

THE EFFECTS OF SYNTACTIC MATURITY
AND SYNTACTIC COMPLEXITY ON
READING COMPREHENSION:
AN EMPIRICAL TEST
OF SMITH'S PSYCHOLINGUISTIC THEORY OF READING

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GURRICULUM STUDIORUM

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INTRODUCTION

Recent psycholinguistic insights into the nature of language and the performance of the language user have formed the basis for new theories of reading that offer a better understanding of the reading process. These psycholinguistic theories of reading have challenged many of the currently held assumptions regarding reading and the teaching practices based upon them. Educators have become increasingly aware of these theories and the pedagogical implications associated with them. Since psycholinguistic theories are already being used to justify educational practices, an area of current educational concern focuses upon the validation of these theories.

One of the most clearly delineated psycholinguistic theories of reading is that of Frank Smith^{1,2}. A major postulate of his theory is that reading comprehension is dependent upon both the syntactic maturity of the reader and the syntactic complexity of the reading passage. While reading comprehension has been shown to be related to these

1 Frank Smith, Understanding Reading, New York, Holt, Rinehart and Winston, 1971, xi-239 p.

2 Frank Smith, Psycholinguistics and Reading, New York, Holt, Rinehart and Winston, 1973, x-211 p.

variables, the exact nature of that relationship has yet to be empirically verified.

Broadly stated, the purpose of the present study is to verify the postulate implicit in Smith's theory that reading comprehension is dependent upon both the syntactic maturity of the reader and the syntactic complexity of the reading passage. In particular, the research is designed to study the interaction effects of these variables on reading comprehension.

The study is organized into three chapters. The first chapter has two parts. The first part presents the theoretical rationale for the study. Smith's psycholinguistic theory of reading is examined with particular reference to the role of syntax within the theory. From this examination of Smith's theory the three hypotheses that form the basis of the study are derived.

The second part of the first chapter presents a review of the literature relevant to these hypotheses. This is itself divided into three parts. First, theoretical evidence in support of Smith's use of the notion of syntax is presented. This support is found in the theoretical work of Noam Chomsky. The second part of this section examines the psycholinguistic literature relevant to the role of syntax within Smith's theory. Finally, the literature relating to

syntactic maturity and syntactic complexity in reading comprehension is examined in support of Smith's theory.

In Chapter II the experimental design is presented. The research instruments and research methods used in the collection of the data are described, the population sample examined and the statistical techniques adopted for the analysis of the data presented.

Chapter III presents the results of the investigation and a discussion of these results in terms of their theoretical and pedagogical implications. The study closes with a summary and a presentation of the conclusions of the study.

CHAPTER I

REVIEW OF THE LITERATURE

In order to develop the theoretical rationale for the proposed study, the major concepts essential to an understanding of Smith's theory are presented. The theoretical relationship of the major variables are developed and evidence in support of this relationship cited from a review of the literature.

1. Smith's Psycholinguistic Theory of Reading

Smith's^{1,2} theory of reading seeks to explain the reading process of the skilled reader. The major premise of the theory is that reading is not primarily a visual process. That is, reading involves the active use by the reader of his knowledge "about reading, about language, and about the world in general."³ As stated by Smith: "the actual marks on a printed page are relatively less important than the knowledge of language that a skilled reader has before he even opens the book."⁴

1 Frank Smith, Understanding Reading, New York, Holt, Rinehart and Winston, 1971, xi-239 p.

2 Frank Smith, Psycholinguistics and Reading, New York, Holt, Rinehart and Winston, 1973, x-211 p.

3 Ibid., p. 6.

4 Frank Smith, Understanding Reading, Op. Cit., p. 9.

Smith considers reading within an information processing framework. The reader has available two sources of information:

... one that comes from in front of the eyeball, from the printed page, that I call visual information, and one that derives from behind the eyeball, from the brain, that I call nonvisual information.⁵

The visual information processed is considered to be distinctive features of the visual configuration. Visual configurations are defined as the collection of inkmarks upon the page.⁶ That is, they are the visual stimuli of reading. Features are elements of the visual configuration and are distinctive when their discrimination allows the reader to distinguish between different visual configurations.⁷

Nonvisual information is associated with the concept of redundancy. Redundancy is said to exist when information is available from more than one source.⁸ Smith postulates the existence of three sources of nonvisual information associated with redundancies in the visual stimuli of reading. These are: orthographic, syntactic, and semantic information.

5 Frank Smith, Psycholinguistics and Reading, Op. cit., p. 6.

6 Frank Smith, Understanding Reading, Op. cit., p. 4.

7 Ibid., p. 5.

8 Ibid., p. 19.

Orthographic information is available because of the sequential redundancy of English spelling. Syntactic information is available because of the sequential redundancy of English grammar across sequences of words. Semantic information is available because of the redundancy of meaning within a sentence.⁹

In Smith's theory, information is defined as the reduction of uncertainty.¹⁰ Uncertainty is reduced as the reader is able to discriminate features of the visual configuration, that is, as he processes information. When the reader has discriminated enough of the visual configuration to identify it, his uncertainty has been reduced to zero. In other words, the information processed has reduced the uncertainty of the reader regarding the visual configuration in front of him.

Comprehension is also defined by Smith as the reduction of uncertainty.¹¹ The information that reduces the uncertainty of the reader, that allows him to comprehend what is read, is meaning. Thus:

9 Ibid., p. 219-220.

10 Ibid., p. 16.

11 Ibid., p. 185.

Meaning and comprehension may be regarded as reciprocal terms: meaning as the input to an information-processing decision-making system, and comprehension as the output. In other words, "meaning" and "information" are synonymous, as are "comprehension" and "uncertainty reduction"¹²

The identification of a visual configuration is regarded as an act of categorization.¹³ This concept is borrowed from Bruner¹⁴ with Smith's concept of distinctive features being equivalent to Bruner's concept of attributes. Categories are specified cognitively by feature lists which are lists of those distinctive features of the visual configuration necessary for identification of that configuration.¹⁵

Any set of features that will categorize an object is considered to be a criterial set.¹⁶ Smith proposes that more than one criterial set exists for any category. As these alternative criterial sets perform the same function, that is, identify the same category, they are said to be functionally equivalent.¹⁷

12 Smith, Psycholinguistics and Reading, Op. Cit., p. 59.

13 Smith, Understanding Reading, Op. Cit., p. 5.

14 J. S. Bruner, "On Perceptual Readiness", Psychological Review, vol. 64, 1957, p. 123-152.

15 Smith, Understanding Reading, Op. Cit., p. 5.

16 Ibid., p. 76.

17 Ibid., p. 112.

According to Smith:

Every aspect of reading can be seen as a process of categorization. The identification of letters involves allocating the incoming of visual information (from the marks on the page) into a set of twenty-six pre-established categories, each associated with the name of a letter of the alphabet. The identification of words involves allocating the visual information to a much larger set of categories, each of which has the sound of the word as a name and also a number of related semantic connections or associations. Reading for comprehension (which I shall also term the identification of meaning) involves the allocation of visual information to category structures that represent meaning to the reader. In every case the same visual information is utilized, but it is allocated cognitively in a different way.¹⁸

Categorization is carried out according to a feature analytic model. In that model the analyzers of the visual system examine the visual configuration for the presence or absence of distinctive features and transmit the results of these feature tests to the feature lists that specify the categories. A configuration is allocated to a category when the results of the featural tests meet the specifications of a criterial set. This relates the visual information to the acoustic and semantic features of the category.¹⁹

As noted earlier, Smith proposes that the skilled reader uses the same visual information for three different identification processes. That is, he uses the distinctive

18 Ibid., p. 76-77.

19 Ibid., p. 214-215.

features of the visual configuration to reduce uncertainty as to letter, word, or meaning identification. The reduction of uncertainty for these three aspects of reading is independent in that the reader may apply visual information to any of the three aspects of uncertainty reduction without the prior reduction of uncertainty in any other aspect.²⁰ That is, letters, words, and meaning are directly identified from the processing of distinctive features of the visual configuration.

It has been shown that Smith considers the establishment of criterial sets of feature lists as a necessary condition for the immediate identification of letters, words, or meaning. Smith maintains that the redundancy that exists in language is the singular feature which makes this possible.

It will be recalled that redundancy is said to exist in the reading process whenever there is more than one source of information available to the reader. Three aspects of redundancy are identified by Smith, orthographic, syntactic, and semantic.

Orthographic redundancy is associated with the sequential redundancy of English spelling. That is, it is

20 Ibid., p. 213.

associated with "the redundancy within the structure of words because letters, or rather patterns of features, tend to occur only in certain combinations".²¹ Because of this redundancy the reader need not identify each letter in order to be able to identify each word. By spreading out the information across the entire configuration (word), the reader is able to establish a criterial set of features for the identification of the word using fewer distinctive features than would be required to identify each letter in the word. Thus, words can be identified immediately, without the prior identification of individual letters. In other words, fewer distinctive features are needed to identify a word as a whole because of the sequential redundancy existing within the letter arrangement of English words.

This contention is supported by the earlier work of Cattell²² who showed that from a single tachistoscopic exposure a skilled reader can identify only four or five unconnected letters but can identify ten letters when they

21 Ibid., p. 219.

22 Cattell, J. McK., Ueber die Zeit der Erkennung und Benennung von Schriftzeichen, Bildern und Farbe. Philosophische Studien, 1885, 2, p. 635-650. Translated and reprinted in James McKeen Cattell, Man of Science, 1860-1944, Lancaster, Penn., Science Press, 1947, p. 13-25.

are in the form of two unconnected words. It would appear that the reader is utilizing the orthographic redundancy available within the word structure to identify the words prior to the identification of the individual letters.

Syntactic and semantic redundancy exists across sequences of words. Syntactic redundancy is associated with the rules of language which specify the permissible combinations of words into phrases. Semantic redundancy is associated with the situational or contextual meaning that provides information about the interpretation of a word sequence. The same process that allows the skilled reader to establish criterial sets of features for immediate identification of words allows him to establish criterial sets of features for the immediate identification of meaning. The reader uses his knowledge that certain feature patterns cannot occur in the language to establish criterial sets for the immediate identification of meaning. This knowledge allows him to establish criterial sets for meaning identification composed of fewer distinctive features than would be required to identify individual words. That is, he requires less visual features to immediately identify meaning because of the syntactic and semantic redundancies existing across sequences of words. Thus, just as words are directly

identified without the prior identification of letters, so meaning is identified immediately without the prior identification of words.

Identification of meaning is said to be immediate because not enough features can be processed for the mediated step of letter or word identification. This is again supported by the work of Cattell.²³ Just as more letters can be identified when they occur in a word, so more words can be identified when they occur in a meaningful sequence. From the same single tachistoscopic exposure needed to identify four or five unconnected letters or two unconnected words, four or five words in a meaningful sequence can be identified. In other words, a sequence comprising approximately twenty-five letters can be identified when orthographic, syntactic and semantic redundancies are present, while only ten letters can be identified when only orthographic redundancy is operative and only five letters can be identified when none of the three redundancies are operative. As the same amount of visual information must be processed for all three identification processes, it is evident that the reader is making use of his knowledge of the three sources of nonvisual information in the identification of words in meaningful sequences. As not enough visual information can be processed for the prior

23 Ibid., p. 13-25.

identification of the twenty-five letters or five words in the meaningful sequence, it appears as though meaning is being identified directly.

Smith maintains that the amount of visual information that can be processed is limited by physiological constraints inherent in the identification process. Redundancy allows the reader to overcome these physiological limitations by supplementing the visual information with nonvisual information. Accordingly, the use of nonvisual information is of critical importance in the reading process. This occurs when the reader, reading for meaning, is able to conduct feature analytic tests over larger areas of the visual configuration. As a result of this, the number of features processed remain the same, but represent samples from a larger area of the visual configuration.

Exactly the same visual analytic process allows for the identification of a letter or a word. The visual configuration is analyzed for distinctive features and is identified when a match is made between the distinctive features of the visual configuration and the cognitively specified feature lists. A letter is identified when it is allocated to one of twenty-six categories of the letter domain. A word is identified when it is allocated to one of an indefinite number of categories in the word domain. Thus,

the only difference is the set of alternative categories to which the input from the feature analyzers is directed.²⁴

For the identification of meaning there are not individual categories to which the input from the feature analyzers is directed. Instead, meaning is regarded as a reorganization of the cognitive structure. Smith holds that this may involve two or more categories. Meaning is accomplished "directly from the results of visual analyzer tests by the reorganization of cognitive structure based on the semantic associations of visual features, and on the rules of syntax."²⁵

The rules of syntax determine how the visual-semantic associations should be interpreted for a cognitive reorganization. This follows from Smith's adoption of the linguistic notion of deep and surface structure. According to this notion, the meaning, or semantic interpretation, of a sentence reside in its deep structure. It is related to the actual written sentence, the surface structure, by the rules of syntax. Thus, for the reader seeking to reduce meaning uncertainty, syntax "is the key to comprehending language".²⁶ Regarding

24 Smith, Understanding Reading, Op. cit., p. 25.

25 Ibid., p. 216.

26 Ibid., p. 38.

this consideration Smith has written:

... while a single distinctive feature may be sufficient to eliminate many letter or word alternatives, reduction of meaning uncertainty cannot take place without the additional application of rules of syntax.²⁷

To summarize, Smith proposes that in reading for comprehension, or extracting the meaning from the text, the skilled reader is able to make maximum use of all the redundancy available in written text. He does this by establishing feature lists for meaning identification that incorporates his knowledge of the nonvisual information of orthographic, syntactic and semantic redundancy of written language. This means that the feature lists he uses for meaning identification require less visual information to identify meaning than would be required to mediate meaning identification through the prior identification of words. In this way comprehension precedes the identification of words, and reading is not primarily a visual process.

As meaning resides in the deep structure of language, the skilled reader reading for comprehension must make use of the rules of syntax which constitute the bridge between the surface structure of visual configurations and

27 Ibid., p. 216.

the deep structure of meaning. As described by Smith:

The fluent reader can be regarded as crossing this bridge from the meaning side, merely sampling the visual information to confirm his expectations. In other words, analysis of meaning at the deep structure level leads to the analysis of the surface visual structure. Syntax is a tool that the fluent reader uses to predict what the surface representation should be, and he needs only a minimum of visual cues to provide a confirmation of that prediction - provided he is able to make use of redundancy accurately.²⁸

Implicit in Smith's theory are three areas of consideration for both the educator and researcher. As a prime consideration marked differences in reading comprehension would be expected between children of differing syntactic maturity.

If, as posited by Smith, the skilled reader is the one who makes maximum use of the redundancies available in language to directly identify meaning (deep structure), then it would be expected that syntactically more mature students would be better readers than students who are syntactically less mature. It should be noted here that the assumption is being made that increased syntactic maturity reflects an increase in knowledge of the rules of syntax.

A second implication of the theory would indicate that the syntactic complexity of the reading passage would significantly affect reading comprehension. If the reader

28 Ibid., p. 221.

is making use of the rules of syntax to bridge deep and surface structure, then as sentences become syntactically more complex through the application of transformational rules to the deep structure it should become correspondingly more difficult to derive meaning from them.

As a third and final implication it would be expected that an interaction should occur between the syntactic maturity of the reader and the syntactic complexity of the reading passage. If the relationship between reading comprehension and syntax functions as posited by Smith, then the syntactic maturity of the reader and the syntactic complexity of the reading passage should interact in their effect upon reading comprehension. More specifically, the effect of a reader's syntactic maturity on reading comprehension would be expected to be greater as the syntactic complexity of the reading passage increases.

2. Review of the Related Literature

This section presents a selected review of the theoretical and empirical literature that relates to and supports the theoretical expectation that reading comprehension is dependent upon the syntactic maturity of the reader and the syntactic complexity of the reading passage and as such is not primarily a visual process.

Current linguistic concepts of the notion of syntax are presented and related to Smith's use of the term. Psycholinguistic research relative to this concept is also presented. A second part examines the literature that relates reading comprehension and syntax. This serves to establish the status of the proposed study in relation to previous research.

(A) Syntax

The concept of syntax used by Smith derives from transformational-generative grammar which is associated with the linguistic insights into the nature of language of Noam Chomsky. It is a descriptive, logically based grammar which attempts to describe the knowledge which people must have to produce and understand language. As such, it is concerned with the competence of the language user rather than his performance. That is, it attempts to describe the abstract, underlying form of linguistic knowledge a language user needs to generate grammatical sentences and distinguish between grammatical and ungrammatical ones. It does not take into account the many psychological variables that intervene to limit the actual performance of the language user.

As described by Chomsky^{29,30,31} the grammar of a language consists of three components; syntactic, semantic, and phonological. These components can be thought of as consisting of sets of rules which are used to generate spoken sentences. According to the theory sentences are represented at two levels - a deep structure which contains the meaning of a sentence and the surface structure which represents the meaning in spoken form. The relationships between the various components of the grammar are shown in Figure 1.

The syntactic component is central to the grammar as it generates both the deep and surface structure. It consists of two parts, a base component and a transformational component. Deep structure is generated by the base component. This consists of a set of phrase structure rules which specify the syntactic rules necessary for the construction of grammatical sentences and a lexicon which specifies the syntactic and semantic word features necessary for meaning interpretation. The transformational component

29 Noam Chomsky, Syntactic Structures, The Hague, Mouton, 1957, p. 117.

30 Noam Chomsky, Aspects of the Theory of Syntax, Cambridge, Massachusetts, The M.I.T. Press, 1965, x-251 p.

31 Noam Chomsky, "Deep Structure, Surface Structure and Semantic Interpretation", in D. Steinbuerg and L. Jakobovits, eds., Semantics, London, Cambridge University Press, 1971, p. 182-216.

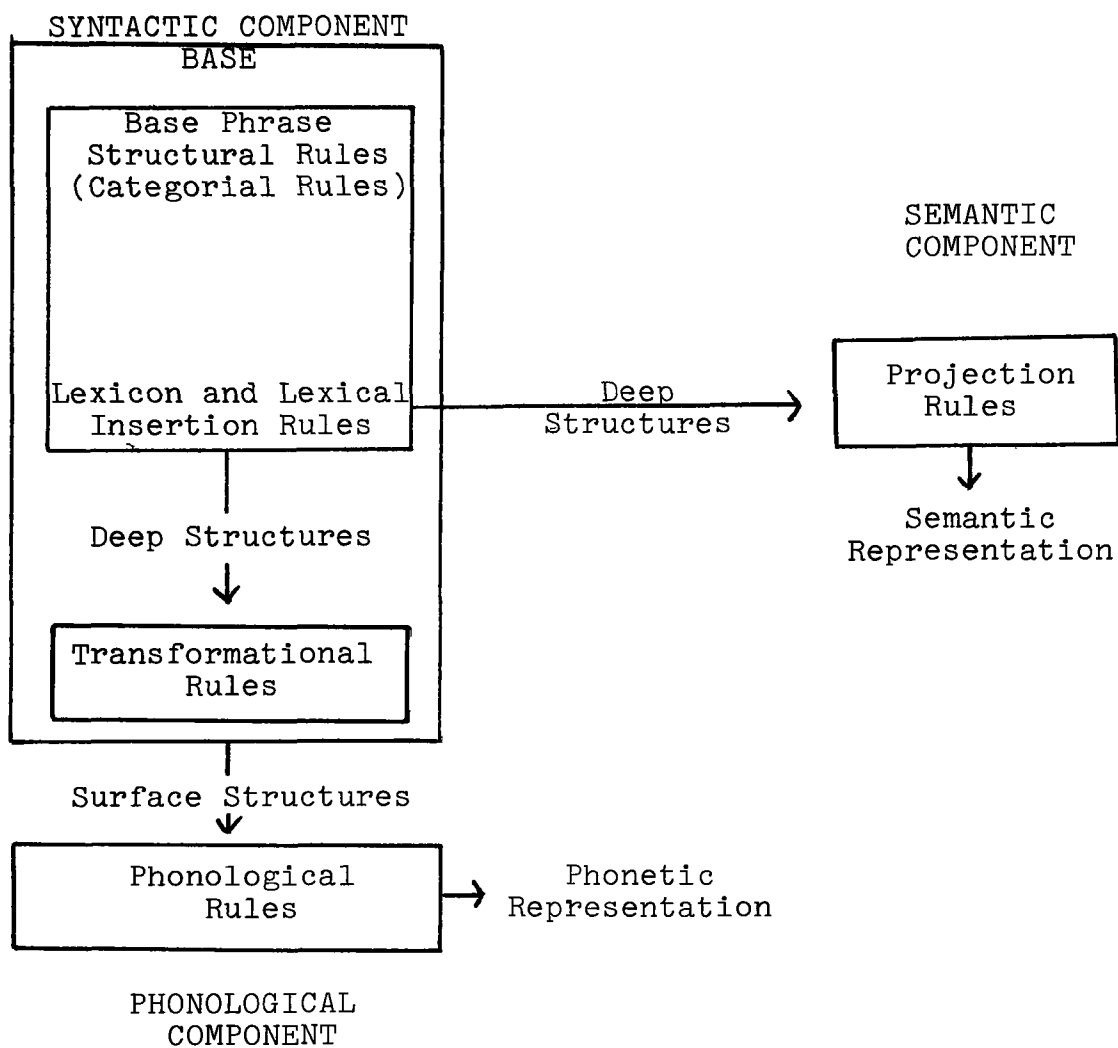


Figure 1: Chomsky's model of the speaker-hearer.
 (From: Dominic W. Massaro, Understanding Language, New York,
 Academic Press, 1975, p. 333)

consists of transformational rules that are applied to the deep structure to produce the surface structure.

The deep structure also serves as input to the semantic component. Here semantic rules of interpretation are applied to the deep structure to derive meaning. In this way meaning is said to reside in the deep structure of a sentence.

The surface structure produced by the application of transformational rules to the deep structure serve as the input to the phonological component. This produces the spoken form of the sentence. In applying this to reading, it is assumed that a graphonic component operates in the same manner as Chomsky's phonological component to produce the written form of the sentence.

It seems apparent from the above discussion that the rules of syntax incorporated into Smith's theory of reading are the results of Chomsky's transformational rules that link deep and surface structure. That is, it is those syntactic rules that link the meaning of a sentence (deep structure) with its written representation (surface structure).

In the example below, sentences (1) to (6) provide a simple illustration of some transformational rules. All of these sentences can be generated from the deep structure

representation John hit Mary by the application to the deep structure of the transformational rules indicated. It should be noted that deep structure is an abstract entity whose structure is assumed on the basis of the meaning of a sentence and its syntax.

- (1) John hit Mary.
- (2) Mary was hit by John. (passive transformation)
- (3) Did John hit Mary? (question transformation)
- (4) John did not hit Mary. (negative transformation)
- (5) John didn't hit Mary. (negative and contraction transformation)
- (6) Didn't John hit Mary? (negative, contraction, and question transformation)

As noted earlier, Chomsky's theory of grammar is concerned with language competence. That is, he is only concerned with describing the grammar of a language not its actual use. While his competence model describes the relationship between components of the language, it says nothing about "which of these is selected 'first' and what is the 'direction' of the relationship."³² Smith, however, is concerned with the performance and must of necessity give directionality to the components. The question of the direction and order of relations between the components of Chomsky's grammar is an area of considerable controversy in current psycholinguistic research. In order to assess

32 Ibid., p. 214.

Smith's use of syntax in relation to current psycholinguistic research, a necessary first step is a clearer delineation of the role of syntax within Smith's theory.

Smith proposes two functions for syntax in the reading process. First, in establishing feature lists for meaning identification the reader uses his knowledge of syntactic redundancy, along with his knowledge of orthographic and semantic redundancy, to lessen his reliance on visual information. Massaro³³ has argued that this does not imply a dynamic use of syntactic rules as the feature lists are pre-established. In defence of Smith, an interpretation of his theory that implies a more dynamic use of the redundancies available in the visual configuration is possible. It will be recalled that the reader establishes criterial sets of functionally equivalent feature lists that incorporate differing amounts of the different redundancies available in the visual configuration. Which particular criterial set the reader uses depends upon the differing amounts of redundancy present in the visual configuration to be identified. In other words, although the feature lists are pre-established and thus can be considered relatively static, the reader can choose between

33 Domic W. Massaro, Understanding Language, New York, Academic Press, 1975, p. 273-277.

several feature lists. This implies a more dynamic application of the syntactic rules.

How the reader establishes feature lists or what the distinctive visual features are, are not described by Smith. It seems clear that the reader must at least be making use of his knowledge of the rules that link deep and surface structure in order to make use of redundancies in the surface structure in the establishment of feature lists identifying meaning in the deep structure. That is, he is making use of cues in the surface structure which locate transformation that separate deep and surface structure.

The second function for syntax in Smith's theory involves the more dynamic application of the transformational rules. After directly identifying meaning, the reader uses his knowledge of syntax to predict what the surface structure should be. He confirms this by using minimum visual cues from the surface structure. Again, the reader is making use of his knowledge of transformational rules that link deep and surface structure, and in so doing the reader is behaving in a manner which is consistent with Smith's view of the reader.

In summary, Smith, like Chomsky, subscribes to a deep structure model that relates print to meaning through the rules that make up the syntactic component. In particular, Smith proposes a performance model in which the

reader uses orthographic, syntactic, and semantic cues in the surface structure to cue him to the deep structures of a sentence. Deep structure is directly identified from distinctive features of the visual configuration. The selectional features of the lexicon, along with the transformations specified in deep structure, are used to predict the words of the surface structure. These predictions are verified by minimal samplings of the surface structure.

Having examined the role of syntax within Smith's theory of reading, the next section considers the psycholinguistical research relevant to this role.

Three areas of psycholinguistic research relate to Smith's use of syntax. These are: (1) investigations into the psychological reality of deep and surface structure; (2) reports of subjects using surface cues to read the deep structure of a sentence, and (3) the use of transformational rules in sentence perception.

(1) The psychological reality of deep and surface structure has been fairly well established in psycholinguistic research. Typical of studies in this area are those of the click paradigm. Subjects are asked to locate the position in a sentence in which a short noise burst (click) is embedded. Results generally indicate that

subjects displace the click location to a part of the sentence that corresponds with a major grammatical break in either the surface structure³⁴ or the deep structure³⁵. Other studies by Bever³⁶, Levelt³⁷, and Blumenthal³⁸, have also empirically established the sensitivity of the language user to the deep and surface structure of a sentence.

(2) Psycholinguistic investigations of sentence recognition tasks generally support the contention that subjects use cues in the surface structure to the deep structure. Fodor and Garrett³⁹ investigated the

34 P. G. Chapin, T. S. Smith and A. A. Abrahamson, "Two Factors in Perceptual Segmentation of Speech", Journal of Verbal Learning and Verbal Behavior, vol. 11, 1972, p. 164-173.

35 T. G. Bever, J. R. Lackner and R. Kirk, "The Underlying Structures of Sentences are the Primary Units of Speech Perception", Perception and Psycholinguistics, vol. 5, 1969, p. 225-233.

36 T. G. Bever, "The Influence of Speech Performance on Linguistic Structures", in G. B. Flores d'Arcais and W. J. M. Levelt eds., Advances in Psycholinguistics, New York, American Elsevier, 1970, p. 4-28.

37 W. J. M. Levelt, "A Scaling Approach to the Study of Syntactic Relations", in G. B. Flores d'Arcais and W. J. M. Levelt eds., Advances in Psycholinguistics, New York, American Elsevier, 1970, p. 109-121.

38 A. L. Blumenthal, "Prompted Recall of Sentences", Journal of Verbal Learning and Verbal Behavior, vol. 6, 1967, p. 203-206.

39 J. A. Fodor and M. Garrett, "Some Syntactic Determinants of Sentential Complexity", Perception and Psychophysics, vol. 12, 1967, p. 289-296.

comprehension of embedded sentences as a function of the cues provided by pronouns. Results indicated that subjects found sentences like (7) with the pronoun left in were easier to paraphrase than those like (8) with the pronouns deleted:

- (7) The shot which the soldier that the mosquito
bit fired missed.
(8) The shot the soldier the mosquito bit fired
missed.

They concluded that subjects were using the pronouns as cues to the deep structure relations between subject and object. Fodor, Garrett and Bever⁴⁰, extending the investigation to verbs, showed that sentences with verbs that are compatible with only one deep structure were easier to understand than sentences with structurally ambiguous verbs.

Further support is provided by an experiment of Perfetti's⁴¹ investigating the relationship between lexical and grammatical words in sentence recognition. Lexical words include word classes such as nouns, adjectives, verbs and adverbs. New words can be added to lexical words. Grammatical words refer to classes such as articles and pronouns that are closed to new words. Using a ratio of lexical words

40 J. A. Fodor, M. Garrett and T. G. Bever, "Some Syntactic Determinants of Sentential Complexity, II: Verb Structure", Perception and Psychophysics, Vol. 3, 1968, p. 453-461.

41 C. A. Perfetti, "Lexical Density and Phrase Structure Depth as Variables in Sentence Retention", Journal of Verbal Learning and Verbal Behaviour, Vol. 8, 1969, p. 719-724.

to grammatical words as a measure of lexical density, Perfetti found sentences of high lexical density more difficult in a sentence recall task. Thus, sentence (9) with seven lexical words proved more difficult than sentence (10) with five lexical words:

- (9) The police watched nearly every move of the
clever thief.
- (10) The family has accepted an offer to purchase
the house.

Greene⁴² suggests that this is the result of the sentence with more lexical words having undergone more deletion and contraction transformations leaving less grammatical cues to a further removed deep structure.

As a point of summary, two areas of psycholinguistic research have been presented in support of the role of syntax in Smith's theory of reading. Evidence in support of the psychological reality of deep and surface structure has been cited and the use by subjects of surface cues to reach the deep structure of a sentence has been established. The next section presents the results of research into the psychological reality of the use of transformational rules.

(3) Evidence in support of the use of transformational rules in sentence processing has been equivocal. Early

⁴² Judith Greene, Psycholinguistics: Chomsky and Psychology, Harmondsworth, Middlesex, Penguin Books, 1972, p. 160-161.

studies tended to support their use while later studies have failed to substantiate this.

Several earlier studies found that transforming kernel sentences into their passive, negative or interrogative form increases the difficulty that subjects have in processing the sentences.^{43,44,45} These studies also found a positive relationship between the time taken to process a sentence and the number of transformations in getting from the kernel form to other forms. Other studies have investigated this issue by using a short memory task.^{46,47} Results indicated that subjects were able to recall fewer words from transformed sentences than from kernel sentences leading to the conclusion that transformational rules require

43 George Miller, "Some Psychological Studies of Grammar", American Psychologist, vol. 11, 1962, p. 748-762.

44 George A. Miller and Kathryn McKean, "A Chronometric Study of the Relationship Between Sentences", Quarterly Journal of Experimental Psychology, vol. 16, 1964, p. 297-308.

45 Jacques Mehler, "Some Effects of Grammatical Transformations on the Recall of English Sentences", Journal of Verbal Learning and Verbal Behavior, vol. 4, 1963, p. 748-762.

46 Harris B. Savin and Ellen Perchonock, "Grammatical Structure and The Immediate Recall of English Sentences", Journal of Verbal Learning and Verbal Behavior, vol. 5, 1965, p. 348-353.

47 Savin, Harris B., "Grammatical structure and the Immediate Recall of English sentences. 2. Embedded clauses", J. Lyons and R. J. Wales, eds., Psycholinguistics Papers, Edinburgh, Edinburgh University Press, 1966

psychological processing space in short term memory. Later research has generally failed to support these findings. Results of these later studies have shown that earlier results were due mainly to confounding variables rather than to transformational complexity.⁴⁸

In summarizing the research into the use of transformational rules in sentence processing, Hellige has stated:

If transformational rules are functional, then it is probably late in the processing sequence, after meaning has been derived. ... there is little evidence that indicates transformation rules are applied in the immediate processing of a sentence string for understanding.⁴⁹

While the research is not supportive of the role of transformational rules in sentence processing it is not altogether inconsistent with the function these rules play in Smith's theory. Two factors concerning psycholinguistic research into the role of transformational rules in sentence processing can be used in support of Smith.

The first factor concerns the interpretation of results. Results generally indicate there is no one-to-one correspondence between the number of transformations in a

48 Greene, Op. cit., p. 136.

49 Joseph B. Hellige, "The Role of Generated Abstract Memory", in Dominic W. Massaro, Understanding Language, New York, Academic Press, 1975, p. 421.

sentence and the difficulty involved in processing it. That is, a sentence with four transformations is not twice as difficult to process as one with two. Results are interpreted as showing that subjects are using cues in the surface structure to cue them to deep structure rather than de-transforming the surface structure to get to the deep structure.⁵⁰ However, there is an important relationship between the number of transformations in a sentence and the number of cues in the surface structure. As the number of transformations increase, there is a tendency for the cues in the surface structure to become obliterated.⁵¹ In other words, sentences that are transformed tend to be more difficult because transformations delete cues in the surface structure. This is in accord with Smith's theory which predicts that difficulties in understanding sentences are dependent upon the semantic and syntactic cues available in the surface structure, or in the depth between the surface and deep structures reflected by the number of transformations that separate them. Therefore, the increase in the number of transformations can be considered as contributing to sentence complexity; not because it involves more de-transformations but because of the obliteration of surface cues.

50 Dan I. Slobin, Psycholinguistics, Glenview, Illinois, Scott, Foresman and Company, 1971, p. 37.

51 Greene, Psycholinguistics, Op. cit., p. 145.

The second factor concerns the notion of de-transformation. Most psycholinguistic studies into the effects of transformations on sentence processing have assumed that subjects use transformational rules to de-transform the surface structure in order to arrive at the deep structure. As noted above, results indicate that this is not strictly true. However, Smith proposes that the fluent reader characteristically uses transformational rules to predict the surface structure having directly identified the deep structure from the visual configuration. The statement of Hellige quoted earlier indicates support for this view.

Finally it should be noted that the majority of studies into the use of transformational rules in sentence processing use aurally presented single sentences in recognition tasks. This is sufficiently different from the reading process to question the validity of these results when applied to a reading task.

In summary, this section has presented a simplified description of Chomsky's theory of grammar as it relates to Smith's theory of reading. In the light of this description, the syntactic component in Smith's theory was further delineated, and its relationship to current psycholinguistic research was examined. This was shown to be generally

supportive of Smith's theory. The following section presents the literature relating to syntax and reading comprehension.

(B) Syntax and Reading Comprehension

Literature dealing with investigations into the relationship between syntax and reading comprehension consists of three main research approaches. One area comprises studies dealing with the analysis of oral miscues in reading. A second area of research has investigated the nature of the relationship between syntactic maturity and reading comprehension. The third area has examined the relationship between the syntactic complexity of the reading material and reading comprehension.

The analysis of oral miscues is associated with the theoretical work of Goodman. His theory of reading, developed prior to Smith's, is also considered within a psycholinguistic framework. Reading is considered to be a psycholinguistic guessing game in which "the reader picks and chooses from the available information only enough to select and predict a language structure which is decodable".⁵² Three inter-related cue systems are used by the reader - graphonic, syntactic and semantic. The proposal by Goodman that the errors

⁵² Kenneth S. Goodman, "Analysis of Oral Reading Miscues: Applied Psycholinguistics", Reading Research Quarterly, vol. 5, 1969, p. 9-30.

made in oral reading can be used to analyze the cue systems being used by the reader, has led to one avenue of research into the relationship between syntax and reading comprehension.

Siler⁵³ analyzed the oral reading errors of second and fourth grade students reading sentences which had been violated syntactically, semantically, or both syntactically and semantically. Results indicated that syntactic violations were significantly more disruptive than semantic violations and syntactic and semantic violations were no more disruptive than syntactic violations. Results were interpreted as supporting reading models such as Smith's that are based on the interaction of graphic, syntactic, and semantic cue systems.

Ohaver⁵⁴ used a sample of college freshmen with low reading performance to investigate the syntactic and semantic cueing used in oral reading. Dividing his subjects into a higher comprehension group and a higher vocabulary group, he found the higher comprehension group produced significantly more miscues than the higher vocabulary group. He concluded

53 Earl R. Siler, "The Effects of Syntactic and Semantic Constraints on the Oral Reading Performance of Second and Fourth Graders", Reading Research Quarterly, vol. 9, No. 4, 1974, p. 583-602.

54 Allan Roy Ohaver, "A Comparison of Semantic and Syntactic Cueing in Low Reading Performance College Freshmen", in Frank P. Greene, ed., Investigations Relating to Mature Reading, Twenty-first Yearbook of the National Reading Conference, Milwaukee, NRC, 1972, p. 110-118.

that "higher comprehension subjects are probably reading deep structure and hence producing more miscues when they re-transform"⁵⁵, a finding that accords well with Smith's theory.

An analysis of the oral reading errors of five-year-old beginning readers by Clay⁵⁶ revealed their reliance upon the syntactic framework of the sentence when guessing at points of uncertainty. The analysis indicated that "the young child's guesses at point of uncertainty in his reading tended to be dominated by his control of the syntax of his language"⁵⁷. In a somewhat similar study of the oral reading errors of beginning readers, Weber⁵⁸ concluded that beginning readers were well aware of the grammatical constraints of the reading passage.

The results of the studies on oral reading errors reviewed above reveal the reliance of the readers on the syntactic cue system in the reading passage and their awareness of the syntactic constraints operating in language. While

55 Ibid., p. 117.

56 Marie M. Clay, "A Syntactic Analysis of Reading Errors", Journal of Verbal Learning and Verbal Behavior, vol. 7, 1968, p. 434-438.

57 Ibid., p. 436.

58 Rose-Marie Weber, "A Linguistic Analysis of First-grade Reading Errors", Reading Research Quarterly, vol. 5, Spring 1970, p. 427-451.

oral reading is a different process from the fluent reading process Smith's theory seeks to explain, results can still be considered as supporting the role of syntax within his theory. A second area of research to be considered, the relationship between syntactic maturity and reading comprehension, is presented below.

The relationship between syntactic maturity and reading comprehension has been investigated by correlational studies and by studies that have compared the syntactic maturity of good and poor readers.

The general research design for correlational studies has been to use a standardized reading test to measure some facet of reading comprehension and correlate this with a measure of syntactic maturity.

Using the transformationally based Sentence Construction Test as a measure of syntactic attainment, Kuntz⁵⁹ reports correlations of 0.68 and 0.80 between the reading achievement and syntactic attainment of seventh grade students. Harris⁶⁰ using the same measure of syntactic attainment, found a correlation of 0.70 between the reading achievement and syntactic

59 Mildred H. Kuntz, "The Relationship Between Written Syntactic Attainment and Reading Ability in Seventh Grade", Ph.D. Dissertation, University of Pittsburg, 1975.

60 Mary McDonnell Harris, "Second Grade Syntax Attainment and Reading Achievement", Ph.D. Dissertation, University of Pittsburg, 1974.

attainment of second grade students. Similar findings are reported by Ribovitch⁶¹ using first graders and a different transformationally based syntactic maturity measure, and by O'Donnell⁶², and Evanechko, Ollila and Armstrong⁶³, using a structuralist based measure of syntactic maturity.

Not all results have demonstrated a clear relationship between syntactic maturity and reading comprehension. Strickland⁶⁴, also employing a structural linguistic framework, investigated the relationship between the complexity of sentence patterns in children's oral language and reading achievement. She found a few significant correlations between the test variables at the grade six level but none at the primary level. She concluded that:

61 Jerilyn Kay Ribovitch, First-grade Children's Comprehension of Selected Oral Language Syntax and its Relationship to Reading Comprehension, Ph.D. Dissertation, University of Maryland, 1975.

62 Roy C. O'Donnell, "A Study of the Correlation Between Awareness of Structural Relationships in English and Ability in Reading Comprehension", The Journal of Experimental Education, vol. 31, 1963, p. 313-316.

63 Peter Evanechko, Lloyd Ollila and Robert Armstrong, "An Investigation of the Relationship Between Children's Performance in Written Language and Their Reading Performance", Research in the Teaching of English, vol. 8, 1974, p. 315-316.

64 Ruth Strickland, The Language of Elementary School Children: Its Relationship to the Language of Reading Textbooks and the Quality of Reading of Selected Children, Bulletin of the School of Education, Indiana University, 1962, vol. 38, p. 1-131.

No conclusions can be drawn from this study. More intensive research is needed at primary grade levels to ascertain whether there is any true relationship between the use of language and the development of skill in silent reading.⁶⁵

Similar relationships between syntactic maturity and reading comprehension are reported for studies that have compared the syntactic maturity and reading comprehension of good and poor readers.

Vogel⁶⁶ compared dyslexic and normal children and found the dyslexic children to be significantly deficient in oral syntax. Denner⁶⁷ found that children classified as problem readers, and children expected to become problem readers, performed more poorly than normal children on tasks requiring syntactic competence. Fry, Johnson and Muehl⁶⁸ observed that above average readers used more transformations

65 Ibid., p. 106.

66 Susan A. Vogel, "Syntactic Abilities in Normal and Dyslexic Children", Journal of Learning Disabilities, vol. 7, 1974, p. 47-53.

67 Bruce Denner, "Representation and Syntactic Competence of Problem Readers", Child Development, vol. 41, 1970, p. 881-887.

68 Maurine A. Fry, Carole S. Johnson and S. Muehl, "Oral Language Production in Relation to Reading Achievement among Select Second Graders", in D. J. Bakkers and P. Satz, eds., Specific Reading Disabilities, vol. 3, Amsterdam, Rotterdam University Press, 1970, p. 123-146.

in their oral language than below average readers. Calvert⁶⁹ using a measure of syntactic maturity derived from Hunt's T-unit, found the oral language of reading achievers to be significantly more complex than under-achievers.

In an experiment to discover whether syntactic structure facilitates recall in good and poor readers, Weinstein and Rabinovitch⁷⁰ had fourth grade students learn lists of nonsense elements that were either syntactically structured or unstructured. Findings indicated that good readers learned the structured list more rapidly than the unstructured list while poor readers performed equally poorly on both lists. It was concluded that:

The difference between the two groups of readers is their ability to make use of the information inherent in the grammatical structure of a sentence.⁷¹

Investigations of the relationship between syntactic maturity and reading comprehension reviewed above suffer from the lack of a consistent interpretation of syntactic maturity. There is a tendency for researchers to construct

69 Kenneth Carole Harbison Calvert, "An Investigation of Relationships Between the Syntactic Maturity of Oral Language and Reading Comprehension Scores", Ed.D. Dissertation, University of Alabama, 1971.

70 Rhona Weinstein and M. Sam Rabinovitch, "Sentence Structure in Good and Poor Readers", Journal of Educational Psychology, vol. 62, 1971, p. 25-30.

71 Ibid., p. 29.

their own measure of this variable based upon differing theories of syntactic complexity. While these are no doubt related, it is doubtful whether they are measuring exactly the same variable.

As a point of summary, the above section has dealt with the relationship between syntactic maturity and reading comprehension. Two types of studies were reviewed in support of the relationship. Correlational studies generally indicated a strong relationship between the two variables. They were also shown to be related by studies indicating good readers to be syntactically more mature than poor readers. The next section considers the research relating the syntactic complexity of reading materials and reading comprehension.

The third area of research to be examined bears upon investigations into the relationship between the syntactic complexity of reading passages and reading comprehension. Investigations employing a structural linguistic analysis of language will be considered first. This is followed by a review of studies based upon a transformational analysis of language.

Nurss⁷² employed a structural linguistic analysis in examining the relationship between syntactic structure

72 Joanne Nurss, "Children's Reading: Syntactic Structure and Comprehension Difficulty" in J. A. Figural, ed., Forging Ahead in Reading, Proceedings of the International Reading Association, 1967, vol. 12, p. 571-575.

and reading comprehension in primary school children. Presenting subjects with one sentence stories of different syntactic complexity she assessed reading comprehension by a picture choice test and by oral reading errors. Results indicated that sentence complexity had some effects on oral reading errors but none on the picture-choice test.

More supportive results are found in the structuralist based studies of Ruddell⁷³ and Tatham⁷⁴. Ruddell used data from the Strickland study⁷⁵ to construct reading passages reflecting high or low frequency oral sentence patterns. He found reading comprehension scores to be higher on passages of high frequency patterns than on passages of low frequencies.

Tatham also examined the effects on comprehension of the use of frequent and infrequent oral language patterns. Two tests of thirty-seven questions were constructed, one using patterns that appear frequently in the oral language of second and fourth graders and one with patterns that

73 Robert B. Ruddell, "The Effects of Oral and Written Patterns of Language Structure on Reading Comprehension", The Reading Teacher, vol. 18, 1965, p. 270-275.

74 Susan Masland Tatham, "Reading Comprehension of Materials Written with Select Oral Language Patterns: A Study at Grades Two and Four", Reading Research Quarterly, vol. 5, 1970, p. 402-426.

75 Strickland, Op. Cit., p. 1-131.

appear infrequently in their oral language. Comprehension was tested by a picture identification task. Results indicated significantly more second and fourth graders obtained higher scores on the test written with the frequently used language pattern.

Some transformational studies have also examined the effects of altering the syntax of a reading passage to approximate the productive syntax of the reader. Peltz⁷⁶ used a transformational analysis of language structure to test the effects of repatterning passages on the reading comprehension of tenth grade students. Passages from a tenth grade text were re-written to approximate the syntactic patterns found in a transformational analysis of the writing of tenth grade subjects, and comprehension of the passages was measured by the cloze procedure. Results indicated significantly more correct responses to cloze items on the re-written passages than on the original passages. It was concluded that repatterning content area material after the syntactic patterns of the reader is likely to have a positive effect on reading comprehension.

76 Fillmore Kenneth Peltz, "The Effect upon Comprehension of Repatterning Based on Student's Writing Patterns", Reading Research Quarterly, vol. 9, 1974, p. 603-621.

Smith^{77,78} used Hunt's T-unit as a basis for re-writing a reading passage at four different levels, grades four, eight and twelve, and an adult level. These were presented to 120 students from each of grades four through twelve. Comprehension was tested by the cloze technique. Results indicated that grade four, five and six students found the fourth grade writing easiest while older students found the eighth grade writing easier. Smith explains these results by hypothesizing that students read best material written near their own syntactic level.

Several studies have examined the effects that specific grammatical classes or specific transformations have on reading comprehension. The following are representative of this group.

Stoodt⁷⁹ studied the relationship between understanding conjunctions and reading comprehension. She found

77 William L. Smith, "The Effect of Transformed Syntactic Structures on Reading", in Carl Braun, ed., Language, Reading and the Communication Process, Newark, Del. IRA, 1971, p. 52-62.

78 William L. Smith, "The Controlled Instrument Procedure for Studying the Effect of Syntactic Sophistication on Reading: A Second Study", Journal of Reading Behavior, vol. 5, 1973, p. 242-251.

79 Barbara D. Stoodt, "The Relationship Between Understanding Grammatical Conjunctions and Reading Comprehension", Elementary English, vol. 49, 1972, p. 502-504.

a significant correlation between fourth graders ability to identify relationships signalled by conjunctions and reading comprehension.

Fagan⁷⁹ examined the effects on reading comprehension of the number and type of transformations in the reading passage. Forty-three transformations were identified from grade four basal readers and grouped into four categories; embedding, conjoining, deletion, simple and position-shift. Stories were drawn randomly from the same readers and re-written to include the transformations identified earlier. Comprehension was tested by means of a cloze test. Results indicated that the presence of deletion and embedding transformations tended to make sentence passages difficult for the 440 grade four, five and six pupils. He further noted that the presence of redundancy in language made sentence difficulty more dependent on transformations than passage difficulty.

Fagan's study was extended by Malicky⁸⁰ who investigated the effect of deletion transformations on the word identification and comprehension of first and second graders. Two reading passages were constructed. One version had odd

79 William T. Fagan, "Transformations and Comprehension", The Reading Teacher, vol. 23, 1971, p. 169-172.

80 Grace V. Malicky, "The Effects of Deletion Produced Structures on Word Identification and Comprehension in Beginning Readers", (abstract), Reading Research Quarterly, vol. 11, 1975, p. 212-216.

numbered sentences with deletion transformations and even numbered sentences with deletions left in the sentence. The other version reversed this structure. The cloze technique was used to assess comprehension and word identification was assessed by analysis of oral errors. Results indicated that sentences containing the deletion transformations were more difficult to comprehend than intact sentences. It was also found that deletion transformations affected comprehension more than word recognition.

Evans⁸² used two matched groups of twelfth graders to study the effect of transformational simplification on reading comprehension. Five passages from the Davis Reading Tests were simplified by de-transforming passive voice, relative clause and deletion transformations. One group read the simplified passages and one group the original passage. The result of a cloze type comprehension test and a multiple choice comprehension test showed significantly better scores for the group using the simplified passage.

Studies investigating the relationship between syntactic structure and reading comprehension have been reviewed in this section. Studies generally indicate that increasing

82 Ronald V. Evans, "The Effects of Transformational Simplification on the Reading Comprehension of Selected High School Students", Journal of Reading Behavior, vol. 5, 1967, p. 273-280.

the syntactic complexity of a reading passage increases the difficulty of the passage. In particular, it would appear from the research that subjects read best material written with a familiar syntactical style. In the following section a summary of the review of the literature relating syntax and reading is presented and the research problem is stated.

3. Summary and Statement of the Research Problem

The literature reveals a clear and consistent relationship between various measures of syntax and reading comprehension. The syntactic maturity of the reader has been shown to be related to reading comprehension. Also, the syntactic complexity of the reading passage has been shown to affect reading comprehension.

Few if any studies have attempted to manipulate the syntactic complexity of the reading passage and study its effect on the reading comprehension of syntactically mature and immature readers.

Implicit in Smith's theory of the reading process is the postulate that reading comprehension is dependent upon the syntactic maturity of the reader and the syntactic complexity of the reading passage. The purpose of the present study is to consider this theoretical contention.

4. Hypotheses

In the light of the stated problem, the following hypotheses will be investigated:

- 1) Syntactically mature students will score significantly higher on tests of comprehension than students who are syntactically less mature.
- 2) Syntactically simpler reading passages are significantly easier to comprehend than syntactically complex passages.
- 3) There is significant interaction between the independent variables of syntactic maturity and syntactic complexity as they affect reading comprehension.

CHAPTER II

EXPERIMENTAL DESIGN

In this chapter the procedures involved in conducting the experiment to test the hypotheses outlined in the previous chapter are presented. The chapter begins with a description of the research instruments used in the project. This is followed by an outline of the research methods used in the collection of the data. Following this description the population sample is described and finally, the statistical techniques adopted for the analysis of the data are presented.

1. The Research Instruments

Two instruments were employed in the collection of the data: 1) a composition which was analyzed using Hunt's T-unit¹ to assess syntactic maturity, and 2) a reading passage written at three different syntactic levels to which the cloze procedure was applied to assess reading comprehension. Each of these instruments will be discussed in detail.

1) In order to obtain a written language sample, subjects were required to write a composition about the best

1 Kellogg W. Hunt, Grammatical Structures Written at Three Grade Levels, NCTE Research Report No. 3, National Council of Teachers of English, Champaign, Illinois, 1965, xix-159 p.

or worst hour of their day. This title was previously used by O'Donnell² in a study comparing two indices of syntactic maturity. Syntactic maturity was assessed by analyzing the compositions for mean T-unit length.

The concept of T-unit was developed by Hunt³ as the basis of a more reliable index of syntactic maturity than such previous measures as sentence length or clause length. A T-unit is a syntactic unit consisting of one main clause plus any subordinate clause attached to the main clause.⁴ It is grammatically capable of being considered a sentence and has the advantage over previous measures of being objectively identifiable and of being independent of the inconsistencies of student punctuation. It has the further advantage over previous measures of preserving all the subordination achieved by the student and all of his coordination of words, phrases and subordinate clauses.⁵

In his study Hunt used the T-unit as a basis for several indices of syntactic maturity. As these tended to

2 Roy C. O'Donnell, A Comparison of Two Indices of Syntactic Complexity, Studies in Language Education No. 20, Athens, University of Georgia, 1975, 13 p.

3 Kellogg Hunt, Op. Cit., p. 20-23.

4 Ibid., p. 20.

5 Ibid., p. 21.

be interrelated, and since one, mean T-unit length, incorporated the other indices, he found mean T-unit length to be the most useful measure of syntactic maturity.⁶

Hunt found a steady, significant increase in mean T-unit length from grade four to grade eight to grade twelve.⁷ These findings were later supported by O'Donnell, Griffin and Norris⁸ in a study of children's syntax. They found increases in mean T-unit length for all grade levels from kindergarten through grade seven⁹ and concluded that "mean length of T-units has special claim to consideration as a simple, objective, valid indicator of development in syntactic control."¹⁰

Since its inception by Hunt, mean T-unit length has been used in numerous studies of syntactic maturity in

6 Kellogg W. Hunt, Differences in Grammatical Structures Written at Three Grade Levels, the Structures to be Analyzed by Transformational Methods, Report to the U.S. Office of Education Cooperative Research Project No. 1998, Tallahassee, Florida, 1964, p. 31.

7 Hunt, Grammatical Structures, Op. Cit., p. 23.

8 Roy C. O'Donnell, William J. Griffin, and Raymond C. Norris, Syntax of Kindergarten and Elementary School Children: A Transformational Analysis, NCTE Research Report No. 8, National Council of Teachers of English, Champaign, Illinois, 1967, xv-115p.

9 Ibid., p. 44.

10 Ibid., p. 98.

children's language development.¹¹ It is calculated by segmenting the language sample into T-units and dividing the number of such units into the total number of words in the sample.

O'Donnell has compared mean T-unit length with several other indices of syntactic maturity. He found it to be highly correlated with Golub and Kidder's Syntactic Density Score ($r = .88$) and as mean T-unit length can be computed far more easily and economically, concluded it to be the more useful and useable of the two measures.¹² Similar conclusions were drawn from a critical analysis of three indices of syntactic maturity.¹³

The original findings of Hunt that mean T-unit length increases with grade level and their verifications in subsequent research, the extensive use of the T-unit in language development studies, and the high correlations between mean T-unit length and other syntactic maturity measures indicate

11 Roy C. O'Donnell, "A Critique of Some Indices of Syntactic Maturity", Research in the Teaching of English, vol. 10, 1976, p. 31-39.

12 Roy C. O'Donnell, A Comparison of Two Indices of Syntactic Complexity, Studies in Language Education No. 20, Athens, University of Georgia, 1975, p. 13.

13 O'Donnell, A Critique of Some Indices of Syntactic Maturity, Op. Cit., p. 38.

the validity of mean T-unit length as a measure of syntactic maturity. The most obvious limitations of this index lies in the fact that it does not discriminate among the various ways that length may be increased. As mean T-unit length was used in the present study merely to identify high and low syntactic maturity groups, however, this limitation is not crucial.

The Kuder Richardson reliability coefficient derived from a small segment of the present sample (N = 50) after a four week interval was .65.

2) The reading instrument used was the reading passage "Bee" developed by Smith¹⁴ and written at three different levels of syntactic complexity. Using data from a study by Hunt¹⁵ in which 4th, 6th, 8th, 10th and 12th graders and skilled adults were asked to rewrite a passage presented in the form of kernel sentences, and a base paragraph of twenty-four kernel sentences describing a bee's stinging, Smith wrote four passages representing the

¹⁴ William Lewis Smith, The Effects of Syntax on Reading, unpublished doctoral dissertation, The Florida State University, 1969.

¹⁵ Kellogg W. Hunt, "Syntactic Maturity in School Children and Adults", No. 134 in Monographs of the Society for Research in Child Development, Chicago, University of Chicago Press, 1970, 67p.

syntactic level of writing of 4th, 8th and 12th graders and of skilled adults. That is, after determining what Hunt's subjects typically did with the kernel sentences, the passages were written accordingly "keeping all syntactic characteristic measurements as close to Hunt's means as possible."¹⁶ Thus the reading passages exhibit the syntactic characteristics of the average performance at each level. For the present study the passages representing 4th, 8th and 12th grade level of syntactic complexity were used and called low, average and high syntactic complexity respectively.

Vocabulary and content are held constant in the three passages and are sufficiently elementary that they would not be "foreign" to grade eight students.¹⁷ Thus Smith's instrument holds constant the semantic component of Frank Smith's theory while allowing for the manipulation of the syntactic component that is the focus of this study.

Reading comprehension was measured by applying the cloze procedure to the reading passages. This is a technique whereby words are deleted from a passage by some objectively specified process. Comprehension is measured by having

¹⁶ William L. Smith, "The Effects of Transformed Syntactic Structures on Reading", in Carl Braun, ed., Language, Reading and the Communication Process, Newark, Delaware, IRA, 1971, p. 53.

¹⁷ Smith, The Effects of Syntax on Reading, Op. Cit., p. 24.

subjects fill in the blanks originating in the deletion process. The comprehension score is determined by dividing the number of correct responses by the total number of blanks in the passage.

Since its inception by Taylor¹⁸ the cloze procedure has attracted much research interest because it seems to offer a valid, convenient and completely objective method of constructing a test of reading comprehension. As defined by Taylor the cloze procedure is:

A method of intercepting a message from a "transmitter" (writer or speaker), mutilating its language patterns by deleting parts, and so administering it to "receivers" (readers and listeners) that their attempts to make the patterns whole again potentially yield a measure of their ability to deal with the general meaning and form intended.¹⁹

The basic theory behind the use of the cloze procedure as a measure of reading comprehension has been simply stated by Hafner: "The individual's choice of words is an index of his ability to comprehend reading matter."²⁰

18 Wilson L. Taylor, "Cloze Procedure: A New Tool for Measuring Readability", Journalism Quarterly, vol. 30, 1953, p. 415-433.

19 Ibid., p. 416.

20 L. E. Hafner, "Cloze Procedure", Journal of Reading, vol. 9, 1966, p. 415-421.

Taylor²¹ and Rankin²² have similarly stated their belief that an individual's performance on a cloze test is indicative of his ability to understand the meaning of the material being read.

Several principles inherent in the cloze procedure correspond closely to the psycholinguistic theory of the reading process. It is based upon probability and syntactic and semantic cues have a constraining effect on the probability of occurrence of a particular word in a particular blank. The reader's ability to use these syntactic and semantic cues allow him to narrow down the choice of words that will fit into a particular blank. That is, the more familiar the content and the syntactic style, the greater is the redundancy and the more easily the reader comprehends the text. Thus the ability to successfully predict the cloze unit is indicative of the reader's comprehension of the passage.

Attempts to prove the validity of the cloze procedure as a measure of reading comprehension have largely dealt with the nature of the relationship between this measure and

21 Taylor, Op. Cit., p. 415-433.

22 Earl F. Rankin, Jr., "The Cloze Procedure - Its Validity and Utility", in Oscar S. Causey and William Eller, eds., The Eighth Yearbook of the National Reading Conference, vol. 8, Fortworth, Texas, The Texas Christian University press, April 1959, p. 131-144.

standardized reading instruments or other procedures. High correlations between cloze tests and standardized reading tests are reported by Rankin²³ and Bickley, Ellington and Bickley²⁴ in reviews of the literature on the cloze procedure. Cloze scores have also been correlated with comprehension tests covering the same material to determine its validity as a measure of specific comprehension. Taylor^{25,26} found correlations ranging from .51 to .92 between cloze tests and comprehension tests made from the same material. Bormuth²⁷ reported correlations of .73 to .84 between cloze tests and conventional test scores made on the same material and stated that the correlations approached 1.00 when corrected for the unreliability of the test.

23 Earl K. Rankin, "The Cloze Procedure: A Survey of Research" in E. I. Thurstone and L. E. Hafner eds., Fourteenth Yearbook of the National Reading Conference, Milwaukee, National Reading Conference, 1965, p. 133-150.

24 A. C. Bickley, Billie J. Ellington and Rachel T. Bickley, "The Cloze Procedure, A Conspectus", Journal of Reading Behavior, vol. 2, 1970, p. 232-249.

25 Wilson L. Taylor, "Recent Developments in the Use of the Cloze Procedure", Journalism Quarterly, vol. 33, 1956, p. 42-48.

26 Wilson L. Taylor, "Cloze Readability Scores as Indices of Individual Differences in Comprehension and Aptitude", Journal of Applied Psychology, vol. 41, 1957, p. 19-26.

27 John Bormuth, "Cloze Readability Procedure", Elementary English, vol. 45, 1968, p. 431.

Factor analytic studies of the cloze procedure have been carried out by Kingston and Weaver²⁸ and by Bormuth²⁹. The Kingston and Weaver study which concluded that "cloze tests are related only moderately to the verbal comprehension factor"³⁰, was criticized on methodological grounds by Bormuth whose own study was an attempt to eliminate many of the limitations of the previous study. Bormuth found that one factor accounted for the preponderance of the variability and had no hesitation in calling this factor "reading comprehension".³¹

Reliability of the cloze test has been assessed by test-retest and split-half reliability statistics. Walter³² in an historical overview of the cloze procedure, reports test-retest reliability coefficients ranging from .70 to .97 and split-half reliability coefficients as high as .97.

28 W. W. Weaver and A. J. Kingston, "A Factor Analysis of the Cloze Procedure and Other Measures of Reading and Language Ability", Journal of Communication, vol. 13, 1962, p. 252-261.

29 John Bormuth, "Factor Validity of Cloze Tests as Measures of Reading Comprehension Ability", Reading Research Quarterly, vol. 4, 1969, p. 358-365.

30 Weaver and Kingston, Op. Cit., p. 269.

31 Bormuth, Factor Validity of Cloze Tests as Measures of Reading Comprehension Ability, Op. Cit., p. 364.

32 Walter, Richard B., Historical Overview of the Cloze Procedure, Study conducted at Kean College of New Jersey, ERIC Document, ed., 094 337, p. 17-23.

The validity and reliability of the cloze procedure are well summarized by Bormuth's statement that "cloze tests are valuable because they are highly reliable and valid, and can be easily and objectively constructed and scored."³³

Much research has been directed at the methodology for the construction and scoring of the cloze test. A deletion system of every fifth word with blanks of a standard length has been generally accepted for test construction.³⁴ The exact word response appears to be the most valid method of scoring cloze tests and has the advantage of eliminating any subjective judgements on the part of the scorer.³⁵ These procedures were used in the present study.

Research has shown that reliability coefficients are highest when cloze passages consist of at least 250 words.³⁶ Bormuth has shown that this length is required to have all sequences equal in difficulty. As the passages used in the present study were not of this length, all possible sequences of the every fifth word deletion schedule were used. That is, each passage was written deleting every fifth word

33 John Bormuth, "Comparable Cloze and Multiple-Choice Comprehension Test Scores", Journal of Reading, vol. 10, 1967, p. 291.

34 Walter, Op. Cit., p. 32.

35 Ibid., p. 32.

36 Ibid., p. 32.

beginning with the second word, then written deleting every fifth word beginning with the third, then the fourth, the fifth and finally the sixth. In this way all words except for the first and the last were deleted in one of the forms.

In summary, this section has presented the two instruments used in the collection of the data. Two procedures, the T-unit analysis and the cloze procedure, have been discussed and the construction of the reading passages described. Copies of the two measuring instruments are included in the appendix. The following section describes the research methods used in the collection of the data.

2. Collection of the Data

Subsequent to the approval of the Peel Board of Education, the principals of the four schools involved in the study were contacted and meetings arranged with the grade eight English teachers. The teachers were told why the study was being conducted, the procedures to be followed, and exactly what was expected of them. A date was set within each school for administration of the instruments and arrangements made for each teacher to be given an envelope on the day of the test containing instructions and the test instruments for the students.

Two sets of test instruments were included in each envelope: the composition test instruments and the "Bee" comprehension test instruments. The set of "Bee" comprehension test instruments was composed of an equal number of each of the low, average and high syntactic complexity versions all of the same deletion sequence.

The teachers were asked in the instructions to administer the composition first, allowing thirty-five minutes for the student to complete the test (see Appendix 1). The teachers were further instructed to randomly distribute the "Bee" comprehension test instrument and allow students a full forty minutes to complete this test. Previous use of the instrument indicated that no student required more than forty minutes to complete the instrument.³⁷ All testing was completed in back to back periods of forty minutes each.

3. The Sample

The population from which the sample was drawn was composed of the students enrolled in the grade eight classes under the jurisdiction of the Peel Board of Education. The Peel Board of Education, one of the largest in Ontario, administers the public schools in Peel County. The southern

³⁷ William L. Smith, The Effects of Syntax on Reading, Op. Cit., p. 31

part of the county is heavily urban, consisting of the newly formed city of Mississauga, while the northern part of the county is predominantly rural.

The subjects in the study consisted of 971 students enrolled in four senior public schools randomly selected from all such schools of the Peel Board of Education. Two schools were in urban areas, one drew its students from both urban and rural areas, and one was largely composed of rural students. They were thus fairly representative of the total population. Twenty-four cases were excluded from the final analysis due to failure to complete one of the two tests, leaving a final sample of 947 grade eight students.

4. Statistical Design

In accordance with the hypotheses stated in Chapter I, the independent variables are level of syntactic maturity and type of syntactic complexity. The dependent variable is performance on the cloze test of comprehension.

Data was analyzed using a two factor analysis of variance ($p < .05$) as described by Keith.³⁸ The design is illustrated in Figure 2. The first factor (A) is level of syntactic complexity. It includes three levels, low (A_1),

³⁸ V. Keith, Design and Analysis in Experimentation, Ottawa, University of Ottawa Press, 1972, p. 98-128.

	A_1	A_2	A_3
B_1	$r = 101$	$r = 101$	$r = 101$
B_2	$r = 101$	$r = 101$	$r = 101$

Figure 2: Statistical Design

average, (A_2), and high, (A_3). These correspond to 4th, 8th and 12th grade level of syntactic maturity respectively.

The second factor, (B), is level of syntactic maturity. It has two levels, (B_1 and B_2), corresponding to a high and low syntactic maturity group. Each group consisted of persons who were among either the highest or lowest third of the distribution for syntactic maturity as assessed by mean T-unit length.

Homogeneity of variance was tested by Levene's test for homogeneity of variance.³⁹ The Scheffe test⁴⁰ was used in the post hoc procedures to test the interaction effects relevant to the hypotheses.

5. Summary

This chapter has been concerned with the experimental design of the study. A review of the literature pertaining to the instruments used to collect the data has shown them to be reliable and valid. The research methods used in the study have been outlined and the population sample described. The chapter concluded with a description of the statistical design of the study. In the following chapter the results of the data analysis will be presented.

39 Ibid., p. 128-129.

40 Ibid., p. 148-151.

CHAPTER III

PRESENTATION AND DISCUSSION OF RESULTS

In this chapter the results of the empirical investigation described in the preceding chapter are presented and discussed under the following headings:

- 1) recapitulation of research problem and hypotheses,
- 2) descriptive data, 3) results of the analysis of variance,
- 4) results of the post-hoc procedures, and 5) discussion of the results.

1. Recapitulation of Research Problem and Hypotheses

The present study was designed to answer the following research question: What are the effects of syntactic maturity and syntactic complexity on reading comprehension? From this definition of the problem, the following hypotheses were formulated:

1) Syntactically mature students will score significantly higher on tests of comprehension than students who are syntactically less mature.

2) Syntactically simpler reading passages are significantly easier to comprehend than syntactically complex passages.

3) There is significant interaction between the independent variables of syntactic maturity and syntactic complexity as they affect reading comprehension.

In accordance with the above hypotheses the independent variables are syntactic maturity and syntactic complexity, and the dependent variable is reading comprehension.

2. Descriptive Data

In the statistical analysis of the data, not all scores of the 947 subjects were used. A high syntactic maturity group and a low syntactic maturity group were identified by taking the upper third and the lower third of the mean T-unit distribution respectively. Table I shows the means and standard deviations for these two groups.

Subjects were randomly assigned to one of the three syntactic complexity groups through the random distribution of the reading passages. As this was carried out prior to the identification of the high and low syntactic maturity groups, the number of subjects in each of the six cells of the experimental design was not equal. In the final analysis of the data therefore twenty-four subjects were randomly dropped to give equal cell sizes of 101 subjects.

The dependent variable, reading comprehension, was measured by the cloze procedure. Table II presents the means and standard deviations of the dependent variable. These

TABLE I

Means and Standard Deviations of
High and Low Syntactic Maturity Groups

Group Classification	N	Mean	S.D.
High Syntactic Maturity	314	14.10	1.7
Low Syntactic Maturity	316	9.12	.97

TABLE II

Means and Standard Deviations of
Dependent Variable Scores for Each Group Involved in
the Analysis of Variance (N=101)

Group Classifications	Mean	S.D.
High Syntactic Maturity Low Syntactic Complexity	55.3267	12.4893
High Syntactic Maturity Average Syntactic Complexity	57.0990	13.2057
High Syntactic Maturity High Syntactic Complexity	61.0099	14.5269
Low Syntactic Maturity Low Syntactic Complexity	53.5050	12.3163
Low Syntactic Maturity Average Syntactic Complexity	48.8317	14.8129
Low Syntactic Maturity High Syntactic Complexity	42.4752	17.5861

results are not completely in the direction predicted by the hypotheses under investigation.

An analysis of variance was carried out to determine if these findings were statistically significant. These results are presented in the next section.

3. Results of the Analysis of Variance

The analysis of dependent variable scores was conducted using a two-factor analysis of variance ($p < .05$). The first factor is syntactic complexity and the second factor is syntactic maturity.

The results of the analysis of variance are presented in Table III. Factor A, syntactic complexity, is not significant at the .05 level. Since the level of significance did not reach the .05 level, the null hypothesis relevant to the second research hypothesis cannot be rejected. The second research hypothesis stated above must therefore be rejected at the .05 level of significance.

Factor B, syntactic maturity, is statistically significant. This indicates that the null hypothesis that there is no difference between the comprehension scores of high and low syntactic maturity groups can be rejected. The first research hypothesis is therefore supported at the .05 level of significance.

TABLE III

Results of the Analysis of Variance

Source of Variance	ndf	MS	F	p
A (syntactic complexity)	2	361.764	1.777	
B (syntactic maturity)	1	13,791.883	67.730*	.0001
AB (interaction)	2	3,587.882	17,620*	.0001
R	600	203.631		

* p < .05

The interaction is also significant at .05 level of significance but post hoc tests are required to test the significance of the differences between mean scores of the high and low syntactic maturity groups on reading passages of different syntactic complexity. Results of the post hoc procedures are presented in the next section.

4. Results of the Post Hoc Procedures

The interaction hypothesis predicts that the difference between the means of the high and low syntactic maturity groups should increase as the syntactic complexity of the reading passage increases. Three contrasts of means were carried out to test the significance of these differences.

In order to further examine the second hypothesis, two further contrasts relevant to the differences in means between the high and low syntactic complexity groups of the high syntactic maturity subjects, and the high and low syntactic complexity groups of the low syntactic maturity subjects were carried out.

The Scheffe tests were employed for these five post hoc tests of significance ($p < .05$). The results of these five contrasts are presented in Table IV.

TABLE IV

Scheffe Simultaneous Confidence Intervals
for Simple Contrasts of Means

Contrast of Means	Scheffe Simultaneous Confidence Intervals
<u>Low Syntactic Complexity</u>	
High - Low Syntactic Maturity Groups	1.822 ± 6.675
<u>Average Syntactic Complexity</u>	
High - Low Syntactic Maturity Groups	8.267 ± 6.574*
<u>High Syntactic Complexity</u>	
High - Low Syntactic Maturity Groups	18.535 ± 6.675*
<u>High Syntactic Maturity Group</u>	
Low - High Syntactic Complexity	5.683 ± 6.675
<u>Low Syntactic Maturity Group</u>	
Low - High Syntactic Complexity	11.030 ± 6.676*

* p < .05

5. Discussion of the Results

The hypotheses that formed the basis for the present study were derived from Smith's psycholinguistic theory of reading. Implicit in this theory is the postulate that reading comprehension is partially dependent upon the syntactic maturity of the reader and the syntactic complexity of the reading passage. The following three hypotheses were developed to test this postulate:

- 1) Syntactically mature students will score significantly higher on tests of comprehension than syntactically less mature students.
- 2) Syntactically simpler reading passages are significantly easier to comprehend than syntactically complex passages.
- 3) There is a significant interaction between the independent variables of syntactic maturity and syntactic complexity as they affect reading comprehension.

These hypotheses were tested by manipulating the syntactic complexity variable and noting its effect on the reading comprehension of a high syntactic maturity group and a low syntactic maturity group. Reading comprehension, the dependent variable, was measured by the cloze procedure.

The results of the investigation clearly demonstrate support for the major contention that syntactic maturity and

syntactic complexity are important factors in reading comprehension. The results, however, are not entirely consistent with the theory. This is clearly shown in Figure 3. While the results for the low syntactic maturity group are in the direction predicted by the theory, the results for the high syntactic maturity group are not.

The theoretical implications of these results are discussed in the following section. As hypotheses 1 and 3 are supported by the data, they are considered first. Hypothesis 2 is discussed at greater length and an interpretation of the results is offered. Finally, some pedagogical implications of the study are considered.

The results of the study support the first hypothesis. The rationale underlying this hypothesis is that since it is the skilled reader who makes maximum use of the redundancies available in language, it must also be the skilled reader who has the greater knowledge of syntax, that is, is syntactically more mature. Stated another way, a greater knowledge of syntax would be required in order to make use of the redundancies available in language.

It should be noted that while the data supports the hypothesis it says nothing about the validity of the underlying rationale. That is, the results cannot be used to prove that it is the use of the redundancies of language that

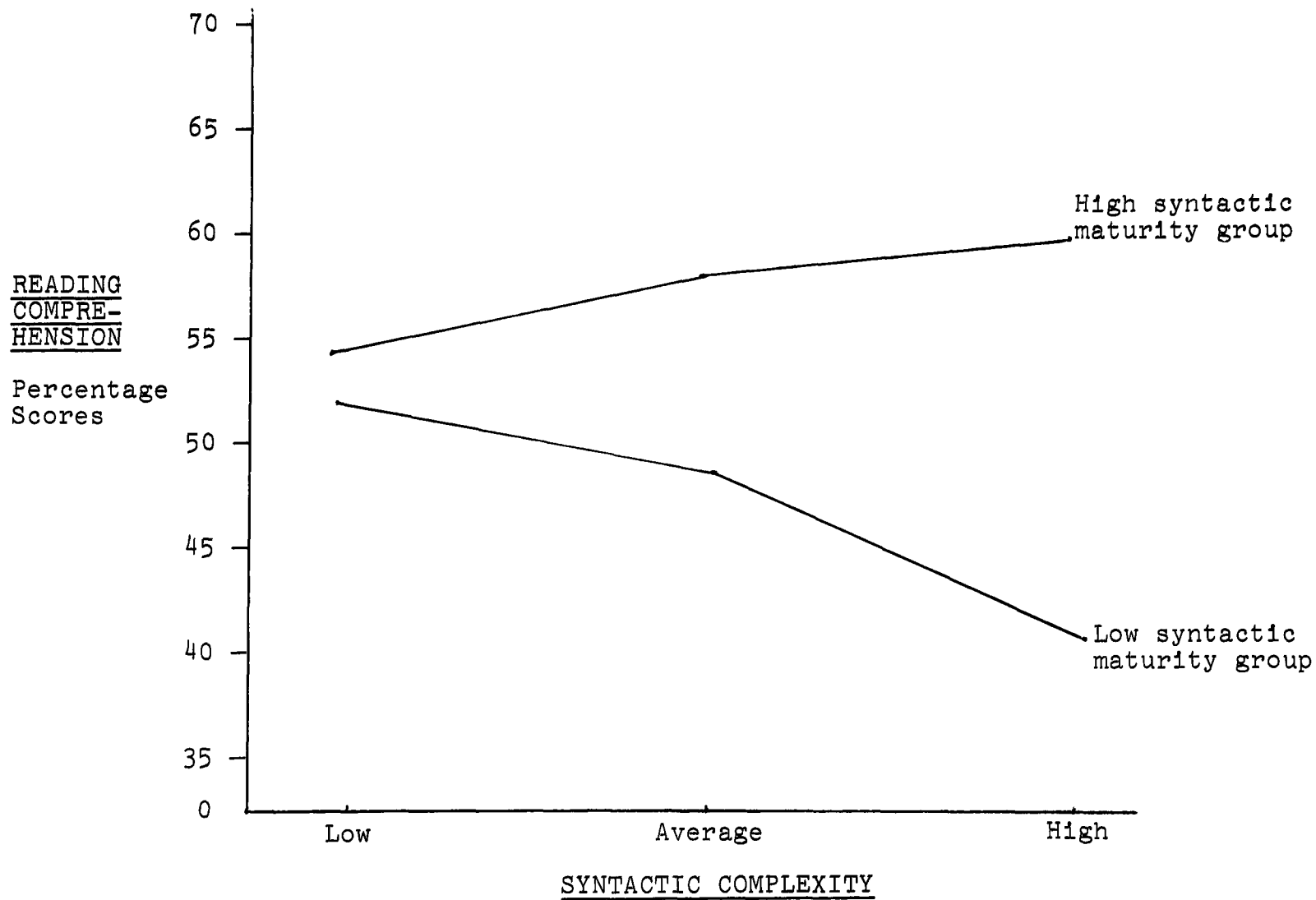


Figure 3. Mean Cloze Unit Scores for Each Syntactic Maturity Group on Each Level of Syntactic Complexity.

make the syntactically more mature subjects better readers. In fact, in light of the total results this is perhaps a too simplistic interpretation of the role of redundancy in reading. A different interpretation will be offered in discussing hypothesis 2.

The third hypothesis was also supported by the results of the study. The ordinal interaction is shown in Figure 3. Post hoc analysis showed that while the differences between the means of the high and low syntactic maturity group were not significant at the low syntactic complexity level, they were at the average and high syntactic complexity level. This is in accord with the theoretical expectations and supports the contention that syntactic complexity and syntactic maturity interact in their effect upon reading comprehension. Interpretations of this interaction are considered under the discussion of the second hypothesis.

The second hypothesis was not supported by the results of the study. According to Smith's theory an increase in syntactic complexity should lead to a decrease in reading comprehension. That is, as the syntactic complexity of the reading passage increases, it should become increasingly difficult to extract meaning from it. This follows from the role that Smith assigns to syntax in the reading process.

As stated by Smith, the rules of syntax serve two functions in the reading process. First, the reader uses his knowledge of the rules of syntax to establish feature lists that allow him to directly identify meaning. He is able to do this because of the redundancies available in the written text. One of these redundancies is syntactic redundancy. Second, having directly identified meaning, he uses his knowledge of the rules of syntax that link deep and surface structure (transformational rules) to predict what the surface structure should be. As sentences become more complex the number of syntactic redundancies become less and the distance between deep and surface structure increases, that is, the distance between the visual array and meaning. This indicates that it would be more difficult to extract meaning from a syntactically more complex sentence.

As Figure 3 clearly shows, while this is true for the low syntactic maturity group, the opposite occurs for the high syntactic maturity group. For this group comprehension increases as the syntactic complexity increases, or as is perhaps more accurate, comprehension decreases as syntactic complexity decreases. Results of post hoc analysis reveal the difference in syntactic complexity to be significant ($p < .05$) for the low syntactic maturity group but not for the high syntactic maturity group.

The findings suggest that when the semantic load is held constant, it is not the amount of syntactic redundancy or the depth between deep and surface structures per se that determines reading difficulty, but rather the level of syntactic complexity in relation to the syntactic maturity of the reader. What is being suggested is that splitting eighth grade students into high and low syntactic maturity groups resulted in the high group being closer to a grade twelve level of syntactic maturity and the low group closer to a grade four level of syntactic maturity. In other words, the subjects read best the material that was closest to their own productive syntactic level.

This suggestion finds support in the works of Tatham¹, Ruddell², Peltz³ and Smith^{4,5}, reported in the

1 Susan Masland Tatham, "Reading Comprehension of Materials Written with Select Oral Language Patterns: A Study of Grades Two and Four", Reading Research Quarterly, vol. 5, 1970, p. 402-426.

2 Robert B. Ruddell, "The Effects of Oral and Written Patterns of Language Structure on Reading Comprehension", The Reading Teacher, vol. 18, 1965, p. 270-275.

3 Filmore Kenneth Peltz, "The Effect Upon Comprehension of Repatterning Based on Students Writing Patterns", Reading Research Quarterly, vol. 9, 1974, p. 603-621.

4 William L. Smith, "The Effect of Transformed Syntactic Structures on Reading", in Carl Braun ed., Language, Reading and the Communication Process, Newark, Del. IRA, 1971, p. 52-62.

5 William L. Smith, "The Controlled Instrument Procedure for Studying the Effect of Syntactic Sophistication on Reading: A Second Study", Journal of Reading Behavior, vol. 5, 1973, p. 242-251.

review of the literature. It will be recalled that Tatham and Ruddell reported higher comprehension scores for subjects on tests written with a frequently used language pattern, while Peltz found comprehension to be facilitated by re-writing content area passages to correspond to the syntactic level of the reader. Smith reported results that led him to the conclusion that students read best material written near their own grade level.

These conclusions can be restated in terms of Smith's theory. The results indicate that the reader is best able to use syntactic redundancies that are at his own productive level. That is, the feature lists that he establishes for the immediate identification of meaning incorporates his current mastery of syntax. As this mastery increases his feature list changes with it to take into account the changing syntactic redundancies he is utilizing. A change of syntax in the reading process disrupts the use he makes of these redundancies. However, it is not only a change up to a more complex syntactic structure with fewer redundancies, but also a change down to a less complex syntactic structure with more redundancies. In other words, there can be too much syntactic redundancy in the reading passage. This appears to interfere as much in the reading process as does too little syntactic redundancy. It is doubtful, therefore, in terms of syntactic

redundancy, that the skilled reader can be termed as one who makes maximum use of the redundancies available in the reading material. Rather, he can be described as making maximum use of the syntactic redundancies available in terms of his own syntactic maturity. It would appear therefore that the role of syntactic redundancy in Smith's theory of the reading process requires modifying to be consistent with the above interpretation of the results of this study.

The present study cannot claim to have supported or disproven Smith's contention of the use made of transformational rules in bridging deep and surface structures from the meaning side to predict surface structure. However, in view of the results of the present study, and the lack of strong support this received from psycholinguistic research, it is an area of the theory that requires further clarification.

The conclusions outlined above suggest one area for further study. The hypothesis that subjects read best material written closest to their own productive syntactic level could be tested by dividing subjects into groups corresponding to grades four, eight and twelve levels of syntactic maturity and comparing their comprehension scores on reading passages corresponding to grades four, eight and twelve levels of syntactic complexity.

To support the findings of the present study, further research using other grade levels is called for. However, it

should be noted that the present design may have to be modified in such research to account for a shifting toward the upper and/or lower extremes on the syntactic maturity continuum.

Another avenue for further research may be to repeat the present study extending the syntactic complexity to include a passage written in kernel sentences at the one extreme and an adult level syntax at the other. This would reveal whether the ordinal interaction changes into a dis-ordinal one at the lower extreme and if the difference between the two groups continues to expand at the upper extreme.

Finally, consideration should be given to the pedagogical implications of the study. The findings indicate the important effects that the syntactic maturity of the reader and the syntactic complexity of the reading passage have on reading comprehension. In particular, the findings were interpreted as indicating that readers read best material written at their own productive level of syntactic complexity.

In terms of syntactic complexity, the findings suggest that consideration should be given to the construction of controlled syntax books similar to the controlled vocabulary books now in use. Also, perhaps thought should be given to the construction of high interest-low syntactic complexity books for older readers of low syntactic maturity. It is also suggested that the syntactic complexity in controlled

vocabulary readers and the high interest-low vocabulary books in present use be examined.

In terms of the syntactic maturity of the reader, two pedagogical techniques are suggested by the findings. First, the findings that subjects read best material written at their own level of syntactic maturity suggests that reading level could probably be assessed by analyzing the syntactic complexity of student's written work. This is a factor that is presently not considered in assessing reading level. Second, it would appear reasonable to suggest that one area of instruction that could increase reading comprehension is the improving of the syntactic maturity of the reader. These implications suggest an area for further educational research.

In summary, the results of this study have been interpreted as supporting Smith's theoretical contention of the importance of syntactic maturity and syntactic complexity in reading comprehension. However, the results were not consistent with Smith's interpretation of the role of syntactic redundancy in reading comprehension. An alternative interpretation of this role was discussed. It was concluded that the results indicate that the reader uses best syntactic redundancies that are at his own syntactic productive level. The last part of this section considered some pedagogical implications of the study.

The study is summarized and the conclusions restated in the following pages.

SUMMARY AND CONCLUSIONS

The purpose of this study was to investigate the postulate implicit in Smith's psycholinguistic theory of reading that reading comprehension is partially dependent upon the syntactic maturity of the reader and the syntactic complexity of the reading passage.

The first section of the study considered Smith's theory of reading in terms of its syntactic component. It was demonstrated that Smith considers the reader as making use of his knowledge of syntax in two ways. First, in establishing feature lists for the immediate identification of meaning, he incorporates his knowledge of the syntactic redundancies available in the written language. Second, having identified meaning, he uses his knowledge of the rules of syntax to predict what the surface structure should be. As syntactic complexity decreases the number of syntactic redundancies available in language, and increases the distance between deep and surface structure, it was hypothesized that:

- 1) Syntactically mature students will score significantly higher on tests of comprehension than syntactically less mature students.
- 2) Syntactically simpler reading passages are significantly easier to comprehend than syntactically complex passages.
- 3) There is a significant interaction between the independent variables of syntactic maturity and syntactic complexity as they affect reading comprehension.

In order to support these hypotheses the theoretical work of Chomsky was examined and the psycholinguistic research arising out of Chomsky's theory of syntax reviewed. A review of the literature relating syntax and reading revealed general support for hypotheses 1 and 2. No studies were found that had directly investigated the interaction of the two independent variables.

To test the hypotheses two research instruments were employed. Subjects were asked to write a composition about the best or worst hour of their day. This was analyzed using Hunt's mean T-unit length as an index of syntactic maturity. A high syntactic maturity group and a low syntactic maturity group were identified on the basis of this analysis representing the upper and low third of the mean T-unit length distribution respectively.

A reading passage "Bee" was used to test comprehension. This passage was re-written to approximate the syntactic complexity of grades four, eight and twelve level writing. The cloze procedure was applied to these reading passages as a measure of reading comprehension.

The research sample consisted of grade eight students drawn from four schools randomly chosen from the senior public schools under the jurisdiction of the Peel Board of Education. A two-factor analysis of variance and post hoc

Scheffe simultaneous contrasts of means were used to analyze the data. Hypotheses 1 and 3 were supported by the data. Hypothesis 2 was not supported.

Results of the study were interpreted as supporting the contention of Smith that reading comprehension is partially dependent upon the syntactic maturity of the reader and the syntactic complexity of the reading passage. However, the results were not in the direction predicted by the theory. Smith's contention of the use of syntactic redundancy in the reading process was questioned in light of these results.

It was concluded that the results indicate that rather than making maximum use of the syntactic redundancies available in all writing, the reader uses best the redundancies closest to his own syntactic maturity level. It was suggested that Smith's theory be amended to reflect this different use of syntactic redundancy.

It was also suggested that the results are of some practical importance. Teaching implications include the use of student's writing as an indicator of reading level and the use of writing exercises that increase syntactic maturity to improve reading comprehension.

Recommendations for further research included an extension of the present study to include a higher and lower

syntactic complexity level, extensions to different age levels, and an experimental design to examine the major conclusion of this study that readers use best the syntactic redundancies in reading passages closest to their own syntactic maturity level. It was also pointed out that Smith's contention of the use made of transformational rules to bridge deep and surface structure is in need of clarification.

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This text presents Smith's major theoretical contention that reading is not primarily a visual process. Findings from the fields of cognitive psychology, psycholinguistics and communication theory are offered in support of this contention.

Smith, Frank, Psycholinguistics and Reading, New York, Holt, Rinehart and Winston, 1973, v-211p.

A book of readings focusing on three major contentions of Smith regarding the reading process: 1) only a small part of the information necessary for reading comes from the printed page, 2) comprehension must precede the identification of individual words, and 3) reading is not decoding to sound. Of special importance are two articles by Smith contending that reading for meaning is an immediate process and does not require the intermediate steps of word identification or decoding to sound.

Smith, Frank, Comprehension and Learning: A Conceptual Framework for Teachers, New York, Holt, Rinehart and Winston, 1975, ix-277 p.

This book provides an account of comprehension and learning from the point of view of a cognitive psychologist. Two themes are counterpointed: a) all children know how to learn, and b) there are severe restrictions within which this knowledge of learning must operate. Information-processing theory and psycholinguistics underlie the theoretical position outlined.

Smith, William L., The Effect of Syntax on Reading, Ph.D. Dissertation, The Florida State University, 1969.

In this study Smith investigated the effects on reading comprehension of passages of different syntactic complexity. Nine different grade levels are used. Results indicated that students read best material that approximated their own syntactic productive level.

Walter, Richard B., Historical Overview of the Cloze Procedure, study conducted at Kean College of New Jersey, ERIC document ed., 094 337, 1974, 33p.

A fairly extensive review of the literature on the cloze procedure. Factors discussed include the origin and underlying theory behind the cloze procedure, the construction and evaluation of cloze tests, and the validity and reliability of this research instrument.

APPENDIX 1

INSTRUCTIONS TO TEACHERS

INSTRUCTIONS

First of all I would like to thank you for participating in this study. I appreciate your assistance.

Since experimental research must effect tight controls, and since I may have forgotten to tell you something when I briefly met with you, here are the instructions for administering the tests.

Enclosed in the envelope are two sets of test papers, one set contains the test papers for the composition, and the other the papers for the comprehension test. Both tests require a class period of at least 35 minutes for administration. Administer the composition first; the comprehension test should be administered immediately afterwards. Return both tests in the envelope to the Principal's office when completed.

A. Composition

1) Before beginning to administer this test make sure the students have a full 35 minutes remaining before they are scheduled for some other activity.

2) Before giving out the papers explain to the students that they will be required to write a composition describing either the best or the worst hour of their day. They are to describe what happens in that hour and explain why it is the best or worst hour of their day.

3) Give out the sheets and go over the information requested at the top of the page with the class. The following may help clarify this section:

Name - first and last name
Age - in years and months
Sex - M or F
Father's occupation - try to keep to one or two word titles; if one parent families, give Mother's occupation.
Mother tongue - language spoken at home.

4) Ask students to write as neatly as possible and to hand in their papers when they are finished. Collect all papers at the end of the 35 minutes whether finished or not.

B. Comprehension

- 1) Before beginning to administer this test make sure the students have a full 35 minutes remaining before they are scheduled for some other activity.
- 2) As this test will only be valid if the student does all the work himself, it is better if students are seated in rows rather than groups. Also do NOT give the students any assistance. If a student cannot read the test, or wants to know what a word means, do not assist him.
- 3) The comprehension test consists of a cloze passage on bees. It has fifteen different forms so that students will not all be doing the same test. Give them out at random, trying to minimize the possibility of students being able to get answers from one another.
- 4) There are no time limits on this test, so allow the students all the time they need: however, no one should take longer than 30-35 minutes. If for some reason a student must be stopped before he has finished all that he can do, write the word "TIME" on the top of the test.
- 5) Ask the students to turn in their papers when they have finished. Make sure that they have put their names on the test. Those who finish early should read quietly so as not to disturb those still working.

Again, thanks.

Andy Manning

APPENDIX 2

COMPOSITION TEST INSTRUMENT

APPENDIX 3

COMPREHENSION TEST INSTRUMENTS

The following instruments are facsimiles of the actual instruments except that the syntactic level of writing and the deletion sequence have been indicated. The first digit indicates grade level, the second deletion sequence.

NAME _____ SCHOOL _____

INSTRUCTIONS: *First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.*

The _____ protects his family. He _____ his stinger, and he _____ his enemies. The stinger _____ hooks on it, and _____ contains poison. The bee _____ the stinger into the _____, and the hooks dig _____ the skin, and when _____ bee flies away, the _____ hold tight, and the _____ pulls out of the _____. Muscles are in the _____, and they are little, _____ they move and push _____ stinger, and the stinger _____ deeper into the skin, _____ the muscles squeeze the _____ out. The sting causes _____, and the pain is _____, and the poison causes _____ skin to swell. The _____ should be scratched off _____, and then not much _____ gets into the skin, _____ the pain is less, _____ the swelling is less.

NAME _____ SCHOOL _____

INSTRUCTIONS: *First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.*

The bee _____ his family. He uses _____ stinger, and he stings _____ enemies. The stinger has _____ on it, and it _____ poison. The bee pushes _____ stinger into the skin, _____ the hooks dig into _____ skin, and when the _____ flies away, the hooks _____ tight, and the stinger _____ out of the bee. _____ are in the stinger, _____ they are little, and _____ move and push the _____, and the stinger goes _____ into the skin, and _____ muscles squeeze the poison _____. The sting causes pain, _____ the pain is sudden, _____ the poison causes the _____ to swell. The stinger _____ be scratched off quickly, _____ then not much poison _____ into the skin, and _____ pain is less, and _____ swelling is less.

NAME _____ SCHOOL _____

INSTRUCTIONS: First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.

The bee protects _____ family. He uses his _____, and he stings his _____. The stinger has hooks _____ it, and it contains _____. The bee pushes the _____ into the skin, and _____ hooks dig into the _____, and when the bee _____ away, the hooks hold _____, and the stinger pulls _____ of the bee. Muscles _____ in the stinger, and _____ are little, and they _____ and push the stinger, _____ the stinger goes deeper _____ the skin, and the _____ squeeze the poison out. _____ sting causes pain, and _____ pain is sudden, and _____ poison causes the skin _____ swell. The stinger should _____ scratched off quickly, and _____ not much poison gets _____ the skin, and the _____ is less, and the _____ is less.

NAME _____ SCHOOL _____

INSTRUCTIONS: *First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.*

The bee protects his _____. He uses his stinger, _____ he stings his enemies. _____ stinger has hooks on _____, and it contains poison. _____ bee pushes the stinger _____ the skin, and the _____ dig into the skin, _____ when the bee flies _____, the hooks hold tight, _____ the stinger pulls out _____ the bee. Muscles are _____ the stinger, and they _____ little, and they move _____ push the stinger, and _____ stinger goes deeper into _____ skin, and the muscles _____ the poison out. The _____ causes pain, and the _____ is sudden, and the _____ causes the skin to _____. The stinger should be _____ off quickly, and then _____ much poison gets into _____ skin, and the pain _____ less, and the swelling _____ less.

NAME _____ SCHOOL _____

INSTRUCTIONS: First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.

The bee protects his family. _____ uses his stinger, and _____ stings his enemies. The _____ has hooks on it, _____ it contains poison. The _____ pushes the stinger into _____ skin, and the hooks _____ into the skin, and _____ the bee flies away, _____ hooks hold tight and _____ stinger pulls out of _____ bee. Muscles are in _____ stinger, and they are _____, and they move and _____ the stinger, and the _____ goes deeper into the _____, and the muscles squeeze _____ poison out. The sting _____ pain, and the pain _____ sudden, and the poison _____ the skin to swell. _____ stinger should be scratched _____ quickly, and then not _____ poison gets into the _____, and the pain is _____, and the swelling is less.

NAME _____ SCHOOL _____

INSTRUCTIONS: First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.

The _____ protects his family by _____ his enemies with his _____ stinger which has hooks _____ it. As the bee _____ the stinger into the _____, the hooks dig into _____ skin, and when the _____ flies away, the tightly _____ hooks pull the stinger _____ of the bee. The _____ muscles in the stinger _____, pushing the stinger which _____ deeper into the skin. _____ muscles then squeeze the _____ out. The sting causes _____ sudden pain, and the _____ causes the skin to _____. If the stinger is _____ off quickly, not much _____ gets into the skin, _____ the pain and swelling _____ less.

NAME _____ SCHOOL _____

INSTRUCTIONS: First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.

The bee _____ his family by stinging _____ enemies with his poisonous _____ which has hooks on _____. As the bee pushes _____ stinger into the skin, _____ hooks dig into the _____, and when the bee _____ away, the tightly holding _____ pull the stinger out _____ the bee. The little _____ in the stinger move, _____ the stinger which goes _____ into the skin. The _____ then squeeze the poison _____. The sting causes a _____ pain, and the poison _____ the skin to swell. _____ the stinger is scratched _____ quickly, not much poison _____ into the skin, and _____ pain and swelling are less.

NAME _____ SCHOOL _____

INSTRUCTIONS: First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.

The bee protects _____ family by stinging his _____ with his poisonous stinger _____ has hooks on it. _____ the bee pushes the _____ into the skin, the _____ dig into the skin, _____ when the bee flies _____, the tightly holding hooks _____ the stinger out of _____ bee. The little muscles _____ the stinger move, pushing _____ stinger which goes deeper _____ the skin. The muscles _____ squeeze the poison out. _____ sting causes a sudden _____, and the poison causes _____ skin to swell. If _____ stinger is scratched off _____, not much poison gets _____ the skin, and the _____ and swelling are less.

NAME _____ SCHOOL _____

INSTRUCTIONS: *First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.*

The bee protects his _____ by stinging his enemies
 _____ his poisonous stinger which _____ hooks on it.
 As _____ bee pushes the stinger _____ the skin, the hooks
 _____ into the skin, and _____ the bee flies away.
 _____ tightly holding hooks pull _____ stinger out of the
 _____. The little muscles in _____ stinger move, pushing
 the _____ which goes deeper into _____ skin. The muscles
 then _____ the poison out. The _____ causes a sudden
 pain, _____ the poison causes the _____ to swell. If the
 _____ is scratched off quickly, _____ much poison gets
 into _____ skin, and the pain _____ swelling are less.

NAME _____ SCHOOL _____

INSTRUCTIONS: *First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.*

The bee protects his family _____ stinging his enemies with _____ poisonous stinger which has _____ on it. As the _____ pushes the stinger into _____ skin, the hooks dig _____ the skin, and when _____ bee flies away, the _____ holding hooks pull the _____ out of the bee. _____ little muscles in the _____ move, pushing the stinger _____ goes deeper into the _____. The muscles then squeeze _____ poison out. The sting _____ a sudden pain, and _____ poison causes the skin _____ swell. If the stinger _____ scratched off quickly, not _____ poison gets into the _____, and the pain and _____ are less.

NAME _____ SCHOOL _____

INSTRUCTIONS: First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.

The _____ stings his enemies with _____ stinger in order to _____ his family. The poisonous _____ is pushed into the _____. The hooks on the _____ dig into the skin _____ hold tight so that _____ stinger pulls out of _____ bee when he flies _____. The movements of the _____ muscles in the stinger _____ it deeper into the _____ and squeeze the poison _____. The sting causes a _____ pain, and the poison _____ a swelling of the _____. The pain and the _____ are lessened if the _____ is scratched off quickly, _____ not as much poison _____ into the skin.

NAME _____ SCHOOL _____

INSTRUCTIONS: *First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.*

The bee _____ his enemies with his _____ in order to protect _____ family. The poisonous stinger _____ pushed into the skin. _____ hooks on the stinger _____ into the skin and _____ tight so that the _____ pulls out of the _____ when he flies away. _____ movements of the little _____ in the stinger push _____ deeper into the skin _____ squeeze the poison out. _____ sting causes a sudden _____, and the poison causes _____ swelling of the skin. _____ pain and the swelling _____ lessened if the stinger _____ scratched off quickly, for _____ as much poison gets _____ the skin.

NAME _____ SCHOOL _____

INSTRUCTIONS: First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.

The bee stings _____ enemies with his stinger _____ order to protect his _____. The poisonous stinger is _____ into the skin. The _____ on the stinger dig _____ the skin and hold _____ so that the stinger _____ out of the bee _____ he flies away. The _____ of the little muscles _____ the stinger push it _____ into the skin and _____ the poison out. The _____ causes a sudden pain, _____ the poison causes a _____ of the skin. The _____ and the swelling are _____ if the stinger is _____ off quickly, for not _____ much poison gets into _____ skin.

NAME _____ SCHOOL _____

INSTRUCTIONS: *First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.*

The bee stings his _____ with his stinger in _____ to protect his family. _____ poisonous stinger is pushed _____ the skin. The hooks _____ the stinger dig into _____ skin and hold tight _____ that the stinger pulls _____ of the bee when _____ flies away. The movements _____ the little muscles in _____ stinger push it deeper _____ the skin and squeeze _____ poison out. The sting _____ a sudden pain, and _____ poison causes a swelling _____ the skin. The pain _____ the swelling are lessened _____ the stinger is scratched _____ quickly, for not as _____ poison gets into the skin.

NAME _____ SCHOOL _____

INSTRUCTIONS: *First read the following paragraph carefully. Then go back and fill in each blank with the word you think should go there. Put only one word in each blank. Write or print as neatly and clearly as you can. Try to fill in each blank. Work carefully and check your work.*

The bee stings his enemies _____ his stinger in order
 _____ protect his family. The _____ stinger is pushed
 into _____ skin. The hooks on _____ stinger dig into the
 _____ and hold tight so _____ the stinger pulls out
 _____ the bee when he _____ away. The movements of
 _____ little muscles in the _____ push it deeper into
 _____ skin and squeeze the _____ out. The sting causes
 _____ sudden pain, and the _____ causes a swelling of
 _____ skin. The pain and _____ swelling are lessened
 if _____ stinger is scratched off _____, for not as much
 _____ gets into the skin.

APPENDIX 4

ABSTRACT OF

"The Effects of Syntactic Maturity and
Syntactic Complexity on Reading Comprehension:
An Empirical Test of Smith's Psycholinguistic
Theory of Reading"

APPENDIX 4

ABSTRACT OF

The Effects of Syntactic Maturity and Syntactic Complexity on Reading Comprehension: An Empirical Test of Smith's Psycholinguistic Theory of Reading¹

An examination was made of the effects of syntactic maturity and syntactic complexity on reading comprehension. Smith's psycholinguistic theory of reading was used as a framework for the following predictions: 1) that syntactically more mature students would be significantly better readers than syntactically less mature students, 2) that the syntactic complexity of the reading passage would significantly affect reading comprehension, and 3) that there would be a significant interaction between the independent variables of syntactic maturity and syntactic complexity as they affect reading comprehension.

A sample of 947 grade eight students was divided into a high syntactic maturity group and a low syntactic maturity group on the basis of a T-unit analysis of their written language. Syntactic complexity was manipulated through the use of a reading passage written at three different levels of syntactic complexity. Subjects were randomly assigned to

¹ Andrew R. Manning, doctoral thesis presented to the School of Graduate Studies of the University of Ottawa, Ottawa, 1977

one of the three syntactic complexity levels. The cloze procedure was applied to the reading passage to test comprehension. Data was analyzed by a two-way analysis of variance technique.

Results indicated support for Smith's contention that reading comprehension is dependent upon the syntactic maturity of the reader and the syntactic complexity of the reading passage. However, the results were not in the direction predicted by the theory and were interpreted as indicating that readers read best material written closest to their own productive syntactic level. The role of redundancy in Smith's theory was questioned in light of these results.

Practical implications and directions for further research are presented.