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City University of New York PH.D. 1980

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PSYCHOLINGUISTIC BASES OF READING DISABILITY:

A STUDY IN SENTENCE COMPREHENSION

by

SHARON GOLDSMITH

A dissertation submitted to the Graduate Faculty in Speech and Hearing Sciences in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

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September 15, 1982
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Abstract

PSYCHOLINGUISTIC BASES OF READING DISABILITY:

A STUDY IN SENTENCE COMPREHENSION

by

Sharon Goldsmith

Advisors: Professor Arthur Bronstein, Chairman
Professor Harry Beilin
Professor Paula Menyuk

This study explored the relationship between language and reading by providing information on listening and reading comprehension processes in normally achieving and reading disabled school age children. The study examined the language comprehension strategies reflecting competing views of language processing. These emphasized: a) The influence of syntactic information within a transformational framework, b) The influence of semantic constraints, and, c) The influence of noun function and perceived temporal order of elements. In particular, the study examined the degree of comprehension difficulty (as predicted by these views) which children encountered when listening to and reading relative clause sentences.

One hundred and sixty reading disabled and normally achieving subjects from third and sixth grades manipulated toy objects to act out thirty-two auditorily presented and thirty-two visually presented relative clause and conjoined control sentences. The design of the study permitted study of the following effects on performance, the last three variables being repeated measures:

GROUP: normally achieving vs. reading disabled

GRADE: third grade vs. sixth grade

SYNTACTIC COMPLEXITY: six types of relative clause sentences

SEMANTIC CONSTRAINTS: reversible vs. non-reversible sentences

MODE OF PRESENTATION: listening vs. reading

Using analysis of variance it was found that all main effects except mode of presentation are significant. Neither the reading disabled nor normally achieving groups displayed significant differences in reading comprehension as compared to auditory comprehension. Disabled readers exhibited a depressed ability in comprehending written material and an equally depressed ability in comprehending spoken material. Significant correlations between mean scores as well as major strategies used in listening and reading tasks were obtained. Duncan Multiple Range procedures provided significant rankings of sentence complexity which were consistent with performance predictions from a theory of sentence comprehension positing a strategy of assigning actor-action-object relationships based on perceived temporal order of elements. Chi square tests on proportions of strategy overuse confirmed group differences in patterns of strategy preference.

The research provided evidence to support previously developed theories concerning the view of language comprehension based on temporal ordering of elements and semantic cueing and demonstrated that such theories are relevant for visually presented information. Reading comprehension and language comprehension are parallel processes which are linked by a common method of representation. This link,

on the level of sentence comprehension, is characterized by the use of identical comprehension strategies for facilitating syntactic analysis.

Reading disabled and normally achieving subjects had identical repertories of comprehension strategies available to them. Strategies used by younger children appear to be integrated in the repertory and reappear when complex material is presented. Reading disability was demonstrated to be related to a bi-modality deficit in the ability to appropriately select or utilize strategies from this repertory. The reading disabled subjects demonstrated increased use of non-efficient and immature strategies suggesting the need for further research on the role of maturation as a factor in reading disability. Comprehension problems of reading disabled subjects reflect greater difficulty in ordering of elements than in utilizing semantic information. This suggests that two sentence comprehension systems operate utilizing and integrating aspects of both systems. Implications for a theory of language acquisition and instructional practices are presented.

IN MEMORY OF MY GRANDFATHERS

MR. LOUIS COHEN

MR. HAROLD SPRING

Their love, their strength and their sense of purpose will always remain with me.

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Professor Paula Menyuk shared so freely her immense knowledge in the field of psycholinguistics and reading. As a distinguished scholar and an extraordinary individual, she serves as an inspiration one can only hope to begin to emulate.

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CHAPTER I

INTRODUCTION

In recent years there has been much interest in the relationship between language and reading. This interest has been motivated by a number of concerns, not the least of which is the increasingly large number of children who are experiencing difficulty learning to read in a manner not commensurate with their potential.

Gibson & Levin (1975, p. 75) indicate that 25% of school age children read more poorly than their grade levels would predict. Harris and Sipay (1975) summarize several nationwide surveys and report that depending on the criteria used to measure reading disability, between 20% and 40% of any school age population are reading one or more years below grade level.

The large proportion of older children with reading difficulties suggest that a major source of reading difficulty may reflect difficulty in the comprehension of written sentences as well as a difficulty in developing phoneme-grapheme correspondences or decoding individual words.

Harris & Sipay (1975, p. 15) note that 30% of fourth graders and 35% of sixth graders are one or more years behind in reading. Thirty three percent of eighth grade students within the Chicago public school system were judged to be reading one to four years below expected achievement levels during the 1977-78 school year. (Katims, 1979 p. 12). Studies reported through the national media would indicate that the above figures do not represent isolated instances of skill deficit.

The nationwide movement toward minimal competency testing for elementary, middle, and high school age children in reading as well as listening and speaking can be interpreted as a reflection of the widespread concern regarding the incidence of reading problems and an acknowledgement of the importance of auditory and verbal language skills to academic achievement.

Psycholinguistics and Reading

A relationship between comprehension of speech and writing has long been acknowledged. Huey (1903, 1968) viewed reading as a skill which at least in part, was linguistic in nature. Bloomfield & Barnhart (1961), Fries (1963), and Venesky (1976), have emphasized the importance of linguistic knowledge by developing reading programs which taught phoneme-grapheme correspondences.

Langendoen (1969, p. 6) views reading and writing as simply "manifestations of a language." Carroll (1977, p. 1) taking a similar position, views reading as a way "in which language manifests itself...A discussion of reading comprehension really has to be a discussion about language comprehension."

Mattingly (1972, p. 145), has stated that "(reading) is a language based skill dependent upon the speaker-hearer's awareness of certain aspects of primary linguistic activity. By virtue of this linguistic awareness, written text initiates the synthetic linguistic process common to both reading and speech."

However, the nature of the synthetic linguistic process used for the comprehension of written or spoken material remains the

subject of extensive controversy in both the linguistic and psycholinguistic literature. Additionally, or perhaps as a result of this controversy, the nature of the language-reading relationship, specifically the processes they share in common, remain to be explored.

The processes which characterize the reading/language relationship have long been limited to a tacitly implied or overtly expressed assumption that a child learning to read must possess a certain degree of expertise in verbal language, before the child can be expected to read. Children with more language exposure and experience have been demonstrated to be better readers than children with less language experience. (C. Chomsky, 1972).

Although Menyuk (1976a, p. 252) has stated that "...the child's knowledge of the structure of language forms the basis upon which knowledge of written (material) is achieved," little attention has been paid to systematically exploring the relationship between syntactic knowledge and reading skills. One possible reason for this is that the bulk of research examining syntactic processes in children was conducted on young (and prereading) subjects. Indeed there has been a widely held belief that the child's syntactic processes are complete by age five or six (McNeil, 1970).

This coincides with the time reading instruction is introduced within our schools. Recent research (Beilin, 1975; C. Chomsky, 1969; R. Cromer, 1970; and Menyuk, 1977), has demonstrated that children continue to acquire more sophisticated language mechanisms well beyond the age of six or seven. Kessel (1970), for example, tested

comprehension of syntactic structures in children age six to twelve, and discovered that it was not until age twelve, that proficiency was demonstrated in the comprehension of structurally ambiguous sentences. Fluck (1979) demonstrated that boys of age nine were still making errors in the comprehension of relative clause sentences.

Partially as a result of the assumption that language learning was complete by the time the child entered school, reading problems, when they did occur, were viewed as a result of deficits in visual perception and visual integration. (Birch & Belmont, 1965). Indeed the terms "dyslexia" and "reading disability" were long used synonymously with the term "word blindness" (Radwin & Wolf-Ward, 1977).

Recently the view of reading deficit as a linguistic problem has received considerable attention in the literature (Rees, 1973; Stark, 1974, Wallach & Goldsmith, 1976). Wepman (1960), de Hirsch (1966), and more recently Roit (Note 2) and Velluntino (1977), have commented on the positive correlations between poor scores on measurements of expressive and receptive language skill and scores on standard measurements of reading skill. Wigg & Semel (1976), and Vogel (1975), demonstrated that children with reading deficits also display problems in their comprehension and use of complex sentence structure, relational items, and morphophonemic markers.

Purpose of this Study

The developing field of psycholinguistics has moved the study of child language research from an earlier emphasis on recording

and categorizing language samples, based on sentence length and frequency of nouns, to a field of study based on methods of behavioral research which actively manipulate and control variables within an experimental (linguistic or extralinguistic) environment in order to support specific theories concerning the acquisition, comprehension or use of language.

However, little of this theory based research has been applied to the study of reading. Schlesinger (1968), in discussing the research on reading-language relationships, noted the lack of theoretical orientation in reading research. He also noted a lack of application of language research to the study of reading processes. Readability formulas to predict degree of difficulty of sentence comprehension are still limited to measures of sentence length, and complexity of lexical items employed (as measured by the number of syllables and the frequency of occurence) (Harris, 1975). Sentence structure was not employed as a criterion of the readability formulas reviewed.

Fortunately many useful studies in reading are now beginning to emerge. A number of them have studied correspondence rules between phonological, morphological and graphological features and their respective influences on processing (Conrad, 1972; Elkonin, 1973; Gibson & Guinett; 1971). Additional research is emerging which expands on these findings in phoneme perception, grapheme-phoneme correspondences and the relative influence on processing, by testing their appropriateness for developing theories of reading disability (Shankweiler & Liberman, 1972).

Strickland (1962), Ruddell (1965), Smith (1973), Wardhaugh (1969), Wanat (1977), and Athey (1977), have discussed the influence of psycholinguistic models of language acquisition and structure on the reading processes. Although acknowledging that language structure has an impact on reading, there is limited comprehensive evidence regarding the degree of impact and the implications for defining the nature of the reading/language relationship. Little research has been conducted which systematically examines and demonstrates the nature and extent of the reading-language relationship at the sentence level for either the normal or disabled reader.

Although there is extensive reference in the literature to a notion of strategies for comprehension of spoken language there is little application of this notion to the reading process. This is unfortunate, since an examination of strategies employed in reading could contribute to the study of the language-reading relationship by isolating and describing those comprehension features which are common to both modalities. Additionally, positing a strategy notion applicable to reading would provide insight into the process involved in reading and contribute to a theory of reading and reading disability.

This study will explore issues which are closely tied to the notion of processing strategies. Language comprehension strategies reflecting competing views of language processing will be examined. These views emphasize: a) the influence of syntactic information within a transformational framework, b) the influence of semantic constraints, and, c) the influence of function and order relationships.

This will be accomplished by examining the degree of comprehension difficulty as predicted by these views which children encounter in processing complex sentences.

Additionally, this study will support the view that reading and language are equivalent, interdependent systems which are linked to each other through a common method of representation which on the level of sentence comprehension is characterized by the use of identical strategies for facilitating syntactic analysis.

These sentence comprehension strategies, (which will be examined within three popular competing frameworks of analysis - syntactic/semantic/cognitive) are proposed as being sensitive to the rules of linguistic description, but are not outcomes of these rules. Rather, it is suggested the strategies reflect general comprehension mechanisms which utilize function and order of elements. Both the listener and the reader require the capacity to utilize these strategies in an efficient fashion in order to abstract meaning from the speaker's and author's messages.

Processing of written sentences will be demonstrated to have correlates in processing of spoken sentences because both systems are parallel means of representation which are sensitive to individual system constraints. Their mutual link is not one of <u>dependency</u>, but of <u>common function</u>, that of representation and a common bond to a more general representation system. Reading difficulty, at least for some portion of the population, might indeed be characterized as an inability to comprehend certain relationships and functions expressed

in language, regardless of whether they are auditorily or visually presented.

The purpose of this study is to provide further information on reading comprehension processes in normal and reading disabled school age populations. This will be accomplished by examining the appropriateness of extending selected theories of oral language sentence processing to processing of written sentences. Within this framework, reading disability will be demonstrated to be a bimodal deficiency in the ability to consistently employ, select or alter comprehension strategies in an effective manner.

Experimental Hypotheses

This study will examine the hypothesis that reading and oral language, are linked to a common representation system. What will be assessed are correlates in the processing strategies employed in comprehension of spoken and written sentences.

The hypothesis, that reading disability represents a bimodal processing strategy difficulty, will be tested by examining the comprehension strategies employed by children, manifesting reading disability across visual and auditory modalities, and by comparing these strategies to those employed by normally achieving children.

Experimental Hypotheses are outlined as follows:

1. Reading disabled students display quantitative and qualitative differences in strategy patterns as compared to normals.

2. Third grade subjects display quantitative and qualitative differences in strategy patterns as compared to sixth grade subjects.
3. For each group linguistic compexity affects comprehension more than mode of presentation.

   For each group:

   a. Strategies employed will remain consistent across listening and reading domains.
   b. For each group a positive correlation exists between listening performance and reading performance.
4. For each group syntactic structure affects degree of comprehension.

   a. an order of difficulty exists for syntactic complexity with nonparallel function sentences being more difficult to process than parallel function sentences.
   b. reduced relative clause sentences are the most difficult of all.
5. An interaction exists between semantic information and syntactic information within sentences.

   For each group:

   a. semantically constrained sentences are easier to process than semantically nonconstrained sentences, when degree of syntactic complexity remains constant.

6. Consistent measurable patterns of error will emerge indicating use of canonical order, and parallel function strategies in processing of relative clause sentences.

CHAPTER II

BACKGROUND AND RELATED LITERATURE

Nature of the Reading and Language Relationship

Reading is a complex process (Kolers, 1970), requiring as many as twenty-one subskills (Herber, 1967). As a result, the relationships one can formulate between spoken language comprehension and reading comprehension are numerous; relationships which are formulated will obviously be influenced by the particular subskill (or group of skills) one is interested in exploring, as well as the theoretical framework within which one conducts an investigation and the experimental methodology employed.

Perhaps the most popular method of demonstrating the reading language relationship has been through correlation studies, in which reading achievement (as measured by standardized testing instruments) is shown to correlate with language skill (as measured by standardized testing instruments). de Hirsch (1966) after conducting a series of longitudinal studies concluded that low scores on clusters of specific language tests in kindergarten correlated with low scores on reading achievement in first and second grade. Burrows (1978) demonstrated that performance of kindergarten age children on widely used commercially prepared tests of auditory discrimination and comprehension correlated very highly (.80) with performance on a popular reading readiness test. Devine (1978) reviewing the research on correlations between listening and reading

skills reports the uniformly high correlations between tests which measure listening skills (particularly auditory memory, sequencing and discrimination) and reading tests.

There is evidence to indicate that strong correlations are more frequently obtained between measures of reading skill and measures of language skill than are obtained between measures of reading skill and either measures of visual perceptual skill or measures of general intelligence (Roit, Note 2; Vernon, 1977).

Studies in process by this author suggest that examining correlations between scores on reading tests and language tests is not a worthwhile avenue to explore. Particularly at the kindergarten level, commercial reading tests are largely measures of auditory skills. Indeed an informal perusal of test items used in tests of reading and tests of language (at the readiness level) suggests many items are measuring identical skills, and are occasionally identically worded. Correlations then between reading readiness tests and listening tests might be more valid as studies in item reliability than as studies concerning relationships between auditory and visual processing of linguistic information.

A number of researchers have examined correlations between knowledge of specific syntactic structures and reading ability.

Ruddell (1965); Strickland (1962); and Tatham (1970) in related studies have demonstrated that children achieve better comprehension scores reading passages containing high frequency (as compared to low frequency) lexical items and structures. They concluded that

comprehension of sentence structure is correlated to reading comprehension.

Harris (1975) demonstrated significant correlations between second graders syntactic skills in oral and written language and reading achievement and concluded that correlation of syntax proficiency to reading achievement was higher than correlation of I.Q. scores to reading achievement.

Rabinovitch and Strassberg (1968) noted that good readers utilize syntax better than poor readers and suggested that some poor readers are deficient in their knowledge of syntax or in their ability to utilize it for reading. Wiig, Semel and Crouse (cited in Wiig & Semel, 1976) compared performance in average and poor nine-year-old readers on the Berko test of morphology and found poor readers deficient in the use of morphologic markers. Similar findings were demonstrated by Hook (1976) using the grammatical closure subtest of Illinois Test of Psycholinguistic Ability on nine and ten-year-old problem readers.

Vogel (1975) compared the performance of seven and eight-year-old normally achieving children with dyslexic children of the same age using a variety of measures of syntax related skills including recognition of melody, recognition of grammatical acceptability, comprehension of syntactic structures, sentence repetition and expressive use of syntactic and morphophonemic markers. Vogel found performance differences between the dyslexic and normal group in recognition of melody, sentence repetition and expressive syntax and

morphology. There were no differences between groups in recognition of grammaticality and comprehension of syntax. It is important to note that Vogel's measure of syntax comprehension could not be expected to be reliable discriminators between performance of her experimental groups. Vogel used the Northwest Syntax Screening Test as the measurement of syntax comprehension. This instrument is designed for children up to seven years and eleven months. Students participating in Vogel's study were between seven years four months and eight years five months of age and it is likely that a ceiling effect was achieved for both populations. Vogel (1975, p. 80) concludes that dyslexics with reading comprehension difficulties were found to be significantly deficient in oral syntax...syntactic ability accounted for approximately one-half of the variance in reading comprehension at the second grade level.

Although much of the research summarized to this point is interesting in demonstrating reading to be a language based activity, and in correlating linguistic variables of morphology and syntax to reading ability, the research has limited value. There is lack of a theoretical foundation concerning the nature of the relationship between oral language comprehension and reading as well as the absence of performance predictions for the process of reading as it occurs in disabled and competent readers.

Within the general framework of reading and language as related activities, two competing theories are of interest. One theory assumes that reading and language are related in a hierarchical

manner; the other theory posits reading and language as parallel processes.

Language and Reading as Hierarchical Processes

Those who subscribe to reading as existing in a hierarchical relationship with language view reading as a higher order language skill, superimposed on spoken language. In this sense reading is a process derived from language (Fries, (1963, p. 113). A skilled reader is a skilled language user who transfers his language skills to the reading process (Venesky, 1976). Bloomfield and Barnhart, (1961) emphasized the reading process as a decoding of the graphemic symbols on a printed page into the phonetic system the reader already knows. Mattingly (1972) has stated that reading is a higher order linguistic process dependent on spoken language. Within this framework reading is viewed as a second order process, dependent on prior linguistic competences and parasitic on language. Myklebust (1954, 1978), conceptualizes this viewpoint by diagraming reading as near the apex of a triangle which is built of a hierarchy of skills beginning with perception and discrimination of sounds, through oral comprehension and use, then written language comprehension (reading) and finally writing. Myklebust (1978) notes that transforming printed symbols to the oral level remains an important comprehension aide, even for the competent reader.

These viewpoints suggest that reading disability may result from defective decoding at the phonological level (Wepman, 1960), or

between graphemic or phonological levels or representation. Much of the research within this framework has concentrated on processing of sound and word sequences. Shankweiller and Liberman (1972) demonstrate that poor readers have difficulty synthesizing sounds into words. Savin (1972) notes that poor readers in first grade had difficulty breaking spoken words into phoneme segments, and changing these segments into words. Venesky (1976) concludes that one of the most important distinctions between good and poor readers in both second grade and fourth grade is the ability to decode graphemes into corresponding sounds.

Gibson (1972) has stated that reading is a second order symbol system which is decoded into speech. After this decoding occurs, comprehension processes associated with speech comprehension are activated. Consistent with this viewpoint, reading disability at the sentence level is often viewed as a result of deficient inter-modal transfer of language skills to the reading process (Fries, 1963).

W. Cromer (1970) concludes that the inability of a child to draw simple inferences about a paragraph he has read is failing to apply the semantic integration skills used in listening to the modality of reading.

Keeton (1978) uses S-V-O strings represented as logographs in a recall task with first and second grade subjects to determine if cognitive integration processes which appear in memory for speech apply to memory for information presented in print. Through analyzing error types for incorrect recalls she demonstrated that a

significant number of children do not use the semantic constructive process to assist in comprehension and retention of printed logographic sentences which they utilized in comprehension and retention of auditorily presented material. Keeton concluded that reading involves learning to transfer mediators used in speech comprehension to the context of print. Unfortunately, she did not discuss her different groups of subject performances as they related to performance in school. An interesting and unanswered question is whether her experimental procedure discriminated between good and poor readers as measured by other criteria. Only then could poor intermodal transfer as a factor in reading disability have been demonstrated.

Language and Reading as Parallel Processes

An alternate hypothesis relating reading and language states that reading and language are parallel processes. Kolers (1970), has stated that the skilled reader recognizes grammatical relations and derives meaning directly from words within a language. Written language is not derived from spoken language, but rather is an alternate means of representation (Smith, 1973). N. Chomsky (1970), rejects a view of reading as decoding into speech and states that orthography provides direct access to deep structure. He notes that in order to understand the reading process, it is necessary to examine the underlying system which make both processes possible. Reading deficits within this framework would be viewed as deficits in underlying comprehension and organizational processes, which are common

to, and therefore reflected in, both representational systems. Language deficit and reading deficit would appear simultaneously, but a de facto causal effect would not be assumed.

Weiner and Cromer (1970), posit that linguistic knowledge influences reading skills at a number of different levels. Beyond the phonological level required for identification of individual grapheme sequences, the structure of language limits possible patterns of co-occurence of words and sequences. This structure is identical for both spoken language and reading. Goodman and Goodman (1977, p. 322) and Smith (1975, p. 184-185) have noted that skilled reading does not require preliminary decoding to speech, but does require the ability to utilize those structures used in speech for the processing of visual material.

Biemiller (1970), Goodman and Goodman (1977), Kolers (1970), and Weber (1970) analyzing errors (miscues) made by children while reading orally, note the influence of syntactic structure, including clause boundaries and grammatical function of word in sentence, on both the nature of the errors made and the children's attempts to spontaneously correct these errors.

When making reading errors where children substituted one word for another, children tended to substitute grammatically equivalent part of speech 90% of the time (Weber, 1970).

Kolers (1970) noted that 88% of self corrected errors and 89% of uncorrected errors were syntactically and semantically acceptable with respect to the preceding words in the sentence.

Errors involving syntax were most common in Koler's study and most commonly occured in the portion of the clause containing the verb. Kolers' (p. 108) data suggest perception of the relations a sentence expresses (reflecting utilization of syntactic clues) is more difficult to attain than perception of the things being related (reflecting utilization of semantic information).

Schlesinger (1968) demonstrated that subjects reported seeing blinks of light randomly introduced during an experimental reading process as occurring at clause boundaries. His findings may be viewed as analogous to the findings of the click experiments in oral language comprehension, reviewed by Bever and Langendoen (1976), and suggests similar comprehension strategies are used in the reading process. Additionally, studies of Eye Voice Span indicate that the skilled reader is sensitive to, and utilizes, syntactic constraints while reading (Levin & Kaplan, 1970; Schlesinger, 1968).

There is evidence to indicate that reading disabled children have difficulty utilizing syntactic information. Weinstein and Rabinovitch (1971) compared recall of auditory sentences in grade level and disabled readers in the fourth grade. They demonstrated that the poor readers did not use constraints of word order and morphophonemic markers as efficiently as did normals. In recall of audibly presented material Waller (1976) concurred that disabled readers, as compared with normal readers, had difficiency in utilizing grammatical markers for sentence recall. Torgeson and Goldman (1977) found

dyslexics less likely than normal readers to use verbal rehearsal strategies (such as mneumonic devices) in recall of visually presented material.

Clay and Imlach (1971) found that seven year old children who were diagnosed as poor readers had more difficulty than their grade level peers in grouping words according to grammatical category. Mackworth (1972) drew similar conclusions. He demonstrated that poor readers made more errors and required more time than normals in selecting the correct grammatical category for missing words in a visual cloze procedure. Cromer and Weiner (1966) found that poor reader's responses to missing words in a cloze procedure tended to be less syntactically consistent. Isakson & Miller (1976) found that oral reading errors in good readers increased when syntactic violations were experimentally placed in sentences but that the performances of poor readers were not influenced by syntactic violations.

These studies taken as a group can be viewed as evidence that disabled readers may not be as sensitive to syntactic constraints while reading as are normal readers. However, the nature of the task may be an important variable for disabled readers since studies of miscues (Goodman, 1977; Weber, 1970) demonstrate that spontaneous reading errors produced by reading disabled populations tended to be as syntactically consistent with prior information as those produced by normal populations. In summary, there are differing opinions regarding the degree of sensitivity of the disabled reader to syntactic constraints.

W. Cromer (1970) and Velluntino (1977) note that poor readers tend to perform equally well as competent readers in decoding single words but may lack the ability to place words together.

Perfetti and Goldman (1976) compared performances of third and fifth grade readers on a sentence paraphrase and recall task. They demonstrated that poor readers at both grade levels performed worse than good readers when presented with multiclause sentences but did equally well when presented with single clause sentences. They suggested that poor readers may be weak in combining information from separate parts of the message into a well organized unit. A similar suggestion is voiced by Guthrie (1973) who demonstrated that the disabled population was able to read and comprehend individual words but was not able to integrate this information in reading a paragraph. These two studies show more promise than those previously cited in defining the language and reading relationship as they attempt to suggest potential process differences between normally achieving and disabled populations.

In order to demonstrate that language and reading systems are parallel means of representation as N. Chomsky (1970) has suggested, it would be necessary to employ an experimental methodology which compares the performance of an individual subject as a function of both auditory and visual presentations. Furthermore, in order to demonstrate differences in performance as a result of modality difference, it might be necessary to compare a population of competent readers with a population of immature and/or disabled readers,

since one would expect that a fully competent reader would correctly perform all tasks in both modalities. Unfortunately, there do not appear to be many studies which have employed this experimental methodology. In other words, only a few studies have simultaneously compared both auditory and visual modalities in the same subject using controlled stimuli while employing subjects with varying degrees of reading competence.

Perfetti (1977), studying comprehension of eight syntactic structures in competent and poor third grade readers, noted that poor readers made more errors in both auditory and visual channels than did normals, but they did not make significantly more errors than normals in reading compared to listening. Unfortunately, no analysis of error as a function of syntactic type was reported. However, Perfetti (p. 37) concluded that "comprehension differences occur for an oral task to the same extent as for a reading task."

Similar results were found by Wallach and Goldsmith (Note 4) and Goldsmith (Note 1) who studied syntactic comprehensions of good and poor readers across auditory and visual modalities. Both studies suggested that syntactic complexity made a greater difference in performance than mode of presentation for both the normal and disabled population.

Berger (1978) compared reading disabled and competent fifth graders on their ability to comprehend and recall passages which were auditorily and visually presented to each subject. Skilled readers did better than poor readers on both auditory and visual modalities

as measured by scores on tests of factual comprehension and paragraph recall. However, both groups did better when material was presented orally. Berger concludes that poor readers have a reduced ability to comprehend spoken language and that language comprehension is interrelated with reading comprehension. While employing a potentially exciting experimental design, Berger's study has limited use. Her conclusion that reading disabled children perform more poorly than normals on written material is self evident as this group had already been characterized as problem readers. Her claim that language comprehension is interrelated with reading comprehension is not innovative and furthermore is supported by only moderate correlations between performance on reading and listening within a small experimental population. Most importantly, the results fail to provide information regarding the nature and extent of the language and reading relationship.

Reading Disability as a Bimodal Strategy Deficit

Despite the pragmatic power that either a theory of reading and language as hierarchical processes or a theory of reading and language as parallel processes might possess, it would be inappropriate to seek a single explanation for all forms of reading deficiency. The nature of this disability is often influenced by its cause, as well as concurrent conditions. Reading disability is attributable to many causes (Critchley, 1968; Rabinovitch, 1968; Weiner & Cromer, 1967), which encompass social, economic, physiological, cultural, genetic, and maturational factors.

Cruikshank (1968) notes 43 different causal descriptions which are equated with reading disability. Vernon (1977, p. 396) notes that "children with reading problems have varieties of deficiencies and no one deficiency appears in all poor readers."

Of most interest here is the individual who does not possess age or grade appropriate reading despite the absence of any obvious causal or concurrent condition. Therefore, the term "reading disability" in this study will conform to the following definition (Samuels, 1971, pps. 74-75), "A reading disability is said to exist when, despite adequate instruction, absence of emotional problems which may interfere with learning, adequate attendance, a cooperative child and absence of sensory impairment, there is a discrepancy between the reading achievement level and some measure of potential ability." It should be noted that this definition has also been applied to the term "dyslexia", which is often used synonomously with reading disability of no known origin (Cruikshank, 1968; Money, 1962).

Competing theories of reading disability within the general framework of this definition have been categorized by Velluntino (1977), as possibly reflective of dysfunction in temporal order processing, dysfunction in intersensory integration, deficiency in visual processing or deficiency in verbal processing.

One could predict different outcomes as a result of testing one or the other of the above theories. For example, in a listen-

read/manipulate task, which is the experimental methodology to be employed in this study, a dysfunction in temporal order processing would yield poor response patterns across auditory and visual modalities with low performance on all syntactic structures which are dependent on temporal order processing. However, equally poor performance might also be predicted for nonsyntactic temporally ordered material such as sound strings, digit sequences and word lists.

If reading disability results from dysfunction in intersensory integration, disabled readers would demonstrate better performance on auditorially presented material than on visually presented material. Mode of presentation, rather than syntactic complexity would be the most significant factor influencing performance. Mode of presentation would also be the most significant influence on performance if reading disability is a result of visual processing difficulties.

However, a theory of reading disability as a deficiency in verbal processing would predict that linguistic complexity overrides mode of presentation as a deterent to comprehension for both the reading disabled and normal populations.

Reading disability as a bimodal strategy deficit is consistent with, and may be regarded as a refinement of a theory of reading disability as a deficiency in verbal processing. A theory of reading disability which suggests a bimodal strategy deficit would also suggest that similar performance is achieved on both audi-

tory and visual modalities because similar comprehension strategies are employed for the processing of linguistic material, regardless of whether the material is presented via auditory or visual channels. Additionally, consistent with a theory of reading disability as a bimodal strategy deficit, it could be demonstrated that a reading disabled population is utilizing different or deficient strategy systems (as compared to competent readers) which result in instances of impaired processing in both auditory and visual modalities.

Language Comprehension and the Concept of Strategy

Theories of language comprehension have been greatly influenced by the model of linguistic description based on a theory of transformational grammar (N. Chomsky, 1965). Transformational Grammar distinguishes between the surface structure and deep structure of the sentence unit. The surface structure is the string of articulated sounds perceived by the hearer while the deep structure refers to the underlying representation of this string.

The underlying representation is characterized as consisting of elements which can be arranged in finite configurations in accordance with the rule system of the language which generates laws of co-occurence and distribution. The linguistic rule system must be comprehensive enough to predict and generate an infinite number of grammatical and acceptable sentences based on these allowable configurations of underlying elements plus the series of rule ordered

transformations. These can act on elemental or deep structure configurations by deletion extraposition, or other operations to alter them.

Access to the underlying representation of the sentence is through the surface structure which is linked, according to N. Chomsky, (1965) through the system of rule ordered transformations noted above. The order in which transformations are applied, and the relative influence of semantic, phonetic and syntactic conditions on underlying representation and output have been the subject of extensive controversy in grammatical description. These concepts are not directly relevant to the current discussion, since the primary focus in this study is on processing, while the concern of grammatical theory is description and prediction. The separation of process and description is viewed here as consistent with Chomsky's distinction between competence and performance (Chomsky, 1968). Processing is an aspect of performance, (the actual production and comprehension of sentences spoken and heard in a communicative interchange) and is distinct from competence which is viewed as the knowledge the speaker has of the laws that govern the structure of sentences which specify which of the set of all possible sequences of words in a language actually can be used and grouped together into acceptable constituents.

Comprehension complexity was predicted by a theory of derivational complexity (Miller, 1962), which stated that the more transformations in a grammatical description of the relation be-

tween surface and deep structure, the more difficult a sentence is to understand. This viewpoint was predicated on the assumption that every grammatical transformation rule corresponds to a psychological operation. However, this theory seems unable to accurately predict levels of comprehension difficulty which can be confirmed by performance data in the adult (Bever, 1970; Fodor & Garrett, 1967).

It appears that the distinction between performance and competence posited in the theory of language previously outlined here, has been blurred partially as a result of the methodological impossibility of separating underlying knowledge (competence) from actual performance. As a result, there has been a tendency to confound systems that are used by linguists to describe language and predict grammatical occurrences by viewing them as identical with systems used to comprehend and produce sentences. Partially as a result of the failure of the predictive value of derivational theory of complexity (to conform to psychological reality), it is believed that individuals do not use the rules of grammar themselves, but rather a set of processes based on these rules in sentence comprehension (Bever & Langendoen, 1976; Langendoen; 1973). However, the nature of these processes and their relation to existing theories of linguistic description are in dispute.

Comprehension Strategies - A Review of the Literature

Within a theoretical framework which stresses the primacy of syntactic transformations in connecting deep with surface structure

representations, an important comprehension strategy for an individual is using surface structure syntactic markers as an aid in processing the sentence.

Fodor (1971, p. 131) has indicated that the complexity of a sentence increases with decrease in the explicitness with which its surface structure configurations represent its underlying deep structure. As an example, relative clause sentences in which the relative pronoun is deleted would be predicted to be more difficult to process than one in which the relative pronoun is preserved (Fodor & Garrett, 1967; Hakes & Cairns, 1970).

Of the following two sentences, sentence (2-1) is predicted to be more difficult to process than sentence (2-2).

(2-1) The girl the boy slapped cried.

(2-2) The girl whom the boy slapped cried.

In sentence (2-2), the relative pronoun serves as the syntactic marker for the clause boundary and contains specific information on the syntactic relation between the main and subordinate clause. The listener using his knowledge of the grammatical rule system knows that the relative pronoun signals that the second NP is the subject, and the first NP is the object of the transitive verb immediately following it. Levelt (1971), has summarized the information the relative pronoun contains as follows: the sequence NP_1 + REL + NP_2 + V can occur in English surface structure, only if NP_2 is the subject of the verb, the object of which is NP_1. This information can be more difficult to retrieve in sentences where REL is deleted.

Within a model of a semantic description of language, processes used for language comprehension are seen as skills which reflect knowledge of the semantic properties of words and their logically acceptable configurations within a sentence. Schlesinger (1968, p. 122) has noted that the concept of syntactic decoding taking place in a semantic vacuum does not seem to agree with our intuitive notions of comprehension.

Ferreiro (1976) suggests that studies of syntactic understanding (particularly those employing an object manipulation task) are sometimes confounded because of the influence of certain belief systems which correspond to logical relations within one's realm of experience. Therefore, processing of certain syntactic forms may be influenced by the semantic constraints expressed in the actor-agent relationship within the construction. She provides the example that some children may believe that cats never chase dogs but dogs do chase cats. Based on her example one could predict that such children would interpret (act out) sentence (2-3) and sentence (2-4) in the same manner.

(2-3) The cat chases the dog.

(2-4) The dog chases the cat.

This study will examine one semantic variable in sentence processing, the reversibility of NP-V-NP sequences as semantically acceptable subject-object pairs. Slobin (1966, 1971) distinguishes between irreversible passives, in which the actor-object relationship is experientially appropriate in only one direction, and reversible

passives where either noun may logically act on the other. Irreversible passives were found easier to comprehend and were comprehended earlier in the language acquisition process than reversible passives. Consider the following sentence sets:

(2-5a) The boy is pushing the girl.

(2-5b) The girl is pushed by the boy.

(2-6a) The girl is watering the flowers.

(2-6b) The flowers are watered by the girl.

Although sentence set (2-5) and sentence set (2-6) are syntactically equivalent, set (2-6) will be interpreted before set (2-5) because in set (2-6) there is only one logically acceptable interpretation. Either boys or girls may push, while flowers cannot water.

The notion of reversibility is related to what Cuciolli et. al (1970) has defined as featural aspects of words and what Clark (1971) has defined as semantic markers. Both the featural aspect of a word or the semantic marker (the terms are treated interchangeably for the purpose of this study), contain information about various properties of a lexical item which include its semantically acceptable noun pairings, its role as actor or object, as well as its acceptable verb pairings. Sentence (2-6b) is not reversible (and can be correctly interpreted in only one direction) because flowers do not have the attribute of serving as actor for the verb water, although they clearly may serve as the object for that verb. Culioli (1970) has performed a series of experiments which manipulate the syntactic

position of NP (as grammatical subject or object) with semantic attributes of NP within a series of sentences. She demonstrated that, for young children, semantic attributes appear to have more influence than the syntactic position of the NP in the perception of the subject-object relationship within the sentences she employed. The studies support her conclusion that one cannot look solely at transformation restrictions in processing but must examine restrictions which relate to the featural properties of nouns, verbs and adjectives which allow them to combine in acceptable sequences.

Turner and Rommetveit (1967) studied children's ability to imitate, comprehend and produce reversible and nonreversible active and passive sentences. Nonreversible sentences were comprehended with less errors until third grade where there is little variation due to sentence type.

Bever (1970) replicated Turner and Rommetveit and noted that children utilize reversibility as a factor in sentence processing starting at four years of age -- as demonstrated by their poorer performance on reversible passives at that age. Before age four cues based on sentence noun-verb-object reversibility are disregarded and sentences are comprehended based solely on perceived temporal order of elements.

Lempert (1978) studied comprehension of reversible and nonreversible passive sentences and produced findings which are generally consistent with those reported above.

A third viewpoint views language processing mechanisms as direct representations of neither syntactic nor semantic based grammatical knowledge but rather as behavioral mechanisms which are a representation of extra linguistic information which interacts with the semantic and syntactic rules required for the prediction of sentences. Bever & Langendoen (1976), have visualized this relationship as follows:

External Structures → Perceptual Mechanisms → Internal Structures

Bever & Langendoen (1976) represent a departure from both syntactic and semantic views of language processing. They claim that these language processing mechanisms are not linguistic in nature, but can better be explained by theories within other disciplines. These processing mechanisms, which herein will be referred to as strategies, are generally viewed as a series of behaviors used for attainment of a concept.

While acknowledging a basic tenet of transformational grammar, that of mapping external (surface) strings onto internal structures, Bever & Langendoen (1976) conclude that the perceptual mechanism which carries out this mapping operation is at least partially independent of the grammar while remaining sensitive to the external patterning of major syntactic categories.

Certain of these strategies act on the perceptually salient word order of items in the sentence and often group adjacent material together as an aid in memory and organization. For example, Bever (1970), has demonstrated that young children interpret any

noun immediately preceeding the main verb of a sentence as the logical subject of the sentence. Therefore, the following three sentences would all be interpreted as COW (actor) - HORSE (object), by a four year old child.

(2-7) The cow kisses the horse.

(2-8) The cow is kissed by the horse.

(2-9) It's the horse that the cow kisses.

There is evidence to indicate that an interpretation of the Noun-Verb-Noun sequence in a sentence as subject-verb-object, appears as a preferred strategy for older children as well (C. Chomsky, 1969).

Fodor, Bever, & Garrett (1974, p. 345) indicate that adults will also overemploy such a strategy. Referring to this strategy as a canonical sentoid strategy, Fodor, Bever & Garrett define it as occurring when the NP-V-NP of a sentence is assumed to be the sequence actor-action-recipient if there is no clause boundary, and if the first verb agrees with the first noun.

Other strategies based on order within a sequence have been described as a temporal order strategy. This may be order of mention = order of meaning (Fier, 1977), (this disregards grammatical clause boundaries entirely) and an adjacency strategy (Sheldon, 1977), which groups together two adjacent NPs with an adjacent noninitial verb.

There has been considerable support for the notion of a system of strategies which individuals selectively employ in order to comprehend linguistic material.

Sheldon (1974), has indicated that learning a language involves learning not to rely on certain strategies, as well as learning to

restrict the use of certain strategies in those sentences where they do not apply. Similar views are expressed by Amidon & Carey (1972), Ferreiro (1976), and Sinclair & Bronckart (1972).

It is also hypothesized that strategies appear (and are utilized) in a developmental sequence (Ferreiro, 1976), so that as new strategies appear, older ones are subordinated (Amidon & Carey, 1972), or integrated with newly acquired strategies with the effect of providing the listener with more flexible processing mechanisms (Sinclair & Bronckart, 1972).

In summary, comprehension requires a receiver to obtain meaning from a stimulus sentence, paragraph or picture, In this sense, comprehension is considered a process for deriving information. Although the process of comprehending a sentence is no longer viewed as equivalent to the process used to describe the grammatical rule system of a language, there are opposing viewpoints regarding the nature of comprehension processes (which shall be referred to collectively as strategies), and the degree to which they are distinct from the grammar. This becomes important because a theory of comprehension strategy based entirely on perceptual mechanisms (as posited by Bever & Langendoen, 1976), places the responsibility for the production and perception of sentences on a theory of behavior. This alternative takes away much of the power of a grammatical model of language use. The issue is additionally important in that it deals with the problem of how linguistic and perceptual factors might interact with one another in influencing performance.

Comprehension Strategies: Implications for the Present Study

Three competing views of processing will be examined in this study. A full discussion of these three views as well as relevant examples of performance predictions is provided in the section Predictions of Sentence Complexity which follows a discussion of the structures under study. The following discussion is intended only as an overview of the concept of comprehension strategy and its implications for the present study.

The first view of sentence processing, which consists of two aspects, "An Interruption Hypothesis and a Clue in Surface Structure Hypothesis," is predicated on the assumption that processing strategies are essentially linguistic in nature, and posit syntactic structures as cues to retrieving deep structure. The closer the form of surface structure resembles the form of deep structure, the easier the sentence will be to process. Therefore, the degree of surface structure changes from deep structure configurations such as interruptions in word order, (Slobin, 1971), or deletion of items, (Fodor & Garrett, 1967), will render comprehension difficult.

A competing view of language processing, defined as "Semantic Strategy" (Levelt, 1974), dependent on the notion of a semantic model of language processing, predicts that sentences that contain semantic constraints, based on logical knowledge of noun characteristics, will be easier to process than sentences in which items are not semantically constrained (Slobin, 1966).

A third view of sentence processing views the mechanisms needed to process language, as based not on either semantic or

syntactic rule based systems of linguistic description, but based on general cognitive principles (Bever & Langendoen, 1976), which enable individuals to assimilate new information and accommodate these information schematas (Piaget, 1974). This view is consistent with a view of language processing as a reflection of more general cognitive organization.

Inhelder (1978, p. 267) has stated:

> The whole body of findings (in Genevan Psycholinguistic research) leads us to challenge Chomsky's assertion that there exists highly specific innate capacities which account for the principles whereby human beings develop scientific theories in order to explain physical phenomena. On the contrary, the progressive construction of knowledge and its heuristic tools (be it knowledge of the physical world, or the knowledge the child develops for dealing with his own language) is of a highly general order.

This viewpoint predicts that language processing strategies would be constrained by organizational patterns of behavior available to the child at various stages of his cognitive development. Strategies used in comprehension of spoken language will tend to be equivalent to strategies used in other forms of information processing.

For example, a strategy based on perception of item function would predict that relationships among items in a sentence are perceived in terms of their function, relative to other items in the sentence. Items maintaining their identity (defined functionally) relative to other items in a sentence are predicted to be easier to process by young children, than items which change function and the child is required to conserve the original function of the item. Bever

(1976), has indicated that a young child cannot perceive a stimulus in two compatible ways simultaneously. Therefore, a lexical item may not be perceived as having the two different classifications within the same sentence. For example, a noun phrase which has a double function as both subject and object of a verb will be more difficult to comprehend than one which does not have a double function but rather has a parallel function. The notion of parallel function as a strategic determiner of sentence complexity has been demonstrated in studies of pronominalization (C. Chomsky, 1969; Maratsos, 1973), and relative clauses, (Sheldon, 1974).

Additionally, strategies based on perception of the order of sentence constituents such as the canonical order and temporal order strategies discussed previously, have been viewed as a reflection of the perceptual regularities of more general experiential schemata (Gibson, 1972), as well as a reflection and example of skills employing reversibility[1] and decentration[2] (Beilin, 1975).

A number of issues relating to strategy theory should be highlighted. The first is that all strategies, in order to be effective, must be sensitive to the rule system of the grammar, as the rule system serves as a framework of operation. The second, is that

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[1]Reversibility may be defined as the ability to mentally perform opposite actions simultaneously (Duckworth, 1979, p. 16). As an example, reversibility allows the listener to be able to separate a whole sentence into clauses and reunite the clauses.

[2]Decentering may be defined as the ability to take into account several aspects at the same time. (Duckworth, 1979, p. 11). As one example, applicable to a study of language processing, the ability to decenter would allow conceptualization of events from other than the immediate/individual's referent point, permitting the speaker to conceptualize and verbalize the views of other individuals and other referents in time or space.

strategies are not designed to replace grammatical rules, which are variously effective in describing and predicting phonemic, morphemic, syntactic and semantic constituents of a language. Rather, these strategies serve to provide efficient ways of interpreting rules at the level of performance. Strategies, then, are performance phenomenon that may be motivated by and/or sensitive to, the grammatical rules of language, but are not identical, or equivalent to, a linguistic rule system.

Structures Under Study: Relative Clauses

Relative clause sentences were chosen as the syntactic structure to be studied since these structures are acquired by older children and older children who manifest more subtle processing difficulties in the comprehension of sentences were the focus of interest. Relative clauses are acknowledged in the literature to be complex structures which are late in emerging developmentally, (Menyuk, 1972; Sheldon, 1974), and therefore, might be expected to elicit interesting data from older children.

Additionally, relative clauses which are diverse and flexible in construction allow for systematic manipulation of their elements. Such manipulation is required by the hypotheses which are examined in the study.

A number of researchers have studied comprehension of relative clauses in both children and adults, however these findings as they related to strategies of comprehension remain in dispute.

One difficulty lies in the variety of relative clause structures available for study. Another difficulty is the inconsistent and varied terminology employed in different studies which render comparisons difficult.

Definition of Terms

Relative clause sentences have variously been described as center embedded, left branching, parallel relative clause, subject relative clause, subject focus relative clause.

Although left branching and center embedding appear to be used synonomously in the literature, the other terms are used intermittently to describe specific aspects of the function and focus of elements within the clause in relation to other elements in the sentence.

Consider the following sentences:

(2-10) The mouse chased the rat that the bird caught.

(2-11) The mouse chased the rat that caught the bird.

(2-12) The rat that the mouse chased, caught the bird.

Sentence (2-10) has been referred to as a right branching relative clause sentence, object relative clause sentence, and parallel relative clause sentence, with object focus. Right branching and object relative clauses are used synonomously while other terms relate to specific issues of subject and focus. Sentence (2-11) for example, is also an example of a right branching relative clause or object

relative clause but with subject focus. Sentence (2-11) is considered therefore, nonparallel since rat serves a dual function as object of the main clause and subject of the relative clause.

The need to clarify terminology is important in order to prevent issues of position, function and focus from becoming experimentally confounded. This study will employ the sentence types and terminology defined by Sheldon (1974, 1977).

Consider the following:

(2-13) The bear that bites the wolf kicks the hippo.

(2-14) The bear that the wolf bites kicks the hippo.

In sentence (2-13), the focus noun, bear, is serving as the actor of both verbs, and therefore, the sentence exhibits parallel function. This sentence will be referred to as a subject relative clause with subject focus. In sentence (2-14), bear is first the object of the verb bite, and then the actor (subject) of the verb kick. Thus the sentence exhibits nonparallel function. This sentence will be referred to a a subject relative clause with object focus. Additionally, examine the following two sentences:

(2-15) The bear bites the wolf that kicks the hippo.

(2-16) The bear bites the wolf that the hippo kicks.

Sentence (2-15) will be defined in this study as an object relative clause sentence, because the relative clause (that kicks the hippo), refer to the object the main clause, wolf. Furthermore, this sentence is defined as having subject focus as the relative pronoun that, which refers to the co-referential NP wolf, serves

as the subject of the relative clause. In summary, sentence type (2-15), will be referred to as an object relative clause with subject focus. In sentence (2-16), the relative clause continues to serve as the object of the main clause, however, the relative pronoun, that (wolf) serves as the object in the relative clause "hippo kicks wolf." Therefore, sentence (2-16), is defined as an object relative clause with object focus.

Table 1 located on the following page illustrates these examples.

The relationship between function and focus terminology in these sentence types can be summarized as follows:

> When the function of the relative clause corresponds with the focus of the relative pronoun within the clause, the co-referential noun will also be exhibiting parallel function. When the function of the relative pronoun of the clause is not the same as the focus of the clause, the noun which is co-referential to the relative pronoun may also be seen to exhibit nonparallel function.

Table 1

Description of Relative Clause Sentences

Sentence Type	Code	Description	Example
Subject Relative Clause Sentence with Subject Focus (Center Embedded or Left Branching)	Ss	Relative Clause modifies subject of main clause. Relative pronoun serves as subject of relative (subordinate) clause.	The bear that bites the wolf kicks the hippo.
Subject Relative Clause Sentence with Object Focus (Center Embedded or Left Branching)	So	Relative clause modifies subject of main clause. Relative pronoun serves as object of relative (subordinate) clause.	The bear that the wolf bites kicks the hippo.
Object Relative Clause Sentence with Subject Focus (Right Branching)	Os	Relative Clause modifies object of main clause. Relative pronoun serves as subject of relative (subordinate) clause.	The bear bites the wolf that kicks the hippo.
Object Relative Clause Sentence with Object Focus (Right branching)	Oo	Relative Clause modifies object of main clause. Relative pronoun serves as object of relative (subordinate) clause.	The bear bites the wolf that the hippo kicks.

Predictions of Sentence Complexity

Interruption Hypothesis

Slobin (1971, p. 352), notes that a sentence with an interruption or rearrangement of linguistic units is more difficult to process than a sentence that does not contain an interruption or rearrangement. The Interruption Hypothesis predicts that a center embedded clause (subject relative clause) is more difficult to process than a right branching relative clause, (object relative clause sentence. Degree of embedding is seen as directly proportional to the degree of difficulty encountered in comprehending a sentence (N. Chomsky, 1965; Miller & Isard, 1964). Center embedding is seen as an interruption of the linguistic unit that places a burden on the memory of receiver (Miller, 1962).

Slobin (1971) states that the greater the separation between related parts of a sentence, the greater the tendency that the sentence will not be adequately processed. "...both adults and children have difficulty in dealing with material interposed between related parts of a sentence." (1971, p. 354).

Consider the following sentences:

(2-17) The rat that the mouse chased caught the bird.

(2-18) The mouse chased the rat that caught the bird.

It is reasonable to predict that sentence (2-17) will be more difficult to process than (2-18) because in sentence (2-17) the relative clause, (that the mouse chased) interrupts the main

clause, (the rat caught the bird) and separates the constituents within that clause (the rat...caught the bird).

This prediction has been supported by child language acquisition data as young children have been observed to acquire control of center embedded relative clauses later than right branching relative clauses (Menyuk, 1972). Menyuk, (1977, p. 93) observed that expansions of subject in a sentence by a relative clause are still rare at age seven. Levin and Kaplan (1970), and Sheldon (1977), demonstrated that right branching relative clauses are easier to comprehend than center embedded relative clauses for adults.

However, an earlier study (Sheldon, 1974), using children as subjects, found no difference in processing of center embedded and right branching. Hakes, Evans and Brannon (1976), found performance on center embedded, superior to performance on right branching relative clause sentences when dependent measure was sentence paraphrase. Baird and Koslick (1974) found no difference in recognition accuracy between the two sentence types and concluded that they are both encoded equally well, although verbatim recall of self embedded sentences was inferior to recall for right branching sentences.

A number of researchers believe that difficulty encountered in producing and comprehending relative clauses is not dependent on an interruption factor, but can be attributed to other factors.

Clues in Surface Structure Hypothesis:

This hypothesis predicts that the complexity of a sentence

increases as the explicitness (with which its surface structure configurations represents its underlying deep structure) decreases (Fodor, 1971).

Both the Interruption Hypothesis and the Clues in Surface Structure Hypothesis are generated from a theoretical perspective that emphasizes the primacy of syntactic information in sentence comprehension.

The clues in surface structure hypothesis would predict that relative clause sentences in which the relative pronoun is deleted will be harder to process than relative clause sentences in which the relative pronoun is maintained. Sentence (2-19) would be predicted to be more difficult to process than sentence (2-20).

(2-19) The dog chased the snake the donkey bit.

(2-20) The dog chased the snake that the donkey bit.

In sentence (2-20) the relative pronoun that, which refers to the co-referential noun snake, serves as the syntactic marker for the relative clause boundary and signals the decoder that the second NP is the subject, and the first NP is the object of the transitive verb, bit.

Previous research has demonstrated that reaction times increase when the relative pronoun is deleted and paraphrase accuracy decreases when the relative pronoun is deleted (Fodor & Garrett, 1967; Hakes & Cairns, 1970).

Semantic Clue Hypothesis

Semantic clue hypothesis would predict that relative clauses in a constrained semantic relationship to other items in the sentence

will be easier to process than relative clauses which contain an unconstrained relationship. This prediction is consistent with Slobin's (1966) discussion of reversible-nonreversible passive sentences mentioned earlier in this paper.

Consider the following:

(2-21) The book that the boy reads is interesting.

(2-21a) Boy reads book.

(2-21b) Book reads boy.

(2-22) The girl that the boy sees is smiling.

(2-22a) Boy sees girl.

(2-22b) Girl sees boy.

Sentences (2-21) and (2-22) are syntactically equivalent, but in sentence (2-21) the listener is able to utilize semantic information to understand the actor and object of the action read, since books do not have the semantic property of being able to be the actor of read (which boy does). Books, however, may serve as the object of read. Books then can only correctly be interpreted as serving as the object, but not the actor, of the verb in the sentence. Therefore, interpretation (2-21a) is semantically acceptable, while interpretation (2-21b), is not. In sentence (2-22), either noun could be the object of see. Both interpretations (2-22a), girl sees boy, and (2-22b) boy sees girl, are semantically acceptable.

It would be predicted therefore, that if a strategy based on semantic information is utilized, sentence (2-21) would be easier to comprehend than sentence (2-22). If a strategy based on other

than semantic information is employed, both sentences will be comprehended with equal ease.

Schlesinger (1968), studying the effects of semantic constraints on visual processing of center embedded relative clause sentences in college age subjects concluded that doubly embedded sentences were easier to decode if they contained semantic cues which paired each appropriate noun with its verb. Fluck (1979) found that semantic constraints did not facilitate children's comprehension of subject relative clauses except with the youngest age group (five-year-olds). This is probably because older children reached ceiling for subject relative clauses. Object relative clauses sentences, produced generally more errors. Object relative clauses with constrained (nonreversible) relationships received more correct responses than nonconstrained sentences for all age groups. However, Stick and Norris (Note 3) found that semantic cueing did not affect ease of comprehension in single and doubly center embedded relative clause sentences with subject and object focus.

It is likely, as Bever (1970) has suggested, that semantic cues will effect processing of some sentences but not others. Perhaps a strategy employing semantic cues would be used selectively by the hearer as a function of degree of structural complexity of the sentence and the hearer's individual capacity to efficiently utilize other strategy systems.

Function/Order Hypothesis

This hypothesis predicts that relationships among items in a sentence are preceived in terms of their function, relative to other

items in a sentence and to perceptually observed sequences in which they occur.

One performance prediction, parallel function, derives from a general psychological principle that in a closed system a component of a stimulus cannot serve two opposite functions at the same time (Bever & Langendoen, 1976), so that a sentence in which a noun is the subject of one clause and the object of another is more complex than a sentence in which a noun retains its original function. (Whether the noun serves as subject or object, in tneory, is irrelevant.)

Sheldon (1977) has defined the parallel function hypothesis as follows:

> In a complex sentence, if coreferential NP's have the same grammatical function in their respective clauses, then that sentence will be easier to process than one in which the coreferential NPs have different grammatical functions. The parallel function hypothesis predicts that in sentence processing, the grammatical function of the relative pronoun will be interpreted to be the same as its antecedent.

Sheldon (1974) defines an order hypothesis as follows:

> A surface structure in which the underlying word order is preserved is easier to process than one in which the underlying word order is not preserved.

Levelt (1977) refers to the strategy resulting from this hypothesis as a temporal strategy while Fodor, Bever and Garrett (1974)

refer to it as a canonical sentoid strategy or a canonical strategy however, both operationally define the strategy as interpreting every sequence NP + (Aux+) V + NP as agent-action-object.

A canonical or temporal order strategy, has been demonstrated by children as young as two years (Bever, 1970), as well as by an adult population (Fodor, Bever & Garrett, 1974), and a [illegible]tric population (Fier, 1977). It has also been documented as occurring for other languages (Ferreiro, 1976; Sinclair & Bronckart, 1972; Slobin, 1971).

Gibson (1972) suggests that the popularity of this strategy results from its conformity to the perceptual regularities of the real world. In real world events somebody does something to recipients of action. Levelt (1974) indicates that temporal order is a popular strategy because it works -- in other words, the processor achieves a high degree of successful interpretation because the most common order of elements in an English sentences conforms to a temporal, subject-verb-object relationship. However, Bever and Langendoen (1976) and Antinucci (1979) a studying dischronic change in language, discuss the frequency of S-V-O orders in many Indo-European languages as reflecting rather than determining comprehension mechanisms. Antinucci (1979, p. 145) argues

> "...that principles of structural nature and principles of perceptual nature are in conflict in languages of the SOV type because of the relative clause construction. The way in which a relative clause is structured in an SOV language is an obstacle to its effective perceptual processing...this conflict is one of the major

factors determining the diachronic change of a language from an OV to a VO typology.

Although the process of diachronic language change is beyond the scope of this study and will not be discussed further, its relationship to the notion of strategy deserves further attention.

Sheldon (1974, 1977) has demonstrated that both children and adults employ a systematic strategy for comprehension of relative clause sentences which is based on both the underlying function of the noun phrase and on temporal ordering of elements and suggests, further, that strategy preference changes with the age of the subject

Parallel Function

Sheldon (1974), studying three-and five-year olds in an object manipulation task, tested what she termed the parallel function hypothesis and found that position of the relative clause in the sentence as predicted by the interruption hypothesis was not significant. She noted that a child encounters difficulty when processing a relative clause at two points:

a. Finding the noun phrase that the relative clause modifies, and

b. Finding the grammatical function of the relativized noun phrase.

An overreliance on an extraposition strategy to determine the antecedent to the relative pronoun in right branching (object)

relative clause sentences and overreliance on a parallel function strategy in determining relation of relativized noun phrase accounted for most comprehension errors. To clarify her findings, consider the next group of sentences:

(2-23) The man saw the boy whom the girl hit.

(2-24) The boy who hit the girl saw the man.

(2-25) The man saw the boy who hit the girl.

(2-26) The boy whom the girl hit saw the man.

In sentence (2-23) the underlying relation is "The man sees the boy", and "The girl hits boy". The focus is on the object in both parts of the sentence. The word boy has parallel function, it is the object in both the main and relative clause. Another example of a sentence in which a noun exhibits similar parallel function is sentence (2-24). Here the underlying relation is "Boy sees man," and "Boy hits girl". The word boy, again has a parallel function, for it is the subject in both the main and the relative clause. However, here, the focus is on boy, as the subject of both parts of the sentence, rather than the object as in sentence (2-23). In sentence (2-25) the underlying relation is "man sees boy" and "boy hits girl". The word boy does not have a parallel function; it is the object in the main clause, and the subject in the relative clause.

Parallel function sentences (2-23) and (2-24) were found easier to comprehend than sentences (2-25) and (2-26) where the relativized noun has a split function.

The notion of a parallel function strategy has been confirmed by Davis and Blaisdell (1975), studying normal and hearing impaired children, and by Wallach and Goldsmith (Note 4), studying comprehension of subject parallel and nonparallel relative clause sentences in learning disabled and normal achieving children.

Ferreiro (1976) studied comprehension and expression of relative clauses in English, French and Spanish in children ranging in age from four years five months to eleven years, and demonstrated that strategies employed in relative clause comprehension change as function of the age of the child. However, the most frequent error type resulted from what she labels a role conserving or parallel function strategy. Role conserving strategies appeared most frequently in children under age six or seven (thus duplicating Sheldon's results with young children (age three to five). After the age of seven, strategies based on word order (in English) came to replace earlier strategies employed. It would appear appropriate in light of these findings to reexamine the results of the Davis and Blaisdell (1975) and Wallach and Goldsmith (Note 4) studies, both of which dealt (in part) with disabled populations to determine if their findings of parallel function strategies with a population older than Sheldons' and Ferreiros' might be the result of the disabled population's use of what Ferreiro (1976, p. 240) terms a "primitive role conserving strategy". The results could provide some interesting implications for a theory of learning and language disability.

Fluck (1979) compared comprehension of Subject Relative Clause sentences with subject focus (Ss) and Object Relative Clause sentences with subject focus (Os) and found the latter more difficult to comprehend for children as old as nine years of age. He accounts for his findings by explaining that Ss sentences can be correctly interpreted using a parallel function strategy (the first noun serves as actor in relation to the remaining nouns in the sentence) whereas employing a parallel function strategy yields incorrect interpretations of Os sentences. Unfortunately, the usefulness of the study is limited as issues of position of the relative clause (as subject or object) are confounded with focus of the relative pronoun (as subject or object) within the clause.

Sheldon (1977) found some evidence of a parallel function strategy employed by college students in comprehending relative clauses but noted that it was not the primary strategy employed. Fier (1977) studying an adult population noted a preference for a parallel function strategy (indeed her results for order of sentence difficulty duplicated Sheldon's (1974) results with children). However, Fier believes that these results, especially the increased difficulty of subject relative clause sentence with object focus as compared with the equally nonparallel object relative clause sentence with subject focus can be explained better by an order of elements strategy.

Order of Elements

The desire to maintain an intact S-V-O order within sentences accounts in a number of studies for errors made in the production and comprehension of relative clauses.

Menyuk (1977) notes that until age seven, children tend not to create sentences which permute S-V-O relationships in the main clause and speculates that this may partially account for the late emergence of center embedded (subject) relative clauses in children's speech.

Slobin (1971, p. 348) has indicated that an early and universal operating principle requires that the listener and speaker "pay attention to the order of words and morphemes."

A discussion of a word order strategy as a processing mechanism in relative clause sentences must address the influence of the clause boundary in processing. Caplan (1972); Townsend, Ottaviano and Bever (1979), among others, have demonstrated the perceptual salience of the clause in sentence perception. This evidence has been well reviewed (Bever & Langendoen, 1976) and will not be repeated here. Levelt (1974) notes that a temporal strategy (defined earlier in this paper) is applied to a surface string (sentence) which has already been segmented to a certain degree and that the basic unit of segmentation is the clause. Bever and Langendoen (1976) note that a primary perceptual strategy is to treat a string consisting of a nominal phrase as the beginning of an internal structure sequence and treat the verb phrase (optionally including a nominal) as the end of such a sequence.

Relative clauses are interesting to study because the shared nominal and verb in internal structures are often interrupted in surface structure by a dependent clause. Thus, the relative clause construction (particularly in subject relative clause sentences) provides an opportunity to examine the influence of clause boundaries in the application of an order strategy.

Consider the following sentences:

(2-27) The woman that the man hit went to the police.

If the hearer (or reader) first breaks the sentence into clauses, and then applies an order strategy, the following misinterpretation could result:

(2-27a) Woman hit man, woman went to police.

If an order strategy is applied before, or in the absence of, segmenting the sentence into its construent clauses, the entire surface string would be treated as a unitary entity resulting in an order strategy which is equivalent to a strategy Bever (1970) has labeled as "order of mention equals order or meaning." This would result in the following misinterpretation:

(2-27b) Woman hit man, man went to the police.

Although Bever demonstrates that an order of mention equal to order of meaning strategy is employed by very young children in the processing of passive sentences, the application of such a strategy in the processing of multiclause sentences is unclear.

The scarcity of literature, which addresses the order of strategy application renders it difficult to draw any conclusions concerning the influence of segmentation into clause strategy as

preceeding an order of elements strategy for the processing of relative clauses. This difficulty is due in large part to the variety of terms being used to describe order strategies. For example, Fier (1977) refers to a temporal order strategy which interprets noun-verb-noun sequences as S-V-O. The noun preceding the verb is viewed as the actor, the noun following the verb is viewed as the object. The role of clause boundaries is not clarified. Wallach (1977) defines a canonical order recency strategy which interprets the last noun-verb-noun in a sentence as S-V-O. So, a canonical order - recency strategy would provide the following misinterpretation for sentence (2-27).

(2-27c) Man hit woman, man went to police.

Sheldon (1977) finds evidence for an order strategy in adults which she calls an adjacency strategy in which two spatially adjacent noun pairs are interpreted as being in an actor-object relationship.

Bever and Langendoen (1976, p. 120), citing an earlier study conducted by Bever, note that the order of "assign clause boundaries strategy" versus the "employ an order strategy" changes with the age of the child "so that children at one age tend to recall (and act out with toys) the first nominal string they hear," even if it is a dependent clause (e.g. <u>dog jumped</u> in (16a) <u>dog fell</u> in (16b). Children at another age tend to recall the main clause "nominal ...verb" and to drop the dependent clause (they recall <u>the dog fell</u> in (16a and b).

(16a) The dog that jumped fell.

(16b) The dog fell that jumped.

Baird and Koslick (1974), and Hakes, Evans and Brannon (1976), studying adults found evidence for a canonical sentoid order strategy by demonstrating that relative clauses with subject focus were easier to comprehend than relative clauses with object focus. They argue that object focus relative clauses violate canonical order in the dependent clause, while subject focus sentence maintains canonical order. Therefore, a strategy which interprets surface strings within a clause as S-V-O will cause subject focus sentences to be interpreted correctly while object focus sentences will be misinterpreted.

H. D. Brown (1971) studying three-four-five year old children in a sentence to picture match demonstrated that the children provided more correct responses for subject focus sentences than for object focus sentences.

Stick and Norris (Note 3) compared the performances of learning disabled and normally achieving children on single and double embedded (subject) relative clause sentences with subject and object focus. Toy manipulation was the dependent variable. Their findings confirmed Brown's. Subject focus sentences received more correct responses than did object focus sentences.

However, as a result of the sentences types they employed H. D. Brown's (1971) and Stick and Norris's (Note 3) findings could be accounted for equally well using a parallel function strategy prediction.

Examine the following subject relative clause sentences with subject and object focus (sentences (2-28) and (2-29) respectively).

(2-28) The man that pushes the boy throws the ball.

(2-29) The man that the boy pushes throws the ball.

A canonical sentoid strategy which is sensitive to clause boundaries would yield the following interpretations for the subject focus sentence (2-28).

(2-28a) Man pushes boy, man throws ball.

Note however, that this interpretation is equally consistent with the predictions of the parallel function hypothesis, as the relativized noun man is serving as actor relative to both other nouns boy and ball within the sentence. This argument also can be extended to sentence (2-29), subject relative clause with object focus. Employing a parallel function strategy or a canonical order strategy sensitive to clause constraints yields the same (incorrect) interpretation for sentence (2-29).

(2-29a) Man pushes boy, man throws ball.

Wallach (1977) suggests that younger normally achieving children may utilize a canonical order strategy for processing relative clauses but by age nine years six months, are employing correct comprehension processes which result in no errors on either subject focus or object focus, subject or object relative clause sentences.

In summary, four major function/order strategy patterns are demonstrated by children in processing relative clauses. These are outlined on Table 2 which is on the following page.

Table 2

Strategy Patterns Employed by Children in Processing Relative Clauses[a]

Incorrect Strategies Employed	Resulting Responses
1. Parallel Function Relativized noun maintains its function as actor or object throughout the sentence.	1. Tiger chases elephant Tiger hits giraffe
2. Canonical Order Noun-verb-noun sequences within a clause are interpreted as actor-action-recipient.	2. Tiger chases elephant Tiger hits giraffe
3. Recency: Canonical Order Last noun-verb-noun clause corresponds to actor-action-recipient.	3. Elephant chases tiger Elephant hits giraffe
4. Order of Mention Order of Meaning 1st noun actor on 2nd noun 2nd noun actor on 3rd noun	4. Tiger chases elephant Elephant hits giraffe

[a] Example Stimulus: "The tiger that the elephant chases, hits the giraffe." (So type)

Reported findings regarding the sensitivity of order strategies to clause boundary constraints, or the order in which order strategies or segmentation strategies are applied, remain inconsistent. One might conclude that the nature of the strategies employed and possibly the order in which they are employed are artifacts of the linguistic structure, the characteristics of the decoder and the nature of the task.

CHAPTER III

METHOD

Design

This study employs a factorial design to examine the effect of syntactic form, semantic constraint and mode of presentation on the performance of groups of reading disabled and normally achieving third grade and sixth grade subjects.

The following are independent variables, and between group factors.

Disability.

A. Reading Disabled

B. Normally Achieving

Grade

A. Third Grade

B. Sixth Grade

Table 3 which is on the following page represents a summary of group types.

The following variables are within group, repeated measures. (Each subject within each grade and disability received all possible treatments arrived at through the combination of each of the following variables):

Structural Relation

Subject Relative Clause Sentence with Subject Focus - Ss

Subject Relative Clause Sentence with Object Focus - So

Object Relative Clause Sentence with Subject Focus - Os

Table 3

Summary of Group Types and Number of Subjects in Each Group.

DISABILITY	GRADE LEVEL	
	3rd Grade	6th Grade
Normal	Group I 40 subjects	Group II 40 subjects
Reading Disabled	Group III 40 subjects	Group IV 40 subjects

Object Relative Clause Sentence with Object Focus - Oo

Subject Relative Clause Sentence with deleted relative pronoun - Sod

Object Relative Clause Sentence with deleted relative pronoun - Ood

Semantic Relation

Constrained N-V-O relationship in relative clause (non-reversible)

Non-constrained N-V-O relationship in relative clause (reversible)

Mode of Presentation

Visual - (reading)

Auditory - (listening)

Treatment combinations are summarized on the following page in Table 4.

Subjects

Eighty third grade and eighty sixth grade students served as subjects for this study. For each level, half the children selected were reading disabled, while the other half were normally achieving.

Reading disabled and normal groups were matched for age, I.Q., and socio-economic status, and were in age/grade appropriate placements. All subjects had an I.Q. within 90 to 120 (average I.Q. for school age population from which most subjects were drawn is 114), as measured by the California Test of Basic Skills (short form), and/or Weschler Intelligence Scales for Children.

The reading disabled group was functionally at least twelve months, but not more than three years below grade level, as measured by the

Table 4

Treatment Combinations: Sentence Type X Condition X Mode of Presentation X # of Presentations

Code	Sentence Type	Condition	Mode of Presentation	
			Auditory	Visual
			# of Presentations	
Ssc	Subject Relative Clause with Subject Focus	constrained	2	2
Ssn	Subject Relative Clause with Subject Focus	unconstrained	2	2
SScc	Coordinate for Subject Relative Clause	constrained	1	1
SSnc	Coordinate for Subject Relative Clause	unconstrained	1	1
Soc	Subject Relative Clause with Object Focus	constrained	2	2
Son	Subject Relaive Clause with Object Focus	unconstrained	2	2
Socc	Coordinate for Subject Relative Clause with Object Focus	constrained	1	1
Sonc	Coordinate for Subject Relative Clause with Object Focus	unconstrained	1	1
Socd	Reduced Subject Relative Clause with Object Focus	constrained	2	2
Sond	Reduced Subject Relative Clause with Object Focus	unconstrained	2	2
Ooc	Object Relative Clause with Object Focus	constrained	2	2
Oon	Object Relative Clause with Object Focus	unconstrained	2	2
Oocc	Coordinate for Object Relative Clause with Object Focus	constrained	1	1
Oonc	Coordinate for Object Relative Clause with Object Focus	unconstrained	1	1
Oocd	Reduced Object Relative Clause with Object Focus	constrained	2	2
Oond	Reduced Object Relative with Object Focus	unconstrained	2	2
Osc	Object Relative Clause with Subject Focus	constrained	2	2
Osn	Object Relative Clause with Subject Focus	unconstrained	2	2
Oscc	Coordinate for Object Relative Clause with Subject Focus	constrained	1	1
Osnc	Coordinate for Object Relative Clause with Subject Focus	unconstrained	1	1

Woodcock Reading Test, or equivalent, and were receiving some form of remedial reading instruction within a public shool setting, but were not diagnosed as having any concurrent emotional, physical or language problems, as estimated by a Team Evaluation consisting of licensed specialists within each of the above areas.

All subjects passed standard school screening for visual and hearing deficits. None of the children manifested any morphologic or syntactic problems in their spontaneous expressive language, as determined by examiner and teacher judgment.

The population sampled was white, middle class and enrolled in three demographically similar public surburban school systems in Massachusetts.

Characteristics of the sample are outlined in Appendix A.

Materials

Description of Stimulus Materials

Relative Clauses.

Six types of relative clause sentences:

Subject relative clause with subject focus

Subject relative clause with object focus

Reduced Subject relative clause with object focus

Object relative clause with subject focus

Object relative clause with object focus

Reduced object relative clause with object focus

Each type of relative clause was represented in a semantically constrained and semantically unconstrained condition in the subordinate clause.

Control/Filler Sentences

Coordinate or cojoined sentences were included in this study as control sentences. Coordinate or conjoined sentences, defined here as a sentence which contains two clauses comprised of a subject-verb – object and which are separated by the conjunction "and." Coordinate sentences were developed which are equal in length (based on number of words) and utilized the same lexical items as relative clause sentences. Additionally, noun change or preservation of noun function across clauses as subject or object of the verb was manipulated to conform to the functional relationships contained within each type of relative clause sentence used.

In summary, coordinate sentences were equivalent to relative clause sentences in length, vocabulary, functional relationships and mode of presentation.

Coordinate sentences, therefore, were designed to serve as controls for problems in general attention to task, memory and individual word decoding as influences on performance.

A memory probe which tapped S-V-O relationships in each clause was attempted during a pilot project. For a sentence such as "The boy that kicked the ball, kissed the girl." Subjects were asked "What kicked what?", "What kissed what?" This proved too difficult for younger disabled subjects. An alternative probe was attempted. "Who kicked?". "Who was kissed?" This elicited more responses, but failed to provide continuous response flow which could reveal strategies employed. An object manipulation response (which had been employed

in an earlier pilot), worked well and subjects enjoyed it. Problems in an intermodal transfer which might confound object manipulation task, have been controlled for in screening condition #3, and by inclusion of coordinate sentences in presentation.

Control for Vocabulary

Sentences were controlled for vocabulary by employing a limited number of nouns and verbs judged to be appropriate for beginning readers by a panel of six elementary school administrators and reusing these nouns and verbs in a counterbalanced design across all sentence types within both modes of presentation.

Verbs were chosen because they can be clearly demonstrated and are familiar to children.[3] All were represented in present tense. Verbs chosen were:

kicks	chases
bites/eats[4]	kisses
pushes	picks

Nouns chosen were selected on the basis of their familiarity, their ease of representation, their flexibility in pairing with selected verbs within constrained and unconstrained subject verb and verb object relationships. Each human noun was represented by commercially available 9-11 inch manipulative dolls (Sunshine Family). Animal and inanimate nouns were represented by plastic toys.

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[3]Sheldon (1974) noted differences in performance as a function of verb composition: two constituent (jump over) vs. one constituent (chase). Although Fier (1977) found no difference in performance as a result of verb type, verb type is controlled by employing only single constituent verbs.

[4]Items are treated interchangeably for stylistic variation.

Nouns chosen were:

Human	Animal	Inanimate
boy	dog	ball
girl	rabbit	apple/cheese/carrot
lady/woman	cat	flower
man	mouse	wagon
	snake	
baby	donkey/horse	

All items are combined in noncausal N-V-N-V-N sentences.

That is consistently used as relative pronoun, as it is viewed as acceptable for both animate and inanimate coreferential nouns. (Huddleston, 1971; Langendoen, 1973).

Procedures:

A. Screening Procedures:

1. Each subject was asked to read individual flash cards containing the verbs and nouns used in the study to control for word decoding difficulties.
2. Each subject was asked to point to the correct toy upon naming by examiner, and upon being shown an appropriate flashcard to control for comprehension of lexical items.
3. Each subject was asked to act out simple active sentences - 3 auditorially presented and 3 visually presented, to control for comprehension of each verb employed in the study, as well as difficulties in inter-modal transfer, and ability to follow directions.

B. Experimental Procedures:

Each subject received single sentence presentations. Stimulus sentences were separated into two presentations; A and B. Each presentation was counterbalanced for vocabularly, structural complexity and semantic condition. Half the subjects within each grade and group, received Presentation A auditorially and Presentation B, visually. The other half received Presentation B auditorially and Presentation A visually.

Order of presentation for each sentence within Set (A) and Set (B) was randomized (Mendenhall, 1971), with the constraint that identical sentences did not appear consecutively.

Sentences which were auditorially presented were read to the subjects by the examiner. During visual presentation, subjects were handed an index card containing a single typed stimulus sentence. Subjects were asked to listen to/or read the sentence. Up to three auditory repetitions were provided on request; reading for individual sentences was not timed, but subjects were required to give the card back to the examiner before beginning object manipulation.

Subjects were instructed "to make the toys do what the sentence says." The Examiner recorded on a score sheet the exact response of the subject. Sample score sheets are represented in Appendix B and C. Each subject received 32 visual and 32 auditory presentations. Treatment combinations are presented in Table 4. Table 5 presents stimulus sentences employed in Presentation A.

Table 6 presents stimulus sentences employed in Presentation B.

Table 5

Sentences Employed in a Presentation A (Non Randomized Order)

Code	#	Stimulus
Ssc	1a	The donkey that pushes the wagon kicks the man.
Ssc	2a	The boy that kicks the ball bites the apple.
Sscc	3a	The boy chases the ball and the dog bites the carrot.
Ssn	4a	The man that chases the boy kisses the lady.
Ssn	5a	The boy that kicks the girl pushes the man.
Ssnc	6a	The lady kisses the baby and the lady chases the dog.
Soc	7a	The boy that the dog bites kicks the ball.
Soc	8a	The lady that the snake bites picks the flower.
Socc	9a	The cat chases the mouse and the mouse eats the cheese.
Socd	10a	The snake the man kicks bites the baby.
Socd	11a	The man the dog bites kicks the ball.
Son	12a	The dog that the snake bites chases the donkey.
Son	13a	The baby that the girl pushes kisses the lady.
Sonc	14a	The boy kissed the girl and the man kicked the boy.
Sond	15a	The man the girl pushed chased the boy.
Sond	16a	The man the boy kissed pushed the man.
Ooc	17a	The girl picked the flower that the rabbit bit.
Ooc	18a	The dog chased the ball that the donkey kicked.
Oocc	19a	The boy picked the apple and the horse eats the apple.
Oocd	20a	The dog chases the wagon the donkey pushes.
Oocd	21a	The girl kicks the ball the dog catches.
Oon	22a	The woman kisses the girl that the man chases.
Oon	23a	The boy kicks the girl that the lady pushes.
Oonc	24a	The baby kisses the lady and the man kicks the lady.
Oond	25a	The dog chases the snake the donkey bites.
OOnd	26a	The donkey chases the dog the snake bites.
Osc	27a	The dog chases the rabbit that eats the carrot.
Osc	28a	The cat chases the mouse that eats the cheese.
Oscc	29a	The donkey kicks the lady and the lady picks the flower.
Osn	30a	The woman kisses the girl that chased the man.
Osn	31a	The boy kicks the man that pushed the girl.
Osnc	32a	The dog chases the snake and the snake bites the horse.

Table 6

Stimulus Sentences Employed in Presentation B (Non Randomized Order)

Code	#	Stimulus Sentences
Ssc	1b	The girl that picks the flower pushes the wagon.
Ssc	2b	The boy that eats the candy catches the ball.
Sscc	3b	The baby pushes the ball and the baby bites the apple.
Ssn	4b	The boy that pushed the man kicked the girl.
Ssn	5b	The man that kissed the lady chased the boy.
Ssnc	6b	The boy pushes the girl and the boy kisses the lady.
Soc	7b	The girl that the snake bites catches the ball.
Soc	8b	The mouse that the cat chases eats the cheese.
Socc	9b	The donkey kicked the lady and the lady picks the flower.
Socd	10b	The boy the dog bites kicks the ball.
Socd	11b	The rabbit the dog chases eats the carrot.
Son	12b	The girl that the boy pushed kicked the horse.
Son	13b	The lady that the man kissed pushed the baby.
Sonc	14b	The horse kicks the donkey and the dog bites the horse.
Sond	15b	The donkey the dog bit chased the horse.
Sond	16b	The dog catches the ball that the man kicks.
Ooc	18b	The rabbit eats the flower that the girl picks.
Oocc	19b	The dog chases the wagon and the boy pushes the wagon.
Oocd	20b	The man catches the ball the lady kicks.
Oocd	21b	The boy kicks the mouse the cat chases.
Oon	22b	The snake bit the dog that the donkey chased.
Oon	23b	The baby kicked the lady that the man kissed.
Oonc	24b	The boy kicks the girl and the lady pushes the girl.
Oond	25b	The man chased the girl the woman kissed.
Oond	26b	The lady pushed the boy the horse kicked.
Osc	27b	The horse kicks the cat that chases the mouse.
Osc	28b	The dog bit the boy that kicked the ball.
Oscc	29b	The dog chases the rabbit and the rabbit eats the carrot.
Osn	30b	The baby kicked the boy that kissed the girl.
Osn	31b	The dog bites the horse that chases the donkey.
Osnc	32b	The man pushes the girl and the girl kisses the lady.

CHAPTER IV

RESULTS

Scoring Procedures

Categorization into Response Types

Sentences were judged correct if both of the Actor-Action-Object relationships contained in each sentence were enacted correctly. Order of clause enactment was not a dependent measure. Responses were coded into a numerical symbol system consisting of one out of a possible eight digits, each digit representing a single mutually exclusive response type. Response types which are reflective of the use of a particular comprehension strategy are summarized on Table 7 which is located on the following page.

These eight categories of responses account for every response type produced. Assignment of a numeric code to a particular response category was arbitrary, since numeric labels do not correspond to any predetermined hierarchy or interval of error severity but constitute a nominal scale.

Each response type coded was variously transformed into a binary system with 0 = absence of response type isolated and 1 = presence of response type in order to obtain mean scores which constituted the basis of the statistical analysis.

Table 7

Description of Response Categories Utilized by Normally Achieving and Reading Disabled Third and Sixth Grade Subjects in the Comprehension of Relative Clause Sentences and Control Sentences.

Response Category	Code	Description[a]
Correct	1	Subjects enactment matches both S-V-O relationships in sentence.
Cannonical Order/ Recency	2	Last N-V-N sequence within sentence interpreted as S-V-O.
Temporal or order of mention = order of meaning	3	Any adjacent N-V-N sequence is interpreted as S-V-O disregarding clause boundaries.
Parallel Function	4	Relativized noun maintains its function as subject or object throughout sentence.
Extraposition	5	Object relative clause always interpreted as if it is extraposed subject modifier.
Mutual Action	6	All nouns preceeding the main (clause) verb combine to perform all actions specified by the verbs in the sentence on all nouns following the main clause verb.
Nonsyntactic Error	7	Substitution of lexical items.
Incomplete Response	8	Only one S-V-O relationship is enacted.

[a]Sample enactments for each response category within each sentence type are presented in the Appendix.

Means as Proportions of Correct Responses

Mean scores presented in the Tables consistently reflect mean number of items answered correctly. Items answered correctly received a score of one (1) an incorrect response to an item was coded as zero (0). The minimum score for any item was 0 and the maximum score was 1. Means of scores for any item or group of items were obtained by adding up the scores for all the items under consideration (this was equivalent to a cumulative score of number of items correct) and dividing these cumulative scores by the number of items (represented in tables as N). Means then would theoretically range from .000 (if all item scores were 0) to 1.000 (if all scores were 1).

Using this device of dummy coding (Winer, 1972) which is defined as allowing a variable to be 1, when a characteristic (in this case correct response) is present and 0, when a characteristic is absent provides means which are equivalent to the proportion of observations (n) in which the correct response is present (Wallis & Roberts, 1956; pp. 226, 240). Therefore, means also represent the proportion of items receiving a correct response.

Effects of Grade, Group, Syntactic Structure, Semantic Constraint and Modality.

A five factor (2 x 2 x 2 x 6 x 2) analysis of variance was created in compliance with the experimental design outlined in the preceeding chapter. The following between subject and within subject (repeated) factors and levels of the factors are referred to by these labels:

Between subject variables:

GRADE - (2 levels) - Grade 3 (3)/Grade 6 (6)

GROUP - (2 levels) - Normal Readers (1)
Disabled Readers (2)

Within subject repeated measures:

SEMANTIC CONDITION - (2 levels) - Constrained (c)
Nonconstrained (n)

SENTENCE TYPE - (6 levels) -

Object Relative Clause with object focus - (Oo)

Object Relative Clause with object focus and deleted relative pronoun (Ood)

Object Relative Clause with subject focus - (Os)

Subject Relative Clause with object focus - (So)

Subject Relative Clause with object focus and deleted relative pronoun - (Sod)

Subject Relative Clause with Subject Focus - (Ss)

MODALITY - (2 levels) - Auditory (A)

Visual (V).

Due to large number of variables acceptable levels of test significance for the Analysis of Variance procedure was set, following convention, at $p < .01$ (Cohen & Cohen 1975, pp.159-160). The effect of GRADE was significant, $F(1, 156) = 96.43$, $p < .0001$ as was the effect of GROUP, $F(1, 156) = 274.41$, $p < .0001$. There was no significant interaction between GRADE and GROUP, $F(1, 156) = 5.06$, $p < .02$.

Table 8, representing mean correct responses for Normal Achieving and Reading Disabled Groups as a function of Grade reveals that scores increased as a function of Grade and that normally achieving subjects in both grades achieved higher scores than their reading disabled peers. One exception is that sixth grade disabled readers achieved lower scores than the normal third graders. The Analysis of Variance table, (Appendix E), demonstrates that Group accounts for more of the variance than Grade.

The effect of Semantic Condition was significant, $F(1, 156) = 959.81$, $p < .0001$.

Table 9, representing mean or proportion of correct item responses made by normally achieving and disabled third and sixth grade subjects as a function of semantic condition indicates that all subjects achieved higher mean scores in sentences presented in

Table 8

Mean[a] Correct Responses By Item Made in the Comprehension of Relative Clause Sentences by Normally Achieving and Reading Disabled Groups as a Function of Grade in School.

		Grade		Total Row Mean
Group	n	3	6	
Normal	3840	.828	.914	.871
Reading Disabled	3840	.615	.752	.683
Column mean		.712	.833	

[a] Mean as discussed in the Introduction to this section is synanomous with proportion of correct responses due to the coding system employed.

Table 9

Mean Correct Response By Item Made by Normally Achieving and Disabled Third and Sixth Grade Subjects in the Comprehension of Relative Clause Sentences as a Function of Semantic Condition.

		Semantic Condition	
Group	N	n(non-constrained)	c(constrained)
		Third Grade	
N	960	.683	.973
RD	960	.381	.848
Ttl for Grade 3	1920	.532	.911
		6th Grade	
N	960	.838	.990
RD	960	.579	.925
Ttl for Grade 6	1920	.708	.957
		Total for Group	
N	1920	.760	.982
RD	1920	.480	.886
		Column Totals	
	3840	.620	.934

semantically constrained conditions. There was a significant interaction between Grade and Condition, $F(1, 156) = 41.25$, $p < .0001$ and between Group and Condition, $F(1, 156) = 83.64$, $p < .0001$. The interaction between Grade x Group x Condition was not significant, $F(1, 156) = 5.06$, $p < .6816$. The interaction between Grade x Condition and Group x Condition can be understood through examining Figure 1 on the following page, which represents mean, or proportion of, correct responses of third and sixth grade normally achieving and reading disabled subjects for sentences with constrained and nonconstrained semantic relationships.

Although all subjects in both groups and grades did better in the semantically constrained sentences, the steeper slope of the two lower lines suggest that differences in semantic condition has more of an effect on the scores of the reading disabled as compared to the normally achieving group and that differences in semantic condition also has more of an effect on the scores of the third grade subjects than on the sixth grade subject. The figure also illustrates that the range of mean scores is smaller on constrained sentences than on nonconstrained sentences suggesting that performance differences between groups and grades are less pronounced in constrained sentences than in unconstrained sentences.

The effect of sentence type was significant, $F(5, 780) = 79.63$, $p < .0001$. Tables 10 and 11 which are on the following pages present the means for the effect of sentence type as well as all the following interactions. These interactions were significant:

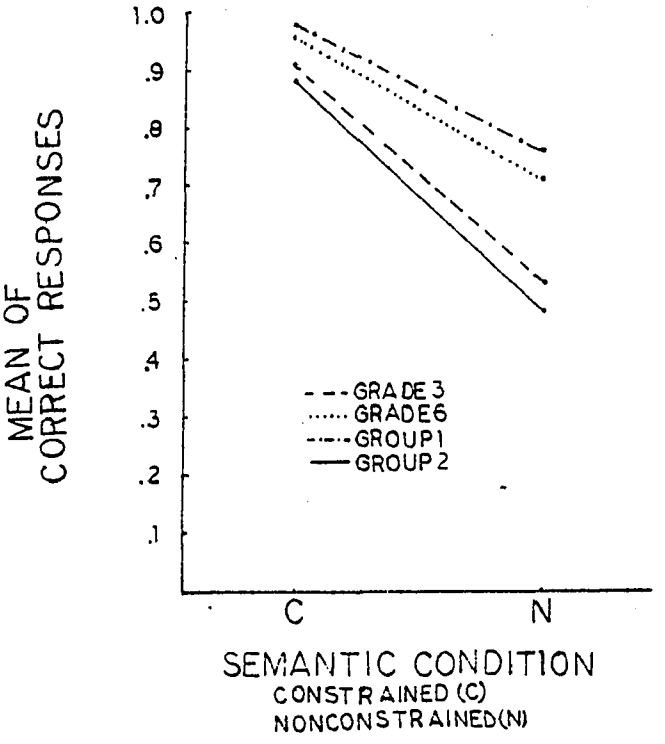

Figure 1. Performance of third grade and sixth grade normally achieving (Group 1) and reading disabled (Group 2) subjects on the comprehension of relative clause sentences as a function of semantic condition.

Table 10

Means of Correct Responses Made by Third and Sixth Grade Normally Achieving and Reading Disabled Subjects in the Comprehension of Relative Clause Sentences as a Function of Sentence Type.

		Sentence Type					
Group	N	Oo	Ood	Os	So	Sod	SS
		Third Grade					
N	320	.881	.878	.940	.800	.703	.768
RD	320	.703	.637	.812	.503	.384	.650
Total	640	.792	.757	.876	.651	.543	.709
		Sixth Grade					
N	320	.953	.943	.956	.925	.750	.953
RD	320	.784	.790	.843	.734	.534	.825
Total	640	.871	.887	.900	.829	.642	.889
		Group Totals					
N	640	.920	.910	.948	.862	.726	.860
RD	640	.743	.714	.828	.618	.459	.737
		Column Totals					
	1280	.832	.812	.888	.740	.593	.799

Table 11

Means of Correct Responses Made by Third and Sixth Grade Normally Achieving and Reading Disabled Subjects in the Comprehension of Relative Clause Sentences as a Function of Sentence Type and Semantic Condition.

Group	N	Sentence Type: Oo		Ood		Os		So		Sod		SS	
		Semantic Condition: n	c	n	c	n	c	n	c	n	c	n	c
Third Grade													
N (1)	160	.768	.993	.775	.981	.887	.993	.625	.975	.481	.925	.562	.975
RD (2)	160	.487	.918	.412	.862	.681	.943	.212	.793	.168	.600	.325	.975
Total for Grade 3	320	.628	.956	.593	.921	.784	.968	.418	.884	.325	.762	.443	.975
Sixth Grade													
N	160	.937	.981	.887	1.000	.912	1.000	.862	.987	.525	.975	.906	1.000
RD	160	.612	.956	.681	.900	.718	.968	.525	.943	.275	.793	.662	.987
Total for Grade 6	320	.775	.968	.784	.950	.815	.984	.693	.965	.400	.884	.784	.993
Group													
N	320	.853	.987	.831	.990	.900	.996	.743	.981	.503	.950	.734	.987
RD	320	.550	.937	.546	.881	.700	.956	.368	.868	.221	.696	.493	.981
Column Totals													
	640	.701	.962	.689	.935	.800	.976	.556	.925	.362	.823	.614	.984

[a]Means are equivalent to proportions of correct responses.

GRADE X TYPE, $F(5, 780) = 6.86$, $p < .0001$

GROUP X TYPE, $F(5, 780) = 6.97$, $p < .0001$

CONDITION X TYPE, $F(5, 780) = 22.80$, $p < .0001$

GRADE X CONDITION X TYPE, $F(5, 780) = 9.12$, $p < .0001$

GROUP X CONDITION X TYPE, $F(5, 780) = 4.06$, $p < .001$

The following interactions were not significant:

GRADE X GROUP X TYPE, $F(5, 780) = 1.36$, $p < .24$

GRADE X GROUP X CONDITION X TYPE, $F(5, 780) = .97$, $p < .44$

Since sentence type proved to be a significant main effect, a Duncan Multiple-Range Test was performed to rank and determine the significance of the differences between all possible sets of means representing each of the six levels of this effect. Means utilized for performing the Duncan are provided in the column totals on Table 10. Ranking of response difficulty for the six levels of sentence type in descending order is SOD, SO, SS, OOD, OO and OS. However, application of the Duncan test reveals that only four of the six levels of sentence type means were signficantly different ($p < .01$).

Most difficult level	SOD
Second most difficult level	SO
Third most difficult level	SS-OOD-OO
Easiest level	OS

Duncan tests were repeated on means of the significant interactions of Sentence Type x Group, and Sentence Type x Grade. The results of these additional Duncan tests are reported on Table 12 which is located on the following page.

Table 12

Ranking of Order of Sentence Difficulty for Third and Sixth Grade Subjects and Normally Achieving and Reading Disabled Subjects as determined by The Duncan Multiple Range Test.[ab]

Group[a]	Significant Levels of Rank Order of Sentence Type in Decreasing Order of Difficulty.
I. Normally Achieving	Sod
	So
	Ood - SS - OO
	OS
II. Reading Disabled	Sod
	So
	Ood - Ss - Oo
	Os
Grade[a]	
Third Grade	Sod -
	So - SS
	Ss - OOd
	Ood - OO
	Os
Sixth Grade	Sod
	So - Ood - OO - SS
	Ood - Oo - Ss - Os

[a] df = 5,180.

[b] p < .01.

Table 11 indicates that means scores for each level of sentence type change as a function of grade and group. Sixth graders achieve higher scores on all sentence types than do third graders and normal subjects achieve higher mean scores for all sentence types than do reading disabled subjects. However, Table 12 indicates that for each group and for each grade, Sod remains the most difficult sentence, receiving significantly ($p < .01$) lower mean or proportion of, correct responses than any of the five other sentence types and Os remains the easiest sentence ($p < .01$). Within these parameters, order of sentence difficulty was the same for the reading disabled and normally achieving group, but differences between the third grade and the sixth grade are evident. For the sixth grade, an order of sentence difficulty (with the exception of Sod) is less distinct, probably reflecting the overall high mean scores achieve d by the normal sixth graders on all sentence types.

The interactions of Condition x Type x Grade and Condition x Type x Group are illustrated in Figure 2 which is located on the following page.

This figure illustrates the information previously outlined regarding tne influence of both semantic and syntactic structure on processing. Althougn the reading disabled group (Group 2) achieved the lowest mean scores overall, performance for both groups and for both grades was influenced by the effects of both sentence type and semantic condition. Additionally, the pattern of the influence of these effects (although not the degree) appears similar for all four sample subsets.

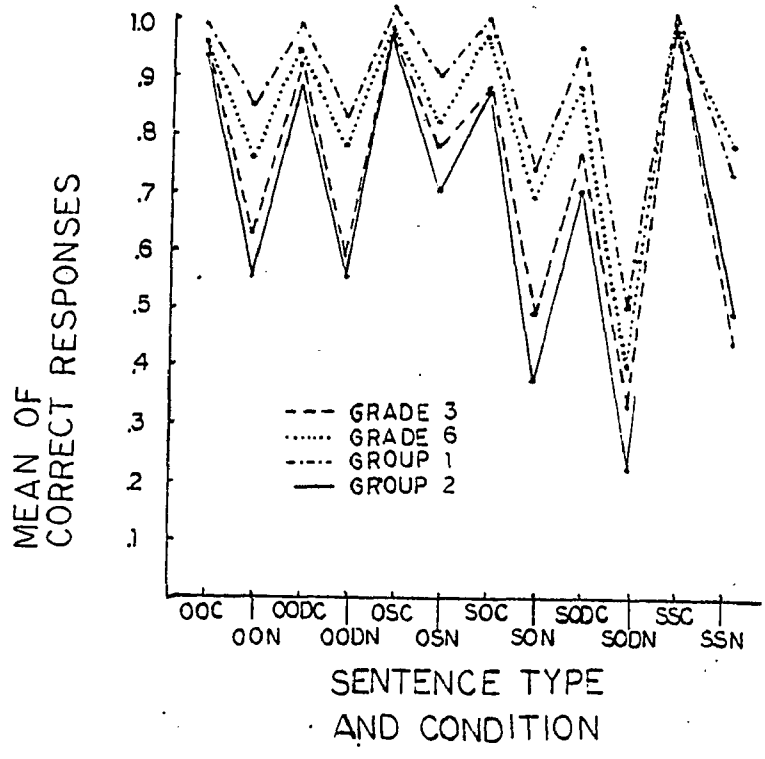

Figure 2. Performance of third and sixth grade subjects and normal and reading disabled subjects in the comprehension of relative clause sentences as a function of sentence type and condition.

The final potential source of variation within the design, MODALITY, was not significant, $F(1, 156) = 5.26$, $p < .02$. Tests of the effects of interactions of modality with each of the other factors in the design were not significant. They are listed in the Analysis of Variance Table (Appendix E) for the reader's reference.

Table 13 indicates that mean scores achieved by subjects as a function of modality are very similar when group and grade are held constant. When these means are graphically displayed (see Figure 3) it is clear that although overall performance differences between grades and between groups occurred, performance levels did not change as a result of mode of presentation.

The relationship between auditory and visual modalities will be examined in the following section.

Correlation Between Auditory and Visual Modalities:

Correlations of auditory with visual modalities were obtained utilizing a number of dependent measures. Pearson product moment correlation of scores on all individual items achieved in the auditory modality ($N = 3840$) with all individual items achieved in the visual modality ($N = 3840$) yielded a significant moderate positive correlation between modalities ($r = .405$, $p = < .0001$). However, when this procedure was repeated utilizing means of individual item scores as a function of Grade, Group, Condition and Sentence Type, ($N = 48$) the correlation coefficient showed an almost perfect

Table 13

Mean[a] Response of Sixth and Third Grade Normally Achieving and Reading Disabled Subjects on the Comprehension of Relative Clause Sentences as a Function of Mode of Presentation.

		Mode of Presentation	
Group	N	Auditory	Visual
		Third Grade	
N	960	.843	.813
RD	960	.630	.600
Total	1920	.737	.706
		Sixth Grade	
N	960	.920	.908
RD	960	.746	.757
Total	1920	.833	.832
		Group Totals	
N	1920	.882	.860
RD	1920	.688	.678
		Column Totals	
	3840	.785	.769

[a]Means are equivalent to proportions of correct responses.

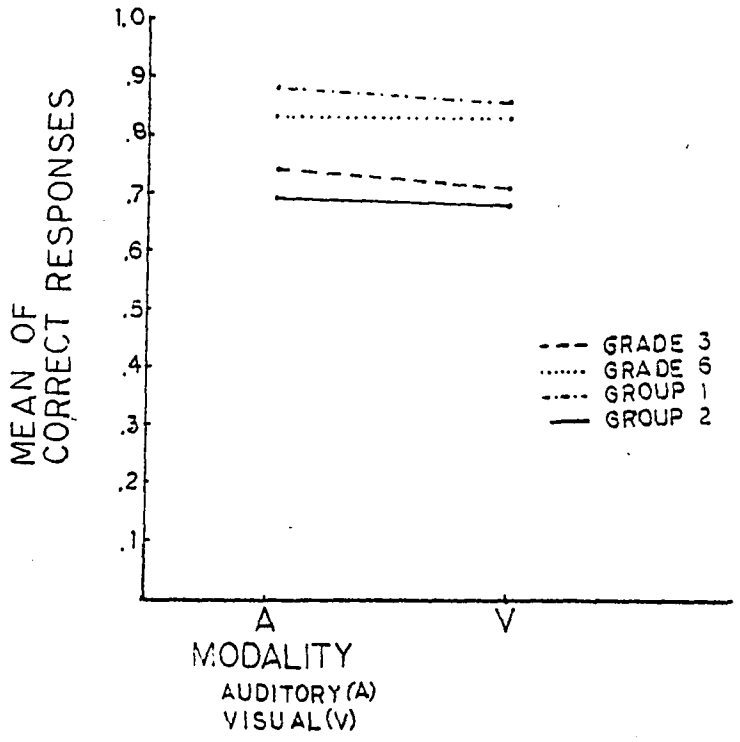

Figure 3. Performance of third and sixth grade subjects and reading disabled and normally achieving subjects in the comprehension of relative clause sentences as a function of listening and reading.

relationship between auditory and visual scores (r = .984, p < .0001). This latter correlation which is illustrated in Figure 4 would suggest that means in each modality are fairly stable and move in the same direction for each group and grade when sentence type and condition are held constant.

Correlations of mean scores within each grade and group subset (presented in Table 14) were uniformly high (r = .954 - r = .993).

Spearman rank-order correlation for ranking of order of difficulty of sentence type across auditory and visual modalities also yielded a high positive correlation - (r_s = .868, p < .0001).

Pearson product moment correlations of dichotomous data (phi correlations) of error types made within each modality were also obtained. This was accomplished by collapsing of each response type (as outlined earlier in this chapter) into a binary system. Each error type then had a range of 0-1, artificial mean scores of error types could then be obtained for each response type. This correlation matrix (Table 15) demonstrates significant positive correlations for each error type.

Correlations across auditory and visual modalities based on error type as a function of sentence type were obtained and are presented in Table 16. Significant correlations were obtained for major strategies employed within each sentence type, but there was no correlation for less popular strategy types.

Significant correlations across auditory and visual modalities were obtained for the following strategies:

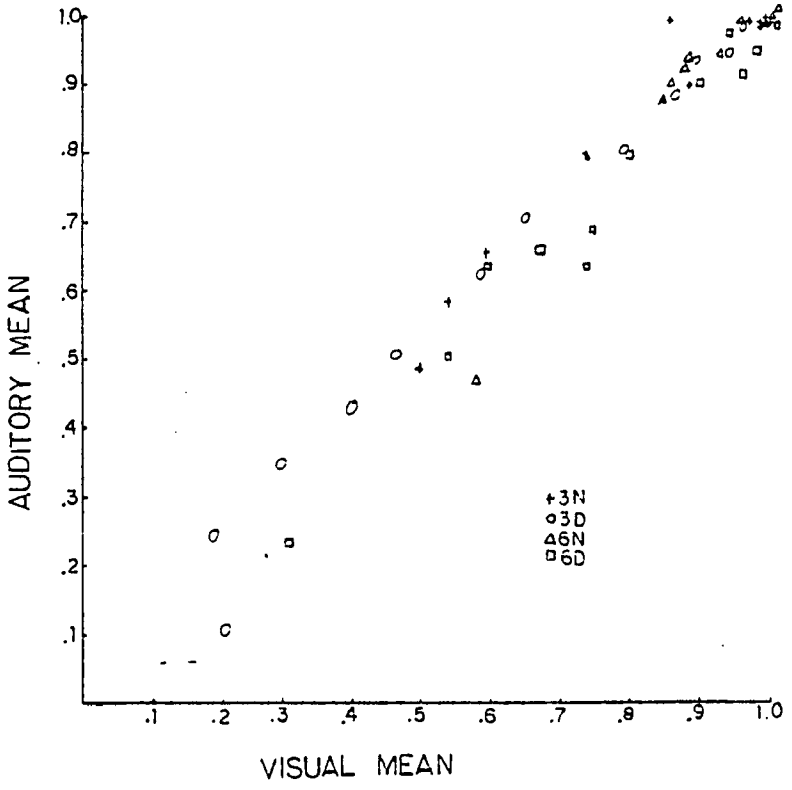

Figure 4. Scatter plot diagram for comparison of mean scores achieved in relative clause comprehension while listening and reading by third and sixth grade normal and disabled readers.

Table 14

Correlation Coefficients[a] for Auditory and Visual Mean Scores Achieved by Third and Sixth Grade Normally Achieving and Reading Disabled Subjects on Semantically Non-constrained Relative Clause Sentences.

		Visual Mean Score			
Auditory Mean Score		Group and Grade			
		3 - 1	3 - 2	6 - 1	6 - 2
Group and Grade	3-1	.986			
		. 0003			
	3-2		.970		
			. 001		
	6-1			.993	
				. 0001	
	6-2				.954
					. 003

[a] Cells represent correlation coefficient/probability level.

Table 15

Correlation Matrix for Frequency of Utilization of Response Categories over Auditory and Visual Modalities (Listening and Reading) by Third Grade and Sixth Grade Normally Achieving and Reading Disabled Children in the Comprehension of Relative Clause Sentences.

	Auditory							
Visual	Response Category							
Response Category	Correct	2	3	4	5	6	7	8
Correct	.405*							
2		.260*						
3			.421*					
4				.231*				
5					.304*			
6						.095*		
7							.089*	
8								.073*

*$p < .0001$.

Table 16

Strategies Employed by Third and Sixth Grade Normally Achieving and Reading Disabled Subjects as a Function of Sentence Type. Correlations between Auditory and Visually Presented Sentences.

	Response Category					
Sentence Type[a]	Correct	Canonical	Temporal	Parallel	Extraposition	Other
OOD	.33	n.s.	.36	.26	.40	n.s.
OO	.25	n.s.	.25	n.s.	.17	.31[b]
Os	.24	-	-	.17	.42	-
So	.40	.17	.33	.21	n.s.	n.s.
Sod	.42	.29	.38	.25	n.s.	.21[c]
Ss	.51	-	.54	-	n.s.	.29[c]

Note. In certain instances no responses within a strategy pattern occurred or occurred infrequently - such columns are marked "-".

[a]number of responses = 640 for each sentence type.

[b]clause omission.

[c]nonsyntactic error.

*All correlations significant at $p < .0001$ unless otherwise noted.

Temporal strategy (response type 3) and parallel function (response type 4) correlated significantly across all sentence types. Extraposition strategy (response type 5) was significant across auditory and visual presentations of object relative clause sentences with object focus. Canonical order strategies correlated significantly across auditory and visual presentations for all Subject Relative Clause Sentences.

Analysis of Response Types as a Reflection of Strategy Use.

Due to the interest in category of incorrect response as reflecting overuse or incorrect employment of comprehension strategies, frequencies and percentages of responses within categories are presented on Table 17.

As incorrect response categories are independent, and mutually exclusive, chi square tests were conducted to determine significance of differences in proportions of types of incorrect responses. All chi square tests were significant ($p < .0001$). Chi square differences in proportions of incorrect response categories between groups was significant , $x^2(18) = 164$, $p < .0001$ indicating that sample subsets were not responding with the same pattern of errors. As expected, the frequencies of responses within a given category of error type (hereinafter referred to as strategy), occur in inverse relationship to the number of correct responses made. Thus, reading disabled subjects, who produced fewer correct responses than the normal

Table 17

Frequency and Percentage of Errors within Each Response Category Which are Produced by Third Grade and Sixth Grade, Normally Achieving and Reading Disabled Subjects in the Comprehension of Relative Clause Sentences.

Grade and Group	Response Category								Total Incorrect Responses
	1	2	3	4	5	6	7	8	
Third Grade - Normal	1591	78[a]	130	42	49	7	11	12	329
	.	4.57	7.61	2.46	2.87	0.41	0.64	0.70	19.26
	.	23.71	39.51	12.77	14.89	2.13	3.34	3.65	
	.	40.21	18.28	14.09	22.07	8.43	13.25	10.26	
Third Grade - Disabled	1181	68	322	83	114	38	41	73	739
	.	3.98	18.85	4.86	6.67	2.22	2.40	4.27	43.27
	.	9.20	43.57	11.23	15.43	5.14	5.55	9.88	
	.	35.05	45.29	27.85	51.35	45.78	49.40	62.39	
Sixth Grade - Normal	1756	15	75	46	14	2	4	8	164
	.	0.88	4.39	2.69	0.82	0.12	0.23	0.47	9.60
	.	9.15	45.73	28.05	8.54	1.22	2.44	4.88	
	.	7.73	10.55	15.44	6.31	2.41	4.82	6.84	
Sixth Grade - Disabled	1444	33	184	127	45	36	27	24	476
	.	1.93	10.77	7.44	2.63	2.11	1.58	1.41	27.87
	.	6.93	38.66	26.68	9.45	7.56	5.67	5.04	
	.	17.01	25.88	42.62	20.27	43.37	32.53	20.51	
Total	.	194	711	298	222	83	83	117	1708
	.	11.36	41.63	17.45	13.00	4.86	4.86	6.85	100.00

[a]Data in columns represent: Frequency - Percent of Total Response - Row Percent - Column Percent

group generally exhibited a greater number of responses within any strategy category than did the normally achieving group. Chi square procedures showed, however, significant patterns of strategy preference regardless of overall error frequency within each grade and group. (Grade Three Group 1: $x^2(6) = 258$, $p < .0001$; Grade Three Group 2: $x^2(6) = 548$, $p < .0001$; Grade Six Group 1: $x^2(6) = 188$, $p < .0001$; Grade Six Group 2: $x^2(6) = 339$, $p < .0001$). Looking at proportion of strategy use in relation to total errors made by any sample subset (presented as "Row Percent" in the data in Table 17) suggests a number of trends. Temporal Order Strategy (response type three) was the strategy overused most frequently by each group. The temporal order strategy also represents similar proportions of the total errors made within group, (ranging from 39% - 46%). A canonical order-recency strategy (response type 2) represents approximately three times greater proportion of total error for the third grade normally achieving subjects, than occurs for any other group. This strategy is also the second most popular strategy over-utilized by the third grade normally achieving group.

A parallel function strategy (response type 4) represented a larger proportion of errors for the sixth grade subjects than for the third grade subjects. However, within each grade, both normally achieving and disabled groups appear to overuse this strategy in equal proportions.

Conversely, an extraposition strategy (response type 5) is used relatively more often by the third grade groups, than the sixth

grade groups. The extraposition strategy represents almost twice as large of proportion of group error for the third graders as it does for the sixth graders.

Use of nonsyntactic strategy and omission of clauses (response types 7 and 8) occurs more frequently and represents a greater total proportion of group error for disabled groups within both grades, than it does for the normally achieving groups at both grade levels. However, the sixth grade disabled group utilized a mutual-action strategy (type six response) more than a nonsyntactic response or clause omission strategy while the third grade disabled group utilized a clause omission strategy more often than either a mutual action strategy or a nonsyntactic response. The disabled third grader utilized clause omission almost as often as a parallel function strategy and more than a canonical order strategy.

Rankings for strategy preference as reflected in error types made are presented in Table 18 which is located on the following page.

Rankings illustrate that a temporal strategy represented the most common example of strategy overuse. However, thereafter, strategy preferences fluctuate as a function of grade. However, disabled groups, at both grades, appear to have similar orders of primary strategy preference, even though (as Table 17 indicates) the relative frequency of incorrect responses declines in the older group.

An analysis of error categories as a reflection of a function of group, grade, sentence type, condition and modality is presented

Table 18

Rankings for Strategy Preference as Reflected in the Category of Errors Made in the Comprehension of Relative Clause Sentences by Third and Sixth Grade Normally Achieving and Disabled Subjects.

	Ranking of Strategy Preference						
	Most Frequent			Least Frequent			
Grade and Group							
Third Grade, Normal	3[a]	2	5	4	7	8	6
Third Grade, Disabled	3	5	4	8	2	7	6
Sixth Grade, Normal	3	4	2	5	8	7	6
Sixth Grade, Disabled	3	4	5	6	2	7	8

Note. Three most preferred strategies account for 97% and 99% of responses (including correct ones) in third and sixth grade normal groups and 88% and 94% of responses (including correct ones) in third and sixth grade disabled groups.

[a] Numbers represent response categories as described in Table 7.

1 = Correct
2 = Canonical Order
3 = Temporal
4 = Parallel Function
5 = Extraposition
6 = Mutual Action
7 = Nonsyntactic Error
8 = Incomplete Response

in Table 19. For the sake of clarity, only the most frequent category of strategy overuse are presented. Most common error types representing less than 5% (or 3 responses) of the total responses made for any sentence type are treated as outliers and omitted from the table (Dunn & Clark, 1974, pp. 338-9). Instances of ties or scores within 5% of each other are reported. A complete tally is included in Appendixes F and G for the reader's reference.

Examining most common instances of strategy overuse summarized on Table 19 indicates that overuse of any particular response type changes as a function of syntactic structure as well as grade and group. This information can be summarized as follows:

A. Object Relative Clause Sentences:

1. For Object Relative Clause Sentences with object focus (Oo), an extraposition strategy accounts for most of the errors made by the third graders. However, a temporal order of mention = order of meaning strategy accounts for most of the errors made by the sixth graders.

2. For Object Relative Clause Sentences with object focus (Oo) where the relative pronoun is deleted, an extraposition strategy accounts for most of the errors made by the third grade subjects, however, the sixth graders are now preferring an extraposition strategy as well as temporal strategy.

3. Because of the small number of incorrect responses occurring overall in Oo sentences in semantically constrained conditions, it would be inappropriate to isolate a single response type

Table 19

Most Common Instance of Strategy Overuse by Third Grade and Sixth Grade Normally Achieving and Disabled Subjects in the Comprehension of Relative Clause Sentences as a Function of Sentence Type, Condition and Modality.

	Auditory (Listening)					Visual (Reading)				
Sentence Type	Third Grade Normal	Third Grade Disabled	Sixth Grade Normal	Sixth Grade Disabled	Most Common	Third Grade Normal	Third Grade Disabled	Sixth Grade Normal	Sixth Grade Disabled	Most Common
Oon	5[a] / 11.0	5 / 25.0	--	3 / 13.8	5/12.1% 3/ 8.8%	5 / 17%	5 / 23.8	3 / 7.5	3 / 25.0	3/14.7% 5/12.8%
Ooc	--	--	--	--	--	--	8 / 6.3	--	--	8/ 2.2%
Oond	5 / 10.0	5 / 35.0	5 / 6.3	3,5 / 13.8,13.8	5/16.3% 3/ 8.4%	5 / 10.0	5(3) / 28.8(263)	3,5 / 5.0,5.0	3 / 12.5	5/12.8% 3/12.5%
Oocd		8 / 5.0	--		8/ 1.6%		5 / 6.3	--	7 / 5.0	5/ 1.8%
Osn	4 / 6.3	4 / 17.5	4 / 5.0	4 / 20.0	4/12.1%	4 / 8.8	4 / 21.3	4 / 10.0	4 / 18.8	4/14.7%
Osc	--	3 / 3.8	--		4/ 1.8%	--	--	--	--	4 + 8/ .9% each
Soc	--	2,3,4 / 5.5,6.3	--	4 / 6.2	4/3.1%	--	2,8 / 7.5,7.5	--	--	(8)2/2.2% (7)4/2.2% (6)8/1.9%
Son	2 / 21.3	3 / 43.8	3 / 8.8	2,3,4 / 12.5, 16.3,13.8	3/18.4% 2/13.4%	3(2,4) / 13.8 (11,11)	3 / 36.2	2 / 5.0	3,4 / 16.3, 16.3	3/17.5% 2 + 4/ 9.6/9.3%
Socd	--	2,3 / 11.3,17.5	--	4 / 12.5	(18)3/ 5.6% (17)4/ 5.3%	2 / 5.0	3,4,5 / 10.0,18.7, 12.5	--	4,5 / 7.5, 6.3	6/5.3% 4/5.0%
Sond	2,3 / 25.0, 18.8	3 / 53.8	3,4 / 23.8, 21.3	3,4 / 37.5, 16.3	3/33.4[a] 2/13.1%	2,3 / 22.5, 16.3	3 / 31.3	3,4 / 21.5, 12.5	3,4,6 / 27.5, 16.3,18.8	3/24% 2-4-hed 10.6+10.3
Ssc	--	--	--	--	--	--	--	--	--	7/1.2%
Ssn	3 / 40.0	3 / 60.0	3 / 6.3	3 / 25.0	3/32.8%	3 / 42.5	3 / 60.0	3 / 12.5	3 / 28.8	3/35.9%

Note. Most common strategy representing less than 5% of total response was eliminated as outlier. Cells represent response category#/ percentage of occurence.

[a] numbers represent response categories as described in Table 7.

1 = Correct
2 = Canonical Order
3 = Temporal
4 = Parallel Function
5 = Extraposition
6 = Mutual Action
7 = Nonsyntactic Error
8 = Incomplete Response

as representative of a pattern of strategy overuse. Although incorrect responses reflecting temporal, extraposition, non-syntactic and clause omission strategies were recorded, no single strategy reflected more than 2% of total response made for this syntactic structure in constrained condition.

4. No differences in patterns of strategy overuse for Object Relative Clause Sentences (with intact or deleted relative pronoun) were noted as a function of disability or mode of presentation.

5. For Object Relative Clause Sentences with subject focus (Os) sentences, a parallel function strategy accounts for most of the errors made by each grade level and each disability group within each grade level and for both modalities. (It will be recalled that a temporal order strategy, which accounted for many of the incorrect responses to Oo sentences, result in a correct response when applied to an Os type sentence.)

B. Subject Relative Clause Sentences:

6. For Subject Relative Clause Sentences with object focus (So), a temporal order strategy accounts for most of the errors made overall. However, the third grade normally achieving group overutilized a canonical order, recency strategy more than they overutilized a temporal strategy. Additionally, the sixth grade disabled group appear to be overrelying on a parallel function strategy and temporal

strategy equally. Fluctuations representing less than five percent (of total responses) between overuse of temporal order, parallel function and canonical/recency strategies were noted as a function of mode of presentation, but did not appear to be indicative of strong shifts of strategy preference for any single group or grade.

7. For Subject Relative Clause Sentences with object focus with deleted relative pronoun, a temporal strategy continues to account for most of the errors. However, for the normal sixth grade group, a parallel function strategy becomes more prominent for Sond sentences than for Son sentences.

8. For So sentences in the constrained condition, no strong trends in strategy overuse can readily be discerned. Temporal, canonical/recency, parallel and clause omission each represent similar proportions of total responses for the third grade disabled group (5.5% - 7.5%). The only strategy utilized for Soc sentences which represents over five percent of total responses for the sixth grade groups was a parallel function strategy (which represented 6.2% of responses on the auditory modality).

9. In Sod in the constrained condition, no trends in strategy overuse by normal groups are apparent, since errors made represented less than 5% of total responses. An exception is the third grade normals use of canonical order/recency

strategy in the visual modality. For the disabled groups, temporal order was the most common pattern detected for the third grade disabled subjects, and parallel function was the most common pattern for the sixth grade disabled subjects, in the auditory modality.

In the visual modality, responses for the third grade disabled population appear to be divided between a temporal strategy, parallel function strategy and extraposition strategy and responses for the sixth grade disabled population appear to be divided between a parallel function and extraposition strategy.

10. For Subject Relative Clause Sentences with subject focus utilization of a temporal order strategy is the most common incorrect response for each of the grades and disability groups, and represents approximately one third of total responses made on SS sentences within each modality.

Coordinate Sentences

Coordinate sentences were employed in this study as filler sentences, for the purpose of serving as controls for the effects of attention, memory and ability to decode individual words in comprehension.

As outlined in the last chapter, a control sentence was employed for each of the four types of relative clauses in each

semantic condition so that eight coordinate services were randomly interspersed among the twenty four stimuli sentences within each modality.

Serving as controls, coordinate sentences were eliminated in the computation of response means on which statistical procedures were conducted. However, it is interesting to explore grade and group performance in the control sentences in order to confirm that scores achieved in the experimental sentences are an outcome of the effects of the variables under study.

Table 20 which presents percentages of correct response to coordinate sentences, indicates that between 93%-100% of responses to coordinate sentences (depending on type) were correct, representing appropriate subject-verb-object enactments in 3495 out of a possible 3560 instances. This information suggests that coordinates did in fact serve as effective control sentences. However, within this generally high level of accuracy, some variation suggesting performace differences as a result of group can be seen. For example, studying Table 20, one sees that 39 of the 65 incorrect responses were made by the third grade disabled group and 14 of these 65 incorrect responses were made by the sixth grade disabled group, thus 53 out of 65 incorrect responses can be attributed to the disabled groups. However, total number of errors made by the disabled group remains small, when contrasted with their performance on Relative Clause sentences. While strong fluctuations occur for performance in relative clause sentences as a function of sentence type and semantic condition, Table 21

Table 20

Percentage of Correct Responses to Coordinate Sentences as a Function of Group and Grade and Mode of Presentation.

		Grade			
		3	Group	6	
Sentence Type	Total[a]	Normal[b]	Reading Disabled[b]	Normal[b]	Reading Disabled[b]
		Auditory Presentation			
1. OOcc	100	100	100	100	100
2. OOnc	93.5	97.5	87.5	97.5	92.5
3. OScc	98.8	100	95	100	100
4. OSnc	95	100	87.5	100	92.5
5. SOcc	100	100	100	100	100
6. SOnc	98.1	100	95	100	97.5
7. SScc	97.5	100	95	97.5	97.5
8. SSnc	95.6	95	92.5	97.5	97.5
		Visual Presentation			
1. OOcc	99.4	100	97.5	100	100
2. OOnc	94.3	97.5	87.5	97.5	95
3. OScc	100	100	100	100	100
4. OSnc	96.3	100	85	100	100
5. SOcc	100	100	100	100	100
6. SOnc	92.5	92.5	82.5	97.5	97.5
7. Sscc	98.8	100	97.5	100	97.5
8. Ssnc	99.4	97.5	100	100	100

[a] n = 160 for each presentation.

[b] n = 40 for each presentation.

illustrates that no such fluctuation occurs for the coordinate sentences.

It becomes evident that fluctuations in correct responses between 54% and 100% occur for relative clause sentences, while percentage of correct responses for coordinate sentences remain stable at or near ceiling (93-100%).

The influence of the structure of the relative clause is particularly striking when contrasting performance on difficult relative clause sentences with their coordinate controls. Since Sod and So relative clause sentences were the most difficult for all groups and grades, this construction was isolated for comparison with its coordinate control. Figure 5, which illustrates this relationship, demonstrates that performance on So coordinates remain near ceiling, regardless of semantic condition, while mean scores on So relative clauses were generally low and changed sharply as a result of semantic condition and elimination of the relative pronoun.

Error response categories reflecting use of comprehension strategies similar to those found for relative clause sentences were seen in the comprehension of coordinate sentences. The small number of total incorrect responses for coordinate sentences makes it inappropriate to perform an analysis of comprehension strategy preference (similar to that conducted for the relative clause sentences). However, the appearance of similar strategies leads to some interesting speculations which will be addressed later.

Table 21

Percentage of Correct Responses Made in the Comprehension of Relative Clauses and Coordinate Sentences by Third and Sixth Grade Normally Achieving and Reading Disabled Subjects.

Sentence Type	Condition	Relative Clause[a]	Coordinate[b]
		Auditory	
Oo	c	97.8	100
Oo	n	72.5	93.8
Os	c	97.5	98.8
Os	n	81.3	95
So	c	92.5	100
So	n	57	98.1
Ss	c	99.3	97.5
Ss	n	63.1	95.6
		Visual	
Oo	c	94.7	99.4
Oo	n	68.1	94.3
Os	c	97.8	100
Os	n	78.8	96.3
So	c	92.5	100
So	n	54	92.5
Ss	c	97.5	98.8
Ss	n	59.7	99.4

[a] $\underline{n}$ = 320 responses in each cell

[b] $\underline{n}$ = 160 responses in each cell

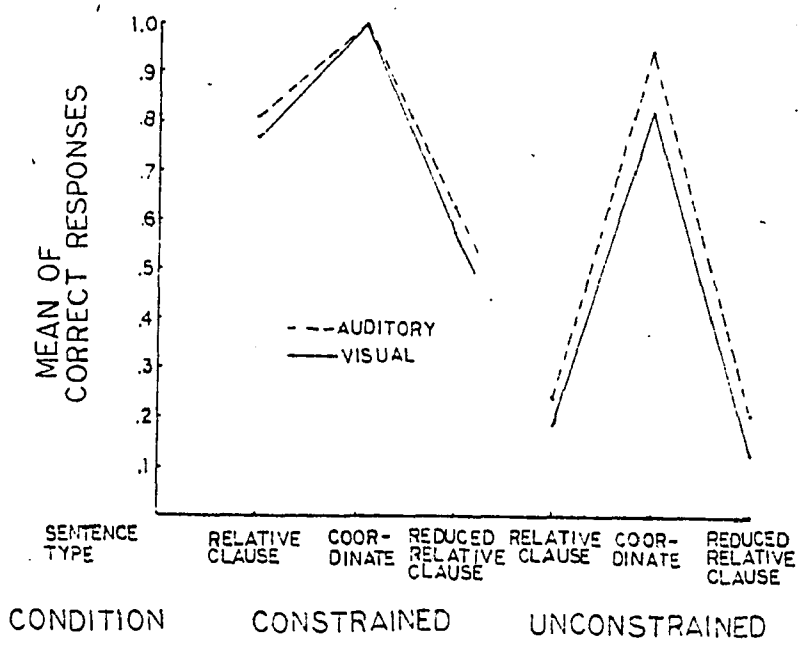

Figure 5. Mean scores achieved by third grade reading disabled subjects on the auditory and visual comprehension of Subject Relative Clause sentences with object focus (So) and Coordinate Control Sentences.

CHAPTER V

DISCUSSION

Hypotheses posed in this study will now be reconsidered in light of the results obtained.

Hypothesis one predicted that reading disabled students would display quantitative and qualitative differences in strategy patterns as compared to normals. This hypothesis was confirmed. As noted in Chapter IV, the analysis of variance determined that Group had a significant effect on performance ($p < .0001$) with the disabled groups achieving lower scores than the normally achieving groups. Furthermore, the sixth grade disabled subjects achieved lower scores than the third grade normally achieving subjects although they did not perform as poorly as the third-grade disabled subjects. The study was designed in such a manner that efficient use and selection of appropriate strategies was necessary to achieve correct responses. Therefore, since the disabled sample achieved less correct responses than the normal sample, the lower scores of the disabled population may be interpreted as reflecting a quantitative difference in their strategy patterns. The disabled population also displayed qualitative differences in their strategy patterns as compared to normals. An important finding is that the repertory of strategy type is the same for both populations; every response category reflecting use of a

particular strategy which was utilized by the normal population was also utilized by the disabled population. Qualitative differences between the groups therefore are a reflection of different patterns of strategy preference within the repertory. This was demonstrated through the ANOVA by a significant Group x Sentence type interaction as well as group differences in rankings of strategies which were inappropriately used. Both groups used temporal strategy, as the preferred strategy. This was demonstrated by the significantly higher mean score of correct responses on Os type sentences, which are the only relative clause sentences presented which can be correctly interpreted by a temporal strategy response. Although instances of correct response and instances of strategy overuse, suggesting a temporal strategy, was the preferred strategy for both groups, strategy preferences, beyond that became apparent. These results are outlined in Table 18 in the previous chapter.

One of the most striking differences between the groups was the significantly greater proportion of disabled subjects responses that reflected utilization of nonefficient strategy patterns. Nonefficient strategies, which comprise response categories six, seven, and eight, are so termed because in no instance does use of these strategies provide a correct interpretation for any of relative clause sentences presented in this study. Within these responses, category eight (clause omission) can probably be considered the most severe of the nonefficient strategies since some of the information in the sentence is simply disregarded or not preserved. Type seven responses, involving a nonsyntactic error, such as substituting one lexical item for another, is less severe than

type eight since the subject maintained two S-V-O enactments. A category six response shows some sensitivity to temporal order since the position of a noun as preceding or following the main verb determines its function as Subject or Object of the verb. Sinclair and Bronckart, (1972) note similar incorrect response categories. They refer to these categories as reflecting immature or primitive strategies since they most frequently occur in the responses of young children and decrease with age, disappearing almost entirely by age six and one half.

The reading disabled groups in this study demonstrated an over-reliance on strategies which were popular with only the very young children in the Sinclair and Bronckart (1972) study. Comparing data from the two studies raises the question of whether disabled performance reflects a delay in the ability to utilize efficient language processing strategies. Definitive support for the notion of reading disability reflecting from a delay in strategy acquisition or utilization is not provided in the current study; the performance of the sixth grade disabled group did not resemble the performance of the third grade normal group. However, two trends were noted which justify further study.

Changes in patterns of strategy overuse are noted as a function of age for the normal group and are consistent with findings in the literature which support the theory that strategy preferences change as children grow older (Bever 1970; Ferreiro, 1976; Sinclair & Bronckart, 1972). However, no concurrent changes in patterns of strategy overuse are noted between the younger and older disabled group; the sixth grade disabled group maintains the same ranking of strategy overuse as the third grade disabled group. The other interesting trend is

that the sixth grade disabled subjects achieve lower correct scores then do the third grade normal subjects. This could be an artifact of the selection procedure, since common measures of reading ability may not be testing skills measured in this study. However, it may be that the reading disabled subjects are functioning at a comprehension level which is even lower than that typically attributed to a normally achieving third grader.

Hypothesis two predicted that third grade subjects would display quantitative and qualitative differences in strategy patterns as compared to sixth grade subjects. This hypothesis was confirmed. The analysis of variance indicated that Grade had a significant effect on performance, with the sixth graders achieving higher mean scores than the third graders. Qualitative differences in strategy utilization was also apparent. The analysis of variance indicated that the interaction for sentence type with grade was significant. Temporal strategy was the most common strategy. Preference for this strategy was reflected in the significantly higher mean scores ($p < .01$) for Os sentences from both grades, demonstrated by the Duncan Multiple Range comparisons on sentence type means. Analysis of incorrect responses as a reflection of strategy type confirm that a temporal strategy consumed a significantly higher proportion of incorrect responses ($p < .0001$), representing approximately 40% of incorrect errors made. However, beyond this, significant grade differences in alternative strategy patterns appear to develop. (The reader is referred to Table 17.) Third graders made more use of a canonical order/recency strategy that did sixth graders, the

third grade accounting for approximately 74% of total use of that strategy. There was also a greater percentage of overuse of an extraposition strategy by the third graders, with the third graders accounting for 72% of the overuse of that strategy. The greater reliance on use of the extraposition strategy by the third graders (compared to the sixth graders) becomes clear in examining performance on Object Relative Clauses with object focus. Use of an extraposition strategy accounted for 50% of the third grade total responses (including correct ones) for this sentence type. In the sixth grade, temporal strategy was generally utilized as often as extraposition strategy in the comprehension of Oo sentences.

Parallel function was utilized more often by the sixth grade subjects than the third grade subjects and represented the second most popular strategy employed by the six grade subjects. The strong preference for parallel function is reflected in the sixth grade subjects higher mean scores in Oo and Ss sentences where use of a parallel function results in a correct interpretation for these sentences. Additionally, there is extensive evidence of overuse of this strategy by the sixth grade population since a parallel function strategy represented approximately 28% of errors made by the sixth grade normally achieving group and 28% of errors made by sixth grade disabled group as compared to 13% and 11% of errors made by third grade groups (see Table 17).

The final qualitative strategy difference between the grades is evidenced in the use of the nonefficient strategies of mutual function, non-syntactic and clause omission discussed in the previous section.

Although much of the differences in the preference for these strategies can be attributed to the processing patterns of the disabled groups, these strategies are employed more often and represent a greater proportion of incorrect responses for the third grade disabled than for the sixth grade disabled subjects. Use of inefficient strategies decrease as disabled subjects get older. Furthermore, there is a shift away from use of a clause omission strategy toward use of a mutual function strategy. It will be recalled that mutual function was considered a less disabling strategy than clause omission, in that mutual function demonstrates some sensitivity to, and ability to utilize perceptually perceived temporal order of elements.

In summary, quantitative differences exist in strategy use as a function of grade which would confirm findings that younger children are less adept at selecting appropriate strategies from their available repertory (Sinclair & Bronckart, 1972). In addition to the greater dependence on nonefficient strategies, third grade subjects display overuse of an extraposition strategy, which is inefficient as it never results in correct enactments for any of the relative clause sentences presented. Third grade subjects also overused a canonical order/recency strategy to a greater degree than did the sixth grade group. In contrast, the sixth grade subjects utilize a parallel function strategy, which if correctly selected, could result in correct responses on half of the experimental sentences. This would suggest that strategy selection processes become more refined and sophisticated as a function of age. Matching the correct strategy to a structure occurred

more frequently as normal children became older and preferences for the strategies that were overused tended to become increasingly efficient in that they were more closely related to and more appropriate for the structures being presented.

Hypothesis three consisted of a number of components related to the role of modality in language comprehension. This hypothesis predicted a) that linguistic complexity is more influential on performance than mode of presentation, b) that a positive correlation would exist between listening performance and reading performance, and, c) that strategies would be consistent across listening and reading domains. All components of this hypothesis were confirmed. Analysis of variance indicated that the effect of Sentence Type (containing six levels of syntactic complexity) was significant ($p < .0001$) while the effect of mode of presentation (auditory vs. visual) was not significant. Although the interactions of Type x Group and Type x Grade were significant ($p < .0001$) there were no significant interactions by either group, grade or type with mode of presentation. The relationship between linguistic complexity and mode of presentation is illustrated on the following page in Figure 6. Figure 6 compares performance of normally achieving and disabled third and sixth grade subjects as a function of linguistic complexity (sentence type and condition) and mode of presentation (listening vs. reading). As Figure 6 illustrates, changes in performance for each segment of the sample occur as a result of changes in sentence type. However, within any single pair

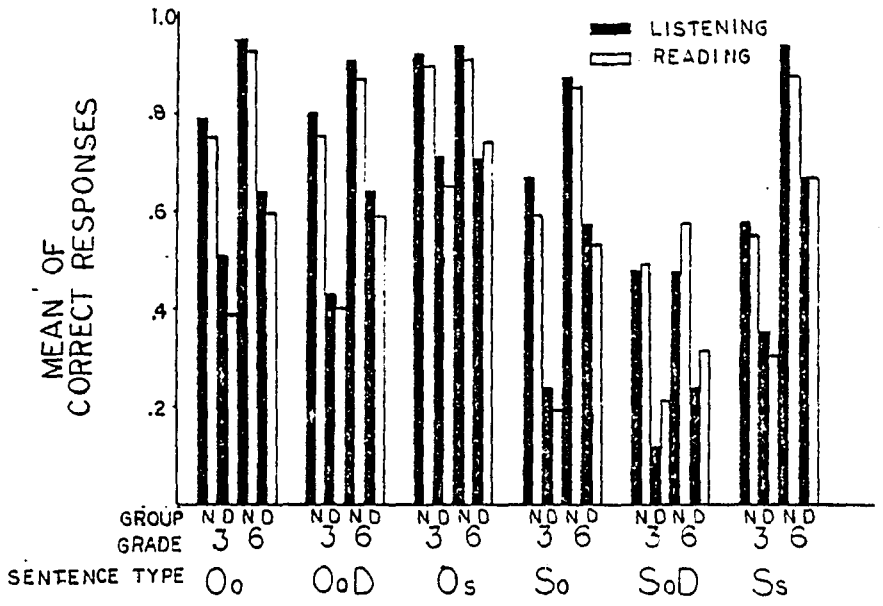

Figure 6. Mean Correct Scores achieved by third and sixth grade normally achieving (N) and disabled subjects (D) on the comprehension of six types of relative clause sentences while listening and reading.

of auditory and visual comparisons it is evident that scores are quite similar. Interestingly, scores for all grades and groups appear slightly depressed in the visual modality, with the exception of scores in the Son and Sond sentences, where visual scores appear higher, suggesting that performance for Son and Sond sentences (which were the most difficult sentences overall) was somewhat improved when subjects were asked to read, rather than listen, to these sentences. However, as these differences are not statistically significant and any explanations advanced here for these differences would be speculative, it is not appropriate to explore this issure further at this time. However, the role of visual versus auditory presentation as facilitating comprehension of syntactically complex material might prove an interesting topic for future research.

When comparing group performance across modalities, it is evident that although the reading disabled groups did more poorly than the normal group, each did equally well on auditory and visual sections of the testing instrument. (This relationship is illustrated on the following page in Figure 7 by the relatively flat lines between auditory and visual modes of presentation for each group within grade subset.) Correlations between mean scores in reading and listening tasks were almost perfect for the sample as a whole and for each group within grade. Performance for any segment in the sample could not be attributed to the mode of presentation but to the linguistic complexity of the sentence being presented. This is illustrated on the following pages in Figures 8 and 9 which show almost perfect correlations in the

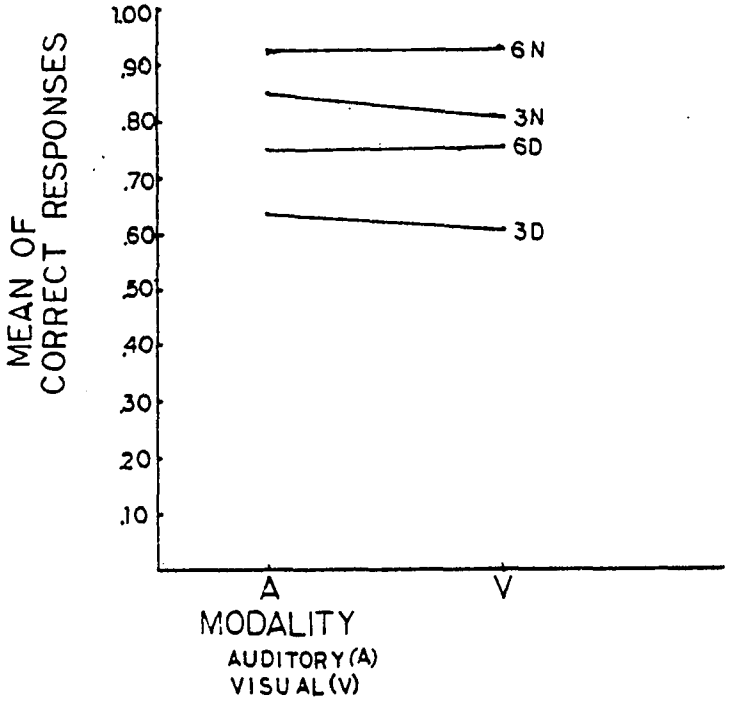

Figure 7. Mean Correct Scores achieved by third and sixth grade normally achieving (N) and reading disabled (D) subjects in the comprehension of relative clause sentences as a function of modality.

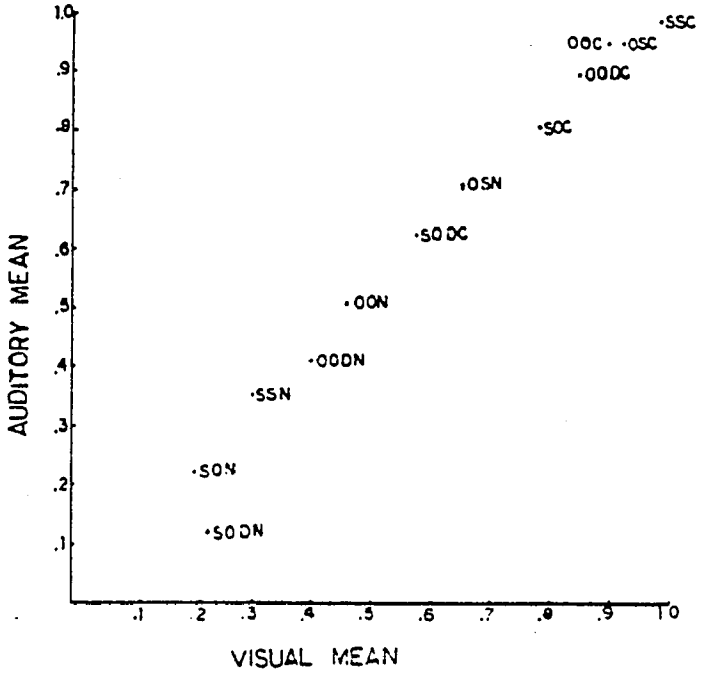

Figure 8. Scatter plot diagram for comparison of mean scores achieved in the comprehension of relative clause sentences while listening and reading by third grade reading disabled subjects.

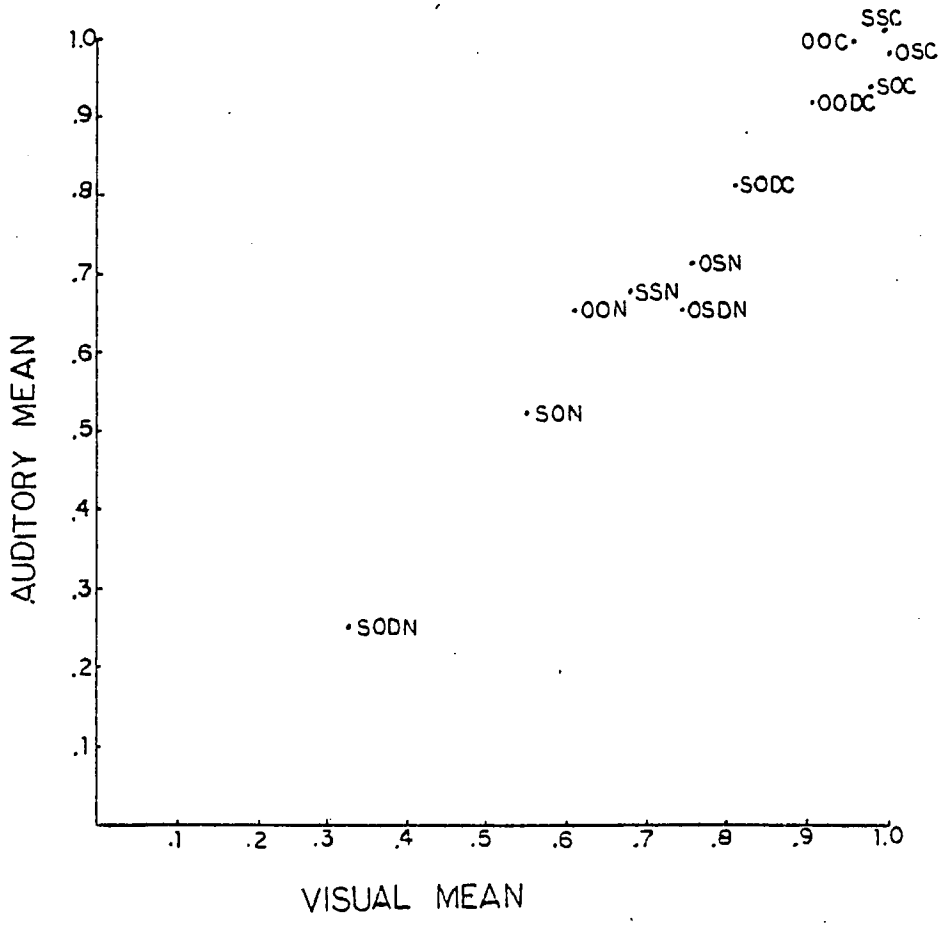

Figure 9. Scatter plot diagram for comparison of mean scores achieved in the comprehension of relative clause sentences while listening and reading by sixth grade reading disabled subjects.

performance of the third and sixth grade disabled groups over auditory and visual domains as a function of sentence type. The reading disabled groups were not failing on the reading task, but were having equal amounts of difficulty in both domains. This finding has important implications in developing a much needed, experimentally valid, theory of reading disability and in determining practices for reading remediation. It will therefore be re-examined along with the other findings concerning mode of presentation in the following chapter.

Examining patterns of incorrect strategy application presented in the preceding chapter (Table 19), it was evident that preferred strategies tended not to change as a function of modality. The same comprehension strategies used by a particular group for sentence comprehension in the auditory modality were also used for comprehension in the visual modality.

These results suggest that reading comprehension and oral language comprehension are parallel processes since both rely on identical strategy systems for comprehension. The findings confirm suggestions (Goodman & Goodman, 1977; Smith, 1975) that skilled reading requires the ability to utilize structures used in speech for the processing of visual material and that reading disabled children have problems utilizing syntactic information (Perfetti, 1977). These findings are not consistent with the hypothesis that reading disability reflects a problem in visual perception or intermodal transfer but does provide experimental evidence to support the hypothesis developed

in Chapter II that reading disability is a bimodal strategy deficit. Discussion of the implication of these findings is treated in the next chapter.

Hypothesis four consisted of a number of related predictions. For ease of discussion, each prediction will be considered separately. The first prediction stated that for each group, syntactic structure influences degree of comprehension and that an order of difficulty exists for syntactic complexity. This was confirmed. Analysis of variance pro- demonstrated that the effect of Sentence type was significant, ($p < .0001$) as were the Sentence type x Group and Sentence type x Grade interactions ($p < .0001$). Duncan multiple range tests indicated significant ($p < .01$) differences in the rank ordering of sentence difficulty so that Sond type sentences were the most difficult and Os were significantly easier than the other sentence types. Rankings of significant levels of difficulty for sentence types varied as a function of age, but not group. However, for the sample as a whole, differences between mean scores on Ood, Oo and Ss type sentences were not significant.

Hypothesis four also predicted that within this order of sentence difficulty, non parallel function sentences (So and Os) would be more difficult to process than parallel function sentences (Ss and Oo). This prediction was not confirmed, as Duncan tests confirmed that parallel function sentences were less difficult than So sentences, but more difficult than Os sentences.

A third prediction, that reduced relative clause sentences (in which the relative pronoun is deleted) would be the most difficult of all sentence types, was partially confirmed. So sentences with deleted relative pronoun were the most difficult of the six sentence types to comprehend, however, Object Relative Clause Sentences with deleted relative pronoun were not significantly more difficult than Object Relative Clauses with intact relative pronouns, and were easier than any of the Subject Relative Clause Sentences with object focus. This order of difficulty is important because of its implications for a theory of language processing. Two such theories were discussed in Chapter II. Certain performance predictions emanating from these theories were isolated for examination. The predicted rank orders of comprehension difficulty for relative clause sentences consistent with these theories are presented in Table 22 which is located on the following page.

A cursory examination of Table 22 indicates that the findings of this study are consistent with the predictions of "a comprehension strategy theory" of sentence comprehension, with a temporal order of elements strategy being the major strategy employed. These conclusions will become more readily apparent during the following discussion of the findings.

As discussed in Chaper II, a theory of sentence comprehension which emphasizes syntactic matching of surface structures to underlying representations, predicts that interruptions or alterations in surface configurations of linguistic units would increase comprehension complexity (Slobin, 1971). This prediction was not supported by the data

Table 22

Rank order of Difficulty in the Comprehension of Relative Clause Sentences as Predicted by Two Theories of Language Comprehension.

Language Comprehension Theories	Predicted Rank Order of Difficulty
Surface Structure to Deep Structure	
Match	
Clue in surface structure and interruption of linguistic unit	Sod
	So = Ss
	Ood
	Oo = Os
Comprehension Strategies	
Parallel function	So = Os
	Oo = Ss
Temporal order[a]	So
	Oo = Ss
	Os
Canonical order	So = Oo
	Ss = Os

[a] This represents the order obtained.

of this study. Sentences with interruptions in linguistic units (such as subject relative clauses in which the dependent clause interrupts the main clause) were not, as a class, more difficult to process than object relative clauses (which do not represent interruptions in the linguistic unit). Although Subject Relative Clause Sentences with object focus did prove to be more difficult than any of the other sentence types, Subject Relative Clause Sentences with subject focus were not significantly more difficult than Object Relative Clause Sentences with object focus. Furthermore, Slobin's hypothesis would predict that So and Ss sentences would be equally difficult to interpret as they both contain equal degrees of interruption within the main clause. This prediction was also not confimed as Ss sentences were significantly easier to comprehend than So sentences.

A theoretically related prediction states that sentences with alterations in their surface structure representations (illustrated in this study by the deletion of the relative pronoun) would be more difficult to comprehend. Again, data obtained did not support this prediction. Sentences with deleted relative pronouns were not consistently more difficult than sentences without such alteration. Deletion of the relative pronoun impeded comprehension of Subject Relative Clause Sentences but did not significantly impede comprehension of Object Relative Clause Sentences.

The differing role of the relative pronoun in comprehension is an unexpected finding which suggests further study. It will be recalled that deletion of the relative pronoun was predicted to increase sentence difficulty because presence of the relative pronoun in the surface

structure marks the deep structure as one in which relativization is applied (Fodor, 1971). Absence of this marking is predicted to deter comprehension for both subject and object relative clauses. However, the findings in this study, as well as those reported by Olds (cited in Fodor, 1971), demonstrated that relative clause deletion in object relative clauses had no significant effect on sentence complexity.

One explanation that can be advanced to account for the influence of the relative clause pronoun in subject relative clauses but not object relative clauses is dependent on the performance predictions emanating from the following hypotheses:

1. A major comprehension strategy is based on maintaining perceptually perceived ordering of elements within a sentence (Bever, 1970).

2. There is a stronger tendency to interpret a sentence initial noun rather than a noninitial noun as subject of a sentence (Bever, 1970; C. Chomsky, 1969; Fodor, Bever, & Garrett,1974).

Fodor, Bever & Garrett (1974) suggest that a relative pronoun functions as a cueing device, not to alert the comprehender to the underlying structure as proposed previously but to alert the processor that the sentence contains a violation of temporally perceived sequences. The insertion of an optionally deletable relative pronoun with a noun-verb sequence informs the processor such a sequence may not represent an actor-action relationship in that the noun preceding the relative pronoun serves as the object of the verb following the relative pronoun rather than its subject.

Because of the strong perceptual tendency to treat sentence initial nouns as subjects of the sentence, deletion of the optional relative pronoun in subject relative clauses (which provides the processor with information concerning the role of the sentence initial noun) will effect comprehension more than deletion of the optional relative pronoun in object relative sentences (in which the relative pronoun modifies a nonsentence initial noun that already has a greater likelihood than the sentence initial noun of being correctly interpreted as an object).

Additional research concerning the degree of comprehension difficulty created by optional subject vs. object relative pronoun deletion would be warranted in order to confirm the relationship between temporal strategy and noun position proposed above.

Within a general theory of sentence comprehension, based on the application of a series of comprehension strategies, predictions concerning the influence of conservation of function and conservation of temporal sequence have been discussed in Chapter II. A sentence processing strategy based primarily on conservation of function was not confirmed by these data. Sentences exhibiting parallel function were less difficult than certain non parallel function sentences, but more difficult than others. Although the two sentences exhibiting parallel function were comprehended with equal ease, and did, in fact, result in different scores from nonparallel function sentences the data cannot support conclusions previously discussed concerning the influence of function conservation as decreasing sentence complexity

(Brown, 1971; Davis & Blaisdell, 1975; Fier, 1977; Fluck, 1979; Sheldon, 1974, 1977; Wallach & Goldsmith, Note 4).

Results obtained are consistent with predictions of a theory of temporal comprehension strategy based primarily on maintaining perceived order of elements within the sentence.

Os, Oo and Ss sentences maintain temporal order within the initial N-V-N sentence sequences. Utilization of a temporal strategy results in correct enactments for the first N-V-N as subject-verb object. Both Oo and Ss, but not Os, violate temporal order in the second N-V-N sequence. Employing a temporal strategy would result in significantly higher degree of correct enactments for Os sentences since it is the only sentence type in which application of a temporal strategy results in two correct S-V-O enactments. Application of a temporal strategy would predict a similar number of correct enactments for Oo and Ss sentences, since both these sentence types contain violations of temporally perceived sequences in the last, but not the first N-V-N sequence.

If sentences are segmented into clauses it is apparent that Oo sentences violate temporal order within the relative clause while Ss sentences maintain order within the relative clause. Thus, analyzing a sentence into its component clauses and then limiting a temporal strategy to N-V-N sequences within a clause will result in a large number of correct responses for Ss sentences (since N-V-N sequences within the clause conform to a S-V-O interpretation) but will result in significantly fewer correct enactments for Oo

sentences since N-V-N sequences within the relative clause do not conform to a S-V-O interpretation).

Since the data show no significant difference in order of difficulty between Oo and Ss sentences, one can conclude that application of a temporal order strategy is not constrained by clause boundaries for Oo and Ss relative clause sentences.

So sentences contain two violations of S-V-O sequences. Neither temporally adjacent N-V-N sequences will be correctly interpreted using a temporal order strategy. Application of this strategy will result in two incorrect enactments and a significantly higher level of comprehension difficulty (reflected in incorrect responses). If clause segmentation occurs first, then the N-V-N sequence within the main clause conforms to S-V-O and will be correctly interpreted when a temporal strategy is employed, leaving only the relative clause vulnerable to error. This segmentation into clauses would render the So sentences as having a predicted level of comprehension difficulty similar to Oo sentences as both contain main clauses which are correctly interpreted as S-V-O. However, the data demonstrated that So sentences were significantly more difficult than Oo sentences and disconfirmed the performance predictions of a canonical order strategy.

In summary, obtained rank order of sentence difficulty is consistent with predictions of a model of sentence processing in which conservation of perceived temporal order plays an important role and supports findings obtained by Ferreiro (1976) and Sheldon (1977).

Findings disconfirm application of clause segmentation as a preliminary strategy; subjects utilization of a temporal strategy on N-V-N sequences was not constrained by clause boundaries.

Hypothesis five predicted that an interaction exists between semantic information and syntactic information within sentences, so that for each group semantically constrained sentences are easier to process than semantically nonconstrained sentences when degree of complexity remains constant.

This hypothesis was confirmed. The analysis of variance indicated that the effect of Condition was significant. Semantically constrained sentences resulted in higher mean scores than nonconstrained sentences. This supports the findings (which have been discussed in this paper earlier) of Schlesinger (1968), Slobin (1971) and others, but is inconsistent with findings of Stick and Norris (Note 3.) which suggest that semantic information did not facilitate comprehension. The significant Sentence type x Condition interaction, illustrated in Figure 2, demonstrates that although every sentence type was easier in the constrained condition, within the constrained condition mean scores differed significantly as a function of sentence type. This suggests that processes employed in decoding semantic information were not operating independently of processes used in analyzing the structure of a sentence and suggest the existence of an interdependent or a common processing system which utilizes and integrates both types of information. Although such a system is outlined by Wanner and Maratsos (1978), further study is necessary in

order to develop a complete understanding of its probable components and operations. In addition to the interaction of Type x Condition, there was a significant Group x Condition interaction and Grade x Condition interaction. The disabled group achieved scores almost identical to the normal group on certain sentences in the constrained condition (SS, OO and OOD) but there were large differences between the groups on all sentences in the unconstrained condition. These smaller differences between the groups in semantically constrained sentences suggest that the disabled group have less difficulty understanding and utilizing semantic information than they have in understanding syntactic information. It may be that the locus of the comprehension difficulty experienced by the disabled group lies in their difficulty with processing information, which requires correct ordering of elements devoid of contextual information concerning likely actor-object relationships. However, the reading disabled subjects may not be as sensitive to semantic constraints as the normal subjects, since lower scores on constrained sentences demonstrated that the disabled group attempted more sentence enactments that violated semantic constraints. Furthermore, informal observation during data collection suggest that the reading disabled subjects were more comfortable violating semantic constraints than the normal group. For example, examine sentence (5-1).

(5-1) The girl that the snake bites catches the ball.

A category three response, which reflects temporal order but violates semantic constraint is:

(5-1a) Girl bites snake, snake catches ball.

In enacting sentence (5-1) as (5-1a), normal subjects might hesitate, look quizzically at the experimenter, shrug their shoulders, shake their head or in some way indicate that the enactment was unusual. However, reading disabled subject provided enactment (5-1a) rapidly and without any such signs of concern.

In summary, the results obtained are consistent with research demonstrating the role of semantic information in facilitating auditory comprehension (Bever, 1970; Culioli, Fuchs & Pecheux, 1970; Lembert, 1978; Slobin, 1971), and reading comprehension (Schlesinger, 1968), and extend this hypothesis to a reading disabled population.

Hypothesis six predicted that consistent measurable patterns of errors would emerge indicating use of order and function strategies in processing of relative clause sentences. Chi square tests for proportions of responses within error categories confirmed this hypothesis. (The nature of the errors made reflected utilization of a comprehension strategy for a sentence in which the strategy did not apply.) Both normal and reading disabled third and sixth graders demonstrated significant patterns of errors ($p < .0001$). There was no evidence to support Wallach's (1977) finding that the performance of a portion of a disabled population is characterized by nonstrategic or random comprehension patterns. An important difference between Wallach's sample and the current sample may lie in the fact that Wallach's group was more severely disabled. Her sample contained many children who possessed a generalized learning disability which affected not just

reading ability but also language and overall scholastic functioning. Further research with abnormal populations is required to determine if level of severity of a disability is related to the ability to employ comprehension strategies. Perhaps the pattern of greater inefficient strategy use by the disabled population represents a point on a continuum ranging from haphazard responses to complete syntactic understanding.

Strategies based on order and function represented the most frequently incorrect responses, with order strategies used more than function strategies. A temporal order strategy comprised the error category most frequently employed by each subset of the sample and represented an equal proportion of errors. A canonical order/recency strategy represented a frequent incorrect response for third graders but not for sixth grade subjects.

The analysis of categories of error, unlike the analysis of rank order of sentence difficulty, did not permit a determination of the degree to which a clause analysis strategy may have been used prior to a temporal strategy. A mutually exclusive response category controlling order of strategy enactment could not be developed. For example, applying a temporal order strategy after a canonical segmentation strategy would yield an enactment identical to that reflecting a parallel function.

Parallel function represented the second most popular example of strategy overuse for sixth grade normal subjects and the third most popular example of strategy overuse for the third grade normal and

sixth grade disabled subjects. These findings support a model of sentencing processing based not on linguistically specific information but on more generalized comprehension strategies based on the perceived relationships among items in a sentence. Although relationships among items can be determined by function of the items (relative to other items) in the sentence and the sequences in which items occur, results suggest that perception of relationships based on sequence plays a more important role than perception based on function. Although parallel function played a more important role in the sixth graders responses, function strategies never equal order strategies as the most frequent example of strategy overuse. Indeed, use of order strategy remained a popular strategy for all groups and grades, with changes in patterns as a function of group or grade limited to the less frequently used strategies. An interesting question is why a strategy based on temporal order as opposed to function was relied on more frequently. Ferreiro (1976) suggests that such strategy preference reflects a child's cognitive abilities to conserve order and function. She suggests that overuse of a function maintenance strategy may reflect an inability to reverse and coordinate sequences within a sentence so that the child is unable to conserve the function of an item in the face of subsequent change. Similar arguments (Beilin, 1975) have been developed to account for the increased difficulty encountered when differences between perceived and actual order of elements exist. Because the degree of cognitive complexity has been demonstrated to have some degree of relationship to linguistic complexity (Beilin,1975) the current findings would suggest that com-

prehension of temporal order relationships may represent a more complex series of logical operations than decentration of functional relationships. If overuse of a temporal rather than a parallel function strategy reflects a concurrently stronger cognitive limitation on reordering of temporal units one would expect to see a decrease in the ratio of temporal strategy to total error as a reflection of grade and possibly group. However, this does not occur.

A more satisfactory explanation is that utilization of a temporal strategy reflects not a cognitive limitation but a pragmatic response. As Gibson (1972) and Levelt (1974) have suggested, a temporal strategy represents the perceptual regulations of the real word in which actors perform actions on objects. Within a descriptive linguistic framework, English corresponds to a S-V-O structure, nouns preceding the verb generally serve as subject while the nouns following the verb serve as objects, so that in an enactment, the first noun does something to the second noun. Temporal order is a popular response strategy, because it conforms to an anticipated ordering of events in the general perceptual and linguistic environment. The processor, therefore, in the absence of any information to the contrary, would be reasonable to assume that new structures conform to the same pattern as structures he is already familiar with. If conservation plays a role in development of sentence comprehension strategies it is likely to be in the fact that conservation of noun order with meaning probably represents a more common linguistic convention than conservation of noun role function within a sentence. Thus, a strategy based on maintenance of temporal order is likely to prove more efficient than one based

on parallel function. Indeed, findings on relative clause comprehension would confirm that parallel function was a major response strategy for children (Brown, 1971; Fluck, 1979; Ferreiro et. al., 1976; Sheldon, 1974) but not for adults (Fier, 1977; Sheldon, 1977).

The child language acquisition literature (cited in Menyuk, 1971; and elsewhere) provides numerous examples of old rule over generalization into new situations, as in the acquisition of morphophonemic markers for tense, and pluralization. Overuse of a previously successful strategy such as temporal order in a complex comprehension task may be considered an additional instance of overgeneralization. This would suggest that the processes utilized by older children in the acquisition of more complex structures may not be that different from those employed by younger children. Differences in the stages of language acquisition, once the child can comprehend simple sentences, may represent differences in the complexity of the structural, lexical or pragmatic information acquired rather than the processes used to attain comprehension.

Because of the limited data available the formulations outlined above must be viewed as speculative. Further research on strategy preference and language acquisition processes is clearly warranted.

CHAPTER VI

CONCLUSIONS & IMPLICATIONS

Comprehension Strategies

This study has provided experimental evidence to support the theory that comprehension strategies are psychologically real sentence processing mechanisms. Sentence processing strategies which utilize semantic information (Schlesinger, 1968; Slobin, 1966) and temporally presented order of elements (Bever, 1970; Fodor, Bever & Garrett, 1974; Sinclair & Bronckart, 1972) have been demonstrated to be used by third and sixth grade normally achieving and reading disabled subjects in processing six types of relative clause sentences. Processing mechanisms based on a grammatical linking of surface representations to underlying syntactic structures (Fodor, 1971; Slobin, 1971) cannot be supported by the results obtained. Sentences with interruptions in underlying linguistic units and lacking surface structure to deep structure markers (such as relative pronouns) were not consistently more difficult to comprehend.

Additionally, the results in this study do not support predictions that strategies used in comprehension of relative clause sentences would primarily reflect efforts to conserve the function of the relativized noun as actor or object in both main and relative clauses (Sheldon, 1974). Although both groups of children displayed a repetory of comprehension strategies, which included especially for sixth

graders, extensive use of a parallel function strategy, a parallel function strategy was employed less frequently than a strategy based on order of elements.

The rank order of relative clause sentence difficulty that was observed in this study was completely consistent with performance predictions based on a temporal comprehension strategy. In such a strategy the processor tends to interpret information based on the temporally presented order of elements, so that the first element is perceived as acting on the second element and the second element acting on the third. In the absence of complete syntactic understanding or other comprehension cues (such as semantic information) there is a tendency for $noun_1$-$verb_1$-$noun_2$-$verb_2$-$noun_3$ sequences to be interpreted as $actor_1$-$action_1$-object of $action_1$, $actor_2$-$action_2$-object of $action_2$. These findings are consistent with findings in adult relative clause comprehension (Fier, 1977; Sheldon, 1977). The primacy of a strategy based on temporal ordering of elements was also suggested by the data obtained in this study regarding the role of the relative pronoun in facilitating comprehension. The results suggest that the role of the relative pronoun in facilitating comprehension is a function of the position of the relative pronoun within the sentence. In instances where the relative pronoun interrupts sentence initial noun-verb sequences, as in a sentence such as "The dog that the cat bit ate the cake";comprehension is facilitated. Comprehension is not affected when non-sentence initial sequences are interrupted as in "The dog bit the cat that the woman kicked." This supports a temporally based comprehension

strategy by demonstrating the strong tendency (which has been suggested by Bever, 1970) to treat sentence initial nouns as subjects of the sentence and as actors of the adjacent verb. The relative pronoun may facilitate comprehension by alerting the processor to an alternation in the expected temporal pattern since lack of this cueing, often resulted in misinterpreting the first noun as actor of the adjacent verb and subject of the sentence.

Support for a temporal strategy was additionally demonstrated by data obtained on the frequency of strategy overuse. Use of sentence enactment as a dependent measure provided the opportunity to examine the comprehension process as well as outcomes. Examination of enactments which resulted in incorrect responses suggests that inappropriate enactments most commonly reflect overutilization of a generally successful strategy with a sentence to which the strategy does not apply. A temporal strategy represented the most frequently employed category of response and was overused by each group within each grade. Reasons for this overreliance on a temporal strategy were suggested in the preceeding chapter.

The results on rank order of sentence difficulty extend existing theory in the process of strategy application by suggesting that temporal order may proceed or function independently of clause segmentation. An interesting area for future research would require replication of the studies in clause segementation which have demonstrated the strong perceptual salience of the clause boundary in sentence processing (cited in Fodor, Bever & Garrett, 1974). Possibly the results

obtained in these studies could be equally well explained as segmentation based on temporally interpreted N-V-N sequences, since for many sentences, the clause boundary and the limit of the temporal sequenced unit occur simultaneously. Incorporating certain exceptional sentences such as subject relative clauses into these studies might provide further information on order of strategy selection, that is the role of the clause boundary and the role of application of a temporal strategy.

Implications for Future Research in Language Acquisition

Incorrect responses have been demonstrated to be related to overgeneralization of strategy use. The issue of rule or strategy overgeneralization in a model of language acquisition was addressed in the previous chapter.

We can conclude from the results in this study that the strategy demonstrated to be a primary comprehension device for very young children (Bever, 1970; Bever & Langendoen, 1976) remains a primary comprehension strategy for older children (between the ages of eight and thirteen) when presented with linguistically complex material. Processing strategies would appear then not to be suppressed with age (Bever & Langendoen, 1976). The results suggest an alternative explanation for changes in strategy use as a function of age. Strategies which are used at an earlier developmental stage do not disappear. These "early" strategies remain included in a repertory of strategy alternatives. The older subjects' increased number of correct responses

and increased use of efficient alternative strategies suggest that with maturing language ability, the size of the strategy repertory increases as does the ability to select strategies which provide correct interpretations. The utilization of a temporal strategy as the preferred response mode supports suggestions (Menyuk, 1977, p. 138; Sinclair & Bronckart, 1972, p. 331) that processing strategies are applied to new domains before correct comprehension is achieved. Strategies utilized in an earlier developmental stage may reappear when the processor is presented with complex or novel material.

Further research is required on the acquisition of complex structures in order to provide information on strategy repertory and strategy selection as a function of both the linguistic stimulus and the age and ability level of the subject.

Implications for a Theory of Reading Disability

Subjects in this study who had been characterized as reading disabled displayed significantly greater difficulty than normally achieving subjects on the reading comprehension component of the task. However, they also had difficulty on the auditory comprehension component. Indeed, neither the reading disabled nor normally achieving groups displayed significant differences in reading comprehension as compared to auditory comprehension. What characterized the disabled readers was not just a depressed ability to comprehend written material but an equally depressed ability to comprehend equivalent spoken material. Mode of presentation, therefore, was not a significant

variable for either the normal or disabled group, although sentence type and semantic condition was a significant variable. Significant correlations of mean scores achieved while listening and reading were obtained. Identical patterns of strategy overuse were observed in each component of the task. In summary, the data obtained support the conclusion that reading and oral language are closely related.

Furthermore, data obtained were inconsistent with performance predictions arising out of various theories of reading disability. It will be recalled that conjoined sentences were employed in this study as a control for possible memory deficits and word decoding problems accounting for difficulties in reading. The coordinates were comparable to the relative clause sentences in sentence length, use of lexical items and change or consistency of noun function as subject or object. The almost perfect scores achieved by the reading disabled group in both auditory and reading comprehension of coordinate sentences suggest, therefore, that the problems of this disabled group cannot be accounted for by a generalized memory deficit for long linguistic strings, phonological decoding problems or difficulty in comprehension of individual word meanings. Nor can the problems of the reading disabled group be attributed to difficulties in visual perception. Such a conclusion would require evidence of differences in performance as a result of mode of presentation with the disabled population achieving higher scores on auditorally as compared to visually presented material. As mode of

presentation was not a significant variable for either group, a theory of reading disability as a visual-perceptual problem cannot be supported.

Central to a theory of language and reading as hierarchical processes is the explanation of reading disability as a problem in the application or transfer of linguistic rule systems to the reading processes. Such a theory for reading disability requires evidence of differences in a disabled group's performance when listening and reading. These differences would be reflected perhaps by differences in rankings of sentence difficulty or patterns of strategy utilization. However, the data demonstrate that similar strategy patterns were employed by the disabled group when listening and reading.

The evidence of similar comprehension outcomes and, most importantly, evidence of similar comprehension processes, support the view of reading and language as parallel processes, which are joined by a common method of representation. This link, on the level of sentence comprehension, is characterized by the use of identical comprehension strategies for facilitating syntactic analysis. The results obtained in this study support the view of reading disability as a bimodality difference in the ability to selectively employ appropriate comprehension strategies. Evidence in support of this view is summarized in the following paragraph.

Both groups of readers display evidence of identical repertories of language comprehension strategies since every strategy category was reflected in both disabled and normal group responses. However,

significant differences were noted between the normal and disabled groups in the number of correct responses made and patterns of strategy use. The third and sixth grade disabled groups displayed more use of immature and inefficient response strategies such as clause omission and mutual function. Furthermore, examining strategy overuse as a function of sentence type suggested that the disabled group employed less variability in strategy selection as a function of sentence type. A temporal strategy remained the most overused strategy for each sentence type for the disabled group while the normal group (particularly the sixth graders) demonstrated changes in patterns of strategy overutilization in response to changes in the sentence types presented. This would suggest that the disabled population may have more difficulty changing strategies in response to structural changes and/or that they may be less sensitive to subtle changes in syntactic information.

The reading disabled group demonstrated less ability than normals in the ability to utilize semantic cues involving actor-action-object reversibility and were more likely to demonstrate what Sinclair and Bronckart (1972) have defined as anti-pragmatic responses. However, it is also evident that the reading disabled group had less difficulty utilizing semantic information than they had in utilizing syntactic information. This conclusion is supported by the higher scores obtained on sentences which contained semantic constraints than on the sentences which did not contain such constraints. In fact, the disabled groups scores appear much closer to normal scores on the con-

strained sentences than on nonconstrained sentences. Perhaps there are two sentence comprehension systems operating - one on semantic information and one on order of elements information - with the processor utilizing and integrating aspects of both systems depending on the complexity of the material presented. It would appear, that the reading disabled group's primary comprehension deficit reflects a difficulty in ordering of elements to a greater degree than a difficulty in utilizing semantic information.

Educational Implications

The view of reading disability as a bimodality difference in strategy utilization has important implications for developing instructional practices in reading. Reading is not, and should not be taught as, a skill isolated from oral language skills. Speech and language pathologists and reading teachers need to work closer together in planning and executing instruction. In order to accomplish this, training programs in speech and language pathology must require courses in reading acquisition and reading disability. and teacher preparation programs in remedial reading must require courses in language acquisition and psycholinguistics. Further, since reading disabled subjects have been demonstrated to be comparatively better able to utilize semantic information than syntactic information, reading instruction should capitalize on this strength. Reading instruction should emphasize utilization of semantic cues in addition to phonic cues for word and sentence comprehension.

Reading programs based on teaching use of contextual information ("linguistic" or "language experience" readers) may be more appropriate for certain reading disabled subjects who are experiencing comprehension problems than reading programs based on teaching phoneme-grapheme correspondences. Reading lessons should not be confined to presentation of visual material but should incorporate the teaching of auditory language comprehension skills. No assumptions concerning the disabled readers' ability to comprehend auditory language should be made. It is likely that the comprehension deficits being experienced are not modality specific. Reading comprehension expectations starting at approximately the third grade are dependent upon intact skills in making inferences, drawing conclusions, seeing logical relationships, etc. These skills are not currently assessed on the auditory and verbal level by the commercially available diagnostic instruments commonly used by speech and language pathologists. As illustrated in the current study, students who pass batteries of language tests may still have serious language comprehension problems which become evident when certain performance expectations are introduced. Assessment of complex syntactic structures and instructional materials and techniques which teach comprehension of complex syntactic structures and address comprehension strategy selection and application need to be developed.

Implications for Future Research in Psycholinguistic Bases of Reading Disability

In summary this study has provided evidence to support previously developed theories concerning the view of language comprehension strategies

based on temporal ordering of elements and semantic information and has demonstrated such theories to be relevant for visually presented information. Furthermore, reading disability has been demonstrated to be related to the inability to selectively employ appropriate comprehension strategies. Further research is required to determine the extent of the relationship between inappropriate use of strategies and degree of impaired performance. As suggested in the last chapter, inability to utilize correct strategies may represent a point in a continuum from haphazard responses to complete syntactic understanding. Evidence of such a continuum would contribute to a more complete description of language and/or reading disability. The need for further research concerning the influence of maturation as a factor in reading disability is suggested by the third and sixth grade reading disabled groups' comparative overuse of strategies which were demonstrated to be utilized by very young children but not by children past the age of seven. (Sinclair & Bronckart, 1972).

Caveats

Although the performance predictions outlined in this study may be viewed as having generated from three varying theoretical frameworks, there is evidence to indicate that syntactic, semantic and cognitive predictions for performance are not mutually exclusive. For example, Bever (1970) has demonstrated that semantic constraint and word order strategies variously influence children's comprehension of passive sentences as a function of age. Additionally, Schlesinger (1968) has demonstrated interactions between degree of semantic cueing

and nesting in visual comprehension of center embedded relative clause sentences. The interaction of semantic information and syntactic information in processing of oral and written sentences has been demonstrated in this study for both a normal and a reading disabled sample.

Slobin (1971), has acknowledged the interactive role of cognitive and linguistic factos in determining rate and order of appearance of linguistic elements in examining cross cultural linguistic data.

Indeed, arguments supporting an interaction between the influence of cognitive and linguistic variables in language acquisition and sentence processing have been developed by leading researchers from both fields of study (Beilin, 1975; Bever, 1975; Inhelder, 1978; Menyuk, 1976; Schlesinger, 1977).

In light of these data, it would be presumptuous to seek definitive support for a mutually exclusive cognitive or linguistic model of sentence processing. Such an attempt would be nonproductive and would not conform to a comprehensive view of sentence processing, which to be complete, must rely on factors from both cognitive and linguistic, as well as environmental, communicative and sociolinguistic and psychological domains. Rather, what is interesting, and relevant to a theory of sentence processing is the interaction between syntax, semantics, order and function as they influence comprehension of both written and spoken material.

Furthermore, this study makes no attempt to provide an answer to what causes reading disability. As discussed earlier, reading

disability has been shown to result from a variety of not necessarily exclusive factors which are further influenced by the age and characteristics of the population under study. For example, the subjects in this study did not exhibit problems in making phoneme-grapheme correspondences, sequencing graphemes or decoding individual words. However, such problems in grapho-phonological coding and/or sequencing have been demonstrated to contribute to the reading difficulties of certain populations (Gibson & Guinet, 1971; Ives & Ives, 1973; Lawson, 1976; Shankweiler & Liberman, 1972). It is therefore, inappropriate to propose any single factor as the most important cause of such a diversely manifested problem. More relevant to a study of psycholinguistics and reading is a description of the processes which may be viewed as both contributing to and reflecting the way at least some portion of a reading disabled population comprehend certain kinds of linguistic information. For as Huey (1908/1968, p. 6) has stated:

> And so to completely analyze what we do when we read would almost be the acme of a psychologist's achievement, for it would be to describe very many of the most intricate workings of the human mind, as well as to unravel the tangled story of the most remarkable specific performance that civilization has learned in all its history.

Appendix A

Characteristics of the Sample Employed in the Study of the Comprehension of Relative Clause Sentences

Grade	Group	Age		I.Q.	
		Range[a]	$\bar{x}$[a]	Range[a]	$\bar{x}$[a]
3	Normal	8.6 - 9.4	8.8	99 - 118	109
3	Reading Disabled	8.5 - 9.5	8.9	90 - 118	103
6	Normal	11.5 - 12.10	11.8	92 - 120	107
6	Reading Disabled	11.4 - 13.2	12.0	90 - 120	98

[a] $\underline{n} = 40$

HOPKINTON PUBLIC SCHOOLS

HOPKINTON SCHOOL COMMITTEE
OFFICE OF THE SUPERINTENDENT

HAYDEN ROWE STREET
HOPKINTON, MA 01748
TELEPHONE 617-435-4511

Dear Mr. & Mrs.

Your child has been tentatively selected to participate in a study for a Ph.D. dissertation conducted by Mrs. Sharon Goldsmith, Doctoral Candidate, Graduate School: City University of New York, which is examining the relationship between listening and reading skills in children with average to above average intelligence. The results of this study will hopefully benefit all Hopkinton teachers and administrators by providing information on the reading process and reading instruction.

One hundred and sixty students in grades 3, 5 and 6 from area schools will be asked to participate. The study consists of asking students to move some toy figures in response to sentences containing varying grammatical forms, which they are asked to read, and sentences they are asked to listen to. There is no score received; what is of interest are the differences in responses to different kinds of sentences.

The study will involve about ½ hour of your child's time, and can be conducted within the regular classroom or school building.

No information relative to your child's participation will be noted in the teachers file. However, Mrs. Goldsmith will be happy to meet with any parents before or after the study is concluded to answer questions. She may be reached at 429-4766.

Please indicate below whether or not you give your permission for your child to participate in this study and return this permission slip to Dr. Russo, Elementary Supervising Principal, in the enclosed stamped self-addressed envelope, by MAY 22, 1979 (Tuesday).

Sincerely,

David P. McCobb
Superintendent

DPM/mf

HOLLISTON PUBLIC SCHOOLS

Office of the Superintendent

LINDEN STREET

HOLLISTON, MASSACHUSETTS 01746

SUPERINTENDENT
Dr. Savino J. Placentino

ASSISTANT SUPERINTENDENT
James W. O'Connell

BUSINESS MANAGER
Howard W. Jackson

Dear Mr. & Mrs.

Your child has been tentatively selected to participate in a study for a Ph.D. dissertation conducted by Mrs. Sharon Goldsmith, Administrator of Special Education, Holliston Schools, which is examining the relationship between listening and reading skills in children with average to above average intelligence. The results of this study will hopefully benefit all Holliston teachers and administrators by providing information on the reading process and reading instruction.

One hundred and sixty students in grades 3,5 and 6 will be asked to participate. The study consists of asking students to move some toy figures in response to sentences containing varying grammatical forms, which they are asked to read, and sentences they are asked to listen to. There is no score received: what is of interest are the differences in responses to different kinds of sentences.

The study will involve about ½ hour of your child's time, and can be conducted within the regular classroom or school building.

No information relative to your child's participation will be noted in the teacher's file. However, Mrs. Goldsmith will be happy to meet with any parents before or after the study is concluded to answer questions.

If, for any reason, you do not wish your child to participate, please contact the Principal of your child's school (Mr. Paul Franson, 429-1600 for grade 3, and Dr. Ralph Toran, 429-1000 for grades 5 & 6), before MAY _____. Mrs. Goldsmith may be reached at 429-4766.

Sincerely,

Savino J. Placentino
Superintendent

SJP/

ASHLAND PUBLIC SCHOOLS
ASHLAND, MASSACHUSETTS 01721

Office of Superintendent
(617) 881-2131

Dear Mr. & Mrs.

Your child has been tentatively selected to participate in a study conducted by Mrs. Sharon Goldsmith, which is examining the relationship between listening and reading skills in children.

The study will involve about ½ hour of your child's time and, can be conducted within the regular classroom or school building.

It is anticipated that this study will benefit the teachers and administrators in the Ashland Public Schools in the areas of reading and listening skills.

If, for any reason you do not wish your child to participate, please contact Mr. Gerald Linder, Principal, Mindess Middle School, at 881-2126. Mrs. Goldsmith may be reached at 429-4766.

Sincerely,

Barry Ruthfield

Barry Ruthfield
Superintendent

BR/mmf

Appendix C

Recording Sheets

A B

TEACHER'S NAME:_____ROOM:_____ 1 2

STUDENT'S NAME:_____GRADE:_____

DATE OF TESTING:_____TIME OF TESTING:_____

PRESENTATION A

AUD. VIS.

1st 2nd

ACTUAL CODE	SENTENCE	CODE
Osc 27a	THE DOG CHASES THE RABBIT THAT EATS THE CARROT.	
Oocd 21a	THE GIRL KICKS THE BALL THE DOG CATCHES.	
Son 13a	THE BABY THAT THE GIRL PUSHES KISSES THE LADY.	
Oocd 20a	THE DOG CHASES THE WAGON THE DONKEY PUSHES.	
Ssnc 6a	THE LADY KISSES THE BABY AND THE LADY CHASES THE DOG.	
Socd 11a	THE MAN THE DOG BITES KICKS THE BALL.	
Sond 15a	THE MAN THE GIRL PUSHED CHASED THE BOY.	
Osnc 32a	THE DOG CHASES THE SNAKE AND THE SNAKE BITES THE HOURSE.	
Oscc 29a	THE DONKEY KICKS THE LADY AND THE LADY PICKS THE FLOWER.	
Osn 31a	THE BOY KICKS THE MAN THAT PUSHED THE GIRL.	
Ssc 2a	THE BOY THAT KICKS THE BALL BITES THE APPLE.	
Sonc 14a	THE BOY KISSED THE GIRL AND THE MAN KICKED THE BOY.	
Oon 22a	THE WOMAN KISSES THE GIRL THAT THE MAN CHASES.	
Socd 10a	THE SNAKE THE MAN KICKS BITES THE BABY.	
Osn 30a	THE WOMAN KISSES THE GIRL THAT CHASED THE MAN.	
Socc 9a	THE CAT CHASES THE MOUSE AND THE MOUSE EATS THE CHEESE.	
Soc 7a	THE BOY THAT THE DOG BITES KICKS THE BALL.	
Sond 16a	THE LADY THE BOY KISSED PUSHED THE MAN	
Sscc 3a	THE BOY CHASES THE BALL AND THE DOG BITES THE CARROT.	
Ooc 18a	THE DOG CHASED THE BALL THAT THE DONKEY KICKED.	
Son 8a	THE LADY THAT THE SNAKE BITES PICKS THE FLOWER.	
Oocc 19a	THE BOY PICKED THE APPLE AND THE HORSE EATS THE APPLE.	
Ssc 1a	THE DONKEY THAT PUSHES THE WAGON KICKS THE MAN.	
Oon 23a	THE BOY KICKS THE GIRL THAT THE LADY PUSHES.	
Ssn 4a	THE MAN THAT CHASES THE BOY KISSES THE LADY.	
Oonc 24a	THE BABY KISSES THE LADY AND THE MAN KICKS THE LADY.	
Osc 28a	THE CAT CHASES THE MOUSE THAT EATS THE CHEESE.	
Ssn 5a	THE BOY THAT KICKS THE GIRL PUSHES THE MAN.	
Oond 26a	THE DONKEY CHASES THE DOG THE SNAKE BITES.	
Ooc 17a	THE GIRL PICKED THE FLOWER THAT THE RABBIT BITES.	
Oond 25a	THE DOG CHASES THE SNAKE THE DONKEY BITES.	

Appendix C (Continued)

A B

TEACHER'S NAME:_____ROOM:_____ 1 2

STUDENT'S NAME:_____GRADE:_____

DATE OF TESTING:_____TIME OF TESTING:_____

PRESENTATION B

AUD. VIS.

1st 2nd

ACTUAL CODE	SENTENCE	CODE
Soc 7b	THE GIRL THAT THE SNAKE BITES CATCHES THE BALL.	
Osnc 32b	THE MAN PUSHES THE GIRL AND THE GIRL KISSES THE LADY.	
Sonc 14b	THE HORSE KICKS THE DONKEY AND THE DOG BITES THE HORSE.	
Oond 25b	THE MAN CHASED THE GIRL THE WOMAN KISSED.	
Ssc 2b	THE BOY THAT EATS THE CANDY CATCHES THE BALL.	
Sond 16b	THE MAN THE BOY CHASED PUSHED THE LADY.	
Osc 27b	THE HORSE KICKS THE CAT THAT CHASES THE MOUSE.	
Sond 15b	THE DONKEY THE DOG BIT CHASED THE HORSE.	
Osc 28b	THE DOG BIT THE BOY THAT KICKED THE BALL.	
Ssc 1b	THE GIRL THAT PICKS THE FLOWER PUSHES THE WAGON.	
Oon 23b	THE BABY KICKED THE LADY THAT THE MAN KISSED.	
Osn 30b	THE BABY KICKED THE BOY THAT KISSED THE GIRL.	
Occ 18b	THE RABBIT EATS THE FLOWER THAT THE GIRL PICKS.	
Son 12b	THE GIRL THAT THE BOY PUSHED KICKED THE HORSE.	
Socd 10b	THE BOY THE DOG BITES KICKS THE BALL	
Soc 8b	THE MOUSE THAT THE CAT CHASES EATS THE CHEESE.	
Oon 22b	THE SNAKE BIT THE DOG THAT THE DONKEY CHASED.	
Socc 9b	THE DONKEY KICKED THE LADY AND THE LADY PICKS THE FLOWER.	
Ssnc 6b	THE BOY PUSHED THE GIRL AND THE BOY KISSES THE LADY.	
Ooc 17b	THE DOG CATCHES THE BALL THAT THE MAN KICKS.	
Oocd 21b	THE BOY KICKS THE MOUSE THE CAT CHASES.	
Son 13b	THE LADY THAT THE MAN KISSED PUSHED THE BABY.	
Oonc 24b	THE BOY KICKS THE GIRL AND THE LADY PUSHES THE GIRL.	
Oond 26b	THE LADY PUSHED THE BOY THE HORSE KICKED.	
Oocc 19b	THE DOG CHASES THE WAGON AND THE BOY PUSHES THE WAGON.	
Ssn 4b	THE BOY THAT PUSHED THE MAN KICKED THE GIRL.	
Socd 11b	THE RABBIT THE DOG CHASES EATS THE CARROT.	
Oscc 29b	THE DOG CHASES THE RABBIT AND THE RABBIT EATS THE CARROT.	
Occd 20b	THE MAN CATCHES THE BALL THE LADY KICKS.	
Sscc 3b	THE BABY PUSHES THE BALL AND THE BABY BITES THE APPLE.	
Osn 31b	THE DOG BITES THE HORSE THAT CHASES THE DONKEY.	
Ssn 5b	THE MAN THAT KISSED THE LADY CHASED THE BOY.	

Appendix D

Sample Enactments in each Response Category as a Function of Sentence Type

SENTENCE TYPE	CATEGORY	ENACTMENT
Oo		
The boy kicks the girl that the lady pushes	1	boy kicks girl; lady push girl
	2	boy kicks girl; girl push lady
	3	boy kicks girl; girl push lady
	4	correct (1)
	5	boy kick girl; lady push boy
	6	boy kicks & pushes girl and lady
	7	lady kicks girl; boy kisses lady
	8	boy kicks girl
Os		
The boy kisses the girl that chased the man	1	boy kisses girl; girl chase man
	2	correct (1)
	3	correct (1)
	4	boy kiss girl; man chase girl
	5	boy kills girl, man chase boy
	6	boy kiss and chase girl and man
	7	boy kicked dog and ball
	8	boy kiss girl
Ss		
The man that chases the boy kisses the lady	1	man chase boy; man kiss lady
	2	man chase boy; boy kiss lady
	3	man chase boy; boy kiss lady
	4	correct (1)
	5	man chase boy; lady kiss man
	6	man and boy chase and kiss lady
	7	boy chase man; boy kiss lady
	8	man chase boy
So		
The baby that the girl pushes kisses the lady	1	girl push baby; baby kiss lady
	2	girl push baby; girl kiss lady
	3	baby push girl; girl kiss lady
	4	baby push girl; baby kiss lady
	5	girl push baby; lady kiss baby
	6	baby and girl push and kiss lady
	7	baby push girl; lady kiss girl
	8	baby push girl

Appendix E

Analysis of Variance of the Means of Scores Achieved by Third and Sixth Grade Normally Achieving and Reading Disabled Subjects in the Comprehension of Relative Clause Sentences

SOURCE OF VARIATION	SS	df	MS	F
Between Subjects				
Grade	23.85	1	23.85	96.43**
Group	67.88	1	67.88	274.41**
Grade x Group	1.25	1	1.25	5.06
Error (between)	38.59	156	.25	
Within Subjects				
Condition	189.38	1	189.38	959.81**
Grade x Condition	8.14	1	8.14	41.25**
Group x Condition	16.50	1	16.50	83.64**
Grade x Group Condition	.03	1	.03	.17
Error	30.78	156	.20	
Type	67.01	5	13.40	79.63**
Grade x Type	5.77	5	1.15	6.86**
Group x Type	5.87	5	1.17	6.97**
Grade x Group x Type	1.14	5	.23	1.36
Error	131.28	780	.17	
Type x Condition	17.27	5	3.45	22.80**
Grade x Type x Condition	6.91	5	1.38	9.12**
Group x Type x Condition	3.08	5	.62	4.06*
Grade x Group x Type x Condition	.73	5	.15	.97
Error	118.18	780	.15	
Modality	.47	1	.47	5.25
Grade x Modality	.41	1	.41	4.58
Group x Modaility	.06	1	.06	.71
Grade x Group x Modality	.06	1	.06	.71
Error	13.92	156	.09	
Condition & Modality	.02	1	.02	.26
Grade x Condition x Modality	.01	1	.01	.13
Group x Condition x Modality	.13	1	.13	1.37
Grade x Group x Condition x Modality	.03	1	.03	.34
Error	15.12	156	.10	-
Type x Modality	.36	5	.07	.65
Grade x Type x Modality	.15	5	.03	.27
Group x Type x Modality	.21	5	.04	.38
Grade x Group x Type x Modality	.32	5	.06	.58
Error	86.05	780	.11	-
Type x Condition x Modality	1.33	5	.07	2.65
Grade x Type x Condition x Modality	.09	5	.02	.18
Group x Type x Condition x Modality	.14	5	.30	.29
Grade x Group x Type x Condition x Modality	.17	5	.03	.34
Error	18.42	780	.10	-
Total				
Model	931.15	3839	.24	2.35[a]**
Error	397.00	3840	.10	
Corrected Total	1328.14	7679	.17	

[a] R^2 = .70

* $p < .001$

** $p < .0001$

Appendix F

Frequency of Strategy Overuse by Third Grade Normally Achieving and Disabled Subjects in the Comprehension of Relative Clause Sentences as a Function of Sentence Type, Condition and Mode of Presentation

SENTENCE TYPE AND CONDITION	Normal Error Type								Reading Disabled Error Type							
	2	3	4	5	6	7	8	TOTAL	2	3	4	5	6	7	8	TOTAL
Auditory																
Ooc	-	-	-	-	-	-	-	0	-	1	-	-	-	1	2	4
Oood	-	-	-	-	-	1	-	1	-	-	1	3	1	-	4	10
Oon	1	3	2	9	-	2	1	17	1	12	-	20	1	3	3	39
Oond	2	3	-	8	1	-	2	16	-	13	-	28	1	1	3	46
Osc	-	-	1	-	-	-	-	1	-	-	3	-	-	1	-	4
Osn	-	1	5	1	-	-	1	8	-	-	14	3	-	2	4	23
Soc	2	-	-	-	-	-	-	2	4	4	5	-	-	-	2	15
Socd	-	-	1	-	-	-	-	1	9	14	5	-	-	-	2	30
Son	17	4	4	1	-	-	1	27	13	35	8	-	1	1	3	61
Sond	20	15	4	1	2	-	-	42	10	43	3	1	7	2	4	70
Ssc	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	1
Ssn	-	32	-	1	-	1	-	34	-	48	-	-	-	3	1	52
Visual																
Ooc	-	-	-	-	-	-	1	1	-	1	-	2	1	-	5	9
Oocd	-	2	-	-	-	-	-	2	-	-	3	5	-	1	3	12
Oon	1	3	1	14	-	-	1	20	-	18	-	19	-	1	5	43
Oond	3	5	1	8	-	1	2	20	32	21	-	23	1	1	2	38
Osc	-	-	-	-	-	-	-	0	-	-	2	-	-	1	2	5
Osn	-	1	7	1	-	1	-	10	-	-	17	6	2	2	1	28
Soc	1	-	1	-	-	-	-	2	6	2	3	-	-	1	6	18
Socd	4	2	2	-	2	-	1	11	4	8	7	-	10	1	4	34
Son	9	11	9	2	1	1	0	33	12	29	6	3	3	6	6	65
Sond	18	13	4	3	1	1	1	41	10	25	6	-	10	5	7	63
Ssc	-	1	-	-	-	1	1	3	-	-	-	-	-	2	1	3
Ssn	-	34	-	-	-	2	-	36	-	48	-	1	-	5	2	56

Appendix G

Frequency of Strategy Overuse by Sixth Grade Normally Acheiving and Reading Disabled Subjects in The Comprehension of Relative Clause Sentences as a Function of Sentence Type, Condition and Mode of Presentation.

SENTENCE TYPE AND CONDITION	Normal Error Type								Reading Disabled Error Type							
	2	3	4	5	6	7	8	TOTAL	2	3	4	5	6	7	8	TOTAL
Auditory																
Ooc	-	-	-	-	-	1	-	1	-	-	-	2	-	-	-	2
Oocd	-	-	-	-	-	-	-	0	-	1	3	-	-	2	1	7
Oon	-	2	-	1	-	-	1	4	-	11	4	9	3	2	-	29
Oond	-	-	1	5	-	-	-	6	-	11	4	11	-	2	1	29
Osc	-	-	-	-	-	-	-	0	-	-	2	-	-	1	-	3
Osn	-	-	4	-	-	-	1	5	-	1	16	3	-	3	1	24
Soc	-	1	-	-	-	-	-	1	-	1	5	-	-	-	-	6
Socd	-	-	1	-	-	-	-	1	2	4	10	-	-	-	-	16
Son	3	7	-	-	-	-	-	10	10	13	11	-	1	2	2	39
Sond	3	19	17	-	-	1	2	38	9	30	13	-	7	-	2	61
Ssc	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	0
Ssn	-	5	-	-	-	-	-	5	-	20	3	2	1	-	1	27
Visual																
Ooc	-	-	-	2	-	-	-	2	-	-	1	2	-	1	1	5
Oocd	-	-	-	-	-	-	-	0	-	2	-	1	1	4	1	9
Oon	-	6	-	-	-	-	-	6	-	20	2	8	1	1	1	33
Oond	-	4	1	4	-	2	-	11	-	10	1	6	1	1	3	22
Osc	-	-	-	-	-	-	-	0	-	-	1	-	-	-	1	2
Osn	-	-	8	-	-	-	1	9	-	1	15	-	-	5	-	21
Soc	-	-	1	-	-	-	-	8	1	-	2	-	-	-	-	3
Socd	1	1	1	-	-	-	-	3	3	1	6	-	5	-	2	17
Son	4	3	2	2	1	-	-	12	6	13	13	-	1	2	2	37
Sond	4	17	10	-	1	-	2	34	2	22	13	-	15	-	3	55
Ssc	-	-	-	-	-	-	-	0	-	-	-	-	-	1	1	2
Ssn	-	10	-	-	-	-	-	10	-	23	2	1	-	-	1	27

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