjects demonstrated a gain in total score, as opposed to two in the skills condition, and the changes for subjects showing improvements reflected greater gains for CRS subjects.

Inferential questions were examined independently of literal questions. As expected, both groups improved comprehension of inferential information. All four of the CRS subjects improved this score, while only three in the skills group improved. Furthermore, the mean gain score for the CRS group was higher (3.5 compared to 1.5). This difference favored CRS but was not significant. These results indicate that college freshmen can improve in their ability to draw inferences from text when provided for a specific inferential skill taught in isolation, such as a lesson on drawing conclusion (i.e., skill-based), but also occurs when this information is provided as needed in the context of reading authentic classroom material (i.e., CRS).

This finding suggests that there is no need for, and no outcome advantage to, isolating a skill and practicing it outside of the context in which you want it to generalize. Inferencing can be taught as part of the interactive process of learning to interpret a text as it is being read, and this indirect learning does generalize to other contexts such as the NDRT passages.

An unpredicted outcome was obtained for comprehension of literal information. No subjects in either group performed better on the posttest than on the pretest, and five of the eight subjects answered fewer literal questions correctly. This negative effect was less pronounced in the

CRS group, with two subjects maintaining their score and two decreasing their score by one point. In the skills condition only one maintained the pretest score while the other three decreased comprehension by 1, 2, and 5 points, respectively.

This finding may be in part related to a ceiling effect. Four subjects (two in each group) answered all 16 literal questions correctly at pretest, while the remaining four subjects responded incorrectly to only one or two questions. Thus, the opportunity for gains was minimal, while at the same time one random error would result in a decrease in performance.

Another possible reason for this finding may be an interaction between literal and inferential meaning. Both treatments were designed to increase inferential abilities, and if effective, would logically focus more attention during reading on this higher level comprehension. A greater focus on higher level comprehension could in turn reduce attention to details or literal meanings.

This appeared to be true for subject 1 in the CRS condition who increased inferential responses by 6 points while decreasing in literal performance by one point. Similarly, two subjects in the skills condition who made gains in inferential meaning decreased in literal comprehension. This effect has previously been noted in the literature, where different types of questions presented prior to reading a passage primed the reader to pay greater attention to that type of information (Kintsch & van Dijk, 1978; Taylor & Beach, 1984). This interactive effect was not universal. Three of the subjects (2 CRS, 1 skills) who made the greatest gains in inferential meaning maintained their pretest

level of literal meaning. These results are consistent with reports by other researchers who found that text organization instruction affects the recall of main ideas but not the recall of details (Armbruster, Anderson, & Ostertag, 1987; Brooks & Dansereau, 1983; Meyer, Brandt, & Bluth, 1980).

Summary

When comprehension of expository text by college students was evaluated following an 8-week intervention period, both direct skill-based instruction and interactive CRS instruction proved effective. These results indicate that college freshmen can improve their reading comprehension skills in a relatively short period with minimal investment of hours when provided small-group instruction.

Previous research supports these results when skills instruction is provided (Gaither, 1968; Mouly, 1952; Pedrini & Pedrini, 1977; Shaw & Shaw, 1987). Increasingly, there is an educational call for direct and systematic instruction of specific skills that challenges whether more contextualized, holistic teaching can effect the desired changes. In this study, the greater overall gain scores, higher grade equivalency levels, and fewer decreases in literal meaning as inferential gains were made all occurred in the CRS condition.

These results indicate that direct and systematic instruction for specific skills is not necessary to acquire these abilities. Interactive teaching that focuses on maintaining meaning rather than on specific skills is effective in establishing the skills, and in fact results in small but consistent advantages. The findings of this study are consistent with other studies evaluating the efficacy of CRS instruction on reading

performance with populations of children (Badon, 1993; DeKemel, 1998; Michaelson, 1995) and adult readers (Reichmuth, 1996).

The NDRT evaluated comprehension of expository text that was independent of the biology course in which students were enrolled. The second question of the study addressed changes in comprehension of the biology text students were reading for their course.

Effects of CRS on Comprehension of Biology Text

Question two examined the effects of CRS instruction on reading comprehension of a biology text compared to a control condition of skill-based comprehension instruction. This question was examined by comparing correct responses to literal and inferential questions for each group on weekly probes. The weekly probes indicated the rate at which changes in performance were attained under the two conditions, in addition to differences in gains specific to the biology text from pretest to posttest.

Weekly Probes for Literal Information

Response to literal questions was probed at weekly intervals to determine how well factual information was recalled following reading of the biology text. After the first week of intervention, the CRS group scored 2.75 (of a possible 3), indicating that they were recalling most of the literal information of the passage. The skills group scored 2.25, indicating that they were not recalling as much literal information as the CRS group. The CRS group scored 2.0 or above for each weekly probe while the skills group only scored above 2.0 four of the weeks.

These weekly performance results showed that the CRS group outperformed the skills group for six of the eight weeks and tied with

them for the other two weeks. The skills group did not attain comparable changes until the sixth week of treatment, suggesting that the CRS intervention produced immediate gains, whereas it took much longer for the skills intervention to produce the same level of improvement. This finding is clinically important since it is not only critical to effect changes for students who are in school, but also to attain these changes quickly before low grades and poor understanding of course information results in failure of the course.

An unpredicted outcome was obtained for the weekly literal scores. Both groups performed better after one week of intervention than after eight weeks of intervention. The mean literal score for the CRS group was 2.25 after the eighth week of intervention and the mean literal score for the skills group was 2.0. Students may have scored relatively well after the first week's intervention because they were accustomed to processing information on a microstructural level. That is, they were used to focusing on the details. However as intervention progressed, students began to focus greater attention on more inferential meaning and less attention on factual information, resulting in slightly poorer recall of literal meaning by the end of the study.

This finding suggests that these students were exhibiting a limited capacity to process information. They could either process literal information at a high level of accuracy or inferential meaning, but could not yet balance both. The focus on higher level comprehension in both treatment conditions resulted in the same decrease in attention to factual details. This effect was less apparent for the CRS condition.

Weekly Probes for Inferential Information

Response to inferential questions was probed at weekly intervals to determine how well inferential information was integrated following reading of a biology text. After the first week of intervention, the mean inferential score for the CRS group was 4.5 (of a possible 6), while the mean for the skills group was 1.25. These results were significant. This finding is important since it is critical that students be able to synthesize course information presented from the beginning of the semester.

Weekly performance results of the inferential probes showed that the CRS group outperformed the skills group for seven of the eight weeks of intervention. The variability of the skills group's weekly means (1.25 to 4.75) suggested that the weekly targeted subskills may have played a role in the group's results. The skills group focused on a different comprehension skill each week, whereas the CRS group's intervention focused on similar skills, but as they were encountered within the context of the text.

The CRS group's weekly probe scores did not vary as much as the skills group's weekly inferential probe scores (3.5 to 5.25), suggesting that not only could skills be learned in context without direct instruction, but also that multiple skills could be simultaneously improved. The only week that the skills group scored higher on the inferential probe than the CRS group was week 2. For this probe, the difference between the two groups was only .25. This was also the lowest weekly mean score for the CRS group, indicating that their lowest score was still comparable to the skills score for that week.

The difference between the first weekly probe and the last weekly probe was examined for the skills group. The skills group gained 3.5 points between the first and eighth weeks of treatment, achieving at the same level the CRS group reached week 1, suggesting that the skills-based intervention may be successful if enough time is provided.

The advantages accrued to CRS in this and other studies are contrary to instructional philosophies that claim direct teaching, practice, and reinforcement of specific skills are necessary and the most effective instructional methods to establish and make these behaviors automatic (Adams, 1990; Juel, Griffith, & Gough, 1986).

Reading Comprehension within a Connectionist Paradigm

The results of this study demonstrate two important outcomes that need to be reconciled in a theoretical model. First, two very different types of instruction for comprehension, one that systematically teaches specific skills and one that provides information in an interactive context, both result in statistically comparable gains on a standardized measure following 8 weeks of instruction. Secondly, the approach that provides intervention within a reading context for a variety of skills simultaneously holds advantages that are apparent in qualitative measures, such as grade level equivalency attained and the rate at which these gains are observed, as well as greater gains in inferential abilities for the biology text. A connectionist paradigm is one theoretical model that can accommodate these findings.

The performance at posttest on the NDRT indicated that both intervention approaches resulted in comparable group gains even though the methods of instruction were very different. Patterns of change were

similar for both literal and inferential questions, with gains observed only for inferential meaning under both intervention conditions. These changes were examined following 8 weeks of instruction.

These findings suggest that the same outcome can be achieved from different patterns of input, consistent with models of self-organizing systems such as connectionist networks. In the skills condition, one inferential skill was introduced each week. The skill was explained and multiple examples were practiced, first on a worksheet with random exemplars and then on a more integrated worksheet designed to correspond to the biology text. This input would enable a network to establish patterns of connectivity consistent with the weekly target. The repetition of the input from multiple exemplars would establish strong connection weights within the network for that specific skill, thus forming the equivalent of a "rule" for that skill. At the same time, the backward propagation resulting from feedback on the correctness of the response would modify the pattern established by the network. This pattern would be consistent with the intended outcome.

The pattern would be further reinforced as the skill was practiced by the subject while studying during the subsequent week. Over the 8 weeks, the combination of skills would result in a change in the network that would support better inferential abilities. The subjects would have 8 different strategies that could be applied to text to interpret the inferential meaning in response to questions.

In contrast, during the 8 weeks of intervention, little attention was directed at literal meaning. Thus, only indirect input for these patterns entered the network. As a result, as the network reconfigured and added

new patterns of connectivity no increases in connection weights for existing strategies for literal comprehension were reinforced. As a consequence, no gains in literal comprehension were attained. The reconfiguration of the system to accommodate the frequently reinforced patterns of connectivity for inferential strategies in the case of three subjects changed the manner in which the textual information was processed to favor the inferential information. As more of the network's processing capacity was used to focus on inferential meaning, less processing of literal information occurred.

Thus, for three of the subjects the performance level for literal questions decreased as the emphasis was placed on inferential meaning. The network appeared to have limited processing capacity, and since the new patterns of connectivity for inferential meaning reflected beginning stages of learning (i.e., relatively weak connection weights that were not well networked to strategies for literal recall), the system could not achieve sufficient activation to support both types of comprehension at a high level of accuracy. Increases in inferencing thus resulted in slight decreases in factual recall.

In the case of the CRS intervention, input was provided for multiple inferential skills presented interactively in the context of reading and interpreting the biology text. The needs of the subject dictated which skills and how often these skills were reinforced. In one session, 8 different inferential strategies might be used in scaffolded interactions, with some occurring with high frequency while others used only a few times. From this changing pattern of input throughout the session, the

network would have to establish the regularities in the patterns for the various strategies.

At the end of the 8 weeks, sufficient exposure to the different inferential strategies created essentially the same output as the systematic introduction of one strategy per week. The network formed patterns of connectivity with sufficient connection weights to result in a variety of inferencing strategies to interpret the text. This was apparent in the similar patterns of gain on both the NDRT and the probes at posttest for the CRS and skills group. However, the network appeared to establish these patterns more rapidly from the CRS input.

After the first week of intervention, one skill had been presented in the skills condition; however, many skills were presented in the CRS condition. The large differences in the first weekly probe scores suggest that CRS intervention provided the system with a quicker way of organizing itself. The text, along with the facilitator's scaffolding, acted as inputs to the system. These inputs, as well as prior knowledge of the subject, became interconnected quickly within the system, demonstrating better organization of the system immediately.

After several weeks of intervention, many skills had been presented in the skills condition. The weekly probe scores became more balanced, suggesting that the system was able to organize itself in the skills condition only after these many units of information had been combined. Thus, the network appears to favor information from different components rather than from discrete ones.

Every individual's system is unique. Each subject in the study had a unique amount of biology background knowledge, text structure

knowledge, and so on. Also, each subject had a different pattern and rate of learning. These factors served as multiple inputs to the network and connected to new information and learning on an individual basis. The better qualitative outcomes of the CRS subjects suggest that an integrated approach to reading comprehension that provides input from multiple sources interactively is more effective for a broader range of subjects.

No computer simulation was used to test the effects of single versus multiple skill inputs on a connectionist network. Rather, the theoretical principles underlying a connectionist model were used to hypothesize how two different types of input could create similar output. In the future as computer simulation replicates this complex type of learning, it may be possible to test this hypothesis on a network.

Conclusions

When reading is viewed from a connectionist model, both types of comprehension intervention are seen as being successful. In both the CRS and skills-based interventions, students received input to their systems that resulted in helping them strengthen and reinforce patterns of connectivity. Both groups made gains in reading comprehension ability, indicating that both types of intervention help the system integrate and coordinate information.

These findings support Weaver's redundancy model of reading (1994). During reading, information is processed simultaneously within a complex, multidimensional system. The system is redundant because meaning can be acquired through multiple sources. These sources

include such processes as orthographic patterns, background knowledge, and text structure.

Because the system is made up of interconnecting processes that work together simultaneously to produce meaning, a reading intervention approach should make use of such a complex system. CRS focuses on successfully integrating and coordinating the processes involved in reading. That an approach such as CRS produced quicker gains in the weekly probes demonstrates that the system is self-organizing and does not need discrete, systematic input to improve reading comprehension. In fact, the findings suggest that the system may prefer an integrated approach in order to produce gains faster. This is clinically important because students may be failing their courses by the time skill-based intervention is successful.

Limitations of the Study

Two instructional conditions were compared in an 8 week intervention study. While gains were made in both treatment conditions, the CRS group produced them quicker. There were several limitations to this study however, that need to be explained in future research.

First, the small number of students participating in the study made it difficult to identify significant differences in the data. Out of the thirty three students who volunteered for the study, only twelve fit the criteria. Participation was voluntary and students could quit at any time. During the course of the study, four of the twelve students dropped out for various reasons. It is not known if the students who completed the study were a representative sample of the original population.

In addition, with such a small sample size, it is difficult to determine if these results would generalize to a larger population. It cannot be determined whether the results that were not significant were achieved due to the small sample or if the two types of intervention did not differ.

Second, attendance may have been a factor in the results. While it was stressed to the students to attend every session, most of the students missed at least two sessions. When a session was missed, they were told to read the material that was reviewed if they were in the CRS group, or they were given the worksheets and told to do them on their own if they were in the skills group. Students in both groups thus missed important information.

A third limitation of the study was the inability to control for the amount of studying the students were doing on their own. Several opportunities were given to all of the students enrolled in the biology course to get assistance, including tutoring and review sessions. Also, students in the study were all enrolled in different courses that had differing amounts of reading requirements. Because of these factors, it is unknown how the other texts they were reading impacted the results.

The fourth limitation of the study was the use of the NDRT. Although this test has been used at the college level for many years, there is disagreement as to its purpose. Flippo, Hanes, and Cashen (1991) suggest that it be used as a screening instrument only and not as an assessment tool. It has also been found that some individuals may be slow readers but not necessarily poor comprehenders (Kerstiens, 1986). A more thorough reading assessment, including one that gives more

information such as instructional reading level, frustration reading level, and independent reading level, may have provided a more complete profile of students' reading abilities. These profiles may have found differences in subjects that could have influenced the results.

A fifth limitation of the study was that both treatment conditions were administered by the same person. Provisions were made to keep the two conditions separate. The facilitator followed a reading workbook and used worksheets for the skills condition while for the CRS condition, the text was the primary reading material. Many sessions were videorecorded and a speech-language pathologist who is familiar with CRS administration reviewed a percentage of the tapes to ensure that correct procedures were being followed. However, there may have been some overflow of the CRS intervention in the skills condition.

The last limitation of the study was in the implementation of CRS. It is imperative that the facilitator be thoroughly familiar with the content of the reading material as well as understanding how meaning is expressed through linguistic forms. Becoming a CRS facilitator for a specific course is much more time consuming than teaching reading comprehension through skills instruction. The CRS facilitator must be aware of the specific parts of the text that will be challenging to poor comprehenders and be able to give immediate feedback. It is much easier for skills instructors who can follow a step-by-step process like that presented in reading comprehension workbooks, and simply augment those texts with passages from the course's textbook.

Suggestions for Future Research

The findings of this study indicate that an 8 week instructional program focusing on reading comprehension results in gains in reading comprehension grade level and inferential abilities. Further, qualitative measures and weekly inferential probes of the biology text revealed advantages in favor of the CRS condition. A connectionist paradigm of reading comprehension may explain these findings. However, few studies of reading comprehension have explored this theoretical construct. Also, the results favoring CRS intervention suggest exploring this type of instruction. More studies need to be performed with college students to support a connectionist model, and specifically CRS intervention.

Future studies could be undertaken in which the two types of intervention (CRS and skills) are administered to a remedial reading class that is conjointly enrolled in a particular course. The intervention could be split between the class so that comparisons may be made with a large sample. Different courses could also be compared to determine if there are differential effects for different types of reading. One group would receive CRS instruction paired with a science course while another group would receive CRS instruction paired with a history or psychology course.

Because effects were observed quicker in the CRS condition than in the skills condition, time effects need to be studied. Intervention could be provided for varying lengths of time to determine the amount of time that is needed to effect changes in comprehension. A multiple baseline

study of CRS intervention would be helpful in determining how comprehension abilities change with certain periods of time.

Finally, other reading comprehension approaches that support social mediation should be compared to CRS intervention to determine if there are specific characteristics of a socially-mediated approach that contribute to improved comprehension. Such approaches that have been studied primarily at the elementary and middle school levels are POSSE (Englert, Tarrant, Mariage, & Oxer, 1994) and reciprocal teaching (Palinscar & Brown, 1984).

Conclusions

Many college students exhibit poor reading comprehension of expository texts. This study was undertaken to determine if an 8 week intervention program termed Communicative Reading Strategies (CRS) that focused on improving the comprehension of college freshmen enrolled in a biology course would be successful. CRS was compared to a program that addressed discrete skills on a weekly basis.

The small sample size of this study resulted in group differences that did not attain a level of statistical difference for most analyses. However, all qualitative measures showed advantages for CRS instruction, including faster gains and better inferential comprehension of the biology text, which was the intended functional outcome. This suggests that learning for this population may be better achieved using an integrated approach to comprehension or one that provides input from multiple sources interactively. Additional research exploring this will lend further insights that will enable better remedial programs to be

developed for college freshmen, while at the same time providing more answers about the nature of integrated learning.

BIBLIOGRAPHY

Adams, M. J. (1979). Models of word recognition. Cognitive Psychology, 11, 133-176.

Adams, M. J. (1990). Beginning to read: Thinking and learning about print. Cambridge, MA: MIT Press.

Adams, S. M., & Mikulecky, L. (1989). Teaching effective college reading and learning strategies using computer assisted instruction. Journal of College Reading, 22, 64-70.

Afflerbach, P. (1987). How are main idea statements constructed? Watch the experts. Journal of Reading, 30, 512-518.

Anastasi, A. (1976). Psychological testing. New York: Macmillan Publishing Company.

Anderson, R. C. (1985). Role of the reader's schema in comprehension, learning, and memory. In H. Singer & R. B. Ruddell (Eds.), Theoretical models and processes of reading (3rd ed.) (pp. 372-384) Newark, DE: International Reading Association.

Anderson, R. C., & Pearson, P. D. (1984). A schema-theoretic view of basic processes in reading. In P. D. Pearson (Ed.), Handbook of reading research (pp. 255-292). New York: Longman.

Applebee, A., Langer, J., & Mullis, I. (1985). The reading report card (NAEP report No. 15-R-01). Princeton, NJ: Educational Testing Service.

Armbruster, B. B., Anderson, T. H., & Ostertag, J. (1987). Does text structure/summarization instruction facilitate learning from expository text? Reading Research Quarterly, 22, 331-346.

Badon, L. C. (1993). Comparison of word recognition and story retelling under the conditions of contextualized versus decontextualized

reading events in at-risk poor readers. Unpublished doctoral dissertation, Louisiana State University, Baton Rouge.

Baker, L. (1985). Differences in the standards used by college students to evaluate their comprehension of expository prose. Reading Research Quarterly, 20, 297-312.

Balajthy, E., Bacon, L., & Hasby, P. (1985). Introduction to computers and introduction to word processing: Integrating content area coursework into college reading/study skills curricula using microcomputers. Paper presented at the Conference on Microcomputers and Basic Skills in College, New York, NY. (ERIC Document Reproduction Service No. ED 273 941)

Balota, D. A. (1983). Automatic semantic activation and episodic memory encoding. Journal of Verbal Learning and Behavior, 22, 88-104.

Bates, E. A., & Elman, J. L. (1993). Connectionism and the study of change. In M. Johnson (Ed.), Brain development and cognition: A reader. Oxford: Blackwell Publishers.

Berk, L. E. (1989). Cognitive development: A Piagetian perspective. In L. E. Berk (Ed.), Child development (pp. 219-264). Boston: Allyn and Bacon.

Berkowitz, S. J. (1986). Effects of instruction in text organization on sixth-grade students' memory for expository reading. Reading Research Quarterly, 21, 161-178.

Blachowicz, C. L. Z. (1994). Problem-solving strategies for academic success. In G. P. Wallach and K. G. Butler (Eds.), Language learning disabilities in school-age children and adolescents (pp. 304-322). New York: Macmillan.

Blanc, R. A., DeBuhr, L. E., & Martin, D. C. (1983). Breaking the attrition cycle: The effects of supplemental instruction on

undergraduate performance and attrition. Journal of Higher Education, 54, 80-90.

Bontekoe, J. F. (1992). The ACT as a predictor of college success at Trinity Christian College. East Lansing, MI: American College Testing Program. (ERIC Document Reproduction Service No. ED 355 258)

Boyle, O. F., & Peregoy, S. F. (1991). The effects of cognitive mapping on students' learning from college texts. Journal of College Reading and Learning, 23, 14-22.

Bransford, J. D. (1985). Schema activation and schema acquisition. In H. Singer & R. B. Ruddell (Eds.), Theoretical models and processes of reading (3rd ed.) (pp. 385-397). Newark, DE: International Reading Association.

Bransford, J. D., & Johnson, M. K. (1972). Contextual prerequisites for understanding: Some investigations of comprehension and recall. Journal of Verbal Learning and Verbal Behavior, 11, 717-726.

Brooks, L. W., & Dansereau, D. F. (1983). Effects of structural schema training and text organization on expository prose processing. Journal of Educational Psychology, 75, 811-820.

Brown, J. I. (1976). Nelson-Denny Reading Test. Boston: Houghton Mifflin.

Brown, J. I., Fishco, V. V., & Hanna, G. (1993). Nelson-Denny Reading Test. Itasca, IL: Riverside Publishing Company.

Bullock, T., Madden, D., & Harter, J. (1987). Paired developmental reading and psychology courses. Research and Teaching in Developmental Education, 3, 22-31.

Carpenter, K., & Johnson, L. L. (1991). Program organization. In R. F. Flippo & D. C. Caverly (Eds.), College reading and study

strategy programs (pp. 28-69). Newark, DE: International Reading Association.

Carpenter, P. A., & Just, M. A. (1981). Cognitive processes in reading: Models based on readers' eye fixations. In A. M. Lesgold & C. A. Perfetti, (Eds.), Interactive processes in reading (pp. 177-213). Hillsdale, NJ: Erlbaum.

Carr, E. M., Dewitz, P., & Patberg, J. P. (1983). The effects of inference training on children's comprehension of expository text. Journal of Reading Behavior, 15, 1-18.

Carson, J. G., Chase, N. D., Gibson, S. U., & Hargrove, M. F. (1992). Literacy demands of the undergraduate curriculum. Reading Research and Instruction, 31, 25-50.

Case, R. (1985). Intellectual development: Birth to adulthood. Orlando, FL: Academic Press.

Catts, H. W. (1989). Phonological processing deficits and reading disabilities. In A. G. Kamhi & H. W. Catts (Eds.), Reading disabilities: A developmental language perspective (pp. 101-132). Boston: Allyn and Bacon.

Caverly, D. C., & Peterson, C. L. (1996). Defining developmental education: Theory, research, and pedagogy (pp. 39- 48). Chicago, IL: National Association of Developmental Education.

Chomsky, N. (1957). Syntactic structures. The Hague: Mouton.

College Board (1983). Degrees of Reading Power. New York: College Entrance Examination Board.

DeKemel, K. D. (1998). Using scaffolded interaction to improve LLD readers' inferencing and narrative abilities. Unpublished doctoral dissertation, Louisiana State University, Baton Rouge.

Dee-Lucas, D., & Larkin, J. H. (1988). Novice rules for assessing importance in scientific texts. Journal of Memory and Language, 27, 288-308.

Dillard, M. L. (1989). Changing a college developmental reading program from three to five semester hours' credit: What's involved? Forum for Reading, 20, 26-31.

Dimon, M. (1988). Why adjunct courses work. Journal of College Reading and Learning, 21, 33-40.

Elliott, M. K., & Fairbanks, M. (1986). General vs. adjunct reading/study skills instruction for a college history course. Journal of College Reading and Learning, 19, 22-29.

Elman, J. L., Bates, E. A., Johnson, M. H., Karmiloff-Smith, A., Parisi, D., & Plunkett, K. (1998). Rethinking innateness: A connectionist perspective on development. Cambridge, MA: MIT Press.

Englert, C. S., Tarrant, K. L., Mariage, T. V., & Oxer, T. (1994). Lesson talk as the work of reading groups: The effectiveness of two interventions. Journal of Learning Disabilities, 27, 165-185.

Flickinger, G. M., Hunter, J. T., & Labat, D. D. (1978). Basic principles of biology workbook. Unpublished course workbook, Xavier University of Louisiana at New Orleans.

Flippo, R. F., Hanes, M. L., & Cashen, C. J. (1991). Reading tests. In R. F. Flippo & D. C. Caverly (Eds.), College reading and study strategy programs (pp. 118-173). Newark, DE: International Reading Association.

Fry, E. B. (1977). Fry's readability graph: Clarifications, validity, and extension to level 17. Journal of Reading, 21, 242-252.

Fulginiti, R. (1998). [Xavier University of Louisiana freshmen biology grade distribution]. Unpublished raw data.

Gaither, L. A. (1968). A study of remedial students. Fresno City, CA: Fresno City College. (ERIC Document Reproduction Service No. ED 025 253)

Garjia, M., & Salvia, J. (1992). The effects of summarization instruction on text comprehension of students with learning disabilities. Exceptional Children, 58, 508-516.

Goodman, K. (1993). Phonics Phacts. Portsmouth, NH: Heinemann.

Gough, P. B. (1984). Word recognition. In P. D. Pearson (Ed.), Handbook of reading research (pp. 225-254). New York: Longman.

Grant, R. (1993). Strategic training for using text headings to improve students' processing of content. Journal of Reading, 36, 482-488.

Gross, T. (1985). Cognitive development. Monterey, CA: Brooks/Cole.

Halford, G. S. (1993). Children's understanding: The development of mental models. Hillsdale, New Jersey: Lawrence Erlbaum.

Hegde, M. N. (1994). Clinical research in communicative disorders. (2nd ed.) Austin, TX: Pro-ed.

Henderson, C. (1995). College freshmen with disabilities: A statistical profile. Washington, DC: American Council on Education.

Henry, W. (1994). In defense of elitism. New York: Doubleday.

Hernandez, S. N. (1989). Effects of communicative reading strategies on the literacy behaviors of third grade poor readers. Unpublished doctoral dissertation, Louisiana State University, Baton Rouge.

Hiebert, E. H., Englert, C. S., & Brennan, S. (1983). Awareness of text structure in recognition and production of expository discourse. Journal of Reading Behavior, 15, 63-79.

Holmes, B. C. (1985). The effects of a strategy and sequenced materials on the inferential comprehension of disabled readers. Journal of Learning Disabilities, 18, 542-546.

Iovino, S. F. (1993). A study of the effects of outlining and networking on college students' comprehension and retention of expository prose. Research and Teaching in Developmental Education, 10, 43-64.

Jenkins, J. R., Heliotis, J., Haynes, M., & Beck, K. (1986). Does passive learning account for disabled readers' comprehension deficits in ordinary reading situations? Learning Disability Quarterly, 9, 69-76.

Johnston, P., & Afflerbach, P. (1985). The process of constructing main ideas from text. Cognition and Instruction, 2, 207-232.

Juel, C. (1983). The development and use of mediated word identification. Reading Research Quarterly, 28, 306-327.

Juel, C., Griffith, P. L., & Gough, P. B. (1986). Acquisition of literacy: A longitudinal study of children in first and second grade. Journal of Educational Psychology, 78, 243-255.

Juel, C., & Solso, R. L. (1981). The role of orthographic redundancy, versatility, and spelling-sound correspondences in word identification. In M. L. Kamil (Ed.), Directions in reading: Research and instruction, (pp. 74-82). Washington, DC: National Reading Conference.

Kaiser, R., & Hawes, K. (1987). College preparation for the underprepared high school student. Memphis, TN: Memphis State University. (ERIC Document Reproduction Service No. 277 989)

Kerstiens, G. (1986). A testimonial on timed testing: Developmental students and reading comprehension tests. In M. P. Douglas (Ed.), Fiftieth yearbook of the Claremont Reading Conference (pp. 261-267). Claremont, CA: Claremont Graduate School.

King, J. R., Stahl, N. A., & Brozo, W. G. (1984). Integrating study skills and orientation courses. Forum for Reading, 16, 6-13.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. Psychological Review, 95, 163-182.

Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. Psychological Review, 85, 363-394.

Kulik, C. C., Kulik, J. A., & Shwalb, B. J. (1983). College programs for high-risk and disadvantaged students: A meta-analysis of findings. Review of Educational Research, 53, 397-414.

Lieberman, I. Y., & Shankweiler, D. (1979). Speech, the alphabet, and teaching to read. In L. B. Resnick & P. A. Weaver (Eds.), Theory and practice of early reading. Hillsdale, NJ: Erlbaum.

Lindsay, P. & Norman, D. (1977). Human information processing (2nd ed.). New York: Academic Press.

Mandler, J., & Johnson, N. (1977). Remembrance of things parsed: Story structure and recall. Cognitive Psychology, 9, 111-151.

Maxwell, M. (1979). Improving student learning skills. San Francisco, CA: Jossey-Bass.

Maxwell, M. (1995). New insights about teaching college reading: A review of recent research. Journal of College Reading and Learning, 27, 34-42.

McClelland, J. L. (1989). Parallel distributed processing: Implications for cognition and development. In R. G. M. Morris (Ed.),

Parallel distributed processing: Implications for psychology and neurobiology (pp. 8-45). New York: Oxford University Press.

McClelland, J. L., & Rummelhart, D. E. (1986). Parallel distributed processing: explorations in the microstructure of cognition Volume II. Cambridge, MA: Bradford Books.

McLaughlin, M. A., Price, P. T., & Shoultz, G. R. (1992). Whole language, critical literacy and accountability. Journal of College Reading and Learning, 25, (1), 29-39.

McNamara, D. S., & Kintsch, W. (1996). Learning from texts: Effects of prior knowledge and text coherence. Discourse Processes, 22, 247-288.

Merrill, E. C., Sperber, R. D., & McCauley, C. (1981). Differences in semantic encoding as a function of reading comprehension skill. Memory and Cognition, 9, 618-624.

Meyer, B. J. F. (1984). Organizational aspects of text: Effects on reading comprehension and application for the classroom. In J. Flood (Ed.), Promoting reading comprehension (pp. 113-138). Newark, DE: International Reading Association.

Meyer, B. J. F., Brandt, D. M., & Bluth, G. J. (1980). Use of top-level structure in text: Key for reading comprehension of ninth-grade students. Reading Research Quarterly, 16, 72-103.

Meyer, D. E., Schvaneveldt, R. W., & Ruddy, M. G. (1974). Functions of phonemic and graphemic codes in visual word recognition. Memory and Cognition, 2, 309-321.

Michaelson, M. (1995). The efficacy of communicative reading strategies with low achieving beginning readers. Unpublished doctoral dissertation, Louisiana State University, Baton Rouge.

Moshman, D. (1998). Cognitive development beyond childhood. In W. Damon, D. Kuhn, & R. Siegler (Eds.), Handbook of child psychology: Cognition, perception, and language. New York: Wiley.

Mouly, G. J. (1952). A study of the effects of a remedial reading program on academic grades at the college level. The Journal of Educational Psychology, 43, 459-466.

Mulcahy, P. (1987). Schemata: cues for understanding expository text. Journal of College Reading and Learning, 20, 138-146.

Nelson, K. (1996). Language and cognitive development: Emergence of the mediated mind. Cambridge, MA: Cambridge University Press.

Nelson, N. W. (1988). Reading and writing. In M. A. Nippold (Ed.), Later language development (pp. 97-125). Austin, TX: Pro-ed.

Nist, S. L., & Hynd, C. R. (1985). The college reading lab: An old story with a new twist. Journal of Reading, 28, 305-309.

Norris, J. A. (1988). Using communication strategies to enhance reading acquisition. The Reading Teacher, 41, 368-373.

Norris, J. A. (1989). Providing language remediation in the classroom: An integrated language-to-reading intervention method. Language, Speech and Hearing Services in Schools, 20, 205-219.

Norris, J. A. (1991). From frog to prince: Using written language as a context for language learning. Topics in Language Disorders, 12, 66-81.

Norris, J. A. (1998). I could read if I just had a little help: Facilitating reading in whole language contexts. In C. Weaver (Ed.), Current issues in whole language. Urbana, IL: NCTE.

Norris, J. A., & Hoffman, P. R. (1993). Whole language intervention for school-age children. San Diego, CA: Singular Publishing Group.

O'Hear, M. (1993). College reading programs: The last 25 years. Journal of College Reading and Learning, 25, 17-24.

Okolo, B. A. (1990). Discourse strategies for improving English language reading and composing skills. Journal of College Reading and Learning, 22, 53-64.

Owens, R. E. (1996). Language development: An introduction (4th Ed.). Boston: Allyn and Bacon.

Palinscar, A. S. (1986). The role of dialogue in providing scaffolded instruction. Educational Psychology, 21, 73-98.

Palinscar, A. S. (1987). Collaborating for collaborative learning of text comprehension. Washington, DC: National Institute of Education. (ERIC Document Reproduction Service No. ED 285 123)

Palinscar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and monitoring activities. Cognition and Instruction, 1, 117-175.

Patterson, K., Seidenberg, M. S., & McClelland, J. L. (1989). Connections and disconnections: Acquired dyslexia in a computational model of reading processes. In R. G. M. Morris (Ed.), Parallel Distributed Processing: Implications for psychology and neurobiology. (p. 46-98.) Oxford: Clarendon Press.

Pedrini, B. C., & Pedrini, D. T. (1977). Grade-point evaluation of an experimental program for disadvantaged college freshmen. College Student Journal, 11, 318-323.

Perfetti, C. (1985). Reading ability. New York: Oxford University Press.

Piaget, J. (1958). Growth of logical thinking. New York: Basic Books.

Piaget, J. (1970). Science of education and the psychology of the child. New York: Orion Press.

Piaget, J. (1972). Intellectual evolution from adolescence to adulthood. Human Development, 15, 1-12.

Pinker, S. (1994). The language instinct: How the mind creates language. NY: William Morrow.

Pinker, S., & Prince, A. (1988). On language and connectionism: Analysis of a parallel distributed processing model of language acquisition. Cognition, 28, 73-194.

Plunkett, K., & Marchman, V. (1991). U-shaped learning and frequency effects in a multi-layered perceptron: Implications for child language acquisition. Cognition, 38, 43-102.

Reichmuth, S. (1996). The effects of communicative reading strategies on fluency and comprehension in adult literacy learning Unpublished doctoral dissertation, Louisiana State University, Baton Rouge.

Risko, V. J., & Alvarez, M. C. (1986). An investigation of poor readers' use of a thematic strategy to comprehend text. Reading Research Quarterly, 21, 298-316.

Roller, C. M. (1990). The interaction between knowledge and structure variables in the processing of expository prose. Reading Research Quarterly, 25, 79-89.

Roueche, J. E., Baker, G. A., & Roueche, S. D. (1984). College responses to low-achieving students: A national study. American Education, 20, 31-34.

Rowan, R. W. (1978). Predictive value of the ACT at Murray State University over a four year college program. Measurement and Evaluation in Guidance, 11, 143-149.

Rummelhart, D. (1975). Notes on a schema for stories. In D. Brown & A Collins (Eds.), Representation and understanding: Studies in cognitive science. New York: Academic Press.

Rummelhart, D. (1977). Toward an interactive model of reading. In S. Dornic (Ed.), Attention and performance (Vol. 1). Hillsdale, NJ: Erlbaum.

Seidenberg, M. S. (1990). Lexical access: Another theoretical soupstone? In D. A. Balota, G. B. Flores d'Arcais, & K. Rayner (Eds.), Comprehension processes in reading (p. 33-72). Hillsdale, NJ: Erlbaum.

Seidenberg, M. (1992). Dyslexia in a computational model of word recognition in reading. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), Reading Acquisition. Hillsdale, NJ: Lawrence Erlbaum Associates.

Seidenberg, M. S., & McClelland, J. L. (1989). A distributed, developmental model of word recognition and naming. Psychological Review, 96 (4), 523-568.

Shaffer, D. (1985). Developmental psychology. Monterey, CA: Brooks/Cole.

Shaw, S., & Shaw, S. (1987). Learning disability college programming: A bibliography. Journal of Postsecondary Education and Disorders, 5, 119-132.

Simon, H. A. (1969). The sciences of the artificial. Cambridge, MA: MIT Press.

Simpson, M. L., & Dwyer, E. J. (1991). Vocabulary acquisition and the college student. In R. F. Flippo and D. C. Caverly (Eds.),

Teaching reading and study strategies at the college level (pp. 1-41). Newark, DE: International Reading Association.

Slater, W. H. (1985). Teaching expository text structure with structural organizers. Journal of Reading, 28, 712-718.

Smith, F. (1988). Understanding reading. Hillsdale, NJ: Lawrence Erlbaum.

Solomon, E. P., Berg, L. R., Martin, D. W., & Villee, C. (1996). Biology (4th ed.). Fort Worth, TX: Saunders College Publishing.

Spires, H. A., Gallini, J., & Riggsbee, J. (1992). Effects of schema-based and text structure-based cues on expository prose comprehension in fourth graders. Journal of Experimental Education, 60, 307-320.

Spring, C., & Prager, J. (1992). Teaching community college students to follow the train of thought in expository texts. Reading and Writing: An Interdisciplinary Journal, 4, 33-54.

Stahl, N. A., Simpson, M. L., & Hayes, C. G. (1992). Ten recommendations from research for teaching high-risk college students. Journal of Developmental Education, 16, 2-10.

Stanovich, K. (1980). Toward an interactive-compensatory model of individual differences in the development of reading fluency. Reading Research Quarterly, 16, 32-71.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. Reading Research Quarterly, 21, 360-406.

Stevens, A. L., & Rummelhart, D. E. (1975). Errors in reading: Analysis using an augmented network model of grammar. In D. A. Norman, D. E. Rummelhart (Eds.), Explorations in cognition. San Francisco: Freeman.

Stone, C. A., & Reid, D. K. (1994). Social and individual forces in learning: Implications for instruction of children with learning difficulties. Learning Disability Quarterly, 17, 72-86.

Stone, N. (1991). Developmental college reading: Secrets of our success. Research and Teaching in Developmental Education. 7, 27-42.

Sullivan, L. L. (1980). Growth and influence of the learning center movement. In K. V. Lauridsen (Ed.), New directions for college learning assistance: Examining the scope of learning centers (pp. 1-8). San Francisco, CA: Jossey-Bass.

Sulzby, E. (1985). Children's emergent reading of favorite storybooks: A developmental study. Reading Research Quarterly, 20, 458-481.

Swanson, H. L. (1989). Strategy instruction: Overview of principles and procedures for effective use. Learning Disability Quarterly, 12, 3-14.

Taylor, B. M., & Beach, R. W. (1984). The effects of text structure instruction on middle-grade students' comprehension and production of expository text. Reading Research Quarterly, 19, 134-146.

Taylor, B. M., & Samuels, S. J. (1983). Children's use of text structure in the recall of expository material. American Educational Research Journal, 20, 517-528.

Thelen, E., & Smith, L. B. (1994). A dynamic systems approach to the development of cognition and action. Cambridge, MA: MIT Press.

Tierney, R. J. (1983). Learning from text. Washington, DC: National Institute of Education. (ERIC Document Reproduction Service No. ED 226 321)

Tierson, J. L. (1990). An introduction to connectionism. In J. L. Garfield (Ed.), Foundations of cognitive science: The essential reading (pp. 381-397). New York: Paragon House.

Torgessen, J. K. (1977). The role of nonspecific factors in the task performance of learning disabled children: A theoretical assessment. Journal of Learning Disabilities, 10, 27-34.

van Dijk, T. A., & Kintsch, W. (1983). Strategies of discourse comprehension. Orlando, FL: Academic Press.

Voss, J. F., & Silfies, L. N. (1996). Learning from history text: The interaction of knowledge and comprehension skill with text structure. Cognition and Instruction, 14, 45-68.

Vygotsky, L. (1978). Mind and society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Weaver, C. (1994). Reading processes and practice: From socio-psycholinguistics to whole language (2nd Ed.). Portsmouth, NH: Heinemann.

Wertsch, J. V. (1979). From social interaction to higher psychological processes. Human Development, 22, 1-22.

Wiener, H. S., & Bazerman, C. (1978). Reading skills handbook. Boston: Houghton Mifflin.

Winn, J. A. (1994). Promises and challenges of scaffolded instruction. Learning Disability Quarterly, 17, 89-104.

Winograd, P. N. (1984). Strategic difficulties in summarizing texts. Reading Research Quarterly, 19, 404-425.

Wong, B. Y. L. (1980). Activating the inactive learner: Use of questions/prompts to enhance comprehension and retention of implied

information in learning disabled children. Learning Disability Quarterly, 3, 29-37.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. Journal of Child Psychology and Psychiatry, 17, 89-100.

Wood, N. V. (1997). Reading instruction as reflected by current reading textbooks. Journal of College Reading and Learning, 28 (3), 79-95.

Wright, D. A. (1985). Many college freshmen take remedial courses. Washington, DC: National Center for Educational Statistics. (ERIC Document Reproduction Service No. ED 262 742)

Yellott, R., Dilks, L., Dick, J., & Ware, C. (1985). Critical thinking: Theories and strategies in reading, English and mathematics. Journal of College Reading and Learning, 28, 48-58.

Zabrucky, K. (1990). Evaluation of understanding in college students: Effects of text structure and reading proficiency. Reading Research and Instruction, 29, 46-54.

APPENDIX A
LETTER TO BIOL 1230 STUDENTS

BIOL 1230 Instructors: **Please read this to your class.**

There is a program on campus that may help you with this course. The program is aimed at helping you better understand the information in your Biology textbooks. It should provide you with a better understanding of the material covered in this course and should help you read all of your textbooks better.

This program took place last semester and all of the participants improved their reading comprehension dramatically. It is part of a study investigating different approaches to improving general reading comprehension.

The program consists of meeting with Ms. Martino three hours per week for approximately eight weeks. If you would like to participate in this program, please see your instructor or sign the sign-up sheet in Dr. Fulginiti's office in Room 403A. Ms. Martino will contact you.

If you need further information, you can call Ms. Martino at 485-5090.

APPENDIX B
CONSENT FORM

TITLE: Treatment Approaches for Reading College Expository Text

Dear Xavier Student:

INVITATION TO PARTICIPATE

You are invited to participate in a research project to help us learn about two different treatment approaches to reading expository text (non-fiction). One is a language-based approach and the other is a skills-based approach to improving reading comprehension and speed.

PURPOSE OF THE STUDY

Many college students have difficulty reading and comprehending their textbooks. Findings indicate that college developmental reading programs help some students but not others. Also, some studies have indicated that, while students learn reading strategies in those courses, they sometimes fail to transfer what they learned to other courses. And finally, some students had no difficulty reading high school materials, yet they find that the reading material is harder in college textbooks. This study will investigate using a course textbook to help students improve their reading rate and comprehension abilities.

EXPLANATION OF PROCEDURES

We are seeking permission for you to participate in a study. You will be asked to take a reading test and, if you qualify for the study, you will be asked to participate in a treatment program aimed at improving reading three hours per week for eight weeks. An instructor who has been trained in these approaches will help you read and understand various sections of your Biology text. You will be asked to read aloud and answer questions pertaining to the text. You will also be asked to read and answer questions from other texts periodically. At the end of the study, you will be asked to take another reading test.
These interactions will be audiorecorded and videorecorded. These recordings will be used to provide measurements of your reading ability and to make sure the instructor is providing appropriate treatment.

POTENTIAL RISKS AND BENEFITS

This study does not involve any risk to you. It may provide you with a better understanding of the material covered in your Biology course and it may help you to read all of your texts better.

ASSURANCE OF CONFIDENTIALITY

The information that we collect from this study will be treated confidentially. Your name will not appear anywhere in the research reports. Written, audiorecorded, and videorecorded data will be stored in locked cabinets, available only to the research personnel directly involved in this study.

WITHDRAWAL FROM THE STUDY

Participation in this study is voluntary. If you decide to participate, you are free to withdraw your consent and to discontinue the study at any time.

OFFER TO ANSWER QUESTIONS

If you have additional questions, please feel free to contact either of the individuals listed below. If you are willing to participate, please sign this form in the space provided below and return it to the investigator. Thank you for your interest in this project.

YOUR SIGNATURE INDICATES THAT, HAVING READ AND/OR HAD EXPLAINED TO YOU THE INFORMATION PROVIDED ABOVE, YOU ARE VOLUNTARILY MAKING A DECISION TO PARTICIPATE IN THE PROPOSED STUDY. YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP.

Signature of Subject	Date
Signature of Investigator Nancy L. Martino XU: 485-5087	Chair of Xavier University IRB Charles Gramlich XU: 483-7397

APPENDIX C
CONSENT TO RELEASE ACT/SAT SCORES

I hereby give my consent to release my ACT and/or SAT score to Ms. Martino for the purpose of a research study. I understand that this information will be treated confidentially and will only be used for this study. I further understand that, at the conclusion of this study, this information will be destroyed.

Signature of Subject	Date
SS #	Date

APPENDIX D
CRS INTERACTIONS

Parsing:

Sentence: Covalent bonds involve the sharing of electrons between atoms in a way that results in each having a filled valence shell.

FACILITATOR (Preparatory set): Remember we said that atoms join together by chemical bonds. This sentence talks about one of those kinds of bonds. Read the first part of that sentence to find out one way atoms join together.
STUDENT: Covalent bonds involve the sharing of electrons.
FACILITATOR (Preparatory Set): In a covalent bond, two or more atoms share their electrons so that something gets filled. Read the rest of the sentence to determine what gets filled.
STUDENT: electrons between atoms in a way that results in each having a filled valence shell.

Cloze:

FACILITATOR: There are three types of epithelial cells . And we determine the type by their ___.
STUDENT: Shape.
FACILITATOR: Right. By their shape. What are the three types? Read that part, Susie.

Explanations to link ideas together:

Sentence: Muscle fibers are either smooth or striated (having stripes).

FACILITATOR: The fibers of a muscle tissue are one of two kinds. What are the two kinds of fibers?
STUDENT: (Reads sentence correctly.)
FACILITATOR: So there are two kinds of fibers.
STUDENT: Smooth and striated.
FACILITATOR: Right. Smooth or striated fibers. And striated means ___.
STUDENT: Striped.
STUDENT: I thought there were three types: smooth, skeletal, and cardiac.
FACILITATOR: Yes, there are three types of muscle tissue (stress on the words, *muscle tissue*): smooth, skeletal, and cardiac. Is it confusing because it's the same word? Smooth is a type of muscle tissue but it's also a way to describe muscle fibers. There is smooth muscle tissue that is composed of smooth fibers. You have smooth fibers and striated fibers. What types of muscle tissue has striated fibers?
STUDENT: Skeletal and cardiac?
FACILITATOR: Yes.

Associate old information with information just read:

Sentence: Epithelial tissue forms the outer layer of the skin and it is called the epidermis.

FACILITATOR: Do you remember back in Module I, what was the definition of an organ?
STUDENT: A group of tissues that have a specific function.
FACILITATOR: Right. And who remembers what the definition of a tissue is.
STUDENT: A group of cells that work together.

FACILITATOR: OK. So now look at that sentence you just read and tell me if skin is an organ or a tissue.

Generalizing:

Sentence: Organisms carry out conversions between potential energy and kinetic energy.
FACILITATOR (Preparatory Set): We're talking about energy in terms of converting energy. The first part here discusses energy conversion. Read the sentence.
STUDENT: Reading: *Organisms carry out conversions between potential and kinetic energy.*
FACILITATOR: What does conversion mean?
STUDENT: To transfer the energy.
FACILITATOR: To transfer or change from one form to another. Here it means that the energy changes from kinetic to potential energy or potential to kinetic energy. But the word can be used to talk about other things that change. Like a religious conversion or money conversion. You can convert from being a Catholic to being a Baptist. And you can convert money from U. S. dollars to British pounds.

Paraphrase:

Sentence: Two laws of thermodynamics govern energy transformations.

FACILITATOR (After the sentence was read fluently by the student): These laws of energy or laws of nature are the rules of all energy transformation.

Semantic Cue:

Sentence: According to the first law of thermodynamics, known also as the law of conservation of energy, the total energy of any closed system remains constant.

FACILITATOR: Let's read the first part of that sentence to see what the first law of thermodynamics is.
STUDENT: Reading: The first laws of thermodynamics is also referred to as the law of conversation (error) of energy.
FACILITATOR: The law of conservation (stressing the word) of energy. Does anyone know what conservation means?
STUDENT: No.
FACILITATOR: Do you know what it means to conserve something? When people talk about the environment, they talk about the conservation movement or just conservation.
STUDENT: Trying to conserve energy?
FACILITATOR: What does that mean? Turn the lights off we're trying to conserve energy.
STUDENT: You don't want to spend too much of something. You're trying to make it last as long as possible.
FACILITATOR: Right. You're trying to make it last. So it's kind of like a protection or a saving. You want to take care of something so we don't run out. So that's a good way to think about conservation of energy.

Further Parsing:

Passage: In almost all energy transformations, some energy is lost as heat to the surroundings. This energy is not destroyed but its capacity to do work is diminished because heat can do work only if heat energy flows from a region of higher temperature to a region of lower temperature.

FACILITATOR: Entropy is the energy that is lost as heat. This leads us then to the second law of thermodynamics.
STUDENT: Reading: In almost all energy transformations, some energy is lost as heat to the surroundings.
FACILITATOR: Yes. And there's the picture of the runner who is giving off heat (pointing to picture). This energy goes into the surroundings. Let's see what happens now.
STUDENT: Reading: This energy is not destroyed but ins- (error) capacity to do work is distinct - diminished because heat can do work only if heat energy flows from a region of higher temperature to a region of lower temperature.
FACILITATOR: Its capacity to do work is diminished. What does that mean?
STUDENT: It's lowered.
FACILITATOR: Right. (Paraphrasing): The amount of energy has a lowered or decreased capacity to do work. It's not able to do as much work. (Further parsing) Read the rest of that sentence to find out why.
STUDENT: Reading: because heat can do work only if heat energy flows from a region of higher temperature to a region of lower temperature.

APPENDIX E
PROBE PASSAGE AND QUESTIONS

Week 3 Probe

Read the following paragraph carefully. When you are finished, give this paper to Ms. Martino. She will give you some questions to answer.

The Endomembrane System

Most cell biologists now consider many of the different membranes of the eukaryotic cell as part of an endomembrane system. These membranes are related either through direct physical contact or by the transfer of membrane segments through the movement of tiny vesicles (membrane-enclosed sacs). These relationships, however, do not mean that the various membranes are alike in structure and function. The thickness, molecular composition, and metabolic behavior of a membrane are not fixed, but may be modified several times during the membrane's history. The endomembrane system includes the nuclear envelope, endoplasmic reticulum, Golgi apparatus, and the plasma membrane. The following paragraph discusses the endoplasmic reticulum.

The endoplasmic reticulum (ER) is a membranous labyrinth so extensive that it accounts for more than half of the total membrane in many eukaryotic cells. (Endoplasmic means within the cytoplasm, and reticulum means network.) The ER consists of a network of membranous sacs or cisternae which are separate from the cytosol; however, the ER membrane is continuous with the nuclear envelope. There are two distinct regions of ER that differ in structure and function: rough ER and smooth ER.

Many types of specialized cells secrete proteins produced by rough ER. For example, white blood cells in humans and other vertebrates secrete antibodies. Proteins destined for secretion are synthesized by ribosomes attached to the rough ER. Most secretory proteins are glycoproteins, which are proteins covalently bonded to carbohydrates.

Week 3 Probe Questions

Answer the following questions.

1. The ER membrane is separate from the ___ because of the structure of its flattened sacs.
   a. cisternae
   b. ribosomes
   c. nucleus
   d. cytosol (correct answer)

2. The ER membrane is continuous with the
   a. nuclear envelope (correct answer)
   b. Golgi Apparatus
   c. cytosol
   d. ribosomal vacuoles

3. Proteins which are attached to carbohydrates are called glycoproteins. They are attached by
   a. ionic bonds
   b. covalent bonds (correct answer)
   c. hydrogen bonds
   d. polar bonds

4. Reread the following passage and give a definition of antibodies.

Many types of specialized cells secrete proteins produced by rough ER. For example, white blood cells in humans and other vertebrates secrete antibodies. Proteins destined for secretion are synthesized by ribosomes attached to the rough ER.

Correct answer: Proteins produced by rough ER and secreted by white blood cells.
(Must have **proteins** for one point and either **produced by rough ER** or **secreted by white blood cells** for one point.)

5. Recalling that endoplasmic means **within the cytoplasm**, define endomembrane system.

Correct answer: A group of related membranes within the cell.
(Must have **group**, **collection**, or **set**, etc. for one point and **within the cell**, **within the cell membrane** or **within the membrane** for one point.)

6. What is the difference between rough and smooth ER?
Correct answer: Rough ER has ribosomes; smooth ER does not have ribosomes.
(Each part of answer is worth one point.)

APPENDIX F
PASSAGE FROM BIOLOGY TEXT
(Solomon, Berg, Martin, & Villee, 1996)

Hydrogen-bonding makes water cohesive and adhesive

Water molecules have a very strong tendency to stick to each other; that is, they are cohesive. This is due to the hydrogen bonds among the molecules. Water molecules also stick to many other kinds of substances, most notably those with charged groups of atoms, or molecules on their surfaces. These adhesive forces explain how water makes things wet.

In a covalent bond between two different elements, such as oxygen and hydrogen, the electronegativities of the atoms may be different. If so, electrons are pulled closer to the atomic nucleus of the element with the greater electron affinity (in this case, oxygen). A covalent bond between atoms that differ in electronegativity is called a polar covalent bond. Such a bond has two dissimilar ends, or poles, one with a partial negative charge and one with a partial positive charge. Each of the two covalent bonds in water is polar because there is a partial positive charge at the hydrogen end of the bond and a partial negative charge at the oxygen end, where the "shared" electrons are more likely to be found.

APPENDIX G
SKILLS LESSON

Week 6: Comparison and Contrast

In order to make a point clearer, a writer often shows how two objects or ideas relate to each other. He or she may show how two things are alike (comparison) or how they are different (contrast). In some cases, the writer may point out how the things are both alike and different.

In one type of comparison and contrast, the writer tells everything about one idea and then everything about the second idea. In the paragraph below, the writer shows the good and bad features of living in a large hotel s a child.

For a child in a big hotel, there were distinct advantages. In addition to having so many recreational facilities available, I never had to do many of the things kids hate to do - like make my bed, was the dishes, take out the garbage, or even clean my room. There was always someone on the staff who was paid to take care of such chores. On the other had, there were disadvantages. Never was I able to eat breakfast in my pajamas. I had to dress for every meal. Nor could I ever raid the icebox. And privacy was something very hard to come by. growing up in a hotel is like growing up in a goldfish bowl. Everybody always seemed to know what everybody else was doing at every given moment. Gossip was the name of the game.

-Tania Grossinger

Notice that in the first part of the paragraph, the details explained the advantages of living in a hotel. But in the second half of the paragraph, the details explained the disadvantages.

Another type of comparison and contrast allows the writer to state one point and discuss both objects in regard to that idea; then to state another point and discuss both objects in regard to that idea, and so on.

The New York Times and the New York Daily News are really quite different. The two newspapers do not even look alike. Each page of the Times is twice the size of each page of the News. And as a tabloid - a smaller newspaper - the News uses many more pictures as a way to report events. They are also different in regard to types of stories each presents. The News is concerned with human interest stories, many about sensational people or events. The Times, although it does not neglect human interest, offers more news of worldwide importance.

Here are some tips for understanding comparison and contrast:

* Look for key words that help relate the two objects or ideas. These words point to like ideas:

similarly	further
also	in the same way
in addition	likewise

These words point to ideas that differ:

but	in contrast
although	yet
however	conversely
nevertheless	still
on the other hand	in spite of

* Look for a sentence or two that tells just what is being compared.

Exercises

1. Underline the two sentences that tell what is being contrasted.
2. What are some advantages in living as a child in a large hotel?
3. What are some disadvantages in being a child in a big hotel?
4. What is the main idea in the second selection?
5. How do the newspapers compare in appearance?
6. How are the stories in the Times different from the stories in the News?

The following questions can be answered by reading your biology textbook.

7. What do an endergonic reaction and an exergonic reaction have in common?
8. How are they different?
9. What do free energy and potential energy have in common?
10. How are they different?
11. What do catabolism and anabolism have in common?
12. How are they different?
13. What do a substrate and a product have in common?
14. How are they different?

APPENDIX H
PERMISSION TO USE TEXTS

HARCOURT BRACE

Harcourt Brace & Company
6277 Sea Harbor Drive
Orlando, FL 32887
Tel 407-345-2000

June 8, 1998

SCP REF: MARTINO/

Nancy L. Martino
Communications Department
Xavier University of Louisiana
7325 Palmetto Street
New Orleans, LA 70125

Dear Ms. Martino:

In response to your 06/01/1998 letter, we are willing to grant permission for the reprinting of excerpts from Chapters 2, 3, 5, and 6 from BIOLOGY, Fourth Edition by Eldra Pearl Solomon, Linda Berg, Diana Martin, Claude A. Villee (Request ID Num: 109867) in your forthcoming dissertation, provided it includes the title page and copyright page of our work (or equivalent information which includes: title, author(s) and/or editor(s), copyright (C) year and claimant(s), reprinted by permission of the publisher).

We are also willing to grant permission for your thesis to be reproduced and distributed in 50 copies only, by University Microfilms, provided you give complete credit to the source. If your dissertation is committed for publication, we ask that you reapply.

Our permission does not cover any graphics, illustrations, or text which may be incorporated in our material.

Our permission does not cover electronic use, including scanning, unless otherwise noted herein.

Sincerely,

Arin Gullett
Paralegal Group

Saunders College Publishing
Permissions Dept., 6th Floor
Orlando, FL 32887-6777
(407) 345-4142

A Publishing Subsidiary of Harcourt General, Inc.

Houghton Mifflin Company

222 Berkeley Street, Boston, Massachusetts 02116-3764
(617) 351-5000 Cable HOUGHTON

College Division
TELEX 4430255
FAX 617-351-3801

June 6, 1996

Dear Sir/Madam:

Thank you for your request to use material copyrighted by Houghton Mifflin Company in your Thesis or Dissertation. We are pleased to grant permission to you to do so without charge. We do, however, ask that you reapply for permission should you choose to use the same material in a commercial publication.

Please use the following format for your credit line: Author/Title/Edition or Volume/Copyright © Year by Houghton Mifflin Company. Used with permission.

Sincerely,

Elin Goldman
Rights & Permissions Department

Enclosures (includes original request)

TO: NANCY MACHADO

2 PAGES

XAVIER UNIVERSITY OF LOUISIANA
Communication Department
7325 Palmetto Street
New Orleans, LA 70125
Office: 504 485-5090
Fax: 504 485-7915

Permissions Department
Houghton Mifflin
Boston, MA

To whom it may concern:

I am [illegible] working on my thesis in the area of Communication and Reading Disorders. My research is with college students who are poor readers. In my [illegible] I would like to use the following book:

Winne, H. S., & Baumann, C. (1978). reading skills handbook. Boston: Houghton Mifflin.

May I have permission to use pages 11-15 in my dissertation as an example of what some students worked on?

Sincerely,

Mary L Martin

[illegible] M.A.C.
Instructor

VITA

Nancy L. Martino received her bachelor of science degree in Speech Pathology from Pennsylvania State University in 1978 and her master of arts degree in Speech Pathology from the University of Tennessee in 1985. Currently, Ms. Martino is an instructor in the Communications Department at Xavier University of Louisiana. She is a doctoral candidate at Louisiana State University and will have the degree of Doctor of Philosophy in December, 1998.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Nancy L. Martino

Major Field: Communication Disorders

Title of Dissertation: Investigation of Two Treatment Approaches for Improving College Students' Comprehension of Science Text

Approved:

Major Professor and Chairman

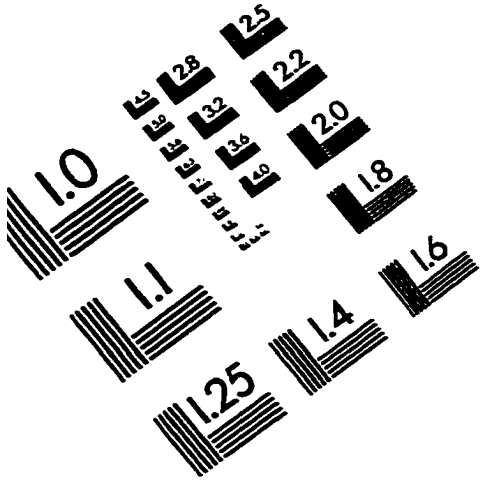
Dean of the Graduate School

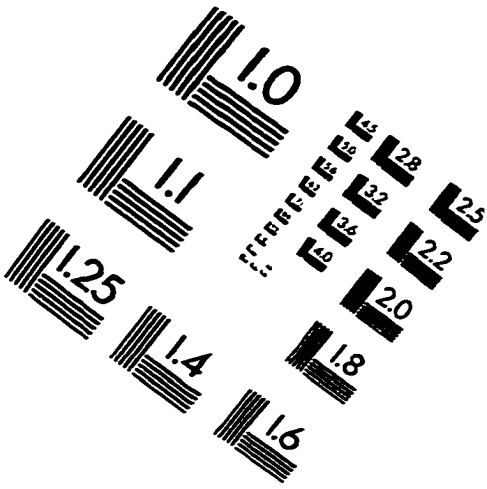
EXAMINING COMMITTEE:

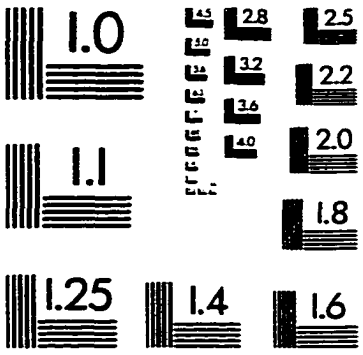
Date of Examination:

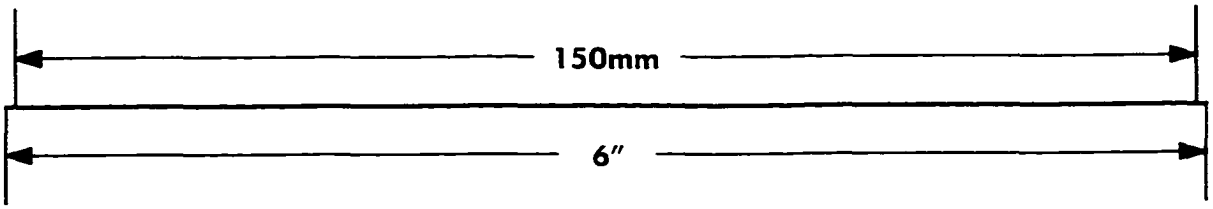
10-26-98

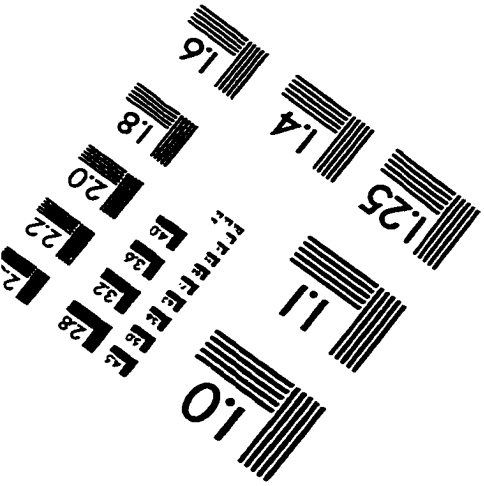
IMAGE EVALUATION
TEST TARGET (QA-3)











APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989