

MAKING MEANING: USING SYNTAX AS A TOOL
FOR READING COMPREHENSION

by

DIANNE DOROTHY CHRÉTIEN

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Bachelor of Education, University of British Columbia 1988

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Department of LLED

The University of British Columbia
Vancouver, Canada

Date April 22, 2003

ABSTRACT

In summary, this study was designed to investigate whether teaching students to approach scientific texts using their knowledge of language (specifically syntax) would help them better understand the passages they are reading. It has long been taken for granted that the study of grammar is unhelpful in teaching students to write. Much of the research in the past decades has been used to provide evidence that the study of the structure of our language restrains the generative, creative process.

The reading process, however, must be admitted to be a more analytic process. Constructive, yes, in that the reader does more than merely receive meaning from the text; rather, he or she constructs meaning from it. But the text is a whole which must be first broken down into parts in order for the reader to *reconstruct* the frame. Simultaneously, the reader is adding to the text frame from his or her own store of knowledge, and the final product of the act of reading will be the construction of something new and unique to that reader.

The theoretical framework upon which the study is based is van Dijk's and Kintsch's concept of discourse structure which represents reading as a process involving the building of both a text base, the aforesaid "frame" and a situation model, the new and unique product of the reader. William Adler's theoretical framework upon which he based his book *How to Read a Book* also serves as a point of reference. Adler describes reading as an active process that requires taking apart an argument proposition by proposition (a process which he says requires a certain amount of grammatical knowledge) in order to fully comprehend it and reconstruct it.

Such a complex analytical approach is usually unnecessary when reading fictional narrative, but the reading of content area text presents different and greater challenges to the young student, and, of all content areas, science can present the most complex concepts. Processing science concepts becomes even more difficult when the concepts are counterintuitive, as in the study of forces in physics.

The questions addressed in this study were the following:

1. Is direct teaching of syntax effective in raising syntactic awareness in young students?
2. Can young students be taught to apply syntactic knowledge during the reading process?
3. Will an increased awareness of syntax and application of syntactic knowledge be accompanied by an increase in reading comprehension of science text?

In the course of the study the experimental group received a pretest and a posttest testing syntactic knowledge and reading comprehension and a seven week intervention which included whole class lessons teaching students to recognize sentence structure, chunk sentences and use connectives as cues for relationships between propositions. The intervention also included guided reading sessions applying the syntactic concepts to reading science text. A control group received only the pretest and posttest.

Results indicate that the experimental group improved in syntactic knowledge and maintained their scores comprehension, while the control improved slightly in syntactic knowledge and, on the whole, did not improve in comprehension. Furthermore, observation notes from the intervention indicate that the intervention allowed students to gain a sense not only that they needed to adjust their pace of reading while reading dense science text, but a notion of how and where to do so, using commas, connectives and their knowledge of

phrases and clauses as points at which to stop and think. What follows in this chapter is an interpretation of the findings and the conclusions that can be drawn in light of the research questions. The quantitative data composed primarily of the pretest and posttest results and the qualitative data in the form of the observation notes on the intervention will be discussed separately.

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CHAPTER I

INTRODUCTION

The Question

What role does grammatical knowledge play in reading comprehension? The following preliminary study and subsequent thesis study grew out of this question. The question arose during a graduate seminar discussion of Rumelhart's interactive model of reading. At the heart of his model lies a three dimensional message center which processes text by simultaneously testing a number of different hypotheses at various levels: the feature level, the letter level, the letter-cluster level, the lexical level, the syntactic level and the semantic level. Once a certain competency is reached, these hypotheses arise automatically as the reader's eyes fall upon the features, letters and words within the context of the text.

Reading instruction targets some of these levels directly. Children receive direct instruction in how to work with the feature level, the letter level, and the letter cluster level. Much effort is expended to ensure that children learn to recognize and reproduce the letters and their features. They are taught to recognize common letter clusters encountered in our language. Direct teaching on the semantic level is a priority. They learn that words have meaning and that reading is all about making meaning. But educators often do very little direct teaching of syntax, particularly in the context of reading instruction. This level, though foundational to the construction of the text, is given cursory treatment. Children are taught that sentences are representations of whole thoughts and begin with capitals and end with periods. They are told that when there is a comma, readers are to take a breath. Beyond this the subject of syntax is rarely broached even as the sentences students are required to read become more and more syntactically complex.

Children embark on their school careers already possessing a good deal of linguistic knowledge (Karmiloff-Smith, 1986). This knowledge has been acquired as they have learned how to speak. Children bring their knowledge of their spoken language to their interaction with written language. Phonemic awareness is one type of linguistic knowledge children possess:

Children have a highly developed knowledge of phonemes long before learning to read; if they did not, they could neither produce nor understand oral language. But, again, this is working knowledge, not conscious knowledge. It is deeply embedded in the subattentional switches, sensors, and gears of their oral language machinery. (Adams, 1990, p. 303)

Building on phonemic knowledge, educators teach children to focus their attention on words in an effort to “break the code”. They teach children to chunk words, separating them into onset and rime. They teach children to find bits of sound they can recognize and chunks of meaning such as “script” in the words “description”, “postscript” and “scripture”. They help students understand the roles of prefixes and suffixes.

What is true of phonemic knowledge is also true of syntactic knowledge. It is deeply embedded. It does not follow that because children possess such working knowledge they will be able to apply it to the task of reading. And, just as words follow a code that must be “broken”, syntax is the code of the sentence, a code fundamentally similar to that governing the composition of words.

The engineering trick behind human language—its being a discrete combinatorial system—is used in at least two different places: sentences and phrases are built out of words by the rules of syntax, and the words

themselves are built out of smaller bits by another set of rules, the rules of “morphology”. (Pinker, 1996, p. 127)

Yet inexplicably, though direct instruction on the word level is considered helpful, direct instruction on the syntactical level is not.

The term “breaking the code” is fitting because reading is an analytic process and the first step of analysis is breaking the whole down into parts. Adler (1972) assigns grammatical, or syntactical knowledge a principal role in this analysis:

You must discover the proposition or propositions that each of these sentences contains. This is just another way of saying you must know what the sentence means. You discover terms by discovering what a word means in a given usage. You discover propositions similarly by interpreting all the words that make up the sentence, and especially its principal words.

Once more, you cannot do this very well unless you know a little grammar. You must know the role that adjectives and adverbs play, how verbs function in relation to nouns, how modifying words and clauses restrict or amplify the meaning of the words they modify, and so forth. Ideally, you should be able to dissect a sentence according to the rules of syntax, although you do not necessarily have to do it in a formal way. (Adler, 1972, p. 125)

Adler’s book, *How to Read a Book*, presents the concept of active reading, taking an argument apart and then putting it back together as a means of comprehending it. This process has been described as constructing meaning, a current popular metaphor for the reading process. For construction, it is necessary both to be familiar with one’s tools and one’s building materials, or the structure of language and the “rules” which govern it, and to

know how one might best use those tools. Surely in the teaching of reading, it would be helpful to make children's intrinsic knowledge of syntax extrinsic and thus applicable to the decoding of complex sentences and larger text. Adams (1990) suggests:

...development of syntactic competence may be far more important than is generally recognized in reading instruction. Without the independent ability to recognize the within-sentence phrasal and clausal boundaries that permit interpretive recoding, the young reader has no rational option but to try to conquer the whole sentence at a time. (p. 415)

The problem so many students encounter is getting lost in text. This is particularly true of young children who have only just mastered decoding and will often forget what the beginning of the sentence says by the time they reach its end. It is also true of more experienced readers who may be able to stick with a simple sentence to the end, but when asked to read a complex sentence composed of several clauses and phrases, they lose the thread of the discourse. But if students were taught how these sentences were put together—what the parts were and how to consider each one singularly and then in relation to the others—how could this not be of aid to them?

Considering the parallels between the word level and the syntax level, the initial question takes a more definite form: Following the pattern of chunking words for sound and meaning, can chunking sentences for sound and meaning enhance reading comprehension?

The necessity of this ability to chunk sentences is most evident in the content areas, where students not only have to deal with complex sentences, but also the complex concepts described within these sentences. Science text can be particularly problematic.

As a young English major in college, attempting to absorb the concepts of various biological functions, I fell back on my knowledge of the language to trace the arguments presented in the ponderous text. I wrestled with the chapter until I had a sufficient outline of the text into which I might integrate the new knowledge which would be presented to me in lectures and upon which I would have to act in the laboratory that week. With my knowledge of language, I had the means of constructing a logical framework upon which I might hang the concepts contained in vocabulary yet to be learned.

Unfortunately, many post secondary students are not well schooled in the structure of their language. They have not had the benefit of much grammar instruction, nor have they had extensive reading instruction past the first few years of school. In the intermediate grades and in high school, students may have encountered science classes in which they were required to read and learn from text, but they have seldom been taught how to do this.

What is needed is a bridge between the closely guided direct instruction primary students receive to allow them to break the code of words and the type of instruction that presumes a student can read and understand a science text independently. This has become a focus both in educational research and in classroom instruction. The proposed bridge in the thesis is instruction in chunking sentences, but in order to examine the efficacy of chunking sentences to enhance reading comprehension of science text in young students—those in elementary school as opposed to post-secondary—it is necessary to back up a few steps. There are questions to be considered within a preliminary study:

1. What do young readers (in this case, grade three students) need to know in order to chunk sentences?
2. What do young readers already know about chunking sentences?

3. Is there a relationship between reading comprehension and syntactic awareness?

Overview of Preliminary Study:

This is an experimental study using both qualitative and quantitative measures. Due to the limitations of a small sample size, descriptive statistics in the form of percentages were used. Participants were selected from a grade three class of 24 students in a K-7 school of approximately 500 students in a middle class suburb. The class was composed of nine girls and eleven boys and included two high incidence SLD (severely learning disabled) students (one of whom was also labeled BD, or behaviour disordered). (N.B. a student is considered “high incidence” if there is a relatively high percentage of children suffering from a similar level of disability within a population and “low incidence” if there is a relatively low percentage of children suffering a similar level of disability within a population. For example, a child with Down’s syndrome would be considered low incidence.) The participants included three boys and three girls divided into three ability groups (high, medium and low), one of each gender in each group:

Child #1, Child #2 - high ability

Child #3, Child #4 - medium ability

Child #5, Child #6 - low ability

The level for each student was determined by the Brigance reading test given in September 2001. Students read both vocabulary lists and grade leveled reading passages to determine their approximate grade level reading ability. Students were placed in guided reading groups and had been functioning within these groups throughout the school year. The study was undertaken in March and April, 2002.

Measurements

Students were given two reading passages to read aloud and were asked to respond orally to questions based on the passages. (See Appendix A for the passages and protocols.) Both the reading and the responses were taped and transcribed. Both tests were designed by the researcher. Two passages were taken from the “Let’s Read and Find Out” series : *You Can’t Make a Move Without Your Muscles* by Paul Showers , readability 2.9 (Flesch-Kincaid) and *High Sounds, Low Sounds* by Franklin M. Branley, readability: 2.6 (Flesch-Kincaid). All the participants were reading at the readability level of the text or above. To assess basic comprehension, students were asked: “What is the passage about?” and then were asked to explain the processes of how the muscles move in the first test and of how the ear hears in the second test. The participant’s level of meta-cognition was assessed through two questions: “Where was it hard to understand?” and “How did you figure it out?” Students’ ability to chunk sentences and their syntactical awareness was assessed through the following activities: identifying beginning and ending of sentences, identifying subject and predicate, chunking complex and simple sentences and distinguishing between dependent and independent clauses.

Several test items in both protocols were excluded from the analysis. The protocols were designed to include a great variety of question types as part of the purpose of the study was to determine what manner of questions were comprehensible to young students and elicited useful information regarding syntactic awareness. Those which did not fit the criteria were omitted. Omissions are noted on the protocols (see appendix A).

Results

For the comprehension questions (questions #1 and #2 on the protocols) the total number of points possible was ten; thus for the two tests together, the total number of points per child is twenty. The scores for the pairs of children in each level group were collapsed into one score out of forty.

Table 1: Reading Comprehension

Groups	Reading Comprehension /40	Reading Comprehension %
High	26	65
Medium	16	40
Low	17	43

Most participants (8 out of 12) responded to the first question “What is the passage about?” with a single word or phrase, leading the researcher to the conclusion that the stated question would need to be revised in future studies to a request for a summary of what they had read. Participants were all then asked, “Can you tell me more?” and proceeded to do so. Points were awarded for each major idea recalled, for relationships noted between ideas and for clarity. The second comprehension question (questions #2 on the protocols) requested students to explain a process. In the first test, they were asked to explain the process by which a muscle bends and, in the second test, the process by which the ear hears. One point was awarded for each step mentioned. Students found the first process much more difficult to explain. In the second test, one of the high level group gave a response that was uncodable. The child was trying a high level strategy, giving an analogy, but failed: “Uhm well, there—it’s kind of like a piece of metal, uhm, that has been connected together with nails and screws

and it moves and when you move the... metal and it squeaks. Or it doesn't squeak when you move your muscles, but it squeaks when you move the piece of metal."

Generally, the high group members were able to describe what they read more fully and clearly and scored higher than the other two groups, achieving 65%. The medium and low groups scored approximately the same, 40% and 43% respectively, with the low group slightly outperforming the medium.

Meta-cognition

Table 2: Meta-cognition

Groups	Meta-cognition /16	Meta-cognition %
High	14	88
Medium	10	63
Low	8	50

For both meta-cognition questions (question #3 and question #4), one point was awarded for giving one word or phrase in response, two points given for a fuller response. For each passage, the total number of points possible was four; thus for the two tests together, the total number of points per child is eight. The scores for the pairs of children in each level group were collapsed into one score out of sixteen.

In response to the question, "Where was it hard to understand?" ten of the twelve responses identified vocabulary words they did not know. Two responses identified an area in text where understanding broke down, and both these responses were given by high level readers. The question, "What did you do to figure it out?" elicited word attack skills such as sounding out and chunking. Higher level respondents explained in more detail, achieving

88% and consistently outperforming the two other groups. The medium group outperformed the low group, achieving 63% to the low group's 50%.

Discussion of Grammar (10 questions)

This section included identifying sentence boundaries, identifying subject and predicates, chunking sentences and giving reasons for the divisions and determining dependent and independent clauses.

Sentence Boundaries

Table 3: Sentence Boundaries

Groups	Sent Bound/8	percent
High	8	100
Medium	8	100
Low	7	88

In establishing sentence boundaries, students were directed: "Show me the beginning of sentence" and "Show me the end of the sentence"(questions #7a and b in test one and questions #8a and b in test two). One point was awarded for the correct response. Total possible points for each child was two on each test, four for both. The scores were collapsed by group for a possible total of eight. All were able to identify both the beginning and the end of the sentence in question for both tests except for one of the subjects in the low group who identified the beginning of the line for the beginning of the sentence in test two. There was very little variance between ability levels regarding sentence boundaries.

Subject and Predicate

Table 4: Subject / Predicate

Groups	Subject / Predicate /16	%
High	9	56
Medium	10	63
Low	10	63

For the Subject / Predicate test items, three sentences were isolated from the passages, two in test one (questions #14 a and b) and one in test two (question #15). In each sentence, students were asked to identify the subject. Two points were awarded if the participant correctly identified the subject of the sentence and one point was given if the participant interpreted “subject” in the general use of the term, that is as the topic of the sentence, and correctly identified that. This led to six total possible points per child, two more possible points were awarded for identifying predicates, for a possible total of eight per child, collapsed to sixteen per group.

The sentences were progressively more difficult. The last one was a long sentence containing many nouns from which to choose. In one sentence in test two, they were asked to identify the predicate also (question #16). This sentence contained two parallel predicates. Two points were awarded for identifying both, one was awarded for identifying one. Only child #1 identified both. This exercise proved difficult across the ability levels with very little difference in achievement between the groups.

Chunking

The participants were shown four sentences within the body of the text and were asked to chunk them (test one #8 a and #11 a and test two #10 a and #14 a). They were then

asked to give their reasons for choosing the spots they chose (test one #8 b and #11 b and test two #10 b and #14 b).

Table 5: Chunking

Groups	Chunking /10	%	reasons /28	%
High	9	90	26	93
Medium	7	70	8	29
Low	9	90	14	50

The points for reasoning were assigned on the basis of the answers received, the best answers serving as the measuring stick. This led to a variable number of possible points for the reasons given for the choice of chunking spots for each sentence. Because of this, a more detailed table has been included.

Table 6: Reasoning re Chunking

Child	#8b /6	#11b /4	#12 /8	#10b /6	#14b /4
High	5	4	7	6	4
Medium	1	2	0	2	3
Low	4	1	3	4	2

Basic determination of points included indication of an awareness of clauses, acknowledgment of commas, and statements indicating that “it made sense” or “sounded right”. Question #12 (test one) asked about relative difficulty of the sentences for chunking; all agreed the complex sentence with the comma was easier to chunk than one without, but the high group members were much more capable of explaining why, achieving 7 out of 8, or 88%, compared to the medium group’s 0% and the low group’s 38%.

Overall, the high group proved very strong in reasoning, achieving 26/28 or 93%, clearly outperforming the other two groups. The low group outperformed the medium group, achieving 50% compared to the medium group's 29%.

Independent and Dependent Clauses

Students were shown sentences in the text and asked whether certain clauses within the sentences could stand on their own. They were shown a dependent clause first, then an independent. All identified the first dependent clause as not being able to stand on its own. (test one questions #9 a and b and test two questions #11 a and b.) One point was awarded for a correct answer, yes or no, with a possible total of four per child, eight per group.

Table 7: Dependent and Independent Clauses

Groups	dep/indep /8	%
High	6	75
Medium	5	63
Low	6	75

Here the high and low groups both achieved 75%, while the medium group achieved 63%.

Table 8: Reasoning re Clauses

Groups	reasons /20	%
High	18	90
Medium	11	55
Low	5	25

There was a possible two points for reasons given for the independent clauses and three for the dependent clauses yielding a possible score of five per sentence, ten per child, twenty for each group of two children. In discussing the independent clauses, two points were awarded for the observation that it needed more information, one was awarded for the

observation that it sounded right. The discussion of the dependent clauses were less uniform, and thus were rated in relation to one another. The second dependent clause presented more difficulty, largely because of the “they”. Students felt that since the clause didn’t disclose who or what the “they” was, it was not able to stand on its own.

Overall, the high group substantially outperformed both the medium and low groups in recognizing dependent and independent clauses and giving reasons for their designations, achieving 90% to the medium group’s 55% and the low group’s 25%.

Table 9: Total points for Grammar Discussion

Groups	Grammar Discussion /90	Grammar Discussion %
High	77	86
Medium	49	54
Low	50	56

When scores for the four types of questioning were totaled, it is clear that the high group outperformed the medium and low. This becomes even clearer when one focuses on the questions requiring reasoning. The medium and low groups are very close in scores, with the low leading by one point or two percent. There is no clear reason for the low group’s outperforming the medium group. It may be accounted for by one member of the medium group proving to be the most reticent to provide any kind of answer at all for the questions. This student is quite timid and quiet by nature. Also, in terms of daily classroom discussion in guided reading groups, the low and medium groups were consistently quite similar. The members of the high group were students of a very high calibre in reading and in reasoning.

A Comparison of All Variables

Table 10: Comparison Chart

Groups	Reading Comprehension /40	Reading Comprehension %	Meta-cognition /16	Meta-cognition %	Grammar Discussion /90	Grammar Discussion %
High	26	65	14	88	77	86
Medium	16	40	10	63	49	54
Low	17	43	8	50	50	56

In summary, as shown in table 10, the high group is consistently higher than all the other groups in all three areas, reading comprehension, meta-cognition and the ability to identify and discuss points of grammar. There is little variance between the other two groups in terms of reading comprehension (40% for the medium group and 43% for the low group) and grammar (49% for the medium group and 50% for the low group), but the low group does slightly outperform the medium group. In meta-cognition, the medium group achieves a score which is 13% higher than that of the low group.

Analysis of Results

In answering the comprehension questions, there was a tendency to give one word answers or phrases for what the passage is about. The students found it easier to give a clear explanation of how the ear hears than of how muscles move. This may be partly due to readability of passage, (The ear, 2.6; The muscle text 2.9), and the fact that hearing was a topic of study for science (though up to that point they had not studied the role of the ear in receiving sound). Also, there was a much clearer diagram for the ear passage. The students may also have found it easier to trace the movement of sound waves through the ear canal than to explain the adversative relationship between muscles. The generally low scores on

comprehension may be partly due to the perception, expressed by one low group member, that science texts are incomprehensible:

Uhm, I don't know—it says something—I forget. Well, my dad and I were doing this science project. My dad told me to read it, and I read it all. It was like three pages. And when I was done, my dad said, “Okay, what do you do first?” And I'm like... I read it, but I don't get anything it said. (Child #5, Test two)

In considering the responses to the meta-cognition questions, it became clear that the students viewed their own understanding as based primarily on whether they were familiar with the words, for instance “cochlea”. Even when they understood what the cochlea was, the sound of the word was difficult and unfamiliar and continued to throw them off. When encountering difficulty understanding, sounding out is still the first acknowledged strategy, though some were beginning to apply chunking of words.

The more advanced students recognized heavier explanation as a flag for slowing down and attending more closely to ensure comprehension.

“Where was it hard to understand what you were reading?”

“I think like right here. It started like more explaining stuff and then they get really hard words like cochlea and stuff.” (Child #2, Test Two)

The students were able to establish sentence boundaries. This indicates this is explicit knowledge by grade three. They had difficulty distinguishing between “subject” as a grammatical concept and “topic”, but some of the oral responses indicate they were beginning to understand and identify subject and predicate.

What is the subject of this sentence? “Your biceps and triceps work together.”

The subject is about like your biceps and triceps work together. So your biceps and triceps, that'd be the subject and "work together", that would be the predi - uh...

Predicate?

Predicate. (Child # 3, Test one)

The children were beginning to get comfortable with the idea of chunking sentences. You'd chunk it where you see the comma. That's where I'd chunk it. "Every time you move any part of you (pause) you use your muscles. It's kind of like a period. You stop, but it doesn't really stop the whole entire sentence, it keeps going. (Child #1)

(chunked at comma)...because it almost like ends, but not quite. Those kind of match (the two clauses), but you just kind of need that to make it a sentence. (Child #2)

Generally, they recognized the significance of the comma. Some still saw it as a pause for breathing, some were beginning to see it's role in separating parts of a sentence (i.e. clauses). This indicates an explicit knowledge of the use of the comma as a signal. They obviously did not possess a full understanding of the role of a comma, but this understanding is in the developing stage. Students had much more difficulty chunking sentences without commas, for example "You even use your muscles when you read". Most were still able to do it, but had a harder time explaining why:

Uhm, you should chunk it... you should say, "You even use muscles" and then you'd put a comma there if there was one there and then you say "when you read".

(Why?)

Uhm, I think because of..., if you cut it and you said, “You eve use” then that wouldn’t make sense, but “muscles when you read”, that doesn’t make sense either. So, if you just cut it to the next—you just add another letter to “you even use” it’ll be “you even use muscles”. (Child #1)

With the sentence with 2 predicates, “The outer part of the ear catches the vibrations and carries them into the opening of your ear”, one student recognized you could make two sentences out of it and gave elaborate instructions on how to do so:

I’d chunk it right there: “The outer part of the ear catches the vibrations”, that could be one sentence, but “and carries them into the opening of your ear”, I don’t think that could be a real sentence.

(What does it need?)

It needs, uh... you should take away the “and” and put “they” and take away the “s” and add “y”, so it would say “They carry them into the opening of the ear”. (Child #1)

The students generally recognized dependent clauses as dependent—but had more difficulty when the clause began with a “wh” question word. This may be due to their tendency to answer or hear questions answered with a dependent clause. For example “When are we going?” will often receive the response, “When we are ready”. The most prevalent reason given for designating a clause dependent or independent was based on sufficiency of information. These grade three students had come to understand that a sentence is a complete thought.

In examining the sentence “When vibrations hit your eardrum, they make it vibrate”, the following discussion ensued:

Does it make sense if we only read the first half?

No, because, like, it says “when vibrations hit your eardrum”... Well, it doesn’t tell you what it DOES at the end. And, like, you have to know once you read it, you have to know what it does, but it doesn’t tell you.

Does it make sense if we only read the second half?

Yes, because it tells you what it does, like “they make it vibrate” and stuff...

(Child #6)

The reasons given for designating an independent clause as being able to stand on its own were more difficult to assess than those given for dependent clauses. Reasoning regarding the syntax was much more complex and varied with independent clauses partly because of the presence of a pronoun in the sentence above (students were looking for the antecedent).

No [it can’t stand on it’s own] because it’s not telling you a subject that will make, like “they’ll make it vibrate”. You don’t know what’ll make it vibrate.

But if you read that, it’ll tell you like what there is.”(Child #3).

Perhaps students also had an easier time saying why a clause doesn’t have enough information rather than why it has all it needs. This may well be due to a lack of extrinsic knowledge of what a sentence is, a lack of the concepts of subject and predicate. Some believed the length of a clause determined its ability to stand on its own as a sentence. Most were able to isolate a modifying clause not separated by a comma.

Discussion

The preliminary study was designed to answer the following questions:

What do readers need to know in order to chunk sentences?

What do young readers (i.e. grade three students) already know about chunking sentences?

Is there is a relationship between reading comprehension and the ability to chunk sentences?

The children who participated in the study had an extrinsic knowledge of where sentences begin and end through the signposts of capitals and periods. They had learned to pay attention to internal punctuation, such as commas, as some sort of signpost—often for breathing i.e., chunking for sound. Some were also beginning to develop a sense of chunking for meaning, separating two parts of a sentence or two related ideas. These children had a sense that a clause can be a sentence when it gives you enough information. Some were also developing a sense of what is necessary to constitute enough information: knowing “who”, or having a subject, and knowing what is happening, or having a predicate. (Note that they had received instruction regarding this in class.) Those children who had a high reading ability also had a relatively high syntactic awareness and an ability to express it. The ability to explain and give reasons for syntactic designations indicates a high level of understanding which means that those concepts are more accessible for extension and application. That is, the high performing students had syntactic information accessible to apply to the reading task. There was little difference between the low and medium groups regarding either syntactic awareness or comprehension.

Implications for the Thesis Study

The comma was clearly a sound starting point for teaching chunking. It would be reasonable to assume that older students would be familiar with this marker as a place to pause. A decision was made to focus on complex sentences including these explicit markers and to develop the understanding of the composition of clauses and the use of connectives. The thesis study was also designed to examine more closely whether or not understanding relationships between clauses can enhance reading comprehension of science text. The intervention includes some exercises which would explore whether children are better able to determine whether clauses or phrases can stand alone if they are presented in isolation.

The thesis addresses the following questions:

1. Is direct teaching of syntax effective in raising syntactic awareness in intermediate students?
2. Can intermediate students be taught to apply syntactic knowledge during the reading process?
3. Will an increased awareness of syntax and application of syntactic knowledge be accompanied by an increase in reading comprehension of science text?

CHAPTER II

LITERATURE REVIEW

In an effort to explore the efficacy of making children's implicit knowledge of syntax explicit to provide them with an analytical tool for the reading of science text, this study lies at the point of intersection between several fields of inquiry: discourse theory, meta-cognition, reading comprehension, science instruction. It is an attempt to link theory and practice within the context of an elementary classroom.

Grammar Instruction

It has already been noted that when the structure of language is a focus in current reading instruction, the focus is on the word level, teaching children to chunk words for sound and meaning. Instruction at both word level and sentence level fall under the umbrella of 'grammar', "the general term for the study of language" (Fowler, 1984, p. 220). Educators tend to consider study at the word level a separate area, encompassing such topics as "spelling" and "phonics", when it is really a subset of grammar and takes many forms: phonology, morphology, accident, orthoepy, and orthography.

Study at the sentence level is a study of syntax, or "how words are arranged in sentences" (Fowler, 1984, p. 220). Given that words and sentences are under similar structural constraints, both functioning as discrete combinatorial systems (Pinker, 1994), this study will explore the possibility of adopting the strategy of chunking used in decoding words and applying it to decoding sentences. Establishing an understanding of the linguist's definition of a sentence and of how the study of syntax has evolved over the last few decades will provide a foundation for the application of this strategy.

Going Beyond the Sentence

Noam Chomsky and many of his contemporaries considered the sentence to be the longest formal syntactic structure which could be studied by linguists (Grimes, 1995). They took sentences and broke them up into their elements, drawing phrase structure trees. They showed how sentences could be transformed by the shifting and embedding of these phrases. But they did nothing to show how a sentence functions within a text to contribute to the overall meaning of the text, nor how a reader processes a sentence in the course of processing an entire text. Their emphasis was on syntax at the expense of semantics in the representation of sentence structure. This same delineation between structure and semantics has marked the traditional grammar teaching in schools. It has been, and often still is, limited to studying parts of speech or establishing a cursory understanding of the sentence as needing a subject and a predicate without providing a bridge between these concepts and their relation to the meaning communicated through their forms. But unlike educational practice, linguistic theory has progressed beyond these limitations:

Criticisms of these two aspects of Chomsky's theory, the emphasis on syntax and the adoption of the sentence as the unit of analysis, have led to a new emphasis on semantics and on discourse as the unit of analysis. (Frederiksen, 1975, p. 373)

An examination of discourse theory will determine how it might serve as a new basis for grammar instruction, particularly grammar instruction as applied in the teaching of reading.

Discourse Theory: The “structure” of discourse

Discourse theory unites structure and semantics. The theory maintains the sentence as the largest structural unit, but situates the sentence within the semantic unit of the *text*. The text is a semantic unit, not a structural unit, which can be said to be realized by, but not consist of, sentences. The text is the meaning behind a group of sentences, it is a discourse. A seeming oxymoron, the term ‘discourse structure’ is employed by linguists to describe the structure of a nonstructural unit. However, discourse structure can be seen as a type of structure in the sense that a discourse takes a contained form—a series of sentences organized in a series of paragraphs. It is not defined as a formal structural unit because its parts (propositions) are not tied to one another by syntactic relations but by semantic relations.

... a text typically extends beyond the range of structural relations, as these are normally conceived of. But texts cohere; so cohesion within a text—texture—depends on something other than structure. There are certain specifically text-forming relations which cannot be accounted for in terms of constituent structure; they are properties of the text as such, and not of any structural unit such as a clause or sentence.... They are ...semantic relations, and the text is a semantic unit. (Halliday and Hasan, p. 7, 1976)

Thus we can speak of two levels of a passage: the syntactic level composed of structural units such as phrases, clauses and sentences united by syntactic relations; and the semantic level, composed of the propositions which are united by semantic relations to form the discourse. These two levels are not distinct from one another. Semantic relations between propositions are cued by syntactic markers—punctuation and connectives. The term

“proposition” has been employed in many different ways within linguistics and certainly has a different meaning in philosophy. For the purposes of this study, we will use van Dijk’s and Kintsch’s definition which unites the syntactic structure of the clause with the semantic unit, the proposition:

Propositions, then, are constructed in our model on the basis of word meanings, activated from semantic memory, and syntactic structures of clauses. In principle, we will assume that there is a one-to-one relationship between propositions and clauses: One clause expresses one proposition. (van Dijk and Kintsch, 1983, p. 14)

Discourse Theory: The process of comprehending

In understanding discourse, one needs to recognize and understand both the propositions and the relations between them. In their model of discourse comprehension, van Dijk and Kintsch (1983) present two levels of comprehension: the text base and the situation model. Definitions given by McNamara, Kintsch, Songer, and Kintsch (1996) will serve for this study:

The text base contains the information that is directly expressed in the text, organized and structured in the way that the author had organized the material. It has a local structure (the microstructure) as well as a global structure (the macrostructure). The construction of the text base involves the extraction of semantic information from a text.... this takes the form of an interrelated networks of propositions.... On the basis of the text base, readers can verify

statements they have read, they can answer questions about the text, they can recall the text, or they can summarize it. (p. 3)

The situation model integrates the information provided by the text with prior knowledge, often reorganizing and restructuring it in terms of the reader's understanding of the knowledge domain as a whole rather than the particular text just read.... The formation of such situation models requires two things as a basis: active inferencing and adequate prior knowledge. (p. 5)

The first step in comprehending text is building a text base. This involves first isolating then understanding propositions. According to van Dijk and Kintsch, "...the evidence for the psychological reality of propositional chunks is overwhelming" (1983, p. 41). In their studies, they found that chunking was a natural process: "readers and listeners are sensitive to the phrase structure of sentence and chunk sentences accordingly" (1983, p. 28).

van Dijk and Kintsch were referring to adults, experienced language users. Adams (1990) notes the same tendency in children. She refers to Karpova's 1955 seminal study of word awareness. Karpova found that when asked to count the words within a spoken sentence, children first break up sentences by propositions or idea units, then into subject and predicate and, later in their development, learn to isolate each word. This sensitivity to syntactic boundaries is also natural in reading, and it is also developmental. The development works in a reverse order—from words to propositions. Once a child is comfortable with decoding words and is able to put words together, she begins to encode sentences, storing the meaning of one word in her short term memory as she decodes the next word. At the beginning of the reader's career, sentences are short and simple and generally do not contain

numerous propositions. But very soon the child encounters longer, more complex sentences. This strains the limits of a child's short term memory.

It is these very limits of the short term memory that necessitate chunking. Kintsch and van Dijk (1983) noted that "one cannot retain everything one reads or hears for very long, and thus it becomes crucial to know when to discard what.... Jarvella (1971) and others have shown that readers hold the final phrase in short-term memory, dumping it when they arrive at a clause boundary" pp. 28-29). The sentence is chunked to allow it to be preserved within the short term memory. But without the ability to find natural breaks, or to chunk the sentences, the child quickly becomes lost in verbiage. And though chunking is a natural process, literate language is not natural but formal. Thus a child unaccustomed to it may fail to comprehend it, for when a child is labouring to decode word by word, word groupings are not necessarily obvious to her. Adams (1990) notes that "because readers must interpretively collapse text at and only at syntactic boundaries, such sensitivity stands as a strong, if indirect, determinant of comprehension" (p. 153).

van Dijk and Kintsch (1983) suggest that chunking is not necessarily automatic for adults either, but rather strategic:

Strategic behaviour is neither necessarily controlled nor necessarily automatic... Like other behaviors, it varies from controlled (i.e., slow, sequential, resource demanding) to automatic (fast, parallel, effortless) as a function of stage of practice. The child, in the process of acquiring a strategy, uses it quite differently than does the mature speaker of the language. For the latter, what were once demanding tasks have become fully automated with very low resource demands—unless, of course, the smooth operation of

strategies is blocked (as in the garden path sentences). and attention-demanding, controlled, repair processes are required. (p. 31)

Strategies can be taught. Chunking is strategic; therefore, it can be taught.

Establishing Relations between Chunks

The second process in building a text base is establishing relations between chunks. This requires the recognition of explicit and implicit ties. This step is not entirely separate from the first; in fact, the mature reader seeks a tie even before the entire proposition is read. The assumption underlying the presence of local strategies is that it is most unlikely that language users will process full sentence pairs before establishing some coherence relation. Rather, they will try to relate fragments of a new proposition to the proposition already processed. (van Dijk and Kintsch, 1983, p. 154) The immature reader will be slower in recognizing ties, and may in fact miss them altogether (Zinar, 1990). This is partly due to the fact that the immature reader may be working more from the bottom-up than from the top-down, decoding word by word and encoding phrase by phrase, sometimes seeing no relation at all between the sentence being read and the one just previous to it. Unless the reader is aware of the existence of a macrostructure and is endeavoring to establish global coherence while establishing local coherence, the proposition may be processed in isolation, and if its interpretation is heavily dependent upon the relation it bears to another proposition, it may be unintelligible. It must be noted that, though the stages described here are represented as moving from the less complex processes to the more complex, the cognitive processes at each level interact with one another, and the building of the situation model does not happen after the construction of the text base is complete, but simultaneous to it. But neither the text

base nor the situation model will be constructed if the reader is unable to establish relationships between propositions; that is, if they are unable to make the text cohere.

Halliday and Hasan describe cohesion simply as “the set of semantic resources for linking a sentence with what has gone before” (1976, p. 10). This link is formed through reference to some other item within the discourse. Such a reference may be explicit, such as when a pronoun refers back to a proper noun (one case of anaphora) or when connectives such as “and”, “but”, and “although” are used to link a clause to one which either precedes or follows; or it may be implicit, in which case the reader will be required to make an inference. These connectives are another structural unit that served as the joining hardware which link propositional building blocks. They are function words—words that cannot be defined apart from the function they perform as compared to form words, such as nouns, verbs and adjectives which carry meaning within themselves.

Recognizing and understanding explicit referential ties can also require inferencing. It involves several processes which, due to their interactive nature, may or may not be engaged in the following sequence: noticing the reference, understanding what it means (e.g. she = female person or animal, although = adversative tie), tracing back or forward to find the referent and finally comprehending how the referent and the element to which it has been linked are related. Various factors such as the degree of ambiguity of the reference or the proximity to the referent determine how much work the reader is required to do and how much background knowledge she must supply, i.e., how much inferring she must do. This brings us to the second great demand on the young reader, the making of inferences.

Making inferences has long been acknowledged as one of the things a skilled reader does. Inferencing places further demands on the already taxed short term memory.

“...when skilled readers are in the course of reading a clause, their ability to recall its precise wording is extremely rapid and accurate; in contrast, this fine, verbatim memory for the clause is all but lost just as soon as they start reading the next. As another outward sign of this recoding, skilled readers characteristically pause at the end of major syntactic units. Appropriately, the duration of this ‘wrap-up’ time is significantly increased if the interpretation of the just-read clause requires inference or subtle resolution of pronouns. (Adams, 1990, p. 186)

What is true for the skilled reader is doubly true for the less-skilled. Stoodt (1970) found that young readers had trouble keeping the individual propositions encoded in a sentence in the mind while establishing the relationships between them. It was particularly difficult for young readers to maintain and comprehend differences between ideas (or adversative relations) as opposed to similarities (causal or descriptive relations). Côté and Goldman (1999) also found evidence that failure in comprehension of the overall message of the text is caused by an inability to establish connections due to the limitations of short term memory:

It is well established that readers often do not construct coherent propositional or situational representations of text information. One reason for failures to detect or generate the connections necessary for coherent discourse representations is the unavailability of relevant information in working memory. In the process of reading a long text, keeping relevant information active in working memory often requires monitoring the coherence of the evolving representations and strategically using discourse and topic knowledge to identify relevant information in order to reinstate selectively

previous text information, retrieve or reinstate information from long-term memory or both (e.g., Ericsson & W. Kintsch, 1995; Fletcher, 1986; W. Kintsch, 1988; W. Kintsch & van Kijk, 1978). (p. 170)

Young readers have not only had less time to develop efficiency in storing and accessing items in their short term memories, they have had less time to acquire background knowledge. Zinar (1990) found evidence to suggest less-skilled readers ignored connectives if they lacked the background knowledge required to make the connection between ideas. “The particular linguistic form in which a particular relationship is expressed may be of little moment if the reader does not have sufficient understanding of real-world phenomena which underlie the relationship” (p. 197). This lack of background knowledge can be noted at various levels—at a specific factual knowledge, e.g., the child has little or no knowledge of how a volcano erupts, at a vocabulary level, e.g., the child is unfamiliar with specific terms such as magma, at a textual level, e.g., the child is unfamiliar with cause and effect text patterns or at a domain level, e.g., the child is unfamiliar with the domain of geological science. Young readers often suffer from a lack of background knowledge at any or all of these levels when reading science text.

Making inferences within a narrative can be relatively easy and more opportunity is granted a child in learning to do so. Making predictions, a form of forward inferencing, is encouraged, even guided, by various narrative conventions. Côté and Goldman note that “... the dominant mode of explanation appropriate to understanding stories is causal inferencing”. They contrast the comparatively straightforward inferencing to that encountered in instructional texts, where “prior knowledge limitations and a greater variety of expository

content structures constrain the success of efforts to understand not only underlying causal mechanisms but also other types of relationships among concepts... “ (1999, p. 187).

In summary, in attempting to chunk propositions as well as establish relations between propositions, the young reader must contend with the limitations of short-term memory and the lack of background knowledge. Readers may overcome these limitations naturally as they develop cognitively or as they gain experience. Zinar (1990) found evidence to support Johnston’s and Pearson’s (1982) three stages of development in the understanding and use of connectives as explicit tools for establishing coherence:

Younger, as well as less-skilled intermediate readers, process text in word or proposition—length units and do not attend to connectives. More skilled intermediate readers, as well as less skilled adult readers, are aware of connectives and use them to integrate what they read, but they are still dependent upon the presence of explicit cues. Fluent adult readers are independent of cueing and actively integrate what they read even in the absence of explicit connectives. (p. 197)

Instruction should be directed at what Vygotsky called the learner’s zone of proximal development, that zone between a child’s actual developmental level, working independently and their potential development, working under guidance (Wertsch & Tulviste, 1992). We need to pave the way for students to progress from one developmental stage into the next. As Johnston and Pearson have indicated, it is also true that students who struggle with decoding do not progress in their reading as they should. Cain and Oakhill (1999) suggest that less skilled readers are less able to make inferences because they are focusing more on word reading accuracy than on monitoring their comprehension. It is their entire approach to

reading that causes the comprehension break down. Because they do not see the text as a whole made up of parts which must cohere, they do not strive to make it cohere.

When readers cannot actively integrate text, they may be able to provide answers from the text verbatim, lifting phrases and propositions from the text, but they cannot provide a summary of the text—they cannot construct a text base. And, though it does not follow that if the reader is able to build a text base he will be able to create a situation model, it does follow that if the reader is unable to build a text base he will be unable to create a situation model.

Understanding relations—inferencing: text base or situation model?

The role of inferencing within the two levels of comprehension is a contentious issue. McNamara et al would place inferencing with the situation model, seeing the results of “active inferencing” as “the formation of more links between the incoming information and information in the personal—knowledge base (Mannes & Kintsch, 1987)” (p. 3). Frederiksen (1977) sees inferencing as a process of taking the text and combining it with old knowledge to create something new:

... there are two levels of processing in discourse comprehension that involve propositional data structures. The first processing level, the interpretive level, involves those processes by which propositional knowledge is “recovered” from text; the second level, the inferential level, involves the generation of new propositional knowledge from a network of propositions which is given—from prior discourse, from context, or from stored knowledge of the world. (p. 68)

But inferencing must be present at the interpretive level, during the processing of the text. Whenever a proposition is not expressly stated and must be supplied by a reader, an inference is made. This can be true even when a proposition contains a referent that directly ties it to another, as in the case of “Because it was cold, Mary didn’t want to swim.” To tie the two together, here the reader must infer an additional proposition to the effect that “Mary doesn’t like to swim in the cold”.

Irwin (1986) cites several “recent theories” (including Frederiksen’s) that place the role of inference in establishing cohesion—noting and processing the relations within a text. She draws attention to Crothers (1978, 1979), who in his analysis of various types of inference, maintains that ‘the purpose of many, though not all, of the proposed inference types is to explicate the implicit coherence of the passage’ (1979, p.7). Cain and Oakhill (1999) mention two types of inferencing: “text-connecting” which make use of syntactic cues and “gap-filling” which require the reader to supply background knowledge. But this background knowledge can be as simple as knowing that when one says “he pedaled home” the person in question is understood to be riding a bike. This is still a text base building inference. The construction of both the text base and the situation model require inferencing. What distinguishes the processes is the type and degree of inferencing they require.

McNamara et al (1996) do note that the distinction between what goes on at each level, the construction of the text base and that of the situation model, “is not absolute, but a matter of degree” (p. 19). They differentiate between “bridging” inferences which link information from two or more sentences within the text and “elaborative” inferences which “require linking textual and outside knowledge information which requires some, but not necessarily a very deep, situational understanding” (p. 19), indicating the need for even

further inferencing to create a fully developed situation model. We might see inferencing then as a process which begins at the level of making sense of the text as it is and follows a gradation that slips into a situation model—building mode. It is in fact, a jumping off point, it puts the mind in motion and it is this momentum that is the glissé into gestalt, those “ah-ha” moments which are at the crux of discovery learning.

van Dijk and Kintsch (1983) acknowledge the ambiguity of the place of inferencing within the two levels of comprehension:

The biggest problem with discourse inferences is to determine when they are made: Are they part of comprehension proper, or do they occur optionally after comprehension? It is clear that not all possible inferences can actually be made... The question therefore is, how can one distinguish those inferences that must occur as an integral part of discourse comprehension proper?

One class of inferences that appear to be necessary during comprehension are the bridging inferences required for the coherence of the text (Kintsch, 1974, Clark, 1977; Miller & Kintsch, 1980). (p. 49).

Despite the ambiguity, van Dijk and Kintsch choose to assign inferences to the situation model, using the following rationale:

The text base is a representation of the text as it is. Bridging inferences and other types of inferences belong to the situation model constructed on the basis of that text base and knowledge. What is inferred are therefore not propositions in the text base but links in the situation model. This shifts the analysis of inferences in discourse processing from the linguistic level to the conceptual level... (p. 51).

Here we see van Dijk and Kintsch assigning inferencing the role of the liaison between linguistics and concepts, that is structure and semantics. But we cannot simply focus on structure in our building of the text base. A reader must construct this base, not simply receive it in its encoded form. Summarizing a text would be considered evidence of having constructed the text base. Summarizing is not possible if the reader has not worked through the propositions and their relations in such a way as to achieved a level of understanding that allows her to manipulate the propositions to create a format that is logical to her and in which she may communicate the meaning of the text. Often this requires a great deal of manipulation, particularly if the author has not organized his propositions logically or has left many propositions to be provided by the reader—many gaps to fill in.

The level at which the reader must engage in inferencing is not a simply theoretical point to be argued for the sake of argument. It is vital that we understand the role of inferencing in the construction of the text base or we will not be aware of the huge difficulties students can encounter at this level of comprehension and what we can do to help them overcome such difficulties. Moreover, if it is true that the conscious manipulation of structure aids the reader in constructing the text base, then it is also true that awareness of structure will aid a reader in inferencing, and thus aid her in comprehending.

The ambiguity may be cleared up in part by separating the first level into two, creating a three level model of comprehension. Tapiero and Otero (1999) describe such a model, stating that the reader engages in both micro processing, by which a locally coherent propositional network is set up, and macro processing, by which the text base is “organized in a hierarchical sequence” (p. 341). These two processes result in a text base which is “a representation that is faithful to the text” (p. 341). Macroprocessing requires determining

which propositions are essential to establishing a text base, as a text base cannot include all the propositions contained in the text. It is a summary, and in constructing a summary, a reader must be able to determine which propositions are essential components of the macrostructure. Here too, attention to connectives can be helpful. Goldsmith (1982) found that connectives alerted students to the organizational structure of the text and guided them to delete irrelevant information and to highlight important information. They allowed inexperienced readers not only to weed out irrelevant information within the text while constructing summaries but also to avoid misinterpreting text by misapplying unrelated personal knowledge. Goldsmith recommends modeling using connectives as guides while reading classroom materials.

Tapiero and Otero, who were studying the reading of undergraduates, noted that often both high and low readers develop propositional structures, but only high readers go beyond text based ideas to developing “an appropriate and elaborated situation model evoked by the text” (p.342). Low readers could not assemble a body of knowledge that could be manipulated. They may have had a clear picture of what the text said, but only in relation to the text itself, not in relation to “the real world” or any other theoretical construct. They were able to remember the text, but not to learn from it.

Many younger readers fail even to achieve Tapiero and Otero’s first and second levels of comprehension and are unable to summarize in any detail or clarity what they have read. This is particularly true of complex content area text such as science textbooks. The pretest and post test of this study is designed to measure the first two levels of comprehension, both incorporated in the text base. The third level, the building of a situation model, will be considered in the discussion of the intervention.

The Discourse Structure, the Domain of Science and the Young Reader

As students progress beyond the third grade, they must meet the demands of expository text. Kent (1984) notes that while a narrative text makes many personal references, an expository text may make none; while a narrative text is agent oriented, an expository text is subject matter oriented; while a narrative “uses an accomplished time, i. e., either past tense or the historical present”, an expository text may vary tenses; while a narrative text is “connected by some chronological linkage”, an expository text is governed by sentence topic and parallelism (pp. 234-235). Spiro and Taylor (1980) suggest that the type of inferencing required in content area texts tends to be logical, while children’s stories tend to demand pragmatic inferences, and the latter makes fewer demands on a child.

Thus, many of the elements of cohesion found in narrative, such as a consistent agent and verb markings, are often lacking in an expository text. Palincsar and Magnusson (2001) note that studies paint a bleak picture of science text, listing as one characteristic a sparseness “with regard to transitions and other devices useful to attaining cohesion” (p.154). But Rodgers (1974) found at least one cohesive prevalent in science text—connectives. Rodgers went so far as to list the most frequently occurring connectives in Social Studies and Science textbooks. He notes that authors of textbooks make liberal use of connectives, fully expecting readers to attend to them.

Yet it is in the reading of science text that we see evidence of the tendency of students to ignore what they do not understand—whether that be a connective or a concept. Background knowledge is essential for attending to connectives, making inferences and constructing a situation model, and many students are either uninformed or misinformed. Misconceptions may be “physically derived (resulting from interactions with the physical

environment), socially derived (based on interactions with family members, peers, or the media), or instructionally derived (resulting from formal instruction)” (Guzzetti et al, 1993, p. 117). It is little wonder that misconceptions abound in that scientific “fact” seems to be ever changing due to new discoveries. But even more confusing is the apparent contradictions between scientific theory and sense experience—as in the case of the intuitive knowledge students have about motion. Most students maintain a “pre-Newtonian impetus theory” (Hynd et al, 1991, p. 597) and are loathe to discard their theory (see also Alvermann et al, 1995).

When students hold tenaciously to misconceptions, they allow these to govern their reading. If their underlying assumptions differ widely from the macropropositions presented in the text, students may fail to establish coherence among individual propositions. In fact, in reading a text refuting a theory they hold as true they may fixate only on the sentence containing a description of that theory, reading this sentence as support for it. (Alvermann et al, 1995)

Otero and Campanario (1990) explain this phenomenon in relation to van Dijk and Kintsch’s model:

It is possible that subjects do not detect the inconsistencies, that is they do not try to build coherent text bases, because they give up building a situation model for the text: “A prerequisite for coherent text representation is the ability to construct a coherent situation model. Without that, memory for text is stored as incoherent bits and pieces...” (van Dijk & Kintsch, 1983, p.361) (p. 451)

Unless students can be made to realize that a text must cohere, they will be lost. Here we see the interplay between the text base and the situation model, but how difficult it is for one to establish a situation model if one is lacking in scientific knowledge. Still, if students can be guided to make sound text bases, they can begin to make connections between texts and begin to build up sufficient knowledge to establish situation models.

Finally, for students to succeed in reading science, they must adopt an attitude of inquiry and discovery. Reading alone will not accomplish this. Palincsar & Magnusson (2001) recommend first hand investigations exploring a concept before a student is exposed to text. But providing students with opportunity for investigation, remains a first step. Students can't learn all they must learn of science from experimentation. At some point, they must read text and at what point will they have sufficient background knowledge for reading the text they must read to supply them with the requisite knowledge? Educators cannot hope to provide all the background knowledge necessary to make students naturally sensitive to the cohesive ties of science argument. It is a catch-22, a vicious circle, rather like using a term to define the same term. At some point one must go outside the domain of science to find a point of entry to the domain. Educators must present the structure of language as a portal to the semantics of science.

CHAPTER III

METHODS AND PROCEDURES

The Study

This is an exploratory descriptive study using both quantitative and qualitative measures. Due to the limitations of a small sample size, descriptive statistics are used. The study consists of tests for selecting and grouping participants, a pretest, an intervention involving both whole class grammar lessons and small group guided reading sessions and a posttest. Scores on tests provided quantitative data and field notes of lessons as well as analysis of individual oral responses on tests provided qualitative data.

Participants

The experimental group were selected from a grade 5/6 class of twenty-eight students (eighteen males, ten females) in a K-7 elementary school in a working, middle class suburb. The class included 6 severely learning disabled (high-incidence) grade six students and one low incidence grade five student with Down's syndrome. A full time teaching assistant was assigned to the low incidence student. All students in the experimental class were native speakers of English. The control group was selected from a grade 6/7 class of thirty-one students (twenty males, eleven females) in the same school. All students in the control class were native speakers of English. This class included one SLD student in grade seven. Students were selected on the basis of their scores on the Stanford Diagnostic Reading Test.

In both the experimental and control groups, participants were divided into low, medium and high groups for analysis. This division was replicated in the guided reading

group make-up for the experimental group. After one low member from the control group and one medium of the experimental group dropped out of the study, the control group consisted of eight grade six students (four girls and four boys) grouped as follows: two low (one girl, one boy), three medium (two girls, one boy) and three high (two boys, one girl). The experimental group consisted of ten students (three girls and seven boys) grouped as follows: two low (one grade six girl, one grade six boy), three medium (two grade five boys and one grade six boy) and five high (one grade five girl, one grade six girl and three grade six boys). For reasons to be given later, the data for the low groups have been reported separately.

Baseline Data

The Stanford Diagnostic Reading Test, 4th edition, published in 1996 by Harcourt Brace and Company yielded baseline data on general reading comprehension which was used to select participants and to establish three subgroups in both experimental and control groups in relation to reading ability: low, medium and high. The Stanford is a diagnostic tool designed to probe students' strengths and weaknesses in the major components of the reading process, which yields both norm-referenced and criterion-reference information. The three subsets from the purple level, form K administered to participants in this study were comprehension, vocabulary and scanning. Selection and grouping were made on the basis of the overall scores for the test. The low group students achieved response scores ranging from about grade 2.5 to grade 4, the medium group students achieved response scores ranging from about grade five to grade six, the high group students achieved response scores at the grade seven level or above. For each subtest, items are presented in the form of multiple

choice. In the comprehension test, subjects are asked to read a passage and then answer questions or complete sentences designed to test comprehension of the passage. The passages vary in genre and include expository, narrative and directions for a given procedure. In the vocabulary subtest, subjects are asked to choose the definition of a given word. The words are given in isolation, so the subtest is a measure of existing vocabulary knowledge, not the ability to determine meaning through context. In the scanning subtest subjects are instructed to read the questions first and then scan the passage for the answers. They are instructed not to read the passage in its entirety. Both the comprehension and scanning subtests test skills which must be applied in reading for information, and the vocabulary subtests measure vocabulary knowledge base.

A second measure was used after grouping to provide baseline data on syntactic knowledge. This was the CELF, Clinical Evaluation of Language Fundamentals, 3rd edition, published by The Psychological Corporation, Harcourt Brace and Company, 1995. This is a diagnostic tool used for assessing syntactic proficiency. It consists of two major parts each consisting of three subtests. One elicits a Receptive Language Score, the other an Expressive Language Score. It is this latter that was administered to the participants of the study. The subtests are Recalling Sentences, Sentence Assembly and Formulated Sentences.

In Recalling Sentences subjects are asked to listen to and repeat verbatim sentences increasing in difficulty, assessing “recall and reproduction of sentence surface structure as a function of syntactic complexity” (p. 56 of Examiner’s Manual). As a straightforward recall activity, it is the least challenging of the three subtests. In Sentence Assembly, students are given a group of words, randomly ordered, and asked to make two sentences, one declarative and one interrogative, assessing “the ability to assemble syntactic structures into

grammatically acceptable and semantically meaningful sentences” (p. 63). It indicates a subject’s “syntactic flexibility” (p. 139) and her ability to manipulate and transform “syntactic structures within the constraints imposed by content words and grammatical markers” (p. 140). Accordingly to Speech Therapist, Esther Baxter, this subset reveals a subject’s facility in grammatical usage and his or her reading experience, or familiarity with literate language. In Formulated Sentences, students are shown a picture and asked to make up a sentence about it using a particular word or phrase, assessing “formulation of simple, compound and complex sentences” (31). Some of the words provided are content words such as “children”, but most are connectives such as “because” and “although”. Among the three subtests, this places the most stringent demands upon a subject’s knowledge of grammar and his or her vocabulary.

Pretests and Posttests

Two measures were designed by the researcher to measure reading comprehension of science text and syntactic knowledge. (See Appendix B.) A pretest was given at the beginning of the study to provide baseline data and the posttest was given at the end of the study. The tests were comprised of a reading passage selected from a grade six science text, “The Nature of Matter” from the Discovery Works series. Comprehension was tested through free recall and guided recall which consisted of four comprehension questions and a meta-cognitive question. Subjects were asked to read a passage silently and answer several comprehension questions in writing. There were no fill in the blank or multiple choice responses and the type of questions were varied by degree of inferencing required. It was marked by the

experimenter and a member of the school district personnel using the BC Performance Standards for Reading for Information.

Syntax was tested through chunking isolated sentences taken from the passages. Subjects were asked to draw in lines to indicate where they would chunk the sentences. They were then asked to give reasons for where they chose to chunk the sentences. Sentences containing connectives were isolated and subjects were asked to explain the meaning or role of the connectives within the sentences. This portion of the test was given orally and responses were transcribed.

The Intervention

The intervention was conducted over a seven week period. It consisted of eight whole class lessons taught within the first five weeks which focused on sentence structure. The concepts of phrases, clauses, subjects, predicates and connectives were introduced and practiced through group activities and individual exercises. During the third week of this instruction, guided reading groups began to meet, focusing on reading the science text while applying the concepts introduced in the lessons. They met for a total of five weeks, one or two sessions a week for a total of eight sessions each. Classroom observation of both whole class lessons and guided reading sessions, recorded as field notes taken by the researcher, also served as a qualitative measure. Results and discussion of the intervention have been assigned its own chapter, chapter 5.

Procedure

At the beginning of October, the two classes from which the participants were selected were given the Stanford Diagnostic Reading test. Participants were chosen on the basis of their performance on the test, and grouped accordingly. After selection, the participants were given the CELF test. This is included in the data as a measure of syntactic competence. The test was given orally and individually by the Resource Room teacher over a period of three weeks, first to the experimental group and then to the control group. Testing was not completed before the reading syntax pretest was given, but it was completed for the experimental group before the intervention lessons commenced.

For both the pretest and posttests, two passages were selected from “The Nature of Matter” (Badders et al, 1999). One major consideration in the selection of the passages was their use of complex sentences which included connectives. Another was the topic—it had to be something about which students would not likely have a large amount of background knowledge and something that would contain some counter-intuitive concepts. The passages were rewritten to ensure similarity in both sentence structure and readability. According to the Flesch-Kincaid measure, the pretest was a 7.28 grade level and the posttest was a 7.51 grade level. This is higher than the grade level of the students and exceeds the comprehension score on the Stanford Diagnostic of both low and medium students, but it is either at or below the score of the students in the high group. Furthermore, it is a recently published (1999) grade level text (regularly used for grade five students as well as grade six students in a split 5/6 class).

Though the texts used for the tests were definitely at frustration level for the low group, the intervention passages were at their instructional or independent level. Low group

participants were included in the pre and posttesting to see if the intervention instruction might help them cope with the type of texts they encounter in their classrooms.

The syntax portion of the test was completed orally and the responses were transcribed. Because of scheduling difficulties within the school day, the tests were given in two sittings.

After the pretest was given, the intervention commenced. At the end of the seven weeks of the study interval, the posttest was administered. Tests were then marked, data was compiled and the relationship between the two variables, reading comprehension of science text and syntactic knowledge, was analyzed. The results are presented in chapter 4.

CHAPTER IV

RESULTS

In this chapter, data on both baseline data and data obtained from the dependent pre and post tests is reported.

Baseline Data—Low Group

The data on the low group is reported separately from the results of the medium and high group. This separation has been made for two reasons. First, it was found that after some omissions from the group, (absences on the date of test administration, failure to complete tests due to unwillingness, etc,) the experimental and control low groups differed substantially from one another, and second, the absence of some data limited the comparisons which could be made. One of the experimental low group (experimental low #2) was designated SLD, yet in performance he was often higher than the other group members. He was, however, accustomed to having responses on tests scribed for him and did not fill out all response blanks for the pretest. One of the control low group (control low #1), scored significantly lower on the both the Stanford comprehension subtest and the CELF, bringing down the control average, yet she had no designation.

Table 11: Low group baseline data

	Stanford Comprehension	Stanford Total	CELF Expressive Language	CELF Formulated Sentences
experimental low	5.2	3.4	94	8.5
control low	2.8	2.8	86	8

The low data has not been completely omitted, however, because overall scores on the Stanford Diagnostic (experimental low - 3.4, control low - 2.8) indicate the group is more homogenous than the comprehension subtest indicates (experimental low - 5.2, control low - 2.8), and, as mentioned previously, each subtest tests skills necessary in reading for information. Also, formulating sentences has been designated as the most stringent indicator of syntactic knowledge of the three subtests, and on this measure, the groups are quite similar (experimental low - 8.5, control low - 8). Furthermore, if one assigns a score of one to the blanks on the comprehension test according to the BC performance standards which states that at a level one “responses to comprehension questions or tasks are often inaccurate or based solely on prior knowledge; often vague or incomplete” (p. 190), comparisons between before and after intervention performance can be made within and between the two low groups. (The description taken from the BC Performance Standards does give an accurate overall “snapshot” of the student.)

Matching of struggling students is fraught with difficulty because the nature of their difficulties can be quite diverse, as is the amount of support they have received or are accustomed to receiving. Such differences in both strengths and weaknesses exist between students of more average or high ability as well, but they tend to be more marked and more problematic in struggling students. The data collected in this study remains useful as an analysis of the efficacy of such syntactic instruction on struggling students.

Baseline Data—Characteristics of Medium and High Groups

Table 12: Medium & High baseline data

	Stanford Comprehension	Stanford Total	CELF Expressive Language	CELF Formulated Sentences
experimental medium	5.2	5.3	101	8.6
control medium	4.5	5.7	92	7
experimental high	9.8	9.8	104.4	9.8
control high	11.4	9.3	108	11.3
experimental medium & high	8.2	7.6	103.3	9.4
control medium & high	8	7.5	100	9.2

As table 12 indicates, the experimental medium group scores are, in all measures save Stanford Diagnostic, higher in than the those of the control medium group. The widest difference exists in the syntactic measures and will be addressed presently. Conversely, the experimental high group scores are in all measures lower than the control high group save in the Stanford Diagnostic total where they scored higher by a very slight margin. When the medium and high groups are combined, the experimental and control groups are quite similar with the experimental leading by a slight margin.

The disparity in the syntactic scores of the two medium groups may be in part due to the fact that the scores of the experimental medium group included the experimental group's extremes—both the lowest and the highest scores for syntactic facility.

Table 13: CELF and Stanford scores

Participants	Stanford Diagnostic				CELF			
	Comprehension	Vocabulary	Scanning	Total	Formulated Sentences	Recalling Sentences	Sentence Assembly	Expressive Language
experimental low 1	5.2	4.5	3.1	3.5	7	10	7	88
experimental low 2	5.2	2.9	3.8	3.3	10	12	8	100
experimental medium 3	7.5	5.7	5.7	6.1	12	13	14	118
experimental medium 4	3.7	4.5	5.7	5.1	9	11	9	98
experimental medium 5	5.2	5	4.8	4.8	5	12	7	88
experimental high 6	13	10.6	8.5	12.1	9	15	10	108
experimental high 7	10.5	10.6	13	13	9	11	12	104
experimental high 8	9.1	5.7	8.5	8.2	11	13	14	116
experimental high 9	9.1	5.7	9.6	8.6	12	11	9	104
experimental high 10	7.5	5.4	7.6	7.3	8	9	8	90
control low 1	2.3	3.5	3.1	2.4	7	6	6	78
control low 2	3.3	3.6	3.6	3.1	9	9	9	94
control medium 3	3.8	5	7.3	5.4	7	7	9	86
control medium 4	4.1	5.7	7.6	5.6	8	9	10	94
control medium 5	5.5	5.7	7.6	6.1	6	13	9	96
control high 6	13	13	5.3	8.2	10	13	9	104
control high 7	8.3	5.7	9.6	9.6	11	10	12	106
control high 8	13	8	9.6	10.2	13	12	12	114

The high score (118) belonged to a grade five student (experimental medium #3) and the low score (88) belonged to a grade six student (experimental medium #5). Both of these students characteristically contribute actively to class discussions and did so consistently throughout the intervention. Both proved to have a decided interest and good store of background knowledge in the topic of study—space exploration, and both were in the same guided reading group for the intervention, but experimental medium #3 demonstrated a marked ability to reason scientifically and to express his reasoning. References will be made to his contributions in later chapters. It is the high score of the experimental medium #3 that proved uncharacteristic of the other medium group members both in the experimental and control groups.

What was interesting about the scores of experimental medium #5 is the disparity between the scores he achieved on the three subtests. This student scored lower than any of the other participants in any group and well below the statistical average on formulating sentences, scoring a 5 where the average score is 10 (confidence interval of 7–12). His score on sentence assembly was also below statistical average and among the lowest in the participants, 7, yet his score for recalling sentences was in the high average range, 12. Such disparity indicates a definite weakness. This student is quite a competent reader and has learned to listen, retain and recall. This is particularly true when the student is reading fictional literature. However, this student generally has more of a struggle processing content area text. He has difficulty maintaining a flow of thought and will often grasp onto a concept and use it as a springboard into an imaginative idea fairly far removed from the scientific context of the discussion. According to the district speech therapist, Esther Baxter, the CELF test analysis suggests that this student would profit from practice with sentence frames in order to build his syntactic flexibility. This is a focus later in the intervention during the composition of sentence summaries. The fact that these two boys had similar reading abilities, interests and propensities to participate in, if not dominate, the discussion but differed substantially in their syntactic ability makes them an interesting pair to observe. It begs the question as to whether the syntactic ability is a correlate of reasoning ability, and whether it helped experimental medium #5 read, comprehend and respond to both comprehension and syntax questions regarding the text. The gains of both will be addressed later.

Experimental medium #5 has a counterpart within the medium group of the control. The three CELF subtests scores of control medium #5 showed a similar disparity and a

similar weakness in processing: 6 for formulating sentences, 9 for sentence assembly and 13 for recalling sentences. control medium #5's overall score was higher, but the spread is similar.

Pretest and Posttest Results: Comprehension

Comprehension was tested through both free recall and guided recall. In part A of the test, free recall was elicited through the statement: "Tell me everything you can about the information in this passage". The free recall responses were graded but the results were not included in the analysis because of the high tendency of the participants to simply copy the text. Had the passages been removed from the students during free recall the measure would provide more reliable information. Testing conditions did not permit this flexibility.

The guided recall portion of the test consisted of four comprehension questions (see section B in the protocols in Appendix B for the questions and chapter 6 for a discussion of the relative difficulty of the questions and the degree of inferencing required). These four questions were marked using the BC Performance Standards for Reading For Information by both the researcher and a trained member of district personnel. Interrater reliability was approximately 72%. Scores for which there was not agreement were discussed and scores were reassigned. A fifth set of questions, "What part of this passage was difficult? What did you do to help you understand it?" was graded but not included in the analysis as it did not yield any new information that pertained to the focus of the study.

Table 14: Comprehension—Medium & High Groups

	score	%		score	%
PRETEST					
experimental medium	23/48	48	control medium	23/48	48
experimental high	48/80	60	control high	34/48	71
experimental total	71/128	55	control total	57/96	59
POSTTEST					
experimental medium	24/48	50	control medium	18/48	38
experimental high	47/80	59	control high	25/48	52
experimental total	71/128	55	control total	43/96	45
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS		0%	-14%		

Table 14 above presents the scores for the comprehension questions for both the pretests and the posttests. Note that the total consists of the total number of points achieved by all the members of a particular group out of the total possible points for the group, where the total possible for each individual was 16 (4 questions marked out of 4). Thus for the pretest, the experimental high group achieved 48 points out 80 (16 x 5 group members). All the other subgroups consisted of three members each rendering the total possible 48.

On the comprehension component of the pretest, the medium groups of the experimental and the control both scored 48%. This may not sound very high, but one must bear in mind that the rating is on the basis of a 4 point rubric used in the BC performance standards wherein 4 is exceptional, 3 is a large range encompassing average to high average and 2 tends to be a low average score. It should not be translated into letter grades. On the

posttest, the experimental medium group scored 50%, a gain of 2%, while the control group scored 38%, dropping by 10%. On the pretest, the experimental high group achieved an average score of 60%, while the control high achieved an average of 71%. Both high groups dropped in the posttest, but the experimental scored 59%, a decrease of 1% whereas the control scored 52%, a decrease of 19%. Overall, the experimental maintained the same average for the posttest that they achieved on the pretest, while the control dropped by 14%. It must be noted once again that the posttest proved to be more difficult than the pretest. The readability level of the passage was greater (7.51 as opposed to 7.28 for the pretest passage) and, perhaps more importantly, the nature of the questions was much more challenging, requiring much more inferencing. The increased cognitive challenge of the questions was not by design, and points to a weakness of the study which will be discussed in chapter 6.

Syntactic Knowledge

Syntactic knowledge was tested with portion C of the test. These items were written by the researcher based on her hypotheses regarding the kind of syntactic knowledge students would employ during reading and regarding the kind of questions which would allow students to access and express that knowledge. They were developed on the basis of the results of the preliminary study (see chapter one) and as means of testing the concepts the researcher hoped to cover in the intervention. Responses were marked both by the researcher and a trained member of district personnel. Interrater reliability was approximately 78%. Scores for which there was not agreement were discussed and scores were reassigned. Several of the questions failed to yield new information and were thus deleted from analysis. Others addressed concepts which were not presented within the intervention. Though these

concepts were part of the original intervention plan, the unit of study was modified to meet the needs of the students and new avenues emerged during the study. These were followed and observation of the results are presented in chapter 5.

Questions #3 d and #3 e, “What would you say is the main or most important chunk in the sentence?” and “Why” were not included in the analysis as isolating main clauses was not covered in the intervention. Questions #4 a, “Why does this sentence begin with the word ‘in fact’?” and #4 b, “What words could you use to replace it?” were not included in the analysis because the term “fact” caused subjects to focus on the concept of fact and diverted their attention from the connection made. Furthermore, it signalled an intersentential tie and thus should have been presented within the context of the text to allow the subjects to recognize the tie. This would be a good focus for further studies—comparing students’ ability to recognize intersentential ties with their ability to recognize intrasentential ties. Questions #4 a and #4 b were originally included to examine their ability to recognize these intersentential ties, but failed to do so because of the difficulties noted above. These ties were a focus in guided reading lessons.

Question #5 read as follows: “Some words and phrases in a passage are there mainly to show how one thought is related to another. They are signals for relations, just like ‘if’ and ‘as’ above. Can you find some other words that do that job?” The responses to this question did not enter into the analysis because it yielded no clear information. The reason for this was made obvious in the intervention; the exercise of digging out connectives from a large block of text proving to be unhelpful and confusing. Finally question #6, “If you had to choose three key words in this passage, what would they be?” was also deleted from analysis as the

concept of identifying key words and how that might interact with the structure was not covered in the intervention.

The questions which became the focus for analysis were of three distinct types: chunking sentences for meaning, giving reasons for chunking, explaining the meaning and role of connectives within sentences. Each type of question will be analyzed separately and then the results of the syntactic portion as a whole will be discussed.

Chunking

Performance on the first component of the syntactic tasks, chunking for meaning (questions #1 a, #2 a and #3 a), is presented in table 4 below. For this task, students were shown a complex sentence taken from the passage they had read. They were then given the following instructions: “We can chunk long sentences to help us understand them just as we can chunk long words. Show how you would chunk this sentence by drawing in dividing lines.” Their responses were rated from 0–2 based on the logic displayed by their choices. A score of two was given if all the divisions were logical—that is, based on syntactic rules, one was given if some points were logical where others were not, or if an obvious division (i.e. at a comma) was ignored. Zero was given if no points were logical.

Table 15: Chunking for meaning

	score	%		score	%
PRETEST					
experimental medium	14/18	78	control medium	11/18	61
experimental high	26/30	87	control high	18/18	100
experimental total	40/48	83	control total	29/36	81
POSTTEST					
experimental medium	14/18	78	control medium	14/18	78
experimental high	30/30	100	control high	14/18	78
experimental total	44/48	92	control total	28/36	78
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS		9%			-3%

Each individual's possible score on this subsection was six; the total possible score for each group is 6 x the number of group members. Therefore, the experimental high's possible total was 30 (for 5 members), while all the other groups had a possible score of 18 (for 3 members). The experimental middle group scored 78% percent both on the pretest and the posttest, demonstrating no change. The control middle group scored lower on the pretest, 61%, but increased to the same score as the experimental middle group, 78%, on the posttest, for an increase of 17%. The experimental high group scored 87% on the pretest and 100% on the posttest, an increase of 13%. The control high scored 100% on the pretest, but decreased to 78% on the posttest, a drop of 22%. Overall the experimental scores averaged to an increase of 9%, while the control dropped by 3%.

Reasons for Chunking

Next, students were asked, “Why would you chunk it (the sentence) at those spots?” (questions #1b, #2b and #3b). Their responses were scored 0–3. This reflected the syntactical understanding evident in their reasoning. It was more difficult to assign points to this as it was an open question for which innumerable responses could be given. A score of three was reserved for those who explained that each chunk was made up of a clause or could be made into a little sentence, two was given for a mention of punctuation (e.g. “There’s a comma there.”), a mention of connectives (e.g. “There’s an “and” there.”) or a statement that indicated that the next chunk contained different information. A score of one was given to explanations that mentioned “enough information”, “taking a breath” or “a pause”, or a claim that it “sounds right”. Zero was given if the response was nonsensical.

Table 16: Reasons for Chunking

	score	%		score	%
PRETEST					
experimental medium	10/27	37	control medium	09/27	33
experimental high	23/45	51	control high	13/27	48
experimental total	33/72	46	control total	22/54	41
POSTTEST					
experimental medium	17/27	63	control medium	16/27	59
experimental high	33/45	73	control high	14/27	52
experimental total	50/72	69	control total	30/54	56
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS					
		23%			15%

Each individual's possible score on this subsection was nine; the total possible score for each group is 9 x the number of group members. Therefore, the experimental high's possible total was 45 (for 5 members), while all the other groups had a possible score of 27 (for 3 members). The experimental middle group scored 37% on the pretest and 63% on the posttest, an increase of 26%. The control middle group scored 33% on the pretest and 59% on the posttest, also realizing an increase of 26%. The experimental high group scored 51% on the pretest and 73% on the posttest, an increase of 22%. The control high group scored 48% on the pretest and 52% on the posttest, an increase of 4%. Overall, the experimental group increased by 23% and the control increased by 15%.

Connectives within Sentences

For the final component of the syntactic testing, students were asked questions regarding the role or meaning of the connectives within the sentences they were asked to chunk: "What does the word "if" do?", "What does "although" mean?" and "Why does it (the sentence) begin with "as"?" (questions #1 c, #2 c and #3 c). These responses were scored 0–2. A two was given if for the "if", subjects explained that it gave a condition under which the other clause or thing would happen. A two was given if for the "although", subjects noted that that showed a contrast. A one was given for each of the above if subjects gave an example of how the "if" and "although" were used, using them within a new sentence. A two was given for the "as" if subjects noted that it indicated simultaneity or cause and effect, a one if subjects indicated that it "tells what happens when..." And a zero was given for nonsensical responses.

Table 17: Connectives within Sentences

	score	%		score	%
PRETEST					
experimental medium	06/18	33	control medium	02/18	11
experimental high	04/30	13	control high	08/18	44
experimental total	10/48	21	control total	10/36	28
POSTTEST					
experimental medium	10/18	56	control medium	03/18	17
experimental high	13/30	43	control high	06/18	33
experimental total	23/48	48	control total	09/36	25
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS		27%			-3%

Each individual's possible score on this subsection was six; the total possible score for each group is 6 x the number of group members. Therefore, the experimental high's possible total was 30 (for 5 members), while all the other groups had a possible score of 18 (for 3 members). The experimental middle group scored 33% on the pretest and 56% on the posttest, an increase of 22%. The control middle group scored 11% on the pretest and 17% on the posttest, an increase of 6%. The experimental high group scored 13% on the pretest and 43% on the posttest, an increase of 30%. The control high scored 44% on the pretest and 33% on the posttest, a decrease of 11%. Overall, the experimental group realized an increase of 27%, while the control group dropped by 3%.

Table 18 below compiles the results of all components of the syntactic testing.

Table 18: Total Syntax

	score	%		score	%
PRETEST					
experimental medium	39/84	46%	control medium	31/84	37%
experimental high	68/140	49%	control high	53/84	69%
experimental total	107/224	48%	control total	84/168	50%
POSTTEST					
experimental medium	53/84	63%	control medium	41/84	49%
experimental high	88/140	63%	control high	49/84	58%
experimental total	141/224	63%	control total	90/168	54%
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS					
		15%			4%

The experimental middle group scored 46% on the pretest and 63% on the posttest, an increase of 17%. The control middle group scored 37% on the pretest and 49% on the posttest, an increase of 12%. The experimental high group scored 49% on the pretest and 63% on the posttest, an increase of 14%. The control high scored 69% on the pretest and 58% on the posttest, a decrease of 11%. Overall, the experimental group realized an increase of 15%, while the control group dropped by 4%.

Table 19: Summary

	TOTAL SYNTAX	COMPREHENSION
experimental pretest	48%	55%
experimental posttest	63%	55%
difference	15%	0%
control pretest	50%	59%
control posttest	54%	45%
difference	4%	-14%
experimental vs control	11%	14%

The above table shows the relationship between the groups' performance on the two sections of the tests, comprehension and syntactic knowledge. Overall, in syntax, the experimental scored 48% on the pretest and 63% on the posttest, an increase of 15 %. In comprehension, the experimental group scored 55% on both the pretest and the posttest, maintaining initial performance. In syntax the control group scored 53% on the pretest and 54% on the posttest, increasing by 1%. In comprehension the control scored 59% on the pretest and 48% on the posttest, decreasing by 11%. In summary then, while the experimental group increased substantially in syntax and maintained initial performance in comprehension in spite of the increased difficulty of the posttest, the control group increase slightly in syntax and decreased significantly in comprehension.

The Experimental Medium Group

A quick comparison of the two students who scored the extreme low and high scores in the CELF syntax measures can now be made. Experimental medium #5 (who had scored 118 in the CELF), scored 11/16 or 69% in comprehension on both the pretest and the

posttest. This was the highest score in the experimental group on the pretest (the range was 4-11) and among the highest for the posttest (the range was 6-12). In syntax, experimental medium #5 gained 21%, achieving 71% on the posttest. His scores were among the highest for both the pretest—14/28 (the range was 8-16) and the posttest—20/28 (the range was 14-21). Experimental medium #3 (who scored 88 on the CELF) gained 18% in comprehension, achieving 56% on the posttest. His score was among the lowest in the pretest (6), but was the median for the posttest (9). In syntax, experimental medium #3 did surprisingly well on the pretest, achieving 15/28. He gained 10% achieving 18/28 or 64% on the posttest. References made to the kind of responses given by each, particularly in the area of reasoning, will further demonstrate the gains made by each.

The gains of both these students indicate that the emphasis placed on structure while reading can benefit both a reader of low syntactic ability as well as one with high syntactic ability. (Note that though experimental medium #3 did not improve his comprehension score, he maintained a high score despite the increased difficulty of the posttest.) The intervention also allowed the student with high syntactic ability to access his strongly established intrinsic knowledge to more clearly explain his syntactic reasoning.

Results of the Low Group

Table 20: Chunking Sentences—Low Group

	score	%		score	%
PRETEST					
experimental low	08/12	67	control low	09/12	75
POSTTEST					
experimental low	12/12	100	control low	10/12	83
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS		33%			8%

The total scores for both the experimental low and the control low have been calculated on the basis of two groups members as both groups are composed of two members. In the questions in which subjects were asked to chunk sentences, the experimental low group scored 67% on the pretest and 100% on the posttest, increasing by 33%. The control low group scored 75% on the pretest and 83% on the posttest, increasing by 8%.

Table 21: Reasons for Chunking—Low Group

	score	%		score	%
PRETEST					
experimental low	05/18	28	control low	04/18	22
POSTTEST					
experimental low	12/18	67	control low	10/18	56
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS		39%			34%

When asked to provide reasons for their chunking choices, the experimental low group scored 28% on the pretest and 67% on the posttest, increasing by 39%. The control low group scored 22% on the pretest and 56% on the posttest, increasing by 34%.

Table 22: Connectives within Sentences—Low Group

	score	%		score	%
PRETEST					
experimental low	02/12	17	control low	03/12	25
POSTTEST					
experimental low	04/12	33	control low	02/12	17
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS		16%			-8%

When asked to explain the meaning or role of connectives within sentences, the experimental low group scored 17% on the pretest and 33% on the posttest, increasing by 16%. The control low group scored 25% on the pretest and 17% on the posttest, decreasing by 8%.

Table 23: Total Syntax—Low Group

	score	%		score	%
PRETEST					
experimental low	22/56	39	control low	23/56	41
POSTTEST					
experimental low	33/56	59	control low	28/56	50
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS		20%			9%

Looking at overall scores on the syntax portion of the tests, we can see that the experimental low group scored 39% on the pretest and 59% on the posttest, increasing by 20%. The control low group scored 41% on the pretest and 50% on the posttest, increasing by 9%.

Table 24: Comprehension—Low Group

	score	%		score	%
PRETEST					
experimental low	10/32	31	control low	10/32	31
POSTTEST					
experimental low	17/32	53	control low	09/32	28
DIFFERENCE BETWEEN PRETEST & POSTTEST TOTALS		22%			
					-3%

In the comprehension portion of the tests, the experimental low group scored 31% on the pretest and 53% on the posttest, increasing by 22%. The control low group scored 31% on the pretest and 28% on the posttest, decreasing by 3%.

Table 25: Summary—Low Group

	TOTAL SYNTAX	COMPREHENSION
experimental pretest	39%	31%
experimental posttest	59%	53%
difference	20%	22%
control pretest	41%	31%
control posttest	50%	28%
difference	9%	-3%
experimental vs control	11%	25%

The above table shows the relationship between the low groups' performance on the two sections of the tests, the first targetting the variable of comprehension, the second targetting the variable of application of syntactic knowledge. Overall, in syntax, the experimental low scored 39% on the pretest and 59% on the posttest, an increase of 20%. In comprehension, the experimental group scored 31% on the pretest and 53% on the posttest, increasing by 22%. In syntax the control low group scored 41% on the pretest and 50% on the posttest, increasing by 9%. In comprehension the control scored 31% on the pretest and 28% on the posttest, decreasing by 3%. In summary then, while the experimental low group increased substantially both in syntax and in comprehension, the control low group increased less dramatically in syntax and decreased slightly in comprehension.

CHAPTER V

THE INTERVENTION

The intervention consisted of nine whole class lessons over a five week period focusing on sentence structure. The concepts of phrases, clauses, subjects, predicates and connectives were introduced and practiced through group activities and individual exercises. During the third week of this instruction, guided reading groups began to meet, focusing on reading science text while applying the concepts introduced in the lessons. There were three groups, sorted by reading ability, low, medium and high. The ten students who made up the experimental groups, low, medium and high, were assigned to the corresponding guided reading groups. The groups met for a total of five weeks, one or two sessions a week for a total of eight sessions each. From beginning to end, the intervention took place during a seven week period.

Table 26: Intervention schedule

Weeks	lessons	guided reading
one	1	-
two	2	-
three	2	2
four	2	1
five	2	1
six	-	2
seven	-	2

The material for the lessons were chosen using the same considerations as the selection of the pre and posttest passages, but the topic had to be distinctly different from that of the test material. Space exploration, a curricular topic, was chosen. The advantages of this

choice was that it was a topic covered by the grade six curriculum, there was a great deal of material on the topic from which to choose, and there were many counter-intuitive concepts involved in space study. The disadvantage was that space is a popular topic and some students were likely to have a good store of background knowledge. This disadvantage was compensated for by focusing on complex counter-intuitive physic principles. For example, one passage discussed the death of a star during which the force of gravity crushes the core. The passage described the weight of the core relative to its size, i.e., the density of the core:

At this stage, 15ml of this matter would weigh the same as four billion full-grown elephants. But gravity squeezes the core still smaller. In a fraction of a second, it may be no larger than a period at the end of this sentence. (Darling, 1998, p. 62)

Furthermore, two of the passages used in the guided reading sessions for the high and medium groups (“Saturn: Lord of the Rings” and “Black Holes and Time Tunnels”) were taken from a grade six anthology, *Space, Stars and Quasars in the Collections* series. And one passage (“Sojourner and Beyond”) used in the low reading group session was taken from the grade four *Collections* anthology. This served to create a more natural setting for the intervention.

Guided reading groups met for 20-30 minute periods. Students were asked to read the selections to themselves in small chunks, either in paragraphs, or at times to the end of a page. For the first few sessions, they were asked to find connectives and discuss the role of the connective in the passage. In the next few sessions, they were asked to read smaller portions aloud (1-2 paragraphs) and choose one chunk and ask a question for which their chosen chunk would provide an answer. In the final sessions they were asked to read the

smaller portions silently and summarize the portion, collaborating on the sentence by providing a clause and thereby building a summative sentence together, supplying connectives and punctuation where necessary. These contributions were made orally with the teacher recording them on a white board.

Think Aloud modeling was used throughout the sessions. Emphasis was placed on thinking while one reads. Identifying chunks was presented as a means of slowing down and pausing to think about what each chunk means and how it interacts with the rest of the information in the passage. In each reading session, the focus quickly shifted from discussing syntax to discussing content. For example, in reading one sentence the teacher stopped to ponder one chunk.

teacher: The sun, a mid-sized star.... 'a mid-sized star', it says. What does that imply?

experimental high #6: There are a whole lot of other stars even bigger than the sun.

Other students agreed and the discussion went on, revisiting information learned in previous lessons about the huge dimensions of the sun relative to those of earth, and tying it into further information from the passage which was about black holes. The teacher emphasized the importance of slowing down to catch each chunk because, especially in science text, each phrase and clause can give so much information.

While the experimental class was engaged in the intervention, the control class also pursued studies in space exploration. The study primarily consisted of reading the grade seven prescribed text, *Science Probe*. The teacher concentrated again on guiding students through the text using strategies listed in *Reading 44*. Since this teacher was also using the

Soar to Success program with her grade sevens, she also used the strategies taught in the program with the class during science classes. These whole class lessons occurred approximately twice a week for 45 to 60 minutes. Both the control and experimental class spent two periods in experimentation during the study.

Qualitative Data Gathered During the Intervention

The first goal of the intervention was to develop an understanding that text is made up of words and that these words play different roles. The focus was on the two basic types of words that make up text: form and function words. The groups were given a set of nine word cards: pull, still, shine, come, if, globe, sun, fire, hydrogen. They were asked to sort these and name their categories. Four groups put them in alphabetical order. When the request was made that they group, rather than sequence the words, they still grouped by initial letters e.g. sun and shine, fire and finally, and then made a miscellaneous group. One group grouped by meaning, for example, placing “sun” and “shines” together because the sun shines and “hydrogen” and “fire” because firefighters sometimes use hydrogen to put out fires. One group attempted to group by nouns and verbs. When trying to deal with the words that didn’t fit, experimental high #10, said “That’s all the type of words there are, aren’t there?”. They were unable to come up with further word types themselves even though they’d had spelling exercises which required them to group adjectives. This group gave up and sorted by initial letters.

The frustration this group suffered as well as the general inability of the students to go beyond alphabetic sorting is indicative of the huge difficulty students have in classifying words and the lack of understanding they have in the shifting roles a word can play. This is a

continuing struggle experienced by the class from which the experimental group was drawn even months after the study concluded. When asked to brainstorm nouns, verbs, adjectives and adverbs beginning with a designated letter and told they must use one word from each category to compose a sentence, students used “excited” which was listed under verb as an adjective, e.g. “Eddie was excited about Easter”. When it was brought to their attention that they had not used a verb beginning with “e”, they argued they had used “excited” and it was on the verb list. They did not understand that by using the word in a certain way, they had given the word a new role—the role of adjective rather than verb.

Students have a great deal of difficulty coming to realize that a word does not belong to a certain category, or perhaps categories (e.g. fire can be both a noun or a verb), but rather that words play roles which are defined by their relationship to other words within a sentence or text. This renders the teaching of each part of speech to young students extremely difficult, and ultimately not worth the effort. Though Adler recommended the acquisition of such knowledge, he was writing for adults, and he concludes that the ability to formally diagram a sentence is not necessary. What is necessary is an understanding of how words are grouped in a sentence and the relationships between groups. This is why the emphasis was placed on the difference between form and function in the initial lesson of the intervention and on subject and predicate throughout the study. It was noted that generally a subject contains a noun and a predicate commences with a verb, but these labels were not focal points. The chunks that were comprised of a subject and a predicate, i.e. the clause, and those chunks which modified it, i.e. the phrases, were the focus.

The second goal of the intervention was to establish an understanding of what a sentence is. In the second session, the students were given a selection of six phrases and

sentences (see below) and asked to identify which were sentences and which were not and state why. They worked on this in groups. There were six groups. The number of groups designating each as a sentence is recorded to the left.

two	1. Saturday at the pool.
one	2. I jumped.
one	3. Running to the car.
none	4. Roger and me together.
five	5. He ate lunch.
five	6. Fifty-five people, all dressed in their best clothes.

The groups that voted for #1 said it “sounded like a sentence”. A member from another group pointed out that it “has a thing, but no action”. Number two was largely agreed upon as being “too short”; students noted it “doesn’t make sense”. Number 6 had both a thing and an action and therefore; they believed, it must be a sentence.

Thus, those groups of words that were long enough and made sense were designated sentences. They also had a sense of sentences needing a “thing”, i.e. noun and an “action”, i.e. verb, but they had little sense of the flexibility of these roles. Although they began with an understanding of the sentence expressing a complete thought and having a noun and a verb, they had a difficult time assessing the completeness of a thought and the use of verbals in the context of the sentence. The fact that a word that normally served as a verb could serve as an introduction to an adjectival phrase was misleading to them. The words “noun” and “verb” were supplied by members of the class. By the time the class got down to discussion question #4, a student, experimental medium #3 noted that it “needs an adjective or verb”, displaying a level of syntactic awareness consistent with his high scores on the CELF

subtests. It should be noted that this student had been in the researcher's class in his grade three year when the class did do a short study of sentences.

The third lesson introduced the concepts of subject and predicate. Students were asked to identify sentences from a sheet of thirty sentences and phrases. They then responded as the sentences were read out with a thumbs up thumbs down. The majority were able to identify sentences, and then identify subjects and predicates. The fourth lesson focussed on phrases and how they differed from clauses. In the lessons that followed, connectives were presented as words that showed relationships between chunks, i.e. between clauses. A variety of connectives and the different types of relationships they signalled were introduced.

After laying the foundations for the concepts to be used, intervention lessons focussed on chunking sentences which required students to isolate clauses and phrases, using commas and connectives as guideposts. This was fairly simple, as most students had been taught in primary grades that one "takes a breath" or pauses at a comma when one is reading aloud. The comma was now presented at a place to pause for thinking and the chunks framed by commas and other punctuation were to be understood as being chunked for meaning as well as sound.

From the first, students were quite competent, averaging 81% accuracy on chunking individual sentences and identifying the connectives within these sentences (for 26 papers). This is a fairly sound average as it included the scores of the SLD students of the class. The intervention moved on fairly quickly to chunking sentences and identifying the connectives within a paragraph. This proved much more difficult. The students averaged 48% (26 papers). This might have been partly due to the difficulty in determining what a connective was.

Guided reading groups had commenced by this time, and students were encountering difficulty picking out connectives from the passages they were reading. Initial requests for students to pick out one key word and one connective in a given passage met with success. Repetition of a commonly used connective (e.g. “but” in a passage contrasting earth and Saturn) in a passage also made identification easy. But when faced with a passage where there was no distinct pattern, requests for contributions to a list of connectives elicited varied responses. Students focused on small words and often suggested prepositions such as “it”, articles such as “an” and short verbs such as “is”. This was particularly true of the lower reading group.

However, when students were instructed more specifically to identify only connectives at the beginning of sentences and after commas (i.e. those prefacing clauses which tend to be the ones which clearly show relationships between clauses), student performance was much better. The average on individual worksheets increased to 86% (23 papers). Again, the use of punctuation (commas and periods) as guideposts simplified matters.

Generally, picking out connectives did not prove a helpful exercise. Focussing on individual chunks and occasionally referring to the connectives to see how a chunk related to the entire passage was more helpful.

In both individual worksheets and in guided reading sessions, the use of questioning to identify the meaning of chunks and their relationship to the passage of the whole was introduced. (There is insufficient data from worksheets to score and comment upon.) This was a struggle for some. In guided reading, the process of reading a paragraph, targeting a chunk and then posing a question that would be answered specifically by the chunk was

modeled by the teacher. Students were then asked to repeat the process. This met with variable success. Students in the high group were able to do this, but those in the lower groups were prone to asking more general questions, or to attempt to ask questions which would be answered by “yes” or “no”, a problem generally encountered with weaker students when one works on questioning.

An emphasis was then placed on thinking when one reads, considering what each chunk means. The teacher modeled this through the Think Aloud method, where she read a paragraph chunk by chunk, pausing to note what each one meant in light of the other. At the end of the paragraph, the teacher wrote a sentence summary on the board. Students were invited to do this, but thinking aloud, a self-conscious process, proved embarrassing to students. Students preferred to read a paragraph, then mention some chunks they noticed and what they meant to them.

Students were then asked to help compose group sentence summaries. In working on these, students were asked to contribute ideas in the form of clauses. These clauses were fitted together into a sentence with the help of connectives provided by the students. This was a collaborative activity utilizing all the concepts studied: subject, predicate, clause, phrase, connectives, in a generative task. Students obviously enjoyed this task and suggested several of the connectives frequently encountered in reading, specifically “but”, “although” and “therefore”. Experimental medium #3 was particularly active in these sentence compositions and it was noted by several students that “therefore” was now his “favourite word”.

Thus students within the class went from the general understanding of a sentence as a groups of words that is long, makes sense and should include a thing and an action, to a working understanding that one can combine a number of clauses to express complex

scientific principles and relationships and a blossoming ability both to read and compose such sentences.

Instruction focussed on syntax—reading chunk by chunk and making sense of each chunk while using connectives to check for relationships—quickly developed into lively and engaging discussion of the passages, engendering questions like “What does it really matter if we find out about black holes, anyway. I mean, besides being interesting, can it really affect us?” (from a member of the class not included among the participants of the test) and comments like “That was a great conversation” (from experimental medium #3). Structure became a key to developing the semantic flow of the text. The building of the text base led to and was at times simultaneous to the formation of a situation model. Following the structure of the sentences and paragraphs that framed the passage allowed students to construct meaning from the text and to manipulate their new knowledge and assimilate their previous knowledge, using both to produce summary sentences.

Granted, often the sessions merely allowed the group to provide sentence summaries for individual paragraphs. In this way the group was establishing the first stage—the locally coherent network mentioned by Tapiero and Otero (1999). Often time did not allow the group to read an entire article in one sitting and they did not progress to the second stage—the hierarchical sequence. But the lack of the hierarchical sequence did not prevent students from beginning to construct a situation model. They freely discussed ideas sparked by the text and often offered the imaginative “what if”. This supports the theory that the two levels of comprehension—text base and situation model—are not constructed sequentially.

Still an understanding of the complete text is important, as confusion arises when important details are missed. This confusion arose when reading “Black Holes and Time

Tunnels”. It is a fairly long (4 pages), fairly dense article. In one section on the third page, reference is made to “Cygnus X-1” as a significant entity to be considered for the remainder of the article (Darling, 1998, p. 63). No one (including the teacher) could recall what Cygnus X-1 was as it had been identified on the first page of the article which the group had read two days previous. All the groups members were forced to do a search through the article to find out who or what was Cygnus X-1.

Students need to be able to read science text and construct a sound but flexible text base, recognizing and incorporating all the main points contained within the text. The goal of reading instruction is to enable students to do this independently. But solitary reading often proves insufficient to move beyond the text base to constructing a situation model. Such a move will require discussion. Discussion strengthens comprehension for readers of all levels of age and experience. It is the foundation for learning in post secondary institutions—one is to read the text and come to class prepared to discuss it. Discussion may well be essential for the younger, less experienced reader. Guided reading has been developed as a format to guide students in both processes. The text base is collaboratively constructed during reading—often with the teacher modeling the process. The discussion which both accompanies and follows reading should also promote the building of a situation model. The guided reading sessions in the intervention provided evidence of both constructive processes and it was the initial focus on language structure which facilitated the processes.

CHAPTER VI

DISCUSSION AND CONCLUSIONS

In summary, this study was designed to investigate whether teaching students to approach scientific texts using their knowledge of language (specifically syntax) would help them better understand the passages they are reading. It has long been taken for granted that the study of grammar is unhelpful in teaching students to write (Elley, Barham, Lamb, & Wyllie, 1976). Much of the research in the past decades has been used to provide evidence that the study of the structure of our language restrains the generative, creative process.

The reading process, however, must be admitted to be a more analytic process. Constructive, yes, in that the reader does more than merely receive meaning from the text; rather, he or she constructs meaning from it. But the text is a whole which must be first broken down into parts in order for the reader to *reconstruct* the frame. Simultaneously, the reader is adding to the text frame from his or her own store of knowledge, and the final product of the act of reading will be the construction of something new and unique to that reader.

The theoretical framework upon which the study is based is van Dijk's and Kintsch's concept of discourse structure which represents reading as a process involving the building of both a text base, the aforesaid "frame" and a situation model, the new and unique product of the reader. William Adler's theoretical framework upon which he based his book *How to Read a Book* also serves as a point of reference. Adler describes reading as an active process that requires taking apart an argument proposition by proposition (a process which he says requires a certain amount of grammatical knowledge) in order to fully comprehend it and reconstruct it.

Such a complex analytical approach is usually unnecessary when reading fictional narrative, but the reading of content area text presents different and greater challenges to the young student, and, of all content areas, science can present the most complex concepts. Processing science concepts becomes even more difficult when the concepts are counterintuitive, as in the study of forces in physics.

The questions addressed in this study were the following:

1. Is direct teaching of syntax effective in raising syntactic awareness in young students?
2. Can young students be taught to apply syntactic knowledge during the reading process?
3. Will an increased awareness of syntax and application of syntactic knowledge be accompanied by an increase in reading comprehension of science text?

In the course of the study the experimental group received a pretest and a posttest testing syntactic knowledge and reading comprehension and a seven week intervention which included whole class lessons teaching students to recognize sentence structure, chunk sentences and use connectives as cues for relationships between propositions. The intervention also included guided reading sessions applying the syntactic concepts to reading science text. A control group received only the pretest and posttest.

Results indicate that the experimental group improved in syntactic knowledge and maintained their scores in comprehension, while the control improved slightly in syntactic knowledge and, on the whole, did not improve in comprehension. Furthermore, observation notes from the intervention indicate that the intervention allowed students to gain a sense not only that they needed to adjust their pace of reading while reading dense science text, but a notion of how and where to do so, using commas, connectives and their knowledge of

phrases and clauses as points at which to stop and think. What follows in this chapter is an interpretation of the findings and the conclusions that can be drawn in light of the research questions. The quantitative data composed primarily of the pretest and posttest results and the qualitative data in the form of the observation notes on the intervention will be discussed separately.

Question One

Is direct teaching of syntax effective in raising syntactic awareness in young students? The syntax portion of the pretest and posttest served to answer this question as well did some of the quantitative data collected during the intervention. In the intervention, scores on the worksheets covering the concepts of what a sentence is composed of, how one chunks a sentence and how one identifies connectives indicated that direct teaching was effective. Students achieved an 85% average on the scores after the directions for identifying connectives was directly tied to the use of commas as cues. Scores on the syntax portion of the pretest and posttest will be interpreted by subcategory first and then as a whole. Refer to chapter 4 for all the tables mentioned below.

Chunking (Refer to table 15)

Generally the performance on chunking tended to be fair to excellent from the outset, the scores on the pretest ranging from 61% for the control medium group to 100% for the control high group. This matches the high performance of the grade threes in the preliminary study (90% for the high and low groups, 70% for the medium) and supports the conclusions drawn from that study that students are aware of commas as signposts. Whereas the experimental medium group realized no gain, they had outperformed the control medium

group substantially on the pretest (78% for the experimental medium and 61% for the control medium) and with their gain, the control medium group just managed to match the performance of the experimental medium group (achieving 78%). Still, one wonders why the experimental medium group did not improve. The experimental high group, on the other hand, did improve, perfecting their performance. The control high group dropped substantially. Such a drop is strange, but is certainly partly accounted for by the small size of the sample and the reaction of these particular students to testing. It was noted by both the classroom teacher and the researcher that one of the control high group demonstrated a fair bit of resistance to the posttest, feeling frustrated with the difficulty of the test. Another of the control high group had a chronic tendency to allow his mind to wander, according to the classroom teacher, and was in that particular space on the day of the posttest.

But the familiarity with the task resulted in an increased comfort level within the control medium group (as was expressed by some to the researcher) and should have had a positive effect with the control high group, particularly since the syntax portion of the posttest was almost identical to that of the pretest and therefore could not be said to be significantly more difficult.

Chunking simply required students to recognize the commas as cues. The questions asking students to give reasons for their choice of where they chunked served to determine what meaning subjects understood the commas to be cueing.

Reasoning (Refer to table 16)

Students are taught at an early age to pause at commas for “breaths” when reading aloud. Evidence of this is provided in the comments of the grade threes in the preliminary study. Results of the thesis study indicate that many of the subjects both in the experimental

and control groups came to the study with this understanding. However, the intervention emphasized that these cues also indicate boundaries for chunks of words that belong together because they express a whole thought i.e. a clause or proposition, or they contain information modifying a thought.

Results of these questions indicate that the direct teaching was effective, with the experimental medium realizing a 26% gain and the experimental high a 22% gain. The control high realized a slight, 4% gain. The surprise this time is that the control medium realized the same gain as the experimental medium a 26% gain. This points to a difficulty in interpreting and scoring the responses given in the section.

There was an effort made to avoid marking responses simply in relation to one another as was done in the exploratory preliminary study. Furthermore, with the greater cognitive development of these older students, it would have been simply impossible to assign points for every combination of reasons given by the subjects; therefore, certain words were used to create delineations among levels for point attribution.

Two points were awarded for the response that a division was made because there was a comma there. It is to be expected that the experimental group is identifying the comma as a boundary for a meaning chunk while the control group is still interpreting the commas as a place to pause for breaths. But there is still a question as to what one is to be doing while inhaling. Does the pause serve as physical preservation, as an opportunity to use silence for emphasis as one would in music, or does it serve as a cognitive cue—time to pause and reflect? This could be the understanding behind the “pause” or “break” reasoning. In the case of those who have undergone the intervention, it should be. This is sometimes but not always evident in the oral responses and the benefit of the doubt was given to those using the proper

term for that point of punctuation. The difference in understanding between the experimental group before and after the intervention and between the experimental and control groups at the posttest becomes more obvious when considering individual responses in which subjects are working through the ideas in an effort to express their reasons.

In the control group we see that the pause is indeed largely related to breaths. Control high #6 says on the posttest: "...there should be a pause there. That's where you're supposed to take a breath", and in a second response this student asserts that you chunk "Right where the comma is". Control medium #5 says on the pretest that a comma "Make's you... not like stop, where's... If there's a period, you stop and take a breath. If there's a comma, you, like, stop for a second. Not as long as you would if there's a period." On the posttest the same subject simply gives as his rationale for chunking "Because there's a comma there." No further clarification as to what a comma does is given.

In the case of control medium #3, there seems to be some development of understanding. On the pretest she gives nonsensical responses when asked to give her reasons for chunking.

"'Cause, "although the specks of dust", well, you can see specks of dust, "are small, the particles that make up matter" ... well, 'cause particles are small, so I thought that would go together. And, uhm, I just thought, "are much smaller."

On the posttest, she is much clearer, using specific terms (comma) and thus receives more points.

“Because ‘although many people think that temperature’, I thought there was a good sentence, and then heat ‘and heat are exactly the same’, since there’s a comma there, I think I should put a line there and then.”

However, though she is identifying commas, she clearly does not understand how the chunks framed by commas are grouped to make meaning since she identifies as a “good sentence” something which splits a relative clause.

Among the experimental group, a growth in understanding is evident, even between responses accorded the same point value. Experimental high #8 was fairly confident explaining chunking from the outset:

“Because I think that’s where you should understand it. Because if you, if you kept going, it would be, it would be way too long, and you could get confused, like ‘the windows are closed’ and that... So you could get confused if it was too long. So you just chunk it where you think a small sentence would be... That’s why I chunked it there.”

This response was given a three because of the reference to small sentences which indicates some understanding of clauses and sentences as complete thoughts. In the posttest, however, experimental high #8 is able to further explain the structure of the clause.

Uhm because the first chunk has—uh, what is it called? It’s called the ... Oh! I can’t remember what it was called—the... predicate! It has a predicate and a subject. So after the predicate and the subject you chunk... you chunk it.

Later he more fully explains the combination of clause and the comma as a clausal boundary marker:

Because that—it has a subject and what the subject does. And then after that it's going on to a new subject, so you chunk it, put a comma or some marker.

Experimental high #10 also demonstrates a growth in understanding in that she mentions the use of a comma for chunking in the pretest, but is obviously adding to that the understanding that a comma can serve as a clausal boundary marker even though it's still quite shaky.

Well, there's a comma right there. And... I don't think I should of chunked it there because there isn't' really... like the- like there's a subject, like a "rate", but there isn't a predicate.

There was, in fact, a predicate and she had, in fact, chunked correctly, and though she could not consistently recognize it, she knew what she needed to look for to make a complete thought—a clause.

Experimental medium #3 (the student who has been noted for his high syntactic ability as reflected in the CELF measures) was able to identify both a comma and a connective and to use the language, but because he did not mention clauses, he was awarded only a two for his response. However, the confidence with which he applies the principles taught in the intervention is evident.

...Well, I chunked it there because, for one, there was a comma, and two, there's a connective at the beginning so I know somewhere around there it's gonna be—there's gonna be a chunk, and 'If the rate at which the particle move changes' makes a lot more sense than 'If the rate at which the particles' would make.

Here he goes beyond the signposts of the comma and the connective to demonstrate which grouping of words constitutes a complete thought and which does not.

Having conducted this study, the researcher would be better prepared to predict what responses one could expect after the intervention and would revise the marking categories for the reasoning responses. But to go back and revise the pretest marking on the basis of experimental posttest responses would not be fair to the control group. Moreover in future studies, it would be helpful to follow up the response with a question, “What does the comma tell you?”

The comments of the experimental group members clearly demonstrate an understanding the role of commas and connectives as markers.

Connectives (Refer to table 17)

These questions dealing with the role of connectives were the most difficult for students. The students were more hesitant in their answers and often asked for clarification. For some reason, the experimental high scored very low on the pretest and though they realized the greatest increase, 30%, they still did not achieve the same level of performance as the experimental medium group on the posttest (43% for the experimental high, 56% for the experimental medium), or that of the control high group on the pretest (44%). The experimental high group did include two students reticent to make educated guesses. They were unwillingly to go beyond giving succinct responses of which they were certain. The group also included experimental high #8, a student who is known to be very hard on himself and who found this category of questions extremely difficult on the pretest. He tried desperately to explain his thinking. In response to “What do the words ‘even if’ do?”, he responds (Note: square brackets indicate researcher’s comments):

Makes you think because... that's like even if, uhm... it could not happen or it could... like if it happened... I don't even know what I meant by that... even if it... (sniffing, close to tears) So that even if made me think that... ehum, what am I trying to say? It's hard to say... [*It is hard to say.*] I'm thinking... Even... Holy crap... [*You want to pass on that?*] Yah. It's hard.

However, the overall improvement of the experimental group, 27%, indicates direct teaching of the role of connectives was effective, even though the end performance was still a mere 48%. It indicates that the instruction had laid an initial foundation upon which further instruction could be built.

Experimental high #8's remarks demonstrate he had received a degree of syntactic understanding sufficient to preserve him from the discomfort he experienced on the pretest. He hadn't forgotten his earlier experience, either.

If—uh? Oh, I had this before! I think 'if' says, means that there's two things, like it can be this, but- or... Like 'if this happens...'—there's a consequence or whatever. Like that.

On the pretest, experimental medium #5 (the student who has been noted for his low syntactic ability as reflected in the CELF measures) is unable to give a rationale explanation of the role of "even if".

Uhm, they like... tell... they, uhm, like tell what the thing is. Or, they like explaining the object that you're talking about or whatever it is that you're talking about, and that's all.

On the posttest, he is much clearer in his explanation of the role of "if".

It kind of explains a possibility of something... because you could, like, 'if it doesn't work... but 'if' can also mean... other things, but I don't know what they can also mean.

His confidence wanes, and he struggles to explain the other connectives, but he has an initial understanding. He has benefited from the intervention, but he needs more guided practice. Experimental high #10 shows that she understands contrasting role of "although" by comparing it with another connective also encountered during the intervention, "however".

It's like how- like however. Like, even though that people think that, that the temperature and heat are the same, they really aren't, so it's like however...

Further evidence of this blossoming understanding of connectives continued to arise within the classroom after the intervention was formally brought to a close and as the students worked on writing sentences. When students were asked to make sure they were writing interesting sentences, rather than short, simple and uninspired sentences, experimental medium #4 asked, "You mean using connectives?".

Total Syntax (Refer to table 18)

Overall, the scores among the experimental group rose consistently. The results among the control group differed between levels. Though the control medium realized a gain (12%) which was not substantially lower to that of the experimental groups (17% for the experimental medium and 14% for the experimental high), the control high dropped (by 11%). All levels of the experimental group, including the low group which will be considered presently, realized gains whereas the control group growth was erratic.

Low Group Data

The data from the low group supports the conclusion that direct instruction can raise syntactic awareness. The gains made in scores on the chunking questions clearly indicate that the experimental low group were able to apply the concrete cues for chunking, gaining a perfect performance along with the experimental high group. The control low also increased their performance, achieving 83% on the posttest. In the reasoning category, both the experimental low and the control low group made substantial gains (39% and 34% respectively), but again, the difference of understanding of comma made marking difficult. In both pre and posttests, control medium #1 notes that she chunks because of commas, using the proper term, and then mentions taking “a breath”. For the experimental group, the fact that they are directly applying instruction received in the intervention is obvious.

In the pretest, experimental low #1 relies on explanations such as “it just sounds right”, but in the posttest, experimental low #1 says she would chunk it at the given spot “Because there’s a comma there, and I remember during class when we were chunking sentences, hum, you said that people usually chunk at commas.”

Experimental low #2 notes on the pretest that “it kinda makes sense”. On the posttest he mentions making sense again, but goes on from there.

I think that it may have been able to chunk it in one spot, but I thought that that’s where it made the most sense to me. And, why would I chunk it there? I would chunk it there so that you wouldn’t get a ton of information right, right there. And again the comma, where you, you said you should chunk it.

Thus, both subjects in the low group were able to restate the idea that one chunks at a comma, and experimental low #2 was beginning to combine that with the fact that one must consider the amount of information contained within a chunk.

The experimental low group also realized a substantial increase in the connectives category (16%), though not as substantial as the other experimental groups. The interesting point here is that, in the experimental group, there is a pattern that emerges which directly correlates with ability levels. Increased understanding of connectives was ranked 30%, 22%, and 16% for high, medium and low groups respectively. In the control groups ranking was less consistent with levels, an increase of 6% for the medium group, a decrease of 8% for the low group and a decrease of 10% for the high group. Here the use of percentages tend to make the difference sound greater than they are. Since the total score is 18 for three participants, a 10% drop is only a drop of two points—the control high scoring 6 on the posttest compared to 8 on the pretest. The medium group gained one point and the low group lost one. One can safely say that there was no substantial difference—either growth or loss of understanding—for the control group regarding connectives, whereas the experimental group did gain in this respect.

Overall, the experimental low group benefited most substantially of all experimental groups from the direct instruction, experiencing a 20% increase in the case of the syntax portion. Regarding comprehension, data was incomplete for this group.

Question Two

Can young students be taught to apply syntactic knowledge during the reading process? Though this question is partially absorbed in the third question, “Will an increased

awareness of syntax and application of syntactic knowledge be accompanied by an increase in reading comprehension of science text?”, it warrants consideration on its own. However, it is primarily answered in observation of the process demonstrated in the guided reading groups. A good deal of the interchanges among the medium and high reading groups provide an affirmative to the answer. (See more detailed discussion of the intervention in the previous chapter.) Fewer of these interchanges occurred while the low group met. This is not altogether surprising, as the low group was comprised largely of students who were far less sure of themselves and far less willing to take risks and try new things. However experimental low #2 began to identify connectives and use them in sentence summaries by the end of the intervention, and he proved to realize the second greatest increase in the syntax portion (an increase of 29%, the highest was that of experimental high #10, 36%), and the highest increase in the comprehension portion (44%—where the average for the group was 0%) although this increase is partly due to the missing responses in his pretest comprehension.

Question Three

Will an increased awareness of syntax and application of syntactic knowledge be accompanied by an increase in reading comprehension of science text? The results of the pretest and posttest are inconclusive, because of the increased difficulty of the posttest. Overall, the experimental group increased in syntactic understanding scores and maintained their comprehension scores in spite of the increased difficulty of this component. The comprehension scores of the control group dropped considerably.

Comparison of the comprehension questions (see Appendix B) reveals that the first two questions in the pretest request information that is explicitly stated in the passage, the third question requires the reader to supply a proposition and the fourth requires a comparison of two processes described in the passage. The posttest includes no questions which can be answered with propositions explicitly stated in the text. The first and fourth questions require information that is implied, but not stated. The second question requires readers to synthesize information supplied in three sentences. The question is "How does matter change state?" The three sentences in the passage are:

The energy of motion is called kinetic energy. If the rate at which the particles move changes, they lose or gain energy. When kinetic energy is lost or gained, the water changes (Posttest passage)

The third question requires the reader to compare two propositions, one defining heat and the other defining temperature.

Regarding the levels, the experimental medium group gained one point or 2%, the experimental high lost one point or 1%, averaging to the same percentage as the two groups realized on the pretest. The control groups both dropped substantially, control medium losing 10%, control high losing 19%, averaging to a loss of 14%. The experimental low group gained 20% in syntax and 22% in comprehension, while the control group gained 9% in syntax and dropped 3% in comprehension.

The results indicate a relationship between syntactic knowledge and reading comprehension, but further research in which the levels of difficulty of the pretest and the posttest comprehension items are more closely matched is necessary to further clarify the relationship.

-Conclusions

It must be noted that this type of comprehension testing was familiar to both groups as teaching students to read for information and give full responses to questions based on information text was a schoolwide literacy emphasis. Strategies to encourage students to check for understanding, etc. were to be a part of each classroom's study.

Such strategies can be very effective. However, they still need unpacking for students who are not familiar with them. To instruct a student to check for understanding is fine, but how does a student know what it means to understand and how one can be certain they have understood what the author intended them to understand? It is fine to ask students to slow down when text becomes dense, but what does it mean to slow down? Does it mean to sound out the words more deliberately, or does it mean to pause and reflect? And if they are to pause and think, where should they pause? and what should they be thinking? The results of this study support the use of punctuation points as places to stop and think, not just general thoughts, but thinking why that group of words was put together, and what the words mean on their own and how they are related not only to the rest of the sentence, but the rest of the passage. The study also shows that in this meaning making endeavor, connectives, the little words which can be found at the beginning of chunks, can help to point out these relationships and make them clearer. Commas and connectives served as "buoys", something for the students to grasp onto in a sea of text. These structural elements can also provided a cue for inferencing which will make connections both within the text and with information outside the text- a bridge between the text base and the situation model.

The atmosphere in the class was one of inquiry and discussion, where the paragraphs of texts were taken apart and made sense of. They were thoroughly discussed for internal

meaning and alongside the text was laid background information students possessed previous to the study as well as facts gathered collectively through the reading of other texts in the classroom. Both the quantitative and qualitative measures support that language structure is a useful focus for reading instruction.

Limitations

The results of this study cannot be generalized due to the small number of 18 participants. A wider population would of course require a greater number of instructors trained in the intervention methods. The researcher was also limited in time and flexibility by the demands of the school curriculum and school schedule. Testing conditions were not optimal (due to limited space and supervision). In future studies, it must be emphasized to participants that they must fill in all response blanks. The increased difficulty of the posttest comprehension test should be amended in future studies. It would also be helpful to have pretests and posttests adapted to the various ability levels of the participants to ensure the low group was not working at their frustration level. In both the pretest and posttests, it would be helpful also to be very deliberate in testing the various levels of inferencing, those essential both in building the text base and the situation model, and to ensure that these questions are as closely matched as the syntax items.

Recommendations

It would be very interesting to pursue these studies at a variety of different levels, from grade four through middle school, to explore the possibility of teaching young students to use commas and connectives at a beginning level and then presenting students with more

and more sophisticated use of syntax throughout high school. What effect might this have on the performance they would be able to achieve at the post secondary level? Young people are expected to arrive at university equipped to read and understand complex information text. Perhaps reading instruction which makes use of the structure of the language as a tool for analytic reading will allow them to do so.

Instruction during the intervention culminated in collaborative sentence summaries. It would be helpful to go further, teaching students to write individual summaries of text, focusing on creating clear hierarchically organized propositional frameworks of the text they read. This is a tool for further developing one's understanding of text, but it is also the beginning of responding to text and of communicating one's own original ideas. Literacy encompasses both reading and writing and it is the use of the structure of language as a means of organizing thought that is the theoretical foundation of this study. Such organization is essential in producing clear, powerful exposition. Our language is designed to guide us through the ideas it is intended to express. Students must learn both to read and to write in full control of that language.

What role does grammatical knowledge play in reading comprehension? The making of meaning is the goal of reading. In the constructive process of making meaning while reading, grammar provides both the building blocks and the tools necessary for the construction. Construction takes two phases, the frame of the house and the finishing of the house. Knowledge of the structure of language must be applied in both phases of construction in reading: the text base and the situation model. Without such knowledge, the reader may be unable to construct a coherent representation of complex text.

Students begin school required only to build simple houses whose basic elements hold no mystery. But if they are to construct more elaborate, more sophisticated text models, if they are to contemplate the construction of a castle or a cathedral, they will require more sophisticated tools and skills. It must be the goal of reading instruction to equip students with the necessary tools and training.

APPENDIX A

Reading Test One

Every time you move any part of you, you use your muscles.

You even use muscles when you read.

There are more than 600 muscles in your body. Some are deep inside. Others lie just under your skin. Some are big and some are very small.

Hold your arm straight out in front of you with the palm of your hand facing up. With your other hand, feel the upper part of your arm, the part between your elbow and your shoulder. you can feel a muscle there.

Make a fist with your right hand. Bring your fist up to your shoulder. You can feel the muscle in your upper arm change. It bunches up and gets harder. This muscle is called the biceps.

The top end of your biceps is fastened to a bone in your shoulder. The other end is fastened to a bone in your lower arm just below your elbow. When your biceps bunches up and gets hard, we say it is contracting. It is drawing itself together. When it does this, it pulls on your lower arm, your elbow bends, and your fist comes up to your shoulder.

Your bicep pulls your fist up to your shoulder. When you want to unbend your arm, you use another muscle. It is called the triceps.

Your triceps is on the back side of your upper arm. It also reaches from your shoulder bone down to a bone in your lower arm, just below the elbow. When your triceps contracts it pulls your arm straight again.

Your biceps and your triceps work together. First one pulls, then the other. Many other muscles in your body work in pairs that way. They pull back and forth.

1. What is the passage about?
prompt: Can you tell me more?
2. Show me how your arm muscles work together with your arm and explain as you demonstrate.
3. Where was it hard to understand what you were reading? Show me the first place that it got hard to understand, where you had to slow down.
prompt: How far back did you go?
4. What did you do to figure it out?
5. (collapsed with #3) How did you know when you had found what you were looking for?
6. (omitted) What is the main subject of the passage?
prompt—remember all sentences have subjects and predicates.
further prompts: Is there more than one subject? How many in all? Where does it shift?
- 7a. Show me the beginning of the second sentence in paragraph three.
- 7b. Show me the end. (pointing)
- 8a. How would you chunk this sentence?
“Every time you move any part of you, you use your muscles.”
- 8b. Why would you chunk it like that?
- 9a. Does it make sense if we read only the first half? Why or why not?
- 9b. Does it make sense if we read only the second half? Why or why not?
10. (omitted) Why does it say “you, you”? Is that a mistake?
- 11a. How would you chunk this sentence?

“You even use muscles when you read.”

11b. Why would you chunk it like that?

12. Is it harder or easier to chunk than the first sentence? Why?

13. (omitted) What kind of a sentence is this?

“Hold your arm straight out in front of you with the palm of your hand facing up.”

(command)

Can you find any others like it?

14a. What is the subject of this sentence?

“Your biceps and your triceps work together.”

14b. What is the subject of this one?

“Many other muscles in your body work in pairs that way.”

Reading Test Two

Strike a key on the piano. The key is attached to a hammer which will hit a string. The string will vibrate, or move back and forth very quickly. When something vibrates, it makes the air all around it vibrate. Air can move back and forth rapidly, just as the strings in a piano can.

You hear sounds because air vibrates. Air carries vibrations to your ear.

The outer part of your ear catches the vibrations and carries them into the opening of your ear. Inside your ear there is a tunnel. The vibrations go down the tunnel and strike against a thick wall. This is your eardrum.

When vibrations hit your eardrum, they make it vibrate. The eardrum vibrates like the top of a drum.

Behind your eardrum there is a chain of three small bones. When the eardrum vibrates, these bones vibrate also. They carry the vibrations deep inside your ear. They go to a part of the ear that is called the cochlea.

The cochlea is shaped like a small ball. It has liquid inside it. Nerves that connect the ear to the brain dip into this liquid.

When vibrations reach the cochlea, the liquid inside vibrates. The vibrations make signals in the nerves, and the nerves carry the signals to the brain.

Your brain changes the signals to what we call sounds. All this happens in less than a second.

1. What is the passage about?

Prompt: Can you tell me more?

2. Here is a picture of the ear. Can you explain how the ear hears sounds as you show me on the picture?
3. Where was it hard to understand what you were reading? Show me the first place that it got hard to understand, where you had to slow down. (Did not use prompt, i.e., how far back did you go?)
4. What did you do to figure it out?
5. (collapsed with #3) What part of the sentence made it hard to understand?
6. (omitted) How did you know when you had found what you were looking for?
7. (omitted) What is the main subject of the passage? (prompt—didn't use—What are you tracing through the ear and through the sentences?)
- 8a. Show me the beginning of third sentence in this paragraph(#1).
- 8b. Show me the end of the sentence.

9. Point to the part of that sentence with the exact words which tell you what “vibrates”.
- 10a. How would you chunk this sentence:
- “When vibrations hit your eardrum, they make it vibrate”?
- 10b. Why would you chunk it like that?
- 11a. Does it make sense if we read only the first half? Why or why not?
- 11b. Does it make sense if we read only the second half? Why or why not?
12. (omitted) What two words in the sentence are referring to the same thing?
13. (omitted) Why does the author often start the sentences with “When”? What does it mean here? Does it tell the time?
- 14a. How would you chunk this sentence:
- “The outer part of the ear catches the vibrations and carries them into the opening of your ear”?
- 14b. Why would you chunk it like that?
15. What is the subject of that sentence?
16. What is the predicate of that sentence?
17. (omitted) Why isn’t there any comma in this sentence while there is in the other?
18. (omitted) In the last sentence “All this happens in less than a second”, what is the “this”?

APPENDIX B

THESIS STUDY: PRETEST

Reading Passage

On a sunny day, beams of light will stream through your window. Even if all the doors and windows are closed and there is no hint of a breeze, you may still notice very tiny specks of dust darting about. These dust specks can show us a lot about the nature of matter. Although the specks of dust are small, the particles that make up matter are even smaller.

In fact, these particles are so small that they can't be seen. Air is made up of such particles, moving through space. As the particles of air move about, they collide with each other and with everything in your room. They collide with the specks of dust. The dust specks move because particles of air bounce the specks of dust around.

Another way to see the effect of moving air particles is to look at inflated objects, such as balloons and basketballs. They also provide evidence that air is made up of particles. When you put air in a container, the moving air particles continuously bang against the sides of the container. It's the pressure of these collisions that keep objects inflated.

Air is a mixture of several different gases. Because gases are invisible, it's easy to think of them as being made up of tiny moving particles. Liquids and solids are not invisible, but they are also made up of tiny moving particles. Like air in a room, water in a standing jar seems calm, but if you gently add coloured liquid to the jar, the water and the coloured liquid mix together on their own. This mixing shows that liquids, like gases, are made up of moving particles. As the particles of water and coloured liquid bump into each other, the particles spread out and mixing occurs.

A. Tell me everything you can about the information in this passage. (omitted from analysis)

- B.
1. How do dust specks and the particles that make up matter compare in size?
 2. According to the passage, why is it easy to think of gases being made up of tiny moving particles?
 3. Why is it more difficult to think of liquids and solids being made up of tiny moving particles?
 4. How is what happens when you put air in a container similar to what happens if you gently add coloured liquid to water in a standing jar?
 5. (omitted from analysis) What part of this passage was difficult? What did you do to help you understand it?

C. Syntactic Awareness—Chunking

“ Even if all the door and windows are closed and there is no hint of a breeze, you may still notice tiny specks of dust darting about.”

We can chunk long sentences to help us understand them just as we can chunk long words.

- 1a. Show how you would chunk this sentence by drawing in dividing lines.
- 1b. Why would you chunk it at those spots?
- 1c. What do the words “even if” do?

“Although the specks of dust are small, the particles that make up matter are much smaller.”

- 2a. Show how you would chunk this sentence by drawing in dividing lines.
- 2b. Why would you chunk it at those spots?
- 2c. What does “although” mean?

“As the particles of air move about, they collide with each other and with everything in your room.”

- 3a. Show how you would chunk this sentence by drawing in dividing lines.
- 3b. Why would you chunk it at those spots?
- 3c. Why does it begin with “as”?
- 3d. (omitted from analysis) What would you say is the main or most important chunk in the sentence?
- 3e. (omitted from analysis) Why?

“In fact, these particles are so small that they can’t be seen.”

- 4a. (omitted from analysis) Why does this sentence begin with the words “in fact”?
- 4b. (omitted from analysis) What words could you use to replace it?
- 5. (omitted from analysis) Some words and phrases in a passage are there mainly to show how one thought is related to another. They are signals for relations, just like “if” and “as” above.

Can you find some other words that do that job?

- 6. (omitted from analysis) If you have to choose three key words in this passage, what would they be?

THESIS STUDY: POSTTEST

Reading Passage

The three common states of matter are gases, liquids and solids. Most forms of matter can be found in all three states. You have seen matter in different states. If you think of water, you will remember seeing water as a solid (ice), a liquid and a gas (water vapor).

In fact, you have seen water change from one state to another. As ice melts and puddles “dry up”, water changes state, from solid to liquid and from liquid to gas. This is how it happens. The particles that make up water move. This movement produces energy. The energy of motion is called kinetic energy. If the rate at which the particles move changes, they lose or gain energy. When kinetic energy is lost or gained, the water changes.

If you want to know how fast the particles of a material are moving, take the material’s temperature! Temperature is a measure of the average kinetic energy of the particles in a material. Not all the particles are moving at the same rate, but if the speed is averaged out, you can find the temperature.

Although many people think that temperature and heat are exactly the same, they are actually quite different. Think of a glass of hot water and a bathtub full of water at the same temperature. The particles of water in each container would have the same average speed. Yet the tub water would have more energy, because there are more particles in the tub.

Heat energy includes the total kinetic energy of the particles in a material. A lot of water will have more heat energy than a little bit of water, even if all the water is the same temperature.

- A. Tell me everything you can about the information in this passage. (omitted from analysis)

- B. 1. How can you learn about matter by observing water?
2. How does matter change state?
3. How are heat and temperature different?
4. Why will a lot of water have more heat energy than a bit of water?
5. (omitted from analysis) What part of this passage was difficult? What did you do to help you understand it?

C. Syntactic Awareness—Chunking

“If the rate at which the particles move changes, they lose or gain energy.”

We can chunk long sentences to help us understand them just as we can chunk long words.

- 1a. Show how you would chunk this sentence by drawing in dividing lines.
- 1b. Why would you chunk it at those spots?
- 1c. What does even if do?

“Although many people think that temperature and heat are exactly the same, they are actually quite different.”

- 2a. Show how you would chunk this sentence by drawing in dividing lines.
- 2b. Why would you chunk it at those spots?
- 2c. What does although mean?

“As ice melts and puddles ‘dry up’, water changes state, from solid to liquid and from liquid to gas.”

- 3a. Show how you would chunk this sentence by drawing in dividing lines.
- 3b. Why would you chunk it at those spots?
- 3c. Why does it begin with as?

3d. (omitted from analysis) What would you say is the main or most important chunk in the sentence?

3e. (omitted from analysis) Why?

“In fact, you have seen water change from one state to another.”

4a. (omitted from analysis) Why does this sentence begin with the words “in fact”?

4b. (omitted from analysis) What words could you use to replace it?

5. (omitted from analysis) Some words and phrases in a passage are there mainly to show how one thought is related to another. They are signals for relations, just like “if” and “as” above.

Can you find some other words that do that job?

6. (omitted from analysis) If you have to choose three key words in this passage, what would they be?

Worksheets—in order of presentation to students

Worksheet One—Chunking Sentences

A. Chunk these sentences by making a slash between chunks. Remember to use commas for cues. Circle connectives.

1. If the earth’s temperature were to fall just a few degrees, many plants and animals would die.
2. If the the earth’s temperature were to rise just a few degrees, changes in ocean currents could have a devastating effect on marine life and the entire food chain.
3. From our perspective, the sun appears constant and stable, but it is actually a chaotic and violent place.

B. Write a question which could be answered by #1 above.

Worksheet Two—Chunking Sentences in a Paragraph

For the following paragraph, chunk each sentence with a pencil slash. Underline the chunks that are NOT clauses. Circle the connectives.

To discover faraway planets, astronomers use telescopes in a special way. They do not use them to look directly at planets. Instead, they look for star wobble. Star wobble occurs when a star moves one way and then the other. Star wobble is movement caused by a planet's gravity. If the wobble repeats, astronomers know that there is a planet orbiting the star.

1. What does "instead" refer back to ? In other words, the scientists look for star wobble instead of_____.
2. There is one longer sentence above that has two clauses which are not separated by a comma. Find it and write it on the lines below.
3. Write a question that can be answered by the last sentence in the paragraph.

Worksheet Three—Chunking Sentences in a Paragraph

Chunk the paragraph below using commas and periods. Underline all connectives which begin the sentence or follow a comma. Write the chunks on the lines that give the information requested below.

With a crew on board, piloted-flight reentry is more controlled than in the case of unpowered flights. Rockets bring the vehicle down into the atmosphere, and in order to protect craft and crew, special external heat shields absorb the heat generated during reentry. In the case of the space shuttle, protective insulation is fastened to the orbiter. Generally,

spacecraft make the final descent by parachute, but the shuttle glides down to Earth like a huge, unpowered aircraft.

1. What chunk indicates why piloted-flight reentry needs to be more controlled than unpiloted flights?
2. What chunk explains why extra protection is needed to absorb the heat generated during reentry?
3. What chunk states how the space shuttle is made safe?
4. What connective marks the contrast between how spacecraft usually comes down and how the shuttle comes down?

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