SKIMMING STRATEGY IN READING AS A FUNCTION OF FAMILIARITY WITH CONTENT AND REDUNDANCY REDUCTION IN PRINTED DISCOURSE

by

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ABSTRACT

The validity of the theory of skimming as a process of looking only at the key words in continuous discourse was investigated in the present study. The primary research questions raised were whether skimming by looking only at key words is an effective reading strategy and to what extent skimming is essentially a process of disembedding key words. Attention was also given to the relationship of familiarity with the content of stimulus passages to skimming performance.

The research design involved manipulating three independent variables: (1) Form of presentation of each of two stimulus passages (key words underlined; key words presented by masking the non-key words; original text with no key words identified; and no stimulus passage at all, the control group); (2) Levels of key words (three levels of redundancy reduction: syntactic, lexical and morphological, and anaphoric or discourse redundancy); and (3) Familiarity with content of the stimulus passage (pretest familiarity: Pretest and No-Pretest; and amount of background information: High, Middle, or Low Pretest scores).
The criterion measure for each stimulus passage was a set of multiple-choice questions which were administered as a pretest (Pretest group only) and as a posttest following the skimming task(s). The dependent variables were the posttest raw scores and the information gain scores (posttest score minus pretest score). Scores on the VanWagenen Rate of Comprehension Scale were used as a covariate.

Grade 11 subjects were randomly assigned to Pretest and No-Pretest groups in the first experimental session. Within these respective groups the Ss were randomly assigned to one of seven treatments for the second session at which the Ss were directed to skim two passages (science and history) under a time-limit condition.

The results of this study indicate that:

1. Familiarity with the content of the reading materials is one of the important factors involved in the skimming process. It was observed that familiarity with the content could be induced by exposure to a related pretest. In fact, skimming was effective only when there was cueing via exposure to the pretest and then only on the science passage. Overall, skimming did not appear to be an effective reading strategy on the history passage. As predicted, having a greater amount of background information did facilitate skimming on the science passage.

2. Elimination of non-key words did not affect skimming performance on the science passage at any level of redundancy reduction.
Therefore, since no significant effects were observed either due to having non-key words eliminated or to the amount of redundancy reduction (levels of key words), it was concluded that grade 11 Ss are able to gain information through skimming by looking only at key words in continuous discourse. Contrary to expectations, however, having key words identified did not facilitate skimming at any level of redundancy reduction. Consequently, skimming cannot be said to be essentially a process of disembedding key words.

3. There was no significant interaction between and among the three independent variables: forms of the passages, levels of key words, and amount of background information.

Implications of the conclusions for methods and materials to be used for instruction are that (1) some materials may not be appropriately skimmed; (2) while readers may be capable of skimming by capitalizing on the redundancy and predictability of the language, they apparently need instruction and practice in order to take advantage of these characteristics of the language in efficient information processing.

The relationship between skimming and other factors such as immediate or short-term memory and practice effect should be investigated.
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The present study was primarily concerned with research questions which relate to the skimming process in reading. Specifically, the investigation was designed to answer five questions:

1) Are students able to gain information through skimming by looking only at key words in printed discourse? An important corollary of this first question was whether skimming is, in fact, an effective strategy for gaining information from stimulus passages at all.

2) What is the relative effect upon skimming performance of reducing the amount of redundancy in discourse, or what is the optimum level of key words which can be used in skimming?

3) Is skimming strategy essentially a disembedding process?

4) Is skimming performance influenced by familiarity with the content of the stimulus passage?

5) What is the relationship between familiarity with the
content of the stimulus passage and the disembedding of key words in
the skimming process?

Skimming is defined, for the present investigation, as the
special reading strategy in which the reader does not look at or fixate
upon all the words on the printed page while processing information
at a reading rate in excess of 800 words per minute (wpm). It was
assumed that in skimming, the reader attempts to perceive the parts
of the discourse which convey more information and to refrain from
looking at the less informative parts. Previous studies involving eye-
movement photography have reported strong evidence that readers are
not able to fixate on every words when proceeding at rates in excess
of 600 wpm (Kolers, 1968) or 800 to 900 wpm (Taylor, 1965; Spache,
1962; Tinker, 1963a, b, 1950). On the basis of the evidence provided
by eye-movement photography, it has been concluded that readers are
necessarily skimming when they cover material at rates in excess of
600 to 900 wpm. It is conceivable, however, that some readers may
use a skimming strategy at rates below 600 wpm. Skimming, in the
present context, is distinguished from "reading," in which a person
tends to look at all or most of the words in the printed discourse
(Spache, 1962). Unless specified to the contrary, in this study, the
term reading is used in the generic sense of information-processing
from printed material without necessarily referring to the above-
mentioned distinction between skimming and "reading."
As noted above, skimming, by definition, requires the reader to refrain from looking at some of the words in the printed discourse. In general, the skimmer could refrain from looking at parts of each sentence, as in the strategy of looking at the key words, or he could refrain from looking at certain whole sentences, as in skimming by looking at topic sentences. Attention in the present study is given to the former alternative.

A remarkably small amount of empirical evidence regarding the nature of the skimming process has been reported to date. Whipple and Curtis (1917) and Grayum (1953) used observation and/or interview techniques in order to identify the strategies applied in skimming. The strategy of looking only at the key words was not recognized as an approach which skimmers used in either of these two studies. Moore (1955, 1962) used an eye-movement camera in his study of skimming and concluded that some of his subjects (Ss) may have been able to skim by looking only at the key words in the passages. To the present, the question of whether students are able to skim effectively by looking only at key words has not been answered. Yet, the writers of reading improvement manuals typically have encouraged the reader to try to skim by looking only at the key words in paragraphs and to refrain from looking at the non-essential words (Maxwell, 1969b; Spache and Berg, 1966; Leedy, 1968, 1963; Berg, Taylor and Frackenpohl, 1962; N. B. Smith, 1958). Although the process of identifying key
words is typically assumed to be intuitive, that is, no special training is needed, many students in high school and college have considerable difficulty in using the key-words approach to skimming (Maxwell, 1969a).

In the present study, the term key words, refers to those words which are relatively more information-bearing and tend to be essential for conveying the message of the continuous discourse. They are the words which have semantic content, not merely those words which form the topic of the sentence. Key words are determined by identifying those words which are redundant in the discourse. Redundant words are considered to be relatively less information-bearing and are referred to as non-key words in this study. Non-key words are defined here as those categories of words in continuous discourse which are redundant at the syntactic, lexical, morphological or anaphoric levels according to modern linguistic theory. Redundancy is defined as the degree to which language is predictable when only parts of it are known. In practice, redundancy reduction in a specific discourse was accomplished by increasing the number of non-key words which were identified or deleted. In turn, the process of increasing the number of non-key words resulted in a decrease in the number of key words remaining in the given discourse.

The term "key words" is understood to denote a relative concept rather than one that is absolute. It is not known whether there exists, in fact, an absolute designation of the ideal minimum number
of key words in a specific discourse. It can be argued that individuals differ in the number and selection of key words which they require for accurate and effective information processing. It was assumed in the present study that levels of key words were reasonable approximations of the "ideal" selections of key words which the typical reader might employ in the process of skimming. This assumption allowed for the possibility that the "ideal" level of key words could include some redundant words. Levels of key words in this investigation were treated as discrete approximations. Thus, some categories of redundant words were designated as non-key words at one level, but were identified as key words at another level. The relationship between levels of key words and non-key words is further delineated in Chapter II.

Theoretical Rationale and Related Literature

As an essential part of the first research question regarding the ability of students to skim by looking only at key words, it was necessary to assess whether skimming was, in fact an effective strategy for gaining information from the passages at all. The results of previous studies by Moore (1956, 1962) and Grayum (1952) have suggested that individuals in high school and college are able to skim effectively. Moore (1962) concluded that Ss who were able to skim effectively were able to score on a comprehension test as well as or better than Ss who were generally slower readers (i.e. they did not skim the passages). It must be pointed out, however, that Moore did
not control the differences in the amount of previous knowledge which
his Ss had and that the Ss in his study included 84 females and only 11
males, with ages of the Ss ranging from 19 to 58 years. On the other
hand, Hill (1964), A.C. Smith (1963), and Maxwell (1969), among others,
have observed that students do not necessarily skim effectively when
directed to do so, even when given a limited purpose such as finding
the main idea. In view of the conflicting and inconsistent previous
findings, it was necessary to determine whether the Ss in the present
study were able to skim the passages effectively.

The theory of skimming as a process of looking only at the key
words is supported by the study of the English language. The elimination
of non-key words from typical discourse in English is possible without
diminishing the quality of the message because discourse typically
includes more signalling devices than are absolutely necessary. This
repeated information, or redundancy, is frequently necessary or at least
desirable because of what has been called "noisy communication channels"
by information theorists (Shannon & Weaver, 1948). In practice, noise
refers to distractions, interruptions or moments of inattention
and the like, on the part of the decoder or reader. Shannon (1948)
observed that a competent subject could reconstruct passages from which
50 per cent of the letters had been deleted. From this fact Shannon
concluded that English has a redundancy of at least 50 per cent. Miller
and Friedman (1957) have supported this deduction. However, Herdan
(1965) has presented strong objections to treating vocabulary items as
letters or phonemes. Miller and Chomsky (1963) have expressed a similar view. More recently, McLeod and Anderson (1970) have pointed out that calculations, such as were made by Shannon for letters and phonemes, have not been made for word distribution or word dependency. Indeed, according to Herdan's (1965) argument it is virtually impossible to make calculations of this sort for the word dependencies or redundancy of words in the English language.

Common experiences with the English language lead the language user to conclude, however, that the amount of redundancy in strings of words, sentences or sentence constituents, must be high, even if the exact quantity has not been measured as precisely as it has for strings of letters or phonemes. Language users are readily able to recover missing words in the following examples: "The solar system ____ held ____ by two forces ____ balance each other." [is, together, which]; "Cabral ____ blown off ____ course." [was, his]. That the language user is able to restore a range of highly predictable words in such cases is evidence of the redundancy in discourse.

While a surface string or words may include many redundant words, the string may, paradoxically, be a reduction of a much more complex structure which contained even more words. This suggests that the process of redundancy reduction is an innate characteristic of the language. It is generally accepted that the language user is
able to delete redundant words as a natural part of his linguistic competence. The language user is able to encode and decode messages with a minimum number of words as in a telegram and he is also able to interpret headlines in newspapers without any special training.

Conversely, another feature of human linguistic behavior seems to be the ability to expand expressions which are ambiguous due to their brevity. For example, if a person hears the statement, "I don't like riding horses," he may expand it to "(you mean) you don't like to ride horses yourself or you don't like horses when they are being ridden or horses that can be ridden, period." The feature of expansion in order to minimize ambiguity, like that of deletion for the purpose of minimizing redundancy, seems to be part of the native language speaker's intuitive competence, not merely a process or skill acquired after learning externally-taught rules.

The two apparently contrary features, deletion and expansion, depend upon a distinction between referential and non-referential words. Both the deletion and the restoration of words in a string involve words which provide structural rather than referential information. The distinction between structure words and reference words has been made by grammarians of all linguistic complexions ("independent sense units" in Sweet, 1891; "form class words" in Fries, 1952; "complex symbols" in Chomsky, 1965). Referential words, which name objects, concepts and relations and are traditionally classified as nouns, verbs, adjectives
and adverbs, form an indefinitely large class of words, whereas structure words form a small, finite class. It is for this reason that the distinction between referential and non-referential, or structural, words is crucial for a discussion of linguistic redundancy. It follows, then, that the frequency of the two categories of words in discourse differs greatly. As a class, reference words comprise 60 per cent of discourse (Herdan, 1965); however, the individual word frequency is relatively low and is necessarily a function of the subject matter in the discourse. On the other hand, although a small number of words make up the class, structure words form 40 per cent of discourse. Consequently, since structure words have a much higher frequency, they are considerably more predictable than referential words. Rankin (1957) investigated the predictability of structural and lexical units and reported that structural words were decidedly more predictable than lexical words.

Strickland (1962) and Loban (1963) have independently observed that children exhibit skill in using language patterns that are far more complex than was previously recognized. Salzinger and associates (1966) demonstrated that children at three years of age were sensitive to the syntactical structure of sentences and that they could use their insight in encoding and ordering sequences.

Thus, after having considered both the nature of the language and the capabilities of language users, it was reasonable to expect that students would be able to skim material by looking only at the key words in the discourse.
An objective procedure for identifying key words was a prerequisite for an investigation of skimming as a function of the use of key words. Specifically, in order to answer the second major question in the present study regarding the relative effect upon skimming of reducing the amount of redundancy in the stimulus passages, it was necessary to identify several degrees of redundancy reduction. It should be recalled that reducing the amount of redundancy in discourse was achieved, by definition, through increasing the number of non-key words. Therefore, on the basis of modern and traditional linguistic theory, three categories of non-key words were determined by identifying the words in the discourse which were: (1) syntactically redundant; (2) lexically and morphologically redundant; and (3) anaphorically redundant within pairs of sentences (also referred to as "discourse redundancy"). These three categories of non-key words were combined cumulatively to establish three levels of key words, such that for Level 1 only syntactic redundancies were eliminated; for Level 2, the lexical and morphological redundancies as well as the syntactic redundancies were eliminated; for Level 3, all three categories of redundancies were eliminated in order to determine the smallest number of key words.

Prior to the present study, there was apparently no formalized qualitative procedure available for identifying key words and non-key words in continuous discourse. Claims have been made for using the cloze technique as a measure of redundancy (Taylor, 1954). A pilot study involving the analysis of cloze scores for each word in a
A 1,000-word passage was carried out by the present investigator as an early attempt at determining key words objectively. The cloze scores were obtained by administering five different cloze forms of the passage. By deleting every fifth word and replacing it with a regular-sized, underlined space, each word in the passage appeared as a cloze item in one of the five forms. These cloze tests were administered to grade eleven students who were assigned at random to the various forms, (N=150). The cloze items were scored for exact-word restorations and for synonym restorations. The proportion of Ss correctly restoring each item was calculated. The results of this pilot study revealed that the cloze procedure was unsatisfactory as a procedure for determining key words in a continuous prose passage. This procedure for identifying key words/non-key words or discourse redundancy was rejected primarily because, at best, it appeared to discriminate only at the extremes, where the most obvious distinctions could be made intuitively, and it clearly included as key words a significant number of items which would typically be considered to be non-key words at any level. Even more problematical was the fact that the cloze procedure identified as non-key words a significant number of words which would necessarily be considered to be referents (essential for conveying the meaning) in the discourse. It may be pointed out here that it appears to be the difference in the function of the referential and non-referential words, discussed in detail previously, and therefore in the relative frequencies, along with the extended range of dependencies which naturally occur
among words in sentences, that makes the cloze technique an inappropriate procedure for measuring redundancy in discourse.

It was therefore decided that the most appropriate procedure for identifying the key words in continuous prose passages was to apply independently-motivated linguistic theory, both traditional and modern, but especially as presented by Fries, Lyons, Chomsky, Katz, and Miller. The algorithm and motivation for selecting the key words are presented subsequently.

Research relating to the effect of redundancy in discourse upon reading performance is very meagre. Morton (1964) demonstrated that the amount of redundancy, which he refers to as contextual restraint, affected the speed of reading 200-word passages of statistical approximations. The faster readers in Morton's study were able to take significantly more advantage of the redundancy in the passages than were the slower readers. While Morton's findings, in general, support the expectation that readers can take advantage of redundancy when reading, it must be stressed that the stimulus passages were statistical approximations rather than regular discourse, and that the task involved was oral reading of relatively short selections.

Bever, Mehler, and Carey (1967) studied the effect of surface phrase structure and deep phrase structure on eye-fixation patterns of adult readers and, after concluding that the entire surface phrase structure hierarchy of sentences influenced visual scanning patterns in
familiar material, suggested the possibility of a general eye-fixation rule for predicting the pattern of adult eye-fixations in reading predictable sentences. The rule postulated is "fixate on the first half of each constituent." While Bever and associates recognized that they built the rule on a small amount of data, there are implications for the present study in that the rule suggests that the mature reader can and does use some restraint or selectivity in visual perception, not as a matter of direct or conscious control, but rather in response to the language and its predictability. Yet, many investigators have found that readers typically look at every word in the material being read (Taylor, 1965; Hill, 1964; A.C. Smith, 1963).

The third major purpose of the study was to determine whether skimming is essentially a disembedding process. This aspect of the investigation was concerned with the issue of whether Ss are able to use a kind of visual restraint, or selective perception, whereby they look only at the key words in the printed discourse. If skimming is essentially a disembedding process, it was reasoned that skimming would be facilitated by having the key words disembedded and that it would not be necessary for skimmers to look at non-key words, since, by definition, the non-key words were redundant and therefore relatively less information-bearing. If skimming is not essentially a disembedding process, then having the key words disembedded would not facilitate the skimming process and looking at the non-key words may be advantageous in information-processing.
The fourth major concern of the study was to determine whether skimming is influenced by the amount of familiarity or prior knowledge which the reader has about the content of the reading material. Familiarity with the content of the passages has two aspects. One aspect of familiarity refers to exposure to a pretest, a set of questions relating to the content of a stimulus passage; the pretest, of course, is administered prior to any presentation of the stimulus passage. The second aspect of familiarity is the amount of information which individuals have about the subject matter or content of stimulus passages prior to exposure to them. The first feature of familiarity refers to the fact of answering the pretest questions, as opposed to not being exposed to the questions. The second aspect refers to the size of the score on the pretest, insofar as the score represents the individual's real prior understandings. For the sake of clarity, in this study the term pretest familiarity is used to designate the familiarity, or cueing, which may result from exposure to a set of questions relating to a stimulus passage prior to the presentation of the passage; background information is used to refer to that aspect of familiarity which relates to the actual amount of prior knowledge about the subject matter of a given stimulus passage.

The amount of background information is commonly considered to affect reading performance (Kingston, 1960; McDonald, 1963). The argument is that the reader who has background information about the subject matter of a passage will find the material easier to read than a person who has little background information about the topic. Weaver (1967) has suggested that reading in most situations is actually a "selecting of the parts of what we already know." Reading in
this sense becomes essentially a process of confirming what the reader already knows, particularly if the reader is responding primarily to the cues in the material about which the person already has information. Weaver's point of view may be more relevant to the process of skimming, or rapid and efficient reading in general, than it is to reading carefully and intensively, or to reading slowly. Certainly, a reader must, at the least, know the meanings of referential words in a passage and be able to make some appropriate associations among the meanings to gain information from the printed discourse. Otherwise, decoding printed discourse is not possible at all, for reading necessarily requires some level of background information. Familiarity with the content of the material, i.e., background information, has not been investigated as a factor which affects a reader's ability to cover words in specific passages at a speed which would be considered to be skimming.

Reading comprehension has typically been measured without ascertaining the amount of previous information which Ss had about the subject matter before reading the material (Kingston, 1960). Since it is known that individuals vary greatly in the amount of background information which they possess, it is readily conceivable that two persons could obtain the same score on a comprehension test after reading a given passage even though they differed significantly in the amount of specific background information which they had before reading the passage. One person may have gained a great deal of information from reading, while the other person may have gained very
little information that he did not possess prior to reading. It is extremely important, therefore, to assess the amount of previous information which readers have before reading in order to determine the amount of information gained from reading (Rankin, 1965). Information gain is measured by administering a pretest as well as a posttest of comprehension. The information gain score is calculated by computing the difference between the pretest score and the posttest score for each individual.

Exposure to a pretest, however, can be a confounding variable in research (Campbell and Stanley, 1963). It can be argued that exposure to a set of questions relating to the content of a stimulus passage may cue a reader to look for specific answers to questions when he subsequently reads the passage. Likewise, exposure to a set of related questions may affect a person's response patterns to parts of the discourse during the act of reading or skimming.

Rothkopf (1966), Rothkopf and Bisbicoes (1967), Bruning (1968) and Frase (1967), in their studies of mathemagenic behavior, or "learning" from prose materials, have concluded that questions presented prior to reading generally do not facilitate comprehension or "learning." Carver (forthcoming) challenged the conclusions drawn by Rothkopf and Frase on the grounds that they have failed to control two important variables, learning strategy and learning time. If the presentation of relevant or adjunct questions just prior to reading a passage does not have a facilitating effect upon reading performance,
then it would seem unlikely that exposure to a pretest would affect reading performance when there is a lapse of time, say several weeks, between the pretest and the posttest, the latter being taken immediately after exposure to the stimulus passage. Karlin and Jolly (1965) found that exposure to a pretest did not affect posttest scores when there was a time lapse of several months. They observed the same results when the pretest and posttest were exactly the same form of the test as when an alternate or "equivalent" form was used. Ware and Bowers (1969) found that the pretest did not influence achievement on the posttest. Despite the findings of previous studies, the Ss involved in a pilot study related to the present investigation frequently indicated that they could remember questions that were part of the pretest, even after a time lapse of more than two weeks. Further, some of the Ss indicated that their having previously answered the pretest questions had helped them to gain information when they skimmed the stimulus passages. For this reason it was considered desirable to determine the possible effect of the pretest on skimming performance.

The fifth, and final, purpose of the study, as a consequence of considering the previous two questions concerned with the disembedding and familiarity factors, was to determine whether there is a relationship between the familiarity factor and the disembedding factor. It can be argued that the person who has a better idea of what specific information he is going to try to find in the passage will have an advantage over the person who has no such prior knowledge of what
to expect or of what to look for when he skims material which he has not previously read. It is also reasonable to expect that the person who brings more related background information to the reading situation will have an advantage because the background information may serve to direct attention to those bits of information which are not familiar. Further, familiarity with the content may assist the reader in making associations or responses to selected bits of information. The reader who has superior background information is likely to be able to spend more of his reading time in confirming his expectations or predictions, which follow out of his awareness of what he already knows. Similarly, he will likely find it easier to observe significant or new relationships among elements in the passage.

On the other hand, the person with little or no prior information about the topic presented in the stimulus passage will likely have more difficulty in making predictions about the content and therefore will be able to confirm fewer expectations (he will, no doubt, be able to make fewer predictions). Similarly, the person with less background information will be more apt to have difficulty in directing his attention toward the bits of information which he seeks, particularly since he apparently would have many more decisions and responses to make with respect to the referential elements presented in the discourse.

Ausubel and Fitzgerald (1962) studied the effect that knowledge
of a first passage of explicitly unfamiliar material had upon learning
the content of a second passage which was sequential and informationally
related to the first passage. The results of the investigation supported
the point of view that the reader needs to have informational referents
in order to process the information.

It was anticipated that there would be a significant interaction
between the amount of familiarity with the content of the passages and
the disembedding process, if skimming is determined to be essentially
a disembedding process. It was thought that both factors would tend to
make the skimming process less complex and therefore less demanding,
since disembedding the more information-bearing words would enable
the skimmer to spend his time in processing those bits of information
which were not familiar to him.

Summary

Based upon characteristics of the English language,
particularly its redundancy and predictability, along with the intuitive
capabilities of the competent language user, it seemed reasonable to
expect readers to be able to skim passages by looking only at the key
words in the discourse. In general, it followed that redundancy
reduction and greater familiarity with content would reasonably
facilitate the skimming process.

The specific expectations and methodology for securing the
data required to answer the research questions formulated in the study are presented in Chapter II.
Experimental Design

In order to answer the research questions raised in the study it was necessary to manipulate three independent variables: (1) the levels of key words; (2) the forms of presentation of the stimulus passages; and (3) familiarity with the content of the stimulus passages.

Levels of key words. Fundamental to the implementation of the study was the development of a rationale and objective procedure for identifying key words in continuous discourse. As noted previously, the selection of key words was made by a systematic process of redundancy reduction which involved identifying three categories of non-key words as follows: (1) recoverable syntactic redundancies $z$; (2) the recoverable lexical and morphological redundancies $y$; (3) the recoverable anaphoric, or discourse, redundancies within pairs of sentences $x$. Then, in order to establish the three levels of key words desired to determine the relative effect of redundancy
reduction on skimming, the three categories of non-key words were deleted in a cumulative manner, so that key words at Level 1 were determined by eliminating the non-key words in category I; key words at Level 2 were identified by eliminating the non-key words in categories 2 and 1; and the key words at Level 3 were selected by eliminating the non-key words in categories 3, 2, and 1.

The relationships of the key words and non-key words at the three levels may be represented by the following formulas:

\[
\begin{align*}
\text{Level 0} &= w + x + y + z \quad \text{(no key words identified)} \\
\text{Level 1} &= w + x + y - (z) \\
\text{Level 2} &= w + x - (y + z) \\
\text{Level 3} &= w - (x + y + z),
\end{align*}
\]

where \( w \) represents the theoretical or "ideal" minimum number of key words in a given discourse and \( x, y, \) and \( z \) refer to the categories of redundancy identified above. Thus it can be clearly observed that the number of key words identified decreased from Level 1 to Level 3, while the number of non-key words, inversely, increased.

The algorithm used for determining the non-key words and key words is given next. A more detailed explanation and motivation of the procedure for determining the key words in continuous discourse is given in Appendix E. The explanation given therein is based upon a forthcoming article by Bowers and Nacke.
Non-key words, Category 1. The following classes of words were identified as non-key words in Category 1:

1) the verb *to be* in any inflection;
2) all verbs *to have*, *to do*, and modals *will*, *may*, and *shall*;
3) all determiners and possessive pronouns;
4) all relative pronouns, (*e.g.* *who*, *whom*, *whose*, *which*, *that*, *whence*, etc.);
5) the conjunction, *and*, *but*, *not only*, *also*, *but also*, *yet*, *thus*, *therefore*;
6) *of* in all instances;
7) *to* when used in the case of the infinitive;
8) *that* when used to introduce noun clauses.

Non-key words, Category 2. Non-key words in Category 2 were identified as follows:

1) Delete empty phrases, such as *in general*, *occasionally*, etc.,
2) First designate the immediate constituent elements in the sentences according to Phrase Structure Rules (*Chomsky*, 1957, 1965) and compute the successively greater groups, beginning with the smallest immediate constituent elements.
a) Then, identify the semantic redundancies within each group and at each level by letting features, $f_1^, f_2^, f_3^$, in one item cancel $f_1^, f_2^, f_3^$, in a second or third item. An item is considered to be dispensible if its features are wholly included in the set of features of another item.

b) Also, identify the syntactic redundancies according to the contextual and selectional rules (Chomsky, 1965) and by the transformational deletion rules and delete all syntactic redundancies, unless ambiguity arises, on a principle of conservation, i.e., retain the smallest number of words. This procedure includes extra positions and clefts.

Non-key words, Category 3. The non-key words in Category 3 were identified as follows:

1) Identify anaphoric references within sentences and between pairs of sentences; then delete the second referring item.

2) Delete items recoverable from the regular topic of the paragraph. [This is not likely to be
Forms of passages. To answer the first major question, whether Ss are able to gain information by looking only at the key words in continuous prose passages, and to answer the third and fifth questions relating to skimming as a disembedding process, it was necessary to create the condition whereby non-key words in the discourse were eliminated from the printed text by a process referred to as masking \[M\]. By masking the non-key words, only the key words, at a given level, were presented in the context with blank spaces resulting from the masking of the non-key words. Three different masked forms were prepared so that only the key words at each of the three levels were presented in a specified form of each passage.

So that the third and fifth questions regarding skimming as a disembedding process could be answered more definitively, it was essential that an additional variation in the form of presentation of the stimulus passages be used. This form of presentation was implemented by underlining \[U\] the key words at each of the respective three levels of key words. The key words underlined in one form were exactly the same as the words presented in the corresponding masked form. Therefore, the underlined forms of the passages differed from the masked forms essentially only in that the non-key words, at the specified level, were not masked in the underlined condition.
By providing the underlined forms of the passages it was possible to determine the effect of the non-key words on skimming performance and to assess whether skimming is facilitated by perceiving only the key words.

A third form of presentation of the passages was required for all aspects of the study. This was the condition in which the passages were presented in their original forms, that is with no masking of non-key words and no underlining of the key words. This form of presentation of the passages served as an essential comparison group with which the features of the other forms of the passages could be evaluated. In this way, the effect of having the key words identified, as in both the masked and the underlined forms, as well as the effect of the non-key words in their respective cumulative categories could be considered. The original form of the passage was also considered to be Level 0 of key words.

Familiarity. The third independent variable was familiarity with the content of the stimulus passages. As previously discussed, familiarity was considered to have two aspects: (1) pretest familiarity; and (2) amount of background information. It was deemed essential to consider both aspects of familiarity in order to assess the amount of information gain due to skimming and to analyze the possible cueing effect due to exposure to the pretest.
The Extra Control Group. The corollary of the first major question was concerned with whether skimming is, in fact, an effective strategy for gaining information. A special condition was required in order to answer this question. Therefore a situation in which Ss did not skim any passages, either before or after the pretest, was created. Instead of skimming the passages, Ss in this group, which is referred to as the No-Passage group, were engaged in a "dummy" activity for the period of time corresponding exactly to the amount of time which the other groups of Ss spent in skimming. The "dummy" activity was concerned with responding to simple mathematical items and, thus, was completely unrelated to the stimulus passages. Through the implementation of the No-Passage condition it was possible to compare and evaluate the posttest performance of the groups of Ss who skimmed the passages with the performance of the No-Passage group which did not skim the passages.

Figure 1 summarizes the plan of collecting data required to answer the research questions formulated in the study. The plan involved fifteen different treatment conditions. Treatment conditions 8 through 14 corresponded, respectively, to treatments 1 through 7 except that groups 1 through 7 answered the pretest batteries of questions [Pretest groups], while treatments 8 through 14 did not answer the pretest questions [No-Pretest groups]. Instead, the No-Pretest groups answered a completely unrelated battery of questions during the given period of time. The Ss in the extra control group [No-Passage] were exposed to the pretest.
1. FORM OF PASSAGES

<table>
<thead>
<tr>
<th>Original Passage (Or)</th>
<th>Underlined Passage (U)</th>
<th>Masked Passage (M)</th>
<th>No-Passage (control)</th>
</tr>
</thead>
</table>

2. LEVELS OF KEY WORDS

<table>
<thead>
<tr>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>(Level 4)</th>
</tr>
</thead>
</table>

3. FAMILIARITY

<table>
<thead>
<tr>
<th>Pre-Test</th>
<th>No-Pretest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi</td>
<td>T_1</td>
</tr>
<tr>
<td>Md</td>
<td>T_8</td>
</tr>
<tr>
<td>Lo</td>
<td></td>
</tr>
</tbody>
</table>

FAMILYRITY involved two aspects:

(a) Pretest familiarity (Pretest, No-Pretest);

(b) Background information (Hi, Md, & Lo Pretest Scores)

FIGURE 1. Experimental design involving three independent variables plus one extra control group.
The fifteen treatment groups were labelled by Pretest/No-Pretest pairs as follows:

Treatments 1 & 8: (To be denoted as $T_1$ & $T_8$) Complete text was presented with no masking of non-key words and no underlining of key words; no key words identified, Level 0 of key words; Original [Or] form of passage.

Treatments 2 & 9: ($T_2$ & $T_9$) Complete text presented as in $T_1$ & $T_8$; with key words at Level 1 underlined [U]; no non-key words were masked.

Treatments 3 & 10: ($T_3$ & $T_{10}$) Only key words at Level 1 were presented; non-key words in category 1 (z) were masked [M].

Treatments 4 & 11: ($T_4$ & $T_{11}$) Complete text presented with key words at Level 2 underlined [U]; no non-key words were masked.

Treatments 5 & 12: ($T_5$ & $T_{12}$) Only key words at Level 2 were presented; non-key words in categories 1 and 2 (z and y) were masked [M].

Treatments 6 & 13: ($T_6$ & $T_{13}$) Complete text presented with key words at Level 3 underlined [U]; no non-key words were masked.
Treatments 7 & 14: \((T_7 & T_{14})\) Only key words at Level 3 were presented; non-key words in categories 1, 2, and 3 \((z, y, \text{and } x)\) were masked \([M]\).

Treatment 15: No exposure to the stimulus passage(s) either before or after the pretest \([\text{No-Passage}]\).

Hypotheses and Specific Expectations

**Hypothesis 1.** Ss who skim a passage will perform significantly better on the posttest than Ss who do not skim the passage.

It was anticipated that Ss who skimmed a stimulus passage would gain a significant amount of information and that they would achieve significantly higher scores on a criterion measure (posttest questions) than Ss who answered the posttest questions without being exposed to the stimulus passage. When the information gain scores (posttest score minus the pretest score) were considered for those Ss who responded on both the pretest and the posttest, the comparison of the groups which skimmed the passages with the No-Passage (no skimming) group was expected to support the expectation that the Ss would be able to gain a significant amount of information through skimming. Any group of Ss which did not perform significantly better than the No-Passage group was considered to have been ineffective in skimming the passages.
Hypothesis 2. Ss who are exposed to the pretest (Pretest groups) will achieve higher scores on the posttest after skimming the related passage than Ss who are not exposed to the pretest (No-Pretest groups).

It was expected that those Ss who responded to the questions related to the stimulus passage as a pretest would have an advantage over those Ss who did not respond to the pretest questions prior to skimming the stimulus passages. It was decided that if the performance of the Pretest groups was significantly superior to that of the No-Pretest groups, then it must be concluded that familiarity with the passage had been induced by exposure to the pretest. The alternative results, i.e., that the No-Pretest groups would perform as well as or better than the Pretest groups, would be interpreted as evidence that there was no familiarizing effect due to exposure to the pretest, or, most unlikely, that exposure to the pretest had a deleterious effect upon the skimming task.

Hypothesis 3. Ss who have a greater amount of background information (higher pretest scores) will perform significantly better on a skimming task than Ss who have less background information (lower pretest scores).

The amount of background information was expected to affect skimming performance as a beneficial effect for those Ss who achieved higher scores on the pretest. If the outcome was that Ss with a high amount of background information did not perform significantly different on the posttest from Ss who had a low amount of background information then there was no effect due to familiarity with the subject
matter. The other possible outcome, that Ss with low background information would perform better than Ss who had a high amount of background information, would be more difficult to relate to current theory and expectations. It is conceivable that Ss who already knew a great deal of information about the subject matter may not have been as attentive and may have adopted a mental set which allowed attention to stray.

Hypothesis 4. Ss who skim passages in which key words are identified \([M, U]\) will perform better than Ss who skim passages in which key words are not identified \([O]\).

Hypothesis 5. Ss who skim passages in which non-key words are not presented \([M]\) will perform as well as or better than Ss who skim passages in which non-key words are presented \([U]\).

It was assumed that the Ss who skimmed the presentations of passages in which non-key words were masked would have the advantage that the key words had already been disembedded, since only the key words were presented; therefore, the Ss could not spend time in looking at those words which were relatively less information-bearing (i.e., at the non-key words). The possible disadvantage of the masked forms \([M]\) of presentation of the passages was that the Ss did not have available the complete text of the passage as normally presented in printed materials. This, theoretically, was not expected to cause problems for the reader in that the redundant words were eliminated on the basis of the study of the native language user's
intuition. Yet, in practice it is possible that individuals may have needed to perceive some non-key words in case uncertainty or ambiguity arose due to the "noise" discussed above.

In the forms of presentation of the passages in which the key words were underlined, the reader again had the advantage that the key words were already disembedded for him by virtue of the fact that only the key words were underlined. As in the masked forms of the passages, the reader could have looked only at those words which had been emphasized by being underlined. At the same time, however, since all words of the original text were presented in context (i.e., no masking of non-key words), the reader was able to look at those words determined to be non-key words if he felt the need to perceive such words in the event of uncertainty or ambiguity. A possible disadvantage of the underlined forms was that the reader may have looked at more words than were actually needed in order to gain the information in the discourse and he would thereby have used processing time inefficiently. The common advantage of the underlined and masked forms was that the key words were disembedded.

The original form of the passages had no underlining of the key words and no masking of the non-key words. Therefore, the readers of the original form of the passages did not have the advantage of having the key words already disembedded for them. On the other hand, since no words were available for clarifying any uncertainties or ambiguities
if necessary for processing the information in the discourse. This was
the advantage which the original forms and the underlined forms had in
common.

If skimming strategy is essentially a matter of disembedding the
key words from context without looking at the non-key words, it was
expected that Ss would gain as much or more information from skimming
the masked forms \([M]\) of the passages than from skimming the original
form \([Or]\) or the underlined forms \([U]\) of the passages. This result
would support the theory of skimming as a process of looking only at the
key words.

If Ss who skimmed the non-masked forms of the passages
\([Or\ and\ U]\) performed better than Ss who skimmed the masked forms \([M]\)
then it would be necessary to conclude that looking only at the key words
in the continuous discourse did not facilitate skimming.

The possible result that the Ss who skimmed the underlined
forms \([U]\) would perform better than either the Ss who skimmed the
masked forms \([M]\) or the original forms \([Or]\) was considered to be
evidence that at least some of the non-key words (redundancies) aided
the information processing, but that skimming was facilitated by
disembedding the key words.

If Ss performed less well on the underlined forms \([U]\) than on
masked forms \([M]\) or the original forms \([Or]\), this would be evidence
that Ss did not take advantage of the underlining (disembedding) of the key words and also that they may have spent time looking at non-key words.

While it was anticipated that Ss would gain as much or more information from the underlined forms and from the masked forms than from the original forms, the converse results (U + M < Or) would have been considered to indicate that skimming was not facilitated by the identification of the key words and therefore that skimming is not essentially a disembedding process.

**Hypothesis 6.** Reducing the degree of redundancy in a passage will facilitate skimming performance; i.e., skimming performance on passages with fewer key words will be as good as or better than on passages with a larger number of key words.

As discussed previously, it was assumed that the various levels of key words used in the study were reasonable approximations of the "ideal" selection of key words in specific discourse, since each discrete level of key words was determined by a process of redundancy reduction which was based upon theories of the nature of language.

With respect to the possible facilitating effect of the various levels of key words upon skimming performance, it was reasoned that if Ss were able to gain as much information or more at Level 3 than at Levels 2, 1 and 0, then the non-key words at Level 3 were not essential for skimming the passage; if the converse resulted, it would indicate
that at least some of the non-key words at Level 3 were, in fact, needed for skimming. Similarly, if Ss who skimmed at Level 2 were to gain as much information or more than Ss who skimmed at Level 1 and Level 0, it would be concluded that at least some of those key words eliminated at Level 2 were not an aid to skimming. Again, the converse conclusion would be required in the event that Ss performed better at Level 1 than at Level 2. While it was anticipated that Ss who skimmed at Level 3 would perform as well as or better than Ss who skimmed at Levels 2, 1, and 0, it was thought that a reasonable alternative could be that Ss would perform better at Level 2 than either Ss at Level 3 or Level 1. It was conceivable that perhaps too much of the redundancy had been removed at Level 3, so that there was more uncertainty and ambiguity than the Ss could handle effectively. On the other hand, it was observed that the number of non-key words at Level 1 may possibly have been so minimal as to have had little or no facilitating effect.

Superior performance at Level 0 over all other levels would indicate that the non-key words did facilitate the skimming. As discussed above, since Level 0 is also the original form of the passage, such results would also indicate that skimming was not essentially a disembedding process.

No significant differences among the various levels of key words would be interpreted as support for the superiority of the level with the smallest number of key words.
Hypothesis 7. Under the conditions where key words are disembedded by either underlining or by masking the non-key words, Ss who have a higher amount of background information will perform better on the skimming task than Ss with a lower amount of background information, especially under the higher levels of redundancy reduction.

[Note: third-order interaction among and between familiarity, forms of passage and levels of key words.]

It was anticipated that Ss with higher background information would perform better when the larger number of non-key words were eliminated and that this performance would be superior to that of Ss with lower background information.

Subjects

The experimental population consisted of 312 students in grade eleven at Carson Graham Senior Secondary School, North Vancouver, B.C. The Ss included the total school population in grade eleven except for the absentees on the day of the present session and the absentees on the day of the posttest session.

The school in which the experiment was conducted serves students from the entire North Vancouver school district since it does not have restricted attendance zones. The school population may be considered to represent the range of socio-economic-intellectual traits of the city.

The Ss were randomly assigned either to the Pretest or No-Pre-test groups for the initial pretesting session. Ss within their
respective groups (Pretest and No-Pretest) were then randomly assigned to treatments for the second session during which the Ss were asked to skim two stimulus passages. All Ss answered the corresponding set of questions (posttest) immediately after skimming a passage.

Ss in the special control group were those Ss in the Pretest group who were randomly assigned to the special condition in which they answered the posttest questions in the second session without having skimmed either passage.

Stimulus Passages

Two stimulus passages were used in the study. One passage was of a scientific nature and dealt with the solar system. The source of this material was "To the Moon and Beyond," *A Book of Popular Science Teacher's Guide* by Grolier, Inc. This selection is included in the book *Skimming and Scanning* by Berg, Taylor, and Frakenpohl, Educational Developmental Laboratories. The other passage, in the area of social studies, was concerned with the age of exploration. This material was taken from *Civilization, Past and Present*, Part I, by T. Walter Wallbank and Alastair Taylor, Scott Foreman and Company, Third Edition, 1954, pages 574-576. The publishers kindly granted permission to adapt and use the material for research purposes.

Table I shows the number of words in each selection, the Flesch reading ease score obtained by applying the Flesch formula to the entire passage in each case, and the grade level assigned by Flesch
to the respective scores. Flesch translated the reading ease scores ranging from 60 to 70 as grade levels 7 to 8 with the lower score representing greater degree of difficulty. The decision to use passages with a readability level below the grade placement of the Ss in the experiment was based upon the desire to minimize the effects of level of difficulty and general reading achievement.

**TABLE I**

**NUMBER OF WORDS, FLESCH SCORE AND GRADE LEVEL OF STIMULUS PASSAGES**

<table>
<thead>
<tr>
<th>Passage</th>
<th>No. of Words</th>
<th>Flesch Reading Ease Score</th>
<th>Grade Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>1400</td>
<td>64.30</td>
<td>7 - 8</td>
</tr>
<tr>
<td>History</td>
<td>1400</td>
<td>63.48</td>
<td>7 - 8</td>
</tr>
</tbody>
</table>

In addition to having comparable readability levels, as indicated by the Flesch scores above in Table I, the selections were also parallel in their overall progression of ideas, since each began with an introductory section followed by sections discussing either the planets and other heavenly bodies or the various explorers.

The two passages were presented in exactly the same format
with regard to type size, arrangement and number of lines of print per page. Exactly one-seventh of the text of each 1,400-word passage was printed on each of the seven pages for each selection. The division was made on the basis of the total number of lines of print rather than putting exactly 200 words per page. In this way there were no partial lines of print at the ends of the pages due to an artificial restriction.

The print and basic layout are considered to be representative of that found in the typical textbook, except that there was only one narrow column centered on the page.

Both passages were printed in 9 point Press Roman type face with 4 point leaded on 100 pound Island Hilite Book stock. The heavier paper was used to safeguard against having print show through from one page to the next. The length of line was 18 picas. The underlining was 2 point underlining.

The printed passages were put into booklets which contained in the first half: (1) a page explaining the procedure for skimming ("Direction to Students"); (2) a practice page which contained X's and O's in place of words; (3) the seven pages of the passage in consecutive order; (4) a blank sheet of pink paper; (5) a page of directions relating to answering the multiple-choice questions; (6) the complete set of questions corresponding to the previous passage; (7) a second blank sheet of pink paper. The second half of each booklet contained the second passage which was presented in exactly the same sequence. The single
difference between the two halves was that the blank sheets at the end of
the article and after the set of questions were gold instead of pink.
The purpose for the colored sheets was to assist the experimenter in
supervising the procedure. They also assisted the subjects in following
instructions.

As indicated above, in front of the first page of the article
there was a page which had groups of X's and O's (XOXOX OXO XOXO)
in place of words. This page was provided as a demonstration or practice
page so that the subjects could determine how fast they would need to
proceed in order to cover all of the paragraphs on the following pages
in the time allowed. They were given the signal to turn this page after
twelve seconds had elapsed. The time interval was the same for all
pages. Since each subject was assigned to only one treatment, both
passages in each booklet were of the same treatment condition with
respect to form of the passage and level of key words.

Measuring Instruments

The measuring instrument for the science passage was a set
of fifty-six multiple-choice questions, each of which had five options.
For the history passage, the battery of questions included forty-four
multiple-choice items, each of which also had five alternatives. The
items in each test battery were arranged in random order. Likewise,
the position of the correct response was randomly assigned in each test
battery.
In developing the batteries of questions, each paragraph in the passages was first analyzed to determine the specific bits of information which could be included in a test item. Then questions were written accordingly. When the maximum number of questions had been written, the items were analyzed to detect items which were redundant. Such items were eliminated. In addition, the items were scrutinized in order to detect any possible cueing of information from one item to another. Any items which contained cueing were either eliminated or modified in order to correct this fault.

In a second pilot study related to the present investigation both batteries of questions were administered to 108 grade eleven students both as a pretest and as a posttest after skimming the respective passages. These data were subjected to an item analysis. Some items were refined still further on the basis of the item analysis since certain proposed distractors did not seem to function adequately.

It should be pointed out, however, that because of the design and rationale of the batteries of questions, items which did not discriminate adequately according to the normal criteria for item analysis were not necessarily eliminated, since it was desirable to maintain questions which few Ss were able to answer correctly. It was intended that the maximum number of discrete questions be provided in order to enable each individual to reveal the maximum amount of information which he gained from skimming. Further, it was necessary that the pretest include a large number of items which few, if any, subjects were able
to answer correctly, since the same questions were used to measure change or information gain after skimming. Thus the batteries of questions were designed so that students would have the maximum opportunity to reveal both the amount of their background information and the amount of information gained from skimming. Precedent for using the same set of questions as both the pretest and the posttest may be found in the study by Karlin and Jolly (1965) and in mathemagenic studies of Rothkopf (1966) and Frase (1967, 1968).

The Van Wagenen Rate of Comprehension Scale, Form D, was used to measure the initial rate of comprehension of each subject in the experiment. This measure of reading achievement was particularly apropos for this investigation since it measures the rate at which an individual can read easy levels of material with understanding. Rather than measuring the rate of reading separately from comprehension on given selections, this test unifies the measure of reading into a single direct score. The test consists of fifty-six thirty-word paragraphs. The reader is instructed to read each paragraph and select the word in the last half of the paragraph that does not fit in with the meaning of the rest of the paragraph; he then makes a mark through this word. The time limit for the test when administered to grade eleven students is four minutes. The raw score for the test is the number of words correctly crossed out. The author provides norms by which the raw scores can be converted to the number of words read per minute with understanding. However, for the purposes of the experiment, the raw
scores were used in all cases. The author reported coefficients of reliability for the scales ranging between .86 and .96. Because of the design of the instrument and the reported reliability of the test, this measure was considered to be the best instrument to use for the experiment. Berger (1967, 1968) concluded that this instrument was the most reliable measure of reading comprehension rate available.

Procedure

Arrangements for conducting the experiment were made in advance through the North Vancouver School Board Office and the Carson Graham Senior Secondary School administration. Both experimental sessions were conducted in the normal classroom setting. While contact with the students was in intact groups, random assignment to treatment and having a single time limit for all treatments made this arrangement acceptable.

The experimenter and an assistant (graduate student) collected all of the data in both sessions. The assistant was thoroughly briefed regarding the details of the procedure. He was provided with a script including those parts which were pre-taped. The scripts are given in Appendix A. Experimenter variables were controlled by using pre-recorded and calibrated instructions.

Session One. At the beginning of the first session the subjects were told that they had been selected to participate in a research study being conducted at the University of British Columbia and that the study
was concerned with how grade eleven students do certain activities. Then the students were randomly assigned to a group which, though not explained to the students, was either the Pretest or the No-Pretest group. Because of the fact that the control group was answering a dummy set of items rather than the two batteries of questions on the stimulus passages, the two groups were assigned to separate rooms for the remainder of the class period.

Then, adhering to the instructions in the technical manual, the Van Wagenen Rate of Comprehension Scale was administered to all subjects in the class. Immediately following the completion of the rate of comprehension test, the Ss in the Pretest group were asked to answer the items on the two batteries of questions based upon the two stimulus passages. In order to counterbalance the possible effects due to order of presentation, the questions on the science passage were administered first to half of the subjects in each experimental group, while the questions on the history passage were administered first to the other half. All responses were recorded on standard I.B.M. multiple-choice answer sheets for machine scoring.

The Ss were allowed a maximum of twenty minutes in which to answer each set of questions. They were advised to pace themselves so that they could complete the set of questions within the specified time limit. The instructions also included the advice not to delay too long on any one item, that they should go on to the next item after a reasonable
effort. They were also told that they could go back to check items about which they were uncertain if time allowed. This time limit seemed to be adequate for most Ss. It should be pointed out that the Ss did not have access to the stimulus passages prior to answering the sets of questions. In fact, their first exposure to the passages was in the second session.

Upon completion of the Rate of Comprehension Scale, the Ss in the No-Pretest group were asked to answer items not related to the two stimulus passages in any way. This dummy activity included 100 items and required approximately the same amount of time for completion as the two batteries of questions which the Pretest group answered.

Session Two. Four weeks after the first session, the Ss were asked to skim the two stimulus passages under carefully-controlled time limits. At the beginning of this second session, the Ss were given two I.B.M. machine scoring answer sheets, a pencil, and a booklet containing the two stimulus passages, each followed by a blank sheet of colored paper and the corresponding set of questions and a second blank sheet of colored paper. Again, the order or presentation was completely counter-balanced, so that half of the Ss skimmed the science passage first, while the other half skimmed the history passage first within each treatment.

After they had filled in the information requested on the answer
sheets, the attention of the Ss was directed to the "Directions to Students" on the front of their booklets and they were asked to listen to the next instructions on the tape which was then played. The instructions are given in Appendix A, along with a transcript of the tape recording.

In the skimming procedure, the Ss were instructed to get as much information as they could from each page within the time allowed. The time limit for each page was twelve seconds. An additional three seconds was allowed for the time required to turn each page. The signals to turn the page were pre-recorded on tape by the experimenter as part of the total pre-recorded instructions for the study. A stop watch was used to determine the exact time intervals.

As soon as the Ss were instructed to turn the last page of the stimulus passage, they were told to turn the next page immediately. This was a colored page, so that it was relatively easy to observe that students were following the instructions exactly. The Ss were then instructed to answer the following set of questions on their answer sheets. A period of twenty minutes was allowed for the Ss to answer the set of questions.

The same procedure was followed for skimming the second passage, except that the instructions were shortened considerably.
CHAPTER III

RESULTS OF THE STUDY

Description of the Data

For the purpose of evaluating the expected treatment effects, two dependent measures were obtained. One of the two measures was the total number of correct answers on the criterion test which is referred to as the posttest raw score(s). The posttest was given to all Ss, T_1 through T_{15}. The other measure was the gain score, which is defined as the difference between the scores of the pretest and the posttest, i.e., posttest minus pretest score. The gain score was calculated only for the groups T_1 through T_7 and T_{15}, since all other groups, T_8 through T_{14}, did not answer the pretest questions.

Rate of Comprehension scores were treated as a covariate in order to adjust the dependent variable for possible differences among Ss in general rate of comprehension.

The posttest raw score means before and after adjustment for the covariate are given in Table II for the science passage and in Table III for the history passage. The rank order for each set of scores is also given in the tables. From the tables it is observed that adjustment
### TABLE II

**SCIENCE POSTTEST RAW SCORE MEANS**

**BEFORE AND AFTER ADJUSTMENT FOR COVARIATE**

(RATE OF COMPREHENSION) T1 THROUGH T15 (N = 312)

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Raw Score Means</th>
<th>Rank</th>
<th>Adjusted Raw Score Means</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ss in Pretest Groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (Or)</td>
<td>25.36</td>
<td>15</td>
<td>25.04</td>
<td>14 14</td>
</tr>
<tr>
<td>2 (1U)</td>
<td>22.63</td>
<td>11</td>
<td>22.54</td>
<td>11</td>
</tr>
<tr>
<td>3 (1M)</td>
<td>21.68</td>
<td>9</td>
<td>21.52</td>
<td>8</td>
</tr>
<tr>
<td>4 (2U)</td>
<td>20.56</td>
<td>5</td>
<td>20.59</td>
<td>4</td>
</tr>
<tr>
<td>5 (2M)</td>
<td>24.54</td>
<td>14</td>
<td>25.17</td>
<td>15</td>
</tr>
<tr>
<td>6 (3U)</td>
<td>23.94</td>
<td>13</td>
<td>23.60</td>
<td>13</td>
</tr>
<tr>
<td>7 (3M)</td>
<td>21.79</td>
<td>10</td>
<td>21.80</td>
<td>10</td>
</tr>
<tr>
<td><strong>Ss in No-Pretest Groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 (Or)</td>
<td>18.47</td>
<td>2</td>
<td>18.66</td>
<td>2</td>
</tr>
<tr>
<td>9 (1U)</td>
<td>21.68</td>
<td>8</td>
<td>21.37</td>
<td>6</td>
</tr>
<tr>
<td>10 (1M)</td>
<td>20.45</td>
<td>4</td>
<td>20.63</td>
<td>5</td>
</tr>
<tr>
<td>11 (2U)</td>
<td>23.35</td>
<td>12</td>
<td>23.48</td>
<td>12</td>
</tr>
<tr>
<td>12 (2M)</td>
<td>18.23</td>
<td>1</td>
<td>18.11</td>
<td>1</td>
</tr>
<tr>
<td>13 (3U)</td>
<td>21.40</td>
<td>6</td>
<td>21.61</td>
<td>9</td>
</tr>
<tr>
<td>14 (3M)</td>
<td>19.48</td>
<td>3</td>
<td>19.46</td>
<td>3</td>
</tr>
<tr>
<td><strong>Ss with Pretests, but No Skimming</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 (No-Passage)</td>
<td>21.56</td>
<td>7</td>
<td>21.46</td>
<td>7</td>
</tr>
</tbody>
</table>

Variance (MS<sub>within</sub>) = 38.29; df = 296
TABLE III

HISTORY POSTTEST RAW SCORE MEANS
BEFORE AND AFTER ADJUSTMENT FOR COVARIATE
(RATE OF COMPREHENSION) T₁ THROUGH T₁₅ (N= 314)

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Raw Score Means</th>
<th>Rank</th>
<th>Adjusted Raw Score Means</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ss in Pretest Groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (Or)</td>
<td>17.70</td>
<td>14</td>
<td>17.47</td>
<td>15</td>
</tr>
<tr>
<td>2 (1U)</td>
<td>15.30</td>
<td>6</td>
<td>15.23</td>
<td>6</td>
</tr>
<tr>
<td>3 (1M)</td>
<td>15.37</td>
<td>7</td>
<td>15.18</td>
<td>5</td>
</tr>
<tr>
<td>4 (2U)</td>
<td>15.28</td>
<td>5</td>
<td>15.30</td>
<td>8</td>
</tr>
<tr>
<td>5 (2M)</td>
<td>16.25</td>
<td>13</td>
<td>16.88</td>
<td>13</td>
</tr>
<tr>
<td>6 (3U)</td>
<td>17.75</td>
<td>15</td>
<td>17.37</td>
<td>14</td>
</tr>
<tr>
<td>7 (3M)</td>
<td>15.62</td>
<td>10</td>
<td>15.61</td>
<td>11</td>
</tr>
<tr>
<td><strong>Ss in No-Pretest Groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 (Or)</td>
<td>15.58</td>
<td>9</td>
<td>15.76</td>
<td>12</td>
</tr>
<tr>
<td>9 (1U)</td>
<td>15.64</td>
<td>11</td>
<td>15.29</td>
<td>7</td>
</tr>
<tr>
<td>10 (1M)</td>
<td>14.55</td>
<td>4</td>
<td>14.71</td>
<td>4</td>
</tr>
<tr>
<td>11 (2U)</td>
<td>13.91</td>
<td>2</td>
<td>14.03</td>
<td>2</td>
</tr>
<tr>
<td>12 (2M)</td>
<td>15.73</td>
<td>12</td>
<td>15.58</td>
<td>10</td>
</tr>
<tr>
<td>13 (3U)</td>
<td>14.00</td>
<td>3</td>
<td>14.20</td>
<td>3</td>
</tr>
<tr>
<td>14 (3M)</td>
<td>12.86</td>
<td>1</td>
<td>12.84</td>
<td>1</td>
</tr>
<tr>
<td><strong>Ss with Pretests, but No Skimming</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 (No-Passage)</td>
<td>15.42</td>
<td>8</td>
<td>15.43</td>
<td>9</td>
</tr>
</tbody>
</table>

Variance (MS_{within}) = 33.18; df = 299
for the initial differences due to the general rate of comprehension changed the rank order of five group means by more than two positions for the history scores; whereas, only two scores changed more than one step for the science scores.

An analysis of covariance was performed on the posttest raw scores of all treatment groups (T1 through T15) with rate of comprehension as a covariate. The results of this analysis are given in Appendix D, Table VIII for Science and Table IX for History. After adjustment for initial differences due to general rate of comprehension there were significant main effect differences among the treatment group means for science ($F = 2.52, df = 14/296, p < .01$). However, no main effect differences were observed for history ($F = 1.05, df = 14/298, p > .05$).

The observed regression coefficient of the covariate on the science data was 0.25, which was found to be a significant deviation from the zero slope ($F = 23.40, df = 1/296, p < .001$). The regression coefficient of the covariate for the history data was 0.27 which was also a significant deviation from the zero slope ($F = 30.96, df = 1/298, p < .001$). These results indicated that the covariate, rate of comprehension, was significantly related to the dependent variable, the posttest raw scores. Further, it was observed that the test for equality of slopes resulted in nonsignificant $F$ values for both science ($F = 1.64, df = 14/284, p > .05$), and for history ($F = 0.30, df = 14/284, p > .05$). The nonsignificant value of the test for the equality of slopes designated that the slopes for
the fifteen treatment groups were approximately parallel in each case.

No further tests were performed on the posttest raw score means for the history data since there was no evidence of differences among the adjusted cell means. For the science data, further contrasts were made involving the posttest raw score means for all groups ($T_1 - T_{15}$).

The gain scores before and after adjustment for the covariate along with the rank order for each set of scores are given in Table IV for science and in Table V for history. These tables show that the gain scores for both science and history retained essentially the same rank order after adjustment for individual differences due to general rate of comprehension as they had before adjustment. The summaries of the results of the analysis of covariance performed on the gain scores of treatment groups $T_1$ through $T_{15}$ are given in Appendix D, Table X for science and Table XI for history.

For science, the regression coefficient of the covariate was $-0.06$. This value was not significantly different from zero ($F = 0.96$, df $= 1/147$, $p > .05$). The regression coefficient was not significant ($F = 1.67$, df $= 1/150$, $p > .05$). Since the covariate, rate of comprehension, was not significantly related to the gain scores, that is, there was no significant deviation from the zero slope, a simple analysis of variance was performed on the gain scores for both science and history. Since there were no significant treatment effects for history ($F = 1.48$, df $= 7/135$, $p > .05$) no further analyses were
TABLE IV
SCIENCE GAIN SCORE MEANS BEFORE AND AFTER ADJUSTMENT FOR COVARIATE (RATE OF COMPREHENSION) T₁ THROUGH T₇ AND T₁₅ (N=156)

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Raw Score Means</th>
<th>Rank</th>
<th>Adjusted Raw Score Means</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Or)</td>
<td>4.18</td>
<td>3</td>
<td>4.24</td>
<td>2</td>
</tr>
<tr>
<td>2 (1U)</td>
<td>4.68</td>
<td>1</td>
<td>4.70</td>
<td>1</td>
</tr>
<tr>
<td>3 (1M)</td>
<td>2.79</td>
<td>6</td>
<td>2.82</td>
<td>6</td>
</tr>
<tr>
<td>4 (2U)</td>
<td>3.50</td>
<td>4</td>
<td>3.48</td>
<td>4</td>
</tr>
<tr>
<td>5 (2M)</td>
<td>4.25</td>
<td>2</td>
<td>4.11</td>
<td>3</td>
</tr>
<tr>
<td>6 (3U)</td>
<td>3.31</td>
<td>5</td>
<td>3.38</td>
<td>5</td>
</tr>
<tr>
<td>7 (3M)</td>
<td>1.71</td>
<td>7</td>
<td>1.70</td>
<td>7</td>
</tr>
<tr>
<td>15 (No-Passage)</td>
<td>0.78</td>
<td>8</td>
<td>0.79</td>
<td>8</td>
</tr>
</tbody>
</table>

Variance ($MS_{error}$) = 21.72; df = 148
TABLE V

HISTORY GAIN SCORE MEANS BEFORE AND AFTER ADJUSTMENT FOR COVARIATE (RATE OF COMPREHENSION) $T_1$ THROUGH $T_7$ AND $T_{15}$ (N=159)

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Raw Score Means</th>
<th>Rank</th>
<th>Adjusted Raw Score Means</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Or)</td>
<td>2.17</td>
<td>2</td>
<td>2.13</td>
<td>2</td>
</tr>
<tr>
<td>2 (1U)</td>
<td>-0.23</td>
<td>7.5</td>
<td>-0.01</td>
<td>8</td>
</tr>
<tr>
<td>3 (1M)</td>
<td>1.05</td>
<td>3</td>
<td>1.02</td>
<td>3</td>
</tr>
<tr>
<td>4 (2U)</td>
<td>3.11</td>
<td>1</td>
<td>3.12</td>
<td>1</td>
</tr>
<tr>
<td>5 (2M)</td>
<td>0.55</td>
<td>5</td>
<td>0.69</td>
<td>5</td>
</tr>
<tr>
<td>6 (3U)</td>
<td>0.50</td>
<td>6</td>
<td>0.43</td>
<td>6</td>
</tr>
<tr>
<td>7 (3M)</td>
<td>-0.26</td>
<td>7.5</td>
<td>0.00</td>
<td>7</td>
</tr>
<tr>
<td>15 (No-Passage)</td>
<td>1.00</td>
<td>4</td>
<td>1.01</td>
<td>4</td>
</tr>
</tbody>
</table>

Variance (MS_{error}) = 13.32; df = 151.
performed on the gain scores for history.

In order to test the third hypothesis, the science data for the Pretest groups were categorized on the basis of pretest raw scores as follows: High (21 and above); Middle (18-20); and Low (17 and below). Table VI presents the posttest raw score means within each treatment condition ($T_1$ through $T_7$ and $T_{15}$) after the subgroups were designated on the basis of high, middle, and low pretest scores. Science gain score means are given in Table VII for the same categories of amount of information within each treatment group.

The posttest raw scores were used to test hypotheses 1, 2, and 3 which were concerned with the general effectiveness of skimming and the effect of familiarity upon skimming performance. The gain scores were used to test the hypotheses relating to the effectiveness of skimming in general, to skimming as a disembedding process hypotheses 1, 4, 5, 6 and 7.

**Analysis of the Data Related to the Question of the Effectiveness of Skimming Performance**

In order to test the assumption, as stated in the first experimental hypothesis, that Ss are able to gain a significant amount of information by skimming stimulus passages, contrasts were made between the combination of all treatment groups in which the Ss skimmed the passages, $T_1$ through $T_{14}$, and the No-Passage group, $T_{15}$, in which the Ss did not skim the passages. For science, the result of this
### Table VI

**Science Posttest Raw Score Means of Treatment Groups (T₁ through T₇ and T₁₅) by Levels of Background Information, High, Middle and Low (N=156)**

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Background Information</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Middle</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>T₁</td>
<td>27.55</td>
<td>18.67</td>
<td>13.38</td>
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</tr>
<tr>
<td>T₂</td>
<td>25.00</td>
<td>19.00</td>
<td>13.44</td>
<td></td>
</tr>
<tr>
<td>T₃</td>
<td>24.00</td>
<td>19.33</td>
<td>15.38</td>
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<td>T₅</td>
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<td>19.20</td>
<td>13.43</td>
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<tr>
<td>T₆</td>
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<td>13.00</td>
<td></td>
</tr>
<tr>
<td>T₇</td>
<td>24.83</td>
<td>18.75</td>
<td>13.63</td>
<td></td>
</tr>
<tr>
<td>T₁₅</td>
<td>24.33</td>
<td>19.25</td>
<td>15.60</td>
<td></td>
</tr>
</tbody>
</table>

**Marginal Mean**

|       | 25.03 | 18.92 | 13.95 |

**Variance (MS\_{error}) = 9.57; df = 132**
TABLE VII

SCIENCE GAIN SCORE MEANS OF TREATMENT GROUPS

(T₁ THROUGH T₇ AND T₁₅) BY LEVELS OF
BACKGROUND INFORMATION, HIGH, MIDDLE, LOW (N=156)

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Background Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>T₁</td>
<td>2.73</td>
</tr>
<tr>
<td>T₂</td>
<td>2.40</td>
</tr>
<tr>
<td>T₃</td>
<td>-0.40</td>
</tr>
<tr>
<td>T₄</td>
<td>1.67</td>
</tr>
<tr>
<td>T₅</td>
<td>1.75</td>
</tr>
<tr>
<td>T₆</td>
<td>4.75</td>
</tr>
<tr>
<td>T₇</td>
<td>0.83</td>
</tr>
<tr>
<td>T₁₅</td>
<td>1.22</td>
</tr>
</tbody>
</table>

Marginal Mean 1.47  2.03  4.86

\[\text{Variance (MS}_{\text{error}}\] = 20.13, \quad \text{df} = 132
contrast showed no significant difference in the performance on the post-
test due to skimming ($F = 0.023, df = 1/296, p > .05$). Similarly,
there was no significant difference due to skimming in the history
passage ($F = 0.0009, df = 1/298, p > .05$). While skimming did not
appear to be effective on the average in either passage when posttest
raw scores were considered, a significant difference was observed
on the science passage for three pairs of posttest means. The observed
difference between the posttest raw score means of $T_1$ and $T_{15}$ was
3.58, which was statistically significant ($F = 3.57, df = 1/296, p < .05$).
The difference between $T_5$ and $T_{15}$ was 3.71, which was significant
($F = 3.61, df = 1/296, p < .05$). The difference between $T_{12}$ and
$T_{15}$ was 3.35, which was also significant ($F = 3.13, df = 1/296, p < .05$).
All other observed differences among skimming/no-skimming pairs were
not statistically different when the posttest raw score means were
analyzed.

When gain scores were used to compare those groups which
skimmed the passages ($T_1$ through $T_7$) with the No-Passage group
($T_{15}$), statistically significant differences were observed for science
($F = 5.23, df = 1/148, p < 0.0001$). No significant differences were
observed for the history passage ($F = 0.002, df = 1.153, p > .05$).

It was expected that $S$s who skimmed the passages would
perform significantly better on the posttests than $S$s who did not skim
the passages. However, the results of testing this assumption using the
posttest raw scores for all groups indicated that none of the No-Pretest group \((T_8 \rightarrow T_{14})\) performed significantly better than the No-Passage group. When gain scores were analyzed, the amount of background information was implicitly considered. Significant differences were then observed between the Pretest groups which skimmed and the No-Passage group which did not skim the science passage. No statistically significant differences between the groups which skimmed the history passage and the No-Passage group were detected. Because the basic assumption regarding the overall effectiveness of skimming was not confirmed for history, no further analyses were performed on the history data. Each of the remaining hypotheses was tested for the science passage.

**Analysis of Data Relating to Pretest Familiarity**

When the Pretest treatment groups \((T_1 \rightarrow T_7)\) were compared with the No-Pretest treatment groups \((T_8 \rightarrow T_{14})\), it was found that the main effect due to the pretest was significant for science \((F = 11.90, \, df = 1/296, \, p < .01)\). From this result it was concluded that the groups exposed to the pretest achieved higher mean scores on the post-test than the groups which did not respond to the pretest questions. Pretest and No-Pretest groups were further compared by treatment conditions. There was a statistically significant difference between \(T_1\) and \(T_8\), the original form of the passage \((F = 11.63, \, df = 1/296, \, p < .01)\), and between \(T_5\) and \(T_{12}\), masked at Level 2 \((F = 14.59, \, df = 1/296, \, p < .01)\). Comparisons between all other Pretest/No-Pretest pairs of treatment groups resulted in nonsignificant \(F\) values. Only those
Pretest groups which skimmed the original form of the science passage and the masked form at Level 2 performed significantly better than the corresponding No-Pretest groups. This suggested that pretest familiarity facilitated skimming only in these two forms of the science passage.

Analysis of Data Relating to Amount of Background Information

It was hypothesized that Ss who had a greater amount of background information would perform better on the criterion measure after skimming than Ss who had a lower amount of background information as indicated by the Ss' pretest scores. For the purpose of testing this hypothesis, Ss within each treatment group were divided into three categories on the basis of their relative pretest scores, i.e. High (21-43), Middle (18-20), and Low (0-17). The observed mean differences among the three levels of background information, as can be seen in Table VI, appear to be in the predicted direction (i.e., 25.03, 18.92, and 13.95 for the High, Middle, and Low groups respectively). That is, the observed mean differences yielded a significant main effect due to the amount of background information ($F = 161.14$, $df = 2/132$, $p < .0001$). Hypothesis 3, therefore was accepted on the basis of this evidence and it was concluded that having a higher amount of background information did facilitate skimming performance.

When the gain scores were analyzed as a post hoc comparison, a significant main effect due to background information was observed ($F = 6.74$, $df = 2/132$, $p < .01$). However, the mean differences were
in the opposite direction from what would have been predicted had the gain scores been the major dependent variable. In all cases except for $T_6$ [3M], the mean information gain score was larger for the Low group than for the High group. The overall observed regression coefficient of the gain scores on the pretest scores was $-0.21$, which was significant ($F = 9.90$, $df = 2/146$, $p < .01$). Had the gain scores been used as the dependent variable in Hypothesis 3, the hypothesis would not have been accepted.

**Analysis of Data Relating to Skimming as a Disembedding Process**

In order to test the fourth, fifth, sixth and seventh experimental hypotheses which were concerned with skimming performance in relation to the use of key words and non-key words, the main effects and interaction due to variations in the form of the stimulus passages and the levels of key words were tested by means of orthogonal comparisons. When performance on the masked forms of the science passage $(T_3, T_5, T_7)$ were compared with performance on the underlined forms $(T_2, T_4, T_6)$, no significant difference was observed ($F = 1.40$, $df = 1/148$, $p > .05$). Initially, this result indicated that performance on the masked forms, which had non-key words masked, was as good as performance on the underlined forms which had key words identified, but no non-key words were masked.

Skimming performance on the forms of the passages in which key words were identified both by underlining and by masking the non-key
words ($T_2$ through $T_7$), was compared with performance on the original form of the passage in which no key words were identified ($T_1$). This comparison yielded no significant differences ($F = 0.65$, $df = 1/148$, $p > .05$). From this result, it appeared that having the key words identified did not facilitate the skimming process. Thus, the fourth experimental hypothesis was not accepted.

With regard to possible differences among the levels of key words, two orthogonal contrasts were made. No significant differences were observed when Level 1 was compared with the combination of Levels 2 and 3 ($F = 0.38$, $df = 1/148$, $p > .05$). Likewise, when Level 2 was compared with Level 3, there was no significant difference ($F = 1.95$, $df = 1/148$, $p > .05$). Consequently, the sixth experimental hypothesis was confirmed, since the results of comparing levels of key words indicated that skimming performance was as good when a smaller number of key words were identified as when a larger number of key words were identified. The fact that no significant difference between the masked presentations and the underlined presentations further supports this conclusion in that the number of non-key words did not affect skimming performance.

Analysis of Data Related to Interaction Between Forms of Passage, Levels of Key Words and Background Information

There was no interaction whatsoever between and among the three variables, familiarity with content, form of passage, and levels of key words. All $F$ values of second- and third-order interaction were less
than 1.00. Therefore, the seventh hypothesis was not accepted. This suggested that, given the form of the passage and the level of key words, there was no differential effect due to background information.
CHAPTER IV

SUMMARY AND CONCLUSIONS

The Problem

Skimming as a strategy in which the reader looks only at the key words in the printed discourse has been widely suggested as an appropriate technique for gaining information. This theory is supported by the study of the nature of the English language, particularly its redundancy and predictability, and also by the ability of the competent language user. The present study was designed primarily to determine the validity of the theory of skimming as a process of looking only at the key words in continuous discourse. Since there was concern for determining the amount of information gained from skimming, attention was also given to familiarity with the content of the stimulus passages in the sense of background information. For this reason, it was also necessary to evaluate the effect of familiarity with the passages as a result of experience with the pretest.

Procedure

Grade eleven students attending a senior secondary school in a large metropolitan area were randomly assigned to Pretest and No-Pretest
groups in the first experimental session. Within the respective groups, the Ss were then randomly assigned to treatments for the second session at which the Ss were directed to skim two 1400-word passages in a time-limit situation, such that the Ss were required to deal with a minimum of 800 words per minute. One passage was in the area of science, "The Solar System"; the other was in history, "The Age of Exploration."

The variations in treatment consisted of modifying the form of presentation for each of the two stimulus passages according to the number of non-key words which were identified or deleted from the passages. Three levels of key words were designated by identifying three categories of redundancy which were treated cumulatively to create three categories of non-key words in each passage. Non-key words and key words were mutually exclusive at each level of key words. Six treatment conditions consisted of presenting the passages with key words identified at each of the three levels either by (1) underlining the key words in the complete text, or by (2) masking the non-key words. A seventh treatment condition was the presentation of the stimulus passages in the original form which had no key words identified either by underlining the key words or by masking the non-key words.

The criterion measure for each stimulus passage was a post-test battery of questions. Posttest raw scores were used as the dependent variable when all fifteen treatment groups were considered and to test the hypothesis concerning amount of background information. Information
gain scores (posttest minus pretest scores) were used for analyses involving only the Pretest groups. The results of a pilot study indicated that rate of comprehension was significantly related to the posttest raw scores. Therefore, the Van Wagenen Rate of Comprehension Scale was administered to all Ss during the first session of the experiment.

Findings

The experimental hypotheses tested in the study dealt with the assumption that skimming is an effective strategy for gaining a significant amount of information, with the effect of varying the form of presentation of the stimulus passages, with the effect of redundancy reduction or levels of key words, and with the effects due to two aspects of familiarity with content. Tests of the experimental hypotheses, based upon analyses involving the pretest, posttest, and information gain scores, along with the rate of comprehension (covariate) scores, produced the following findings.

1. It was first necessary to test the basic assumption that Ss would be able to gain a significant amount of information by skimming the stimulus passages. The assumption that skimming would be an effective strategy for gaining information from the history passage was not supported when either the posttest raw scores ($F = 0.0009, \text{df} = 1/298, p > .05$) or the gain scores ($F = 0.002, \text{df} = 1/153, p > .05$) were considered. Likewise, analysis of the science posttest raw scores, overall did not support the assumption of skimming effectiveness.
Further pair-wise comparisons of the skimming groups with the no-skimming (No-Passage) group indicated that two groups skimmed effectively: T₁ (F = 3.57, df = 1/296, p < .05) and T₅ (F = 3.61, df = 1/296, p < .05). When gain scores were used to assess the effectiveness of skimming the science passage, the assumption of skimming effectiveness was supported (F = 5.23, df = 1/150, p < .02).

2. The hypothesis that induced familiarity with the content of the stimulus passages would result from exposure to the related pretest was tested by comparing the posttest raw scores of the Pretest and No-Pretest groups. A significant difference was observed for the science passage (F = 11.90, df = 1/296, p < .01). Pair-wise, significant differences were observed only between T₁ and T₈ [Or] (F = 11.63, df = 1/296, p < .01) and between T₅ and T₁₂ [2M] (F = 14.59, df = 1/296, p < .01). The hypothesis that familiarity with the content would be induced by exposure to a related pretest was supported for the science passage.

3. It was hypothesized that there would be a positive relationship between the amount of background information (High pretest scores) and skimming performance. A significant main effect due to amount of background information was found (F = 161.14, df = 2/132, p < .0001), meaning that the observed difference was in favor of the Ss who had a greater amount of background information, as indicated by their higher pretest scores.
4. The primary research question raised in the study pertained to skimming as a process of looking only at the key words in continuous discourse. In order to answer this question, three hypotheses were tested using the information gain score. There was no significant difference between performance on the masked forms \([M]\) and the underlined forms \([U]\) of the science passage \((F = 1.11, df = 1/150, p > .05)\). This result gave limited support to the hypothesis that \(Ss\) who skimmed the masked forms would perform as well as or better than \(Ss\) who skimmed the non-masked forms in which all words were presented in context. Initially, this result suggested that the non-key words were not needed in order to gain information and that having the non-key words available did not facilitate the skimming process.

It was further hypothesized that having the key words already disembedded or identified in the discourse would facilitate skimming. To test this hypothesis, the performance of the groups which skimmed the forms of the passage in which key words were identified \([M\text{ and } U]\) was compared with the performance of the group which skimmed the form in which the key words were not identified \([\text{Or}]\). There was no significant difference due to the identification or disembedding of key words \((F = 0.65, df = 1/148, p > .05)\). Consequently, the hypothesis that having key words disembedded was not confirmed.

The additional hypothesis that there would be a positive relationship between the degree of redundancy reduction and skimming performance
was tested by comparing the various levels of key words. The two orthogonal contrasts involving levels of key words yielded no significant differences due to variations in the degree of redundancy reduction: Level 2 vs Level 3 ($F = 1.95$, $df = 1/148$, $p > .05$) and Level 1 vs Levels 2 and 3 ($F = 0.38$, $df = 1/148$, $p > .05$). These results did not support the hypothesis that Ss would gain as much or more information by skimming a passage when redundancy had been reduced to a greater degree than when it had been reduced less, or not at all.

5. There was no significant interaction between and among the three independent variables: forms of presenting the passages [Or, U, M], levels of key words (Levels 1, 2, 3), and familiarity with content (High, Middle, and Low pretest scores) (all $F$'s 1.00).

Discussion

Based upon the analyses of the data collected in the study, skimming does not appear to be an effective reading strategy for Grade 11 students unless familiarity with the content of the passage is induced. Such a process of familiarization or cueing may be in the form of pretest questions as in the present study, but other forms of cueing may operate in a similar manner. For example, the style and format of the passage may serve such a purpose. As Carver (in press) has pointed out, the mathemagenic studies of Rothkopf (1965, 1967) and Frase (1968, 1969) have not taken into account the strategy of reading or the time limit allowed for "learning." Both of these factors were controlled in the
present study. This may account, in part, at least, for the fact that the results of the present study are apparently in conflict with the results of the studies cited previously, which have reported that questions presented prior to the learning or reading task generally did not facilitate performance. Further investigation of the question is certainly indicated. The evidence strongly suggests that in further related studies rate of reading, in the broad sense of information-processing, should be treated as a variable in both time-limit and time-amount conditions. While varying the nature and location of the questions has been studied in some aspects, these conditions have not been considered in relation to skimming and efficient reading. In this regard, attention should also be given to the time interval between the cueing or exposure to questions and the skimming task.

Differences in the nature of the stimulus passage affected skimming performance since, overall, the students were able to skim the science passage, but did not skim the history passage effectively. This result may be attributable in part to the observation that the history passage is considered to be distinctly more discursive than the science passage in spite of the fact that the two passages were matched with respect to their readability level and their overall progression of ideas. Thus it seems that skimming strategy may be appropriately used for some types of passages, but not for others without special instruction and practice.
The conclusion in Morton's (1964) study that the faster readers were able to take significantly more advantage of redundancy in discourse than the slower readers was not confirmed in the skimming situations in the present study.

The fact that having a greater amount of background information did prove to be an advantage in skimming is in agreement with Weaver's (1967) point of view and confirms the prediction made in the present study that skimming as a function of redundancy reduction is predicated to a large extent upon a process of confirming (or disconfirming) predictions which the skimmer makes on the basis of his prior knowledge or background information. Further research on the validity of such a model of skimming behavior is indicated. The question raised in experimental hypothesis 3 could have been asked in terms of information gain scores instead of in terms of performance on the post-test. Considering the fact that readers with less background information achieved higher gain scores than readers with more background information as observed in the present study, it appears that clarification of the effect of background information on skimming performance as measured by change scores is needed.

The feasibility of the rule to "fixate on the first half of each constituent" as proposed by Bever and associates (1967) was not challenged since in the present study Ss who skimmed the masked forms of the science passage were able to skim as effectively as the Ss who
skimmed the science passage in which all the words were presented. Using the basic experimental procedure developed in the present study, it would be possible to investigate further the practicability of the fixation rule under discussion.

The obvious implication of applying such a rule to skimming strategy, however, would be that instruction should be aimed at helping the reader to develop facility in identifying the constituents quickly or spontaneously. This then may be an aspect of skimming strategies and instructional methodology which should be investigated further.

Conclusions

Given the data analyzed in the present study, it may be concluded that familiarity with the content of the reading materials is one of the important factors involved in the skimming process. It was further observed that familiarity with the content could be induced by exposure to a pretest related to the passage. In fact, for the Ss in the present experiment, it was only when there was cueing resulting from exposure to pretest that skimming was effective.

It appears that skimming may not be an appropriate reading strategy for some types of material. It may be possible that special instruction and practice may enable readers to apply skimming strategy to different types of reading material.
Regarding skimming as a disembedding process, it was concluded that, on the whole, the non-key words were not required for effective skimming, since the Ss were able to gain as much information when the non-key words were masked as when the complete text was available. However, having the key words disembedded, either by masking the non-key words or by underlining the key words, did not facilitate skimming at any level of redundancy reduction. Thus, on the basis of the present investigation, it could not be said that skimming is essentially a disembedding process. Consequently, the theory of skimming as a process of looking only at the key words is supported only to a limited extent. In spite of the fact that redundancy reduction did not appear either to facilitate or to interfere with information processing in skimming, there was, at the same time, no positive effect due to the disembedding of key words. Therefore, Ss apparently do not have to look at all of the words on the printed page in order to process the information. Still, Ss generally do not seem to have acquired the additional skill necessary for taking advantage of redundancy reduction under the time-limit conditions imposed by skimming. Investigation of other factors such as practice effect and short-term memory in relation to the skimming process may reveal further information about the nature of skimming strategy in reading.
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APPENDICES
APPENDIX A

Instructions for Examiner
APPENDIX A

Instructions for Examiner

Session One

Introduction

Greeting

"You have been selected to participate in a research project being conducted at UBC. Your participation and cooperation is very much appreciated.

"We are going to split into two groups for the activities today. For this purpose, take one piece of paper from the box which is being passed at this time."

Pass the box with the blue and gold slips of paper. Eight gold (exper): Seven blue (control).

"As soon as you have your slip of paper, write your name on it along with the letter of this block (period) and the room number.

"Those of you who have a gold slip of paper, write (room number) __________ on your paper and circle this number. Now, you people with the gold (blue) slips of paper will go immediately to room __________ for the remainder of this period. (Take your books etc. with you and go now.)"

Pause for room changes (Assist Ss as indicated)

Collect gold slips of paper from Ss.

"There are two parts to the activities which we will do today. The first part is very short. DO NOT turn the page of the handout which is being passed out now."

Distribute one copy of the Van Wagenen Rate of Comprehension to each Ss.

"Look at the front page of this handout. In the spaces provided along the right margin of this page, fill in the information requested. Print your name, grade and school. In the space for teacher, put the name of your regular teacher in this period; also indicate the block and your regular room number. Today's date is April 9 (April 10).

"Now look at the bottom half of this page where it says: DIRECTIONS FOR RATE OF COMPREHENSION TEST and follow along:

"Read paragraph A carefully. It says: (read from copy of test) 'In the last half of this paragraph the word buttons does not
fit in with the rest of the paragraph, so buttons is crossed out."

Now look at paragraph B and find the word which does not fit in with the meaning of the rest of the paragraph. PAUSE. Yes, the word which should be crossed out in B is "Matches."

"Now, in the next one half minute or so try to find and cross out the word which does not fit in the last half of paragraphs C, D, E, F, and G."

After one half minute approximately,

"O. K., what word should be crossed out in C? (Afternoon)  
D? (Water)  
E? (laughed)  
F? (table)  
G? (first)"

"Are there any questions or disagreements?"...

"On the next two pages you will find more paragraphs just like the ones we have just done. When I give the signal you will turn the page and read each paragraph to find the word in the last half of the paragraph which does not fit in with the meaning of the rest of it. Make a cross through this word just as you have done on the sample paragraphs. Work as fast as you can without making mistakes. Do not stay too long on any one paragraph. After a reasonable effort, go on to the next one.

"Are there any questions?"

Have timer ready for four minutes.

"If not, GET READY, TURN THE PAGE. . . BEGIN.

Collect the test papers when the timer goes off at four min.

Have the IBM Answer Sheets ready to hand out. Distribute them. 
Distribute question booklets.

"Fill in the information requested on the top of your IBM answer sheet."

"Listen carefully to the directions on the front of your booklet."

Start tape on which is recorded the directions printed on the front of the question booklets ("Directions to Students")

At the end of the taped instructions answer any questions that arise.

When students have had 20 minutes in which to answer the questions collect the first answer sheet and say:

"Now go on to the second set of questions in the same manner as you have just done on the first set of questions. Go ahead."

Observe students to verify that they follow instructions.

Collect all materials after students have had twenty minutes of working time.
APPENDIX A
Instructions for Examiner
Session Two

Greeting

Distribute a pencil and two IBM answer sheets to each student.

"Please fill in the information requested on the top two lines of both the IBM answer sheets.

"Today's date is May 5 (May 6).

"In the space after INSTRUCTOR, write_________(the name of your regular English teacher).

"We will fill in the space for NAME OF TEST later.

"Now, when your name is called, please come and pick up an IBM card with your name on it and a booklet. Please DO NOT OPEN THE BOOKLET UNTIL YOU ARE GIVEN DIRECTIONS TO DO SO.

"On your IBM card there is a number written under your name. Copy this number in the squares below the arrow on both of your answer sheets. Start at the top and put only one number in each page."

Distribute the booklets by groups according to the IBM cards:

Control: Pink stripe
Experimental: Blue stripe

If a student is absent, write "abs" on the IBM card.
There is a separate sequence of materials for students for whom there is no IBM card (these Ss should not have been present for the first session.)

N. B. Booklets must be given to the Ss present in sequence within the respective groups (C;E). When the entire initial sequence of booklets for the group has been exhausted, it is necessary to repeat the process in order (as numbered) in the upper left corner.

As soon as each Ss has received a booklet:

"Now you should each have a booklet. (Remind about not opening if necessary)

"On the upper right corner of your booklet you should find a letter and a number (e.g. H-1, or S-7; H-0); Write this letter and number on just one of your IBM answer sheets in the space after NAME OF TEST. Put the other answer sheet under your test booklet until later.

"Next, put a "1" in the upper left corner of your answer sheet above the word NAME and circle it.
"Now follow along on the front page of your booklet and listen to the next instructions on the tape.

Start the tape deck.

After the Ss have skimmed:

"Now turn the first pink page and look at the directions for answering the questions.

"You will have approximately 15 minutes in which to answer this set of questions. Work as rapidly as you can. If you are unsure of an answer, do not delay too long. After a reasonable effort, go onto the next item. If time allows, you may go back to those items about which you were uncertain.

"Do not look back at the article for any reason. (Repeat).
Do not look back at the article.

"Do not turn past the second colored page until you are instructed to do so.

"When you have finished answering all of the items in this set, close your booklet and wait quietly for further instructions. If you brought materials with you, you may study until we are ready to start the next part.

"Go ahead . . . begin."

When the time is up for answering the first set of questions (20 minutes):

"Pass forward the answer sheet which you have just completed. Be sure that you have filled in the information at the top of the answer sheet: NAME; I; ID number; NAME OF TEST (as on the front cover of your booklet).

"Now turn the second colored page, so that your booklet is open to the page headed "DIRECTIONS TO STUDENTS" at the middle of the booklet (This page is opposite the second pink page.) Stop recorder - on the upper right corner of this page is a letter and a number. Write.

"These instructions are exactly the same as before. In order to review the procedure briefly, look toward the bottom of the page where it says, "Remember, then:"

After the Ss have skimmed the second article:
"Now turn the first gold page.

"Be sure to write the name of test on your answer sheet and then go ahead immediately.

"You will have approximately 15 minutes in which to do the next part of the activity. Be sure to write the name of test in the proper space now.

"When you have finished please wait quietly until all have finished.

"Please do not discuss the activities you have done this period with other students. This is very important. We appreciate your cooperation.

"Thank you very much for your assistance and cooperation."
APPENDIX B

Measuring Instruments
SCIENCE

The Solar System

DIRECTIONS: Do not make marks of any kind on this set of questions. All of your answers should be marked on the IBM answer sheet.

On the top of the answer sheet fill in the information requested. In the space after "NAME OF TEST" write the subject given on top of your set of questions: "SCIENCE". In the same space put a "1" if you are doing this set of questions first; put a "2" if you are doing them second, for example: "SCIENCE-1". In the space after "INSTRUCTOR" write the name of your regular teacher in this block. Then put the letter indicating the block and the room number for this class period.

Now look at the "DIRECTIONS" on the top left of your answer sheet:

Read each question (item) and its numbered answers (choices). When you have decided which answer is correct (or the best choice), blacken the corresponding space on this sheet with a (No. 2) pencil. Make your mark as long as the pair of lines, and completely fill the area between the pair of lines. If you change your mind, erase your first mark COMPLETELY. Make no stray marks; they may count against you.

Now look at the sample given next. You will notice that the space between the dotted lines under the small number four has been completely filled in because Chicago is a city and "a city" is choice number 4 in the sample.

Note that the answer spaces for the items go left to right across the page:

<table>
<thead>
<tr>
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<th>2</th>
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Remember then:

1. Choose the one best answer or completion for each item.
2. Erase completely any answer you wish to change.
3. Make your marks heavy and black.
4. Do not bend or crease your answer sheet.
5. Move left to right across the answer sheet.

When you have finished answering all of the items, close the set of questions and wait quietly for further instructions.
SCIENCE

The Solar System

1. An object weighing 150 pounds on earth would weigh on Mercury:
   1) 60 pounds; 2) 40 pounds; 3) 190 pounds; 4) 210 pounds; 5) 150 pounds. (2)

2. The planet named for the Roman god of the harvest is:
   1) Saturn; 2) Mars; 3) Earth; 4) Uranus; 5) Ceres. (1)

3. Most asteroids are found in a zone between the orbits of:
   1) Mars and Saturn; 2) Pluto and Neptune; 3) Earth and Saturn; 4) Venus and Jupiter; 5) Mars and Jupiter. (5)

4. Jupiter was first seen in:
   1) ancient times; 2) 1930; 3) 1846; 4) 1671; 5) 1905. (1)

5. Neptune was discovered in:
   1) 1905; 2) 1801; 3) 1846; 4) 1676; 5) ancient times. (3)

6. The last planet to be discovered was:
   1) Pluto; 2) Uranus; 3) Saturn; 4) Mercury; 5) Neptune. (1)

7. The planet farthest from the sun has an orbital speed of about:
   1) 1/2 mile per minute; 2) 3 miles per second; 3) 15 miles per second; 4) 30 miles per second; 5) 26 miles per minute. (2)

8. The diameter of the sun is:
   1) 528,000 miles; 2) 88,700 miles; 3) 1,027,700 miles; 4) 865,400 miles; 5) 27,500 miles. (4)

9. The planet which has an atmosphere that reaches outward about as far as the earth's is:
   1) Mercury; 2) Venus; 3) Jupiter; 4) Apollo; 5) Mars. (5)

10. The planet named for the Roman goddess of beauty and love is:
    1) Venus; 2) Neptune; 3) Earth; 4) Ceres; 5) Saturn. (1)

11. The smallest planet is:
    1) Venus; 2) Mercury; 3) Pluto; 4) Ceres; 5) Jupiter. (2)

12. The diameter of Apollo is:
    1) about one mile; 2) about 50 miles; 3) about 100 miles; 4) about 500 miles; 5) nearly as large as the earth's. (1)

13. The temperature on the surface of the sun is:
    1) 830 degrees F.; 2) 770 degrees F.; 3) 40,000,000 degrees F.; 4) 8,370 degrees F.; 5) 10,000 degrees F. (5)

14. The planet on which a great red spot has been seen periodically is:
    1) Venus; 2) Mars; 3) Mercury; 4) Saturn; 5) Jupiter. (5)

15. The sun and the other heavenly bodies travel through space as a unit at the rate of:
    1) 30 miles per minute; 2) 1/2 miles per second; 3) 6-1/2 miles per minute; 4) 12 miles per second; 5) zero miles per second. (4)

a correct answers are given on the right for each item.
16. The closest any planet comes to earth is: 1) 15,600 miles; 2) 26 million miles; 3) 43 million miles; 4) 43,800 miles; 5) 13 million miles.  
17. Telescopic observations indicate changing seasons on the planet: 1) Mars; 2) Jupiter; 3) Uranus; 4) Saturn; 5) Venus.  
18. The planet named for the Roman god of the sea is: 1) Venus; 2) Neptune; 3) Pluto; 4) Ceres; 5) Saturn.  
19. Pluto was first seen in: 1) ancient times; 2) 1930; 3) 1846; 4) 1801; 5) 1905.  
20. The "tails" on some heavenly bodies may be as long as: 1) 30,000 miles; 2) 100 million miles; 3) 300 billion miles; 4) 3,000 miles; 5) 10,000 miles.  
21. The planet closest to the sun is: 1) Venus; 2) Pluto; 3) Mars; 4) Mercury; 5) Apollo.  
22. The name "planet" comes from the Greek word meaning: 1) plane; 2) orbit; 3) circling; 4) wandering; 5) star.  
23. The color of Uranus is: 1) bright red; 2) pale blue; 3) pale green; 4) bright gold; 5) orange.  
24. In all, there are: 1) eight planets; 2) nine planets; 3) eleven planets; 4) seven planets; 5) twelve planets.  
25. The number of asteroids is believed to be about: 1) 1,500; 2) 2,200; 3) 2,500; 4) 150,000; 5) a million.  
26. The largest of all of the planets is: 1) Jupiter; 2) Saturn; 3) Uranus; 4) Earth; 5) Neptune.  
27. The axis of the earth is tilted at: 1) a 12.5 degree angle; 2) a 19 degree angle; 3) a 23.5 degree angle; 4) a 33 degree angle; 5) a 29.5 degree angle.  
28. The sun rotates from: 1) north to south; 2) west to east; 3) south to north; 4) east to west; 5) none of these.  
29. The planet named after the Roman god of war is: 1) Pluto; 2) Gemini; 3) Mercury; 4) Jupiter; 5) Mars.  
30. The planetary bodies with "tails" are called: 1) planets; 2) asteroids; 3) comets; 4) meteors; 5) none of these.  
31. The planet nearest the sun has an orbital speed of about: 1) three miles per second; 2) 12 miles per minute; 3) 15 miles per second; 4) 30 miles per second; 5) 26 miles per minute.
32. The planet which weighs more than all the other planets together is:
   1) Saturn; 2) Uranus; 3) Jupiter; 4) Earth; 5) Mercury. (3)

33. Most planets travel in the same plane except for:
   1) Neptune and Jupiter; 2) Mercury and Saturn; 3) Apollo; 4) Pluto; 5) Venus. (4)

34. The "tails" of certain heavenly bodies are always:
   1) behind the body; 2) in front of the body; 3) making clouds; 4) moving away from
   the sun; 5) none of these. (4)

35. The surface of Venus is:
   1) covered by clouds; 2) pale greenish colored; 3) marked by many canals and craters;
   4) sometimes bright red; 5) covered with ice. (1)

36. The sun is:
   1) mostly potash; 2) extremely hard rock; 3) a combination of minerals; 4) mostly granite and silicone; 5) a mass of gases. (5)

37. In relation to the size of the earth, the sun is:
   1) 500,000 times larger; 2) one million times larger; 3) 5,000 times larger; 4) five
   million times larger; 5) nine-tenths as large. (2)

38. Scientists have suggested that life may exist on:
   1) Saturn; 2) Venus; 3) Mars; 4) Jupiter; 5) Mercury. (3)

39. The planet named after the oldest Greek God is:
   1) Pluto; 2) Gemini; 3) Uranus; 4) Mars; 5) Neptune. (3)

40. The diameter of the rings which circles one of the planets is more than:
   1) 8,600 miles; 2) 88,700 miles; 3) 170,000 miles; 4) 528,000 miles; 5) a million miles. (3)

41. The total volume of the asteroids is:
   1) one-fifth the earth's; 2) four times the earth's; 3) a thousand times the earth's; 4) one-five hundredth
   of the earth's; 5) one-fourth the earth's. (4)

42. The planet farthest away from the sun is:
   1) Venus; 2) Pluto; 3) Mars; 4) Mercury; 5) Apollo. (2)
49. The planet which has three rings circling its equator is: 1) Neptune; 2) Apollo; 3) Jupiter; 4) Saturn; 5) Mars. (4)

50. The planet named after the Greek god who ruled the "lower world" is: 1) Saturn; 2) Jupiter; 3) Neptune; 4) Uranus; 5) Pluto. (3)

51. The planet named after the messenger of the Greek gods is: 1) Jupiter; 2) Pluto; 3) Mercury; 4) Apollo; 5) Uranus. (3)

52. The orbit of Uranus is influenced by the planet: 1) Neptune; 2) Apollo; 3) Jupiter; 4) Pluto; 5) Saturn. (1)

53. The planet often considered to be the most interesting and beautiful of all the planets is: 1) Jupiter; 2) Mars; 3) Saturn; 4) Moon; 5) Venus. (3)

54. The planet which glows red in the sky is: 1) Venus; 2) Mars; 3) Mercury; 4) Gemini; 5) Saturn. (2)

55. In the order of the distance from the sun, the earth is: 1) second; 2) third; 3) fourth; 4) fifth; 5) sixth. (2)

56. The planet which comes closest to the earth is: 1) Mars; 2) Mercury; 3) Venus; 4) Jupiter; 5) the Moon. (3)
1. Most of Mexico was taken under the control of: 1) Italy; 2) Spain; 3) Portugal; 4) England; 5) France. (2)

2. Cabral sailed in the service of: 1) Spain; 2) Italy; 3) France; 4) Portugal; 5) none of these. (4)

3. Cabot sailed in the service of: 1) Spain; 2) England; 3) France; 4) Holland; 5) Italy. (2)

4. The most advanced culture of the western world before the age of exploration was the: 1) Aztecs; 2) Tenochtitlan; 3) Incas; 4) Conquistadores; 5) Brazilians. (3)

5. Cook explored: 1) the northeast; 2) Australia; 3) South America; 4) Africa; 5) Central America. (2)

6. The leader of a native people in Mexico was: 1) Cortes; 2) Montezuma; 3) Aztecs; 4) Tenochtitlan; 5) Incas. (2)

7. The explorer who tried to find a straight route to the Spice Islands was: 1) Diaz; 2) Magellan; 3) Cabot; 4) Columbus; 5) Cartier. (2)

8. Magellan sailed in the service of: 1) Spain; 2) Portugal; 3) France; 4) England; 5) Italy. (1)

9. The man whose exploration first gave England claim to much of North America was: 1) La Salle; 2) Hudson; 3) Cartier; 4) Cabot; 5) Drake. (4)

10. Francis Drake: 1) was poorly paid for his voyages; 2) sailed for France; 3) tried to establish a colony for England; 4) circled the globe in the late 1500's; 5) sought to colonize the East coast. (4)

11. The leader of the famous expedition to Mexico was: 1) Montezuma; 2) Pizarro; 3) Aztec; 4) Cortes; 5) Cartier. (4)

12. The explorer of Peru was: 1) Pizarro; 2) Cortes; 3) La Salle; 4) Cartier; 5) Cabot. (1)

13. The person usually credited with being the first European to see the Pacific Ocean is: 1) Balboa; 2) Magellan; 3) Vasco da Gama; 4) Columbus; 5) Cortes. (1)

14. The period referred to as the age of exploration of the New World is: 1) the 15th and 16th centuries; 2) the 16th and 17th centuries; 3) the 14th to the 17th centuries; 4) the mid-15th to the late 17th centuries; 5) the 13th to the 15th centuries. (1)
15. The first European to sail past the southern tip of Africa was:  
   1) da Gama; 2) Cortes; 3) Magellan; 4) Diaz; 5) Cabot. (4)

16. The first permanent French colony was started by: 1) La Salle;  
   2) Cartier; 3) Cabot; 4) Laffitte; 5) Champlain. (5)

17. The explorer credited with opening passage to the Far East was:  
   1) Vasco da Gama; 2) Vasco de Balboa; 3) Magellan; 4) Cortes;  
   5) Pizarro. (1)

18. Cartier tried to explore: 1) a route to Australia; 2) a northern  
   route to the Far East; 3) a route around Africa; 4) a route to the  
   Far North; 5) the South Pacific. (2)

19. The first permanent French colony in America was started in:  
   1) 1596; 2) 1607; 3) 1696; 4) 1608; 5) 1495. (4)

20. The explorer who found the route that led to the Pacific Ocean was:  
   1) Balboa; 2) Cabot; 3) Cortes; 4) Pizarro; 5) Magellan. (5)

21. The name of a group of native people in Mexico was: 1) Cortes;  
   2) Montezuma; 3) Incas; 4) Aztecs; 5) Tenochtitlan. (4)

22. The man whose exploration first gave France its claim to parts of  
   North America was: 1) La Salle; 2) Hudson; 3) Drake; 4) Cabot;  
   5) Cartier. (5)

23. The capital city of Mexico in the time of the early native empire  
   was: 1) the "city of Kings"; 2) Darien; 3) Mexico City; 4) Tenochtitlan;  
   5) Cathay. (4)

24. The time required for the first crew to circumnavigate the world was:  
   1) a year and a half; 2) a little over two years; 3) three years;  
   4) fourteen months; 5) twenty-nine months. (3)

25. The Bull of Demarcation was intended to settle a dispute between:  
   1) France and Spain; 2) Spain and Portugal; 3) France and England;  
   4) France and Portugal; 5) Spain and England. (2)

26. The explorer who was killed in the Philippine Islands was: 1) Cartier;  
   2) da Gama; 3) Cabot; 4) Diaz; 5) Magellan. (5)

27. The first European to reach North America after the Northmen was:  
   1) Magellan; 2) Cartier; 3) La Salle; 4) Cabot; 5) Cortes. (4)

28. The leader of the first expedition to circumnavigate the world was:  
   1) Diaz; 2) da Gama; 3) Magellan; 4) Balboa; 5) Columbus. (3)

29. The first permanent English colony in America was started in: 1) 1596;  
   2) 1695; 3) 1608; 4) 1607; 5) 1495. (4)
30. The claim of France in North America was based on the exploration of:  
1) La Salle; 2) Cartier; 3) Cabot; 4) Champlain; 5) Cook.  (2)

31. Not a reason for the downfall of the native empire of Mexico was:  
1) their being outnumbered; 2) the stern rule of their leader; 3) their superstitions; 4) their great wealth; 5) their lack of horses and iron armor.  (1)

32. John Cabot was by birth: 1) an Englishman; 2) a Frenchman; 3) an Italian; 4) a Dutchman; 5) a Spaniard.  (3)

33. Brazil came under the control of: 1) Spain; 2) England; 3) France; 4) Italy; 5) Portugal.  (5)

34. The famous explorer of the Mississippi was: 1) Cabot; 2) Hudson; 3) Champlain; 4) Laffitte; 5) La Salle.  (5)

35. Henry Hudson sought to discover: 1) Australia; 2) the South Pacific; 3) a route to China; 4) a route to the Indies; 5) a route to the Far North.  (3)

36. Magellan began his famous expedition in: 1) 1490; 2) 1500; 3) 1519; 4) 1576; 5) 1607.  (3)

37. The natives of Mexico lost the control of their capital in: 1) 1490; 2) 1521; 3) 1590; 4) 1441; 5) 1607.  (2)

38. The first permanent French colony in America was in: 1) Montreal; 2) Quebec; 3) Nova Scotia; 4) Prince Edward Island; 5) St. Lawrence.  (2)

39. Balboa was from: 1) Italy; 2) Spain; 3) France; 4) Portugal; 5) England.  (2)

40. Captain Cook made his explorations in: 1) the early 1500's; 2) the 1700's; 3) the late 1600's; 4) the late 1400's; 5) the 1800's.  (2)

41. France's claim to the Louisiana Territory was the result of exploration by: 1) La Salle; 2) Magellan; 3) Cartier; 4) Laffitte; 5) Champlain.  (1)

42. Montezuma was: 1) leader of the Incas; 2) the capital of a native tribe in Mexico; 3) a conquistador; 4) ruler of the Aztecs; 5) a tribe of Indians.  (4)

43. A new city was built in Peru by: 1) Cortez; 2) Cartier; 3) Pizarro; 4) Diaz; 5) Balboa.  (3)

44. By the "northwest passage", the English sought a route to: 1) Russia; 2) China; 3) the North Pole; 4) Australia; 5) Canada.  (2)
(4) Van Wagenen RATE OF COMPREHENSION SCALE  Form D

Also Part I Van Wagenen Verbal Mental Abilities Scales Form A Division 4 and Part I Dvorak-Van Wagenen Diagnostic Examination of Silent Reading Abilities Senior Division

In Grades 4, 5, 6, 7, 8 and 9, give five minutes for working on the scale and use this conversion table.

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In Grades 10, 11 and 12, give four minutes for working on the scale and use this conversion table.

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DIRECTIONS FOR RATE OF COMPREHENSION TEST

Read paragraph A carefully.

A Jane needed a spool of silk thread to finish her new dress. But when she went to the store for her mother she forgot to get the buttons she needed.

In the last half of this paragraph the word buttons does not fit in with the meaning of the rest of the paragraph, so buttons is crossed out.

B The carpenter asked Tom to go to the hardware store and get him a pound of nails. When Tom got back with the matches the carpenter gave him a nickel.

E When we hit the man as he was crossing the street it made him very angry. While he was getting up and brushing off his clothes he laughed at us.

F There was a very large crowd to see the motion picture last night. We got there very early but even then there was hardly an empty table in the place.

G The ball game was more than half over when we got to it but it was so exciting that we were glad to see even the first part of it.
1. Alice had wanted a new sewing machine for a long time. She was very happy when she got one as a Christmas present and has already learned to play it.

2. The fire in the city last night was such a big one and could be seen from so far away that people drove long distances to see the fireworks.

3. Henry feels sure that he will be a good carpenter when he grows up. Whenever his mother has anything to be repaired around the house he does it very poorly.

4. The blizzard lasted so long that the Scott family was without food for two days. As soon as the storm let up Mr. Scott hurried to the store for some fuel.

5. My friend lives a mile from the main road. Whenever I visit her I go as far as I can on the bus and swim the rest of the way.

6. Mary expects to get a letter telling her of her brother's death at any time so she watches with a great deal of happiness for the coming of the mailman.

7. Thomas' new bicycle breaks down nearly every time he rides it. The boys think it must have been a very costly one, however much he may have paid for it.

8. Margaret liked to sit on the beach in her bathing suit but the sun shone so brightly that she was afraid of getting wet if she stayed out too long.

9. Every one in Marshall calls the old shoemaker on the corner Uncle John. Many people have been going to him to have their watches repaired for the last twenty years.

10. It is cloudy this morning and looks as if it would rain in a short time. If you go to the store be sure to take your cane with you.

11. During the winter squirrels can seldom get food from the earth because it is covered with deep snow, so during the fall they store up fuel for the coming winter.

12. Since they have been living at the lake the boys have become so fond of rowing that we have bought each one of them a new bicycle for his birthday.

13. Alice is making a new dress to wear to a party next week. She expected to have it done tonight but she did not have enough paint to finish it.

14. All the boys in our school like Peter and want him to play in all their games. This is because he plays unfairly when he is on the losing side.

15. There was danger of fire in the woods since no rain had fallen for weeks. So when campers came they were told it was too wet to start a fire.

16. Otto always shares his toys and candies with his playmates whether he likes them or not. Because of this trait everyone who knows him thinks he is very selfish.

17. The firemen came rushing down the street to the corner house but when they got there they were too late to help as the cat had already been put out.

18. Eggs were so high last winter that Mrs. Scott decided not to use them any longer in baking. In making cakes she selected recipes which did not call for butter.

19. Mr. Brown is an honest man and has been such a good mayor of our city that nearly everybody will vote against him if he runs for the office again.

20. Some children who live in the country think a library is a place where books are made but city children know that it is a place where they are sold.

21. There has been a great deal of rain this summer. In fact, we have had so much that it has been too dry for anyone's garden to grow well.

22. Henry and John started to build a kennel in which their new dog could sleep nights. When it was nearly finished they suddenly discovered that they were out of mucilage.

23. Mr. Jones expects to move into his new house soon. Only a little carpenter work remains to be done and the plumber thinks he can have that finished next week.

24. John had never seen a mountain before he went to visit his country cousins. He was very much thrilled at his first view of one because it seemed so active.

25. When it is cold the ice freezes thick enough for children to skate safely but it was so warm last winter that children could not go swimming at any time.

26. The old roof on our house has been leaking very badly for a long time. Father says that we shall just have to have a new chimney before winter comes.

27. We started out for the concert very early last night but when we got there we found the restaurant already so crowded that we could not get a seat anywhere.

28. The children were a very gay and happy lot when they got back from the picnic. To be in such a mood they must have had a dismal time indeed.

(Continue on next page)
29. The man who does our painting always forgets to paint something so he has to come back again. The last time he was here he forgot to do the rugs.

30. Mr. Williams has been going to his work on the bus. He bought a new car one day last week so now he can walk to his work every morning.

31. When Ralph's mother lets him play every afternoon during the summer while she washes clothes for other people to earn a living, we think she is very cruel to him.

32. The new hunting dog which we bought only a short time ago was delivered in a crate. When we opened it he jumped out and began to purr very happily.

33. You had better look in your mailbox for some mail for you. When Jane and I were coming down the street we saw the milkman stop at your house.

34. Joseph is so fond of animals that he has no trouble in taming the wild ones that he catches young. When he grows up he expects to be a butcher.

35. Many children have been having the measles lately. Although it was clear and warm yesterday very few children were at the school picnic. The rain must have kept them away.

36. Last month the carpenters put a new roof on our house and this week the painters have been here. Our house begins to look much like an old one again.

37. Martin ran hurriedly out of the house with his ball and bat. His sister, who saw him go, called to her mother that Martin had gone to play marbles again.

38. The doctor has been stopping at the next door every day for a week. As we have not seen the little boy for a while he must be away again.

39. All the boys except Ralph were wearing their bathing suits, so when a swim was decided upon Ralph ran home as fast as he could to get his baseball suit.

40. It always makes Frank very angry to see a big boy tease and abuse a smaller one. He started in to laugh when Henry tripped up his little brother yesterday.

41. When Harry fell off his new pony and broke his arm his mother was very much frightened and rushed him to the dentist just as fast as she could drive.

42. Jane is a clerk at the ribbon counter in a large department store in our city. It amuses her very much when some people try to match dishes for themselves.

43. When we drove home after the shower it seemed as if half the trees along the road had been blown down. It must have taken a heavy rainfall to do that.

44. Harry started to the store on his bicycle to get some groceries. The streets were so icy and the wind blew so hard that he found the walking very difficult.

45. During his vacation Theodore had to work in a meat market instead of playing with the other boys. He used to get very tired of cutting cloth day after day.

46. The boys were afraid that the waves would overturn their boat when the wind came up so quickly so they swam back to the shore as quickly as they could.

47. Our teacher told us one morning that sponges are the skeletons of animals. Since then we have been trying to find out what kind of looking plants they come from.

48. Whenever John was late to breakfast he always laid it to his broken watch. He will have to find another excuse now as he got a new pen for Christmas.

49. John earns money by keeping hens and selling eggs in a nearby city. As he delivers them while they are perfectly fresh he gets a good price for his vegetables.

50. Jane learned so easily that she seldom took the trouble to look at her lessons. When she failed in school everyone knew that it was due to her stupidity.

51. Margaret is very much afraid of getting sunburned in the summer. This is the reason why she will never go out for a walk without taking her dog with her.

52. The teacher seems to think that Jack is either very stupid or very lazy or perhaps both. It must be because he does all of his school work so well.

53. John has already worn a hole in the bottom of one of his new shoes. Tell him to be sure to stop at the tailor's to have it repaired today.

54. When Harold started the brush fire in the dry grass back of our house this afternoon he never thought that the disease would spread so rapidly over the whole place.

55. The president had been shot in the morning. Every detective in the country was working on the case but at a late hour the thief had not yet been caught.

56. Frank must have had a breakdown on the way as he is very late in getting home from the village tonight. Otherwise he must have started much earlier than usual.

If you have finished before the time is up, raise your hand and let the examiner know
APPENDIX C

STIMULUS PASSAGES
DIRECTIONS TO STUDENTS

DO NOT TURN THIS PAGE UNTIL DIRECTED TO DO SO.

Read the following instructions silently as you listen:

This is a test of your ability to skim an article which has been divided into seven equal parts. Each part is printed on a separate page. You will be given a limited amount of time to get as much information as you can from each page.

When the examiner says “Turn,” you should turn the page immediately and skim through the entire part of the article on that page. Try to get as much information as you can. Do not delay in turning the page. No matter how far you have gotten when you hear the signal, go right on to the next page.

The amount of time you will have on each page will be quite short. For example, it will be from now... (pause)... to now. You will not expect to get every bit of information, but do try to get as much as you can.

You should try to pace yourself so that you are able to get to the bottom of each page by the time you are given the signal to turn the page. In order to reach this goal you will probably need to proceed at a rate which is much faster than your usual reading rate. Therefore, you should not plan to look at every word.

In front of the first page of the article you will find a page which has x’s and o’s (xoxoxox oxo) in place of words. This is a practice page which you should use to see how fast you will need to proceed in order to cover all of the paragraphs on the following pages in the time allowed.

When you have finished skimming the article you will be asked to answer some questions about the information contained in the article.

Remember, then:
1. The first page will have x’s and o’s in place of words. The purpose for this page is to show you how much material you will need to cover in the given amount of time.
2. Try to skim all of each page to get as much information as you can in the time allowed.
3. When the examiner gives the signal, “Turn,” turn to the next page immediately. Do not delay for any reason.

If you have any questions, ask them now.

WAIT FOR THE SIGNAL TO TURN THE PAGE.
SCIENCE

The Solar System

WAIT FOR THE SIGNAL TO TURN THE PAGE.
The vastness of our solar system is almost incomprehensible. At the center of the solar system is the sun. Circling the sun are nine planets. Moving around some of the planets are their moons. In the space between the orbits of Mars and Jupiter are the thousands of little planets, or asteroids, also revolving around the sun. Cutting in, this way and that, across the paths of the planets, are countless comets and meteors. All these moving bodies — sun, planets, satellites, asteroids, comets and meteors — travel together as a unit through space, at the rate of about twelve miles a second.

The planets, in order of their distance from the sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. The first four are relatively close to the sun and to each other. The outer five planets are not only farther from the sun, but are also separated from each other by vast distances. The planets revolve around the sun counter-clockwise in nearly circular orbits. All travel in almost the same plane except for Pluto, the outermost planet. In general, as the distance from the sun increases, the planet paths are more and more widely separated. The farther from the sun, the longer

S–2.1

a The numeral to the left of the period designates the treatment condition T₁ through T₇. The numeral to the right identifies the page number within the treatment condition.
It takes a planet to complete one revolution. This is due not only to the longer orbital path, but also to the slower speed with which the more distant planets revolve. Mercury, the planet nearest to the sun, has an orbital speed of almost thirty miles a second, while Pluto, farthest from the sun, has an orbital speed of only three miles a second.

The solar system is held together by two forces, gravitation and centrifugal force, which balance each other. If they did not balance each other, one of two things would happen: either the planets would fly out into space or they would be pulled into the sun.

The sun, located in the center of our solar system, is a star, a heavenly body that produces light and heat. It is a huge mass of gases burning at a temperature ranging from 10,000 degrees Fahrenheit at the surface to about 35,000,000 degrees Fahrenheit at the center. The sun, whose diameter is 865,400 miles, is large enough to contain one million planets the size of our earth. The sun rotates on its axis from east to west.

The five planets nearest to the sun, Mercury, Venus, Earth, Mars, and Jupiter, were
known and named in ancient times. Babylonian astronomers could predict the motion of the planets but could not explain it. The name "planets" comes from the Greek word planetes, which means wandering.

Mercury, named for the messenger of the Greek gods, is the smallest planet in the solar system. Because Mercury is tiny and not very dense, its gravitational pull is much less than that of Earth. A man weighing 150 pounds on our Earth would weigh only 40 pounds on Mercury. Since its rotation and revolution are identical in time, Mercury always presents the same face to the sun. It is estimated that the temperature of this sunny side ranges from 500 degrees to 770 degrees Fahrenheit. The dark side is believed to have a temperature less than 400 degrees.

Venus, named for the Roman goddess of love and beauty, is the brightest planet of the solar system. Venus comes closer to our Earth than any other planet, sometimes approaching to within 26,000,000 miles. The surface of Venus cannot be seen because the planet is covered by a layer of clouds.

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axis of the earth is tilted at a 23½ degree angle to the plane of its orbit. This causes the sun’s rays to strike the earth at different angles during different times of the year, thus creating seasonal changes.

Mars, the planet that glows red in the sky, is named for the Roman god of war. Astronomers have long speculated on the possibility that life exists on Mars. It has an atmosphere extending outward about as far as earth’s atmosphere. Scientists believe, however, that there is much less oxygen and water in Mars’ air than in ours. Telescopic observations show large areas that turn blue-green at certain seasons and polar ice caps that grow larger in the Martian winter and recede in the Martian summer. Many straight lines can be seen through the telescope. These lines are believed by some astronomers to be canals.

Jupiter, largest and heaviest of all the planets, is named for the king of the gods in Roman mythology. Jupiter weighs more than all the planets put together. Through the telescope this planet is seen to shine brilliantly and in many colors. In 1878, a great red spot was noticed on Jupiter. After a few years, it faded.
The last time it was unusually red was in 1936. This spot was visible through the gaseous clouds which hide Jupiter's surface.

Saturn, named for the Roman god of the harvest, is the most beautiful and most interesting of all the planets. Though much larger than our earth, Saturn is made up of matter that is lighter than water. Circling Saturn's equator are three rings forming a band somewhat like the brim of a man's straw hat. These rings, more than 170,000 miles across, consist of millions of tiny particles.

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S-2.7
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S-4.4
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HISTORY

The Age of Exploration

WAIT FOR THE SIGNAL TO TURN THE PAGE.
HISTORY

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A stout heart and a burning desire to explore the unknown and discover new lands for the sake of “gospel, gold and glory” made possible the exploits of Columbus, da Gama, Magellan and many other adventurous explorers. The age of exploration was a breath-taking epoch of discovery. Within eighteen years after Columbus died in 1506, the general configuration of the New World had been revealed, the most southern point of South America had been rounded, and the vast expanse of the Pacific Ocean traversed.

In 1500 a Portuguese commander named Cabral, sailing around Africa to the Indies, was blown far off his course. He sighted land in South America. This territory was acquired for Portugal, and that is why today the people of Brazil speak the Portuguese language.

Explorers kept looking for a passage through the new lands which would lead them to Asia, voyaging along the coasts of Central America and the northern portion of South America. A settlement was made on the isthmus of Darien, and here a youthful Spaniard, Vasco de Balboa, heard tales from the Indians of a great ocean but a short distance to the west. In 1513 Balboa with a handful of soldiers set eyes
upon the Pacific Ocean and Europe was ready to explore a new realm of conquest.

In 1519 a Portuguese navigator in the service of Spain found the passage that led into the Pacific. He was Ferdinand Magellan, whose remarkable achievements entitle him to equal rank with Columbus and Vasco da Gama. Columbus made Europe acquainted with the New World; da Gama showed the way to the Far East; Magellan now linked the two areas by circumnavigating the world. He had for some time believed that it was possible to sail around South America just as Diaz had rounded Africa. The Spanish king fitted him out with a fleet of five small ships which were "very old and patched up" and ordered Magellan to make straight-way for the Spice Islands.

In March 1521, Magellan came to islands that he mistook for the Spice Islands, which were in reality the Philippines. At one of these islands the intrepid explorer was slain during a skirmish with natives. His crew in a single vessel, the Victoria, crossed the Indian Ocean, rounded the Cape of Good Hope, and dropped anchor in a Spanish harbor in September 1522. Practically three years to the day had been required to circumnavigate the globe.
Meanwhile the Spaniards were making valuable land discoveries in the interior of the New World. In 1519, the year Magellan set forth, a youthful adventurer by the name of Hernando Cortes led an expedition to Mexico, whence had come rumors of great riches and a high native civilization. Montezuma, ruler of the native Aztecs, had thousands of warriors, while Cortes had a mere handful. But the Spaniards possessed horses, iron armor, and gunpowder, all unknown to the Aztecs. Two other factors aided the Europeans — the discontent of many native tribes, who chafed under the stern rule of the Aztecs and who were willing to join Cortes, and an ancient legend in Mexico that the Aztecs would one day be visited and destroyed by strange, white-skinned gods.

The superstitious Montezuma sent many embassies bearing rich gifts to Cortes with the order to leave the country. But such lavish gifts had the opposite effect, for instead of persuading the Spaniards to depart, they excited the gold-mad adventurers to push on to Tenochtitlan, the Aztec capital city. Cortes eventually captured Tenochtitlan in 1521. With this defeat the Aztecs soon lost their entire empire to the Spanish conqueror, or conquistador, and it was not long
before the Spanish had explored most of Central America and California.

Other conquistadors now emulated the success of Cortes. Tales had come to Darien that a mighty empire lay to the south, of such boundless riches that a cattle raiser by the name of Francisco Pizarro decided to explore and conquer the fabulous kingdom of Peru.

The civilization which Pizarro was searching for was that of the Incas, the most advanced people in the western world, whose far-flung empire stretched along the western coast. Pizarro managed to meet the emperor, whom he treacherously seized.

Despite a huge ransom the Spaniards did not release the emperor, but on trumped-up accusations sentenced him to be burned to death. In 1533 Pizarro entered the Inca capital, where he reaped further treasure. Later he built a new city, Lima, the "City of Kings." It took many years to subjugate the infuriated Incas elsewhere, but eventually most of South America (with the exception of Brazil) passed into Spanish control.

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In March 1521, Magellan came to islands that he mistook for the Spice Islands, which were in reality the Philippines. At one of these islands the intrepid explorer was slain during a skirmish with natives. His crew in a single vessel, the Victoria, crossed the Indian Ocean, rounded the Cape of Good Hope, and dropped anchor in a Spanish harbor in September 1522. Practically three years to the day had been required to circumnavigate the globe.
Meanwhile the Spaniards were making valuable land discoveries in the interior of the New World. In 1519, the year Magellan set forth, a youthful adventurer by the name of Hernando Cortes led an expedition to Mexico, whence had come rumors of great riches and a high native civilization. Montezuma, ruler of the native Aztecs, had thousands of warriors, while Cortes had a mere handful. But the Spaniards possessed horses, iron armor, and gunpowder, all unknown to the Aztecs. Two other factors aided the Europeans — the discontent of many native tribes, who chafed under the stern rule of the Aztecs and who were willing to join Cortes, and an ancient legend in Mexico that the Aztecs would one day be visited and destroyed by strange, white-skinned gods.

The superstitious Montezuma sent many embassies bearing rich gifts to Cortes with the order to leave the country. But such lavish gifts had the opposite effect, for instead of persuading the Spaniards to depart, they excited the gold-mad adventurers to push on to Tenochtitlan, the Aztec capital city. Cortes eventually captured Tenochtitlan in 1521, With this defeat the Aztecs soon lost their entire empire to the Spanish conqueror, or conquistador, and it was not long...
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While Portuguese and Spaniards were making discoveries and establishing empires, other European powers had not been idle. France, England and Holland were embarking upon significant geographical schemes. Naturally the division of the overseas world between Spain and Portugal as set forth by the Bull of Demarcation of 1493 and the treaty of 1494 was scarcely calculated to arouse enthusiasm among other European powers, and it was not long before France and England encroached on the private preserves of both Portugal and Spain.

In 1497 John Cabot, an Italian mariner in the employ of England, sailed across the north Atlantic in a small ship manned by only eighteen men. Although close-fisted Henry VII had contributed no money to the defraying of expenses, he granted Cabot the right to enlist English sailors and sail west to Cathay in the name of the king of England. After six weeks of turbulent sailing the ship arrived off the northern coast of the New World. Cabot's main discovery was an extensive fishing ground, but he was disappointed in not reaching at least Japan and the Spice Islands. When he returned home, he
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H-4.7
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APPENDIX D

TABLES
### TABLE VIII

**SCIENCE**

A SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE POSTTEST RAW SCORE MEANS ADJUSTED FOR COVARIATE (RATE OF COMPREHENSION) T₁ THROUGH T₁₅ (N=312)

<table>
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<th>DF</th>
<th>SS</th>
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<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equality of adjusted cell means</td>
<td>14</td>
<td>1,256.92</td>
<td>89.78</td>
<td>2.52</td>
<td>.01</td>
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<tr>
<td>Zero slope error</td>
<td>1</td>
<td>833.35</td>
<td>833.35</td>
<td>23.40</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>296</td>
<td>10,540.76</td>
<td>35.61</td>
<td></td>
<td></td>
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<tr>
<td>Equality of slopes error</td>
<td>14</td>
<td>791.42</td>
<td>56.53</td>
<td>1.64</td>
<td>ns</td>
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<td></td>
<td>282</td>
<td>9,749.34</td>
<td>34.57</td>
<td></td>
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</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Source of Variance</th>
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<td>Equality of adjusted cell means</td>
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<td>442.61</td>
<td>31.61</td>
<td>1.048</td>
<td>ns</td>
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<td>Zero slope error</td>
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<td>933.69</td>
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<td>.001</td>
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<tr>
<td></td>
<td>298</td>
<td>8,988.34</td>
<td>30.16</td>
<td></td>
<td></td>
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<td>Equality of slopes error</td>
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<td>131.51</td>
<td>9.39</td>
<td>0.301</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>284</td>
<td>8,856.83</td>
<td>31.19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE X
SCIENCE
A SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE GAIN SCORE MEANS ADJUSTED FOR COVARIATE (RATE OF COMPREHENSION) T₁ THROUGH T₇ AND T₁₅

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equality of adjusted cell means</td>
<td>7</td>
<td>245.78</td>
<td>35.11</td>
<td>1.62</td>
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</tr>
<tr>
<td>Zero slope error</td>
<td>1</td>
<td>20.83</td>
<td>20.83</td>
<td>0.96</td>
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<tr>
<td></td>
<td>147</td>
<td>3,195.46</td>
<td>21.74</td>
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<td></td>
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<tr>
<td>Equality of slopes error</td>
<td>7</td>
<td>246.50</td>
<td>35.21</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>2,948.96</td>
<td>21.06</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<tr>
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<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equality of adjusted cell means</td>
<td>7</td>
<td>161.62</td>
<td>23.09</td>
<td>1.74</td>
<td></td>
</tr>
<tr>
<td>Zero slope error</td>
<td>1</td>
<td>22.21</td>
<td>22.21</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>1,988.77</td>
<td>13.26</td>
<td></td>
<td></td>
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<td>12.00</td>
<td>1.71</td>
<td>0.12</td>
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<tr>
<td></td>
<td>143</td>
<td>1,976.76</td>
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<td>Form of Passage</td>
<td>Raw Score Means</td>
<td>Rank</td>
<td>Adjusted Raw Score Means</td>
<td>Rank</td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------</td>
<td>------</td>
<td>---------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>Or ((T_1 + T_8))</td>
<td>16.74</td>
<td>8</td>
<td>16.69</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>IU ((T_2 + T_9))</td>
<td>15.48</td>
<td>6</td>
<td>15.26</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IM ((T_3 + T_{10}))</td>
<td>14.93</td>
<td>3</td>
<td>14.93</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2U ((T_4 + T_{11}))</td>
<td>14.51</td>
<td>2</td>
<td>14.59</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2M ((T_5 + T_{12}))</td>
<td>15.98</td>
<td>7</td>
<td>16.20</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>3U ((T_6 + T_{13}))</td>
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<td>5</td>
<td>15.44</td>
<td>6</td>
<td></td>
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<tr>
<td>3M ((T_7 + T_{14}))</td>
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<td>1</td>
<td>14.28</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>No-Passage ((T_{15}))</td>
<td>15.42</td>
<td>4</td>
<td>15.43</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
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BEFORE AND AFTER ADJUSTMENT FOR COVARIATE
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<table>
<thead>
<tr>
<th>Form of Passage</th>
<th>Raw Score Means</th>
<th>Rank</th>
<th>Adjusted Raw Score Means</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Or ((T_1 + T_8))</td>
<td>22.17</td>
<td>7</td>
<td>22.09</td>
<td>6</td>
</tr>
<tr>
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TABLE XIV

RESULTS OF ITEM ANALYSIS FOR SCIENCE PRETEST SHOWING PER CENT OF RESPONSES CORRECT FOR TOTAL, FOR THE TOP AND BOTTOM QUARTILES, AND THE DIFFERENCE BETWEEN THE QUARTILES FOR EACH OF 56 ITEMS (N=175)

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TABLE XV

RESULTS OF ITEM ANALYSIS FOR SCIENCE POSTTEST
SHOWING PER CENT OF RESPONSES CORRECT
FOR TOTAL, FOR THE TOP AND BOTTOM QUARTILES,
AND THE DIFFERENCE BETWEEN THE QUARTILES
FOR EACH OF 56 ITEMS (N=339)

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TABLE XVI

RESULTS OF ITEM ANALYSIS FOR HISTORY PRETEST
SHOWING PER CENT OF RESPONSES CORRECT
FOR TOTAL, FOR THE TOP AND BOTTOM QUARTILES,
AND THE DIFFERENCE BETWEEN QUARTILES
FOR EACH OF 44 ITEMS (N=176)

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TABLE XVII

RESULTS OF ITEM ANALYSIS FOR HISTORY POSTTEST
SHOWING PER CENT OF RESPONSES CORRECT
FOR TOTAL, FOR THE TOP AND BOTTOM QUARTILES,
AND THE DIFFERENCE BETWEEN THE QUARTILES
FOR EACH OF 44 ITEMS (N=344)

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APPENDIX E

PROCEDURE FOR DETERMINING KEY WORDS
AND NON-KEY WORDS IN CONTINUOUS DISCOURSE
APPENDIX E

Procedure for Determining Key Words and Non-Key Words In Continuous Discourse

Syntactic Redundancy

Standard structural theory of language (Fries, 1952) and standard transformational theory (Chomsky, 1965) show that in English, structure words, certain auxiliary verbs and other recoverable items are readily deletable from sentences without impairing the referential or grammatical meaning. It is possible to list such words which may be deleted from a sentence at sight since a small number of words meet this criterion. In the texts which were used as stimulus passages in the present investigation, the following categories of words were found to be deletable at sight on syntactic grounds:

(1) Unquantified determiners: a, the, this, that, these, those (unstressed)

  e.g. (1) ______ vastness of our solar system (the)
  (2) ______ sun is ______ star (the, a)
  (3) At one of ______ islands (these)
  (4) With ______ defeat, ______ Aztecs ... (this, the)

1 based on a manuscript by Bowers & Nacke; submitted for publication.
The universal quantifier all seems to be recoverable from the plural form of the noun, but some is not: England eventually won Canada (all of)

(2) Conjunctions

(i) co-ordinates: and, but, or, also, yet

  e.g. Captain Cook explored Australia other lands in the South Pacific (and) meteors are called "shooting stars" "falling stars." (or)

  The Spaniards did not release the emperor on trumped-up accusations, sentenced him ... (but)

All sentences and parts of sentences have the possibility of being co-ordinately joined. The kinds of co-ordinators which can be deleted are those which are recoverable from the sense of the referential remnants.

(ii) sentence connectors: thus, therefore, consequently, for this reason, that is why, accordingly, etc.

  e.g. Cabot's discovery laid the foundation for England's claim to the whole rich continent, for 10 pounds and a title, England eventually won all of Canada. (Thus)

  This territory was acquired for Portugal and today the people of Brazil speak the Portuguese language. (that is why)

  Astronomers had noticed that Uranus was not moving in its expected orbit, they began to suspect that Uranus might be under the influence of an unknown planet. (Therefore)

Like co-ordinators, sentence connectors are recoverable from the connected sentences themselves, as they merely act as editorial
signals to indicate to the reader the particular part of an argument or description reached.

(iii) subordinating conjunctions, relative pronouns: who, whom, whose, whence, that, etc.

e.g. The solar system is held together by two forces ______ balance each other. (which)

The sun, ______ diameter is 865,4000 miles ... (whose)

(The sun is) a heavenly body ______ produces light and heat. (that)

Relative pronouns are recoverable by anaphora, i.e., by reference to their antecedents. In this respect they resemble co-ordinators, which delete or pronominalize recoverable nouns obligatorily: John arrived and John started work is not a well-formed sentence: John arrived and he started work is better, but John arrived and started work is the more acceptable. It is noteworthy that current theory derives many adjectives from restrictive relative clauses. The man fell down and the man is tall transforms to the man who is tall fell down; further, to the tall man fell down. This regular process confirms the deletability of relative pronouns. In earlier English all forms of the relative pronoun were quite deletable in normal usage, not merely in the relative clause-object structure as is the case today.

(iv) subordinating that

e.g. It is estimated ______ the temperature ... (that)

It is believed ______ such a passage must exist north of Canada. (that)
Tales had come to Darien ______ a mighty empire lay to the south. (that)

In normal English usage, that is optional as a signal for a following noun clause in all but unexraposed subjects, e.g. that he is living is obvious is an obsolescent structure.

(3) Auxiliary verbs and modals: to have, to do, can, must, may will, shall

  e.g. He ______ for sometime believed (had)

    ... if they ______ not balance, one of two things ______ happen. (did, would)

    Babylonian astronomers ______ predict the motion of the planets but _____ not explain it. (could, could)

    It was believed that such a passage ______ exist north of Canada. (must)

All these verbs are grammatically auxiliary and structural in English. The word have as a perfect tense operator is recoverable from the past participle verb inflection; do is recoverable from the infinitive. The modals, of course, have semantic force but not reference. In most discourse the force, (i.e. the tone, the presupposed viewpoint of the speaker) is clear from the overall intention and effect, from the title to the conclusion. This is particularly the case in expository discourse of which the test or stimulus passages used in the initial investigation were examples. Whether one could delete modals from highly rhetorical discourse without losing the sense is doubtful; however, even in rhetorical discourse, deletion of modals would not
affect referential meaning. In grammar models, modal force is represented in two ways; one is to describe the verb phrase as modals + verb (Chomskyan standard theory) while the other represents modality as a superordinate sentence with the referential sentence embedded in it. Although the former makes the modal depend from the verb and the latter the verb from the modal, both descriptions keep the modals, like the auxiliaries, strictly separate from the predicate, and it is this principle which permits the auxiliary and the modal deletions.

(4) to be

e.g. At the center of the solar system _____ the sun. (is)

The outer five planets _____ separated from each other by vast distances. (are)

Cabral _____ blown off his course. (was)

Meanwhile the Spaniards _____ making valuable land discoveries. (were)

The verb to be, in both its existential and auxiliary uses, is recoverable from word order, where juxtaposition implies copularity and from the participal form of the following verb in passive and continuous aspect structures. The formal motivation for deletion was discussed earlier.

(5) Infinitival to

e.g. ... the longer it takes a planet _____ complete one revolution ... (to)

Instead of persuading the Spaniards _____ depart ... they excited them _____ push on to Tenochtitlan. (to, to)
to is wholly predictable in English structures which involve the
infinitive.

(6) of in all cases

e.g. Montezuma, ruler _____ the native Aztecs ... (of)

     After six weeks ______ turbulent sailing ... (of)

     Venus is the brightest planet ______ the solar
     system. (of)

Among the prepositions, which as a whole belong to the area at which
content words and structure words intersect, of seems to be the only
one which can be recovered unambiguously. Fillmore (1968) has shown
it to be the marker of the neutral case and, as such, the least marked
and most deletable of the prepositions.

In suggesting these deletions, it must be stressed that it is
not necessary for a reader to have a 100 per cent prediction, i.e., to
replace the word exactly in order to understand the message. Often,
of course, a reader can restore the exact word, but it is not on the
principle of absolute prediction that linguistic redundancy is based,
but on the principle of recoverability of meaning from other signals.
This principle underlies not only syntactic redundancy, but also
semantic or lexical redundancy which will be considered next.

The result of identifying syntactic redundancies in the stimulus
passages can be seen by referring to form 2 of the passages in
Appendix C. Words which are syntactically redundant are not underlined
in form 2.
Lexical (Semantic) Redundancy

Of particular interest to a discussion of linguistic redundancy are the notions of semantic "components" (Lyons, 1968) or "features" (Katz, 1966) which are the meaning-constituents of referential terms. For example, a consideration of terms like man, woman: bull, cow will show that they are analyzable into "features" or "components": man (+ adult + human + male) woman (+ adult + human - male) bull (+ adult - human + animate + male) cow (+ adult - human + animate - male). Such analysis, although not to ultimate components, is valuable in calculating the redundancy of a string because it allows the analyst to locate the common and non-common items of lexical units. For example, in:

Moving around some of the planets are their moons. In the space between the orbits of Mars and Jupiter are thousands of little planets, or asteroids, also revolving around the sun.

We can compare moving around and revolving around in terms of features and notice that revolving (+ motion + round) minus moving (+ motion) = + round, and, consequently, that around in revolving around is redundant. Further, the prepositional phrase in the space (+ locative) and between (+ locative + relational) overlap to the extent that between includes the feature of in the space: therefore in the space is redundant.

Clearly, there is nothing very esoteric about this procedure. It is based, in fact, on the traditional and widely-utilized principle of definition by division into genus and species (Lyons, 1968, 472 ff).
It is also the principle underlying the native speaker's avoidance of semantic deviance. Strings such as Auntie drank the bacon are syntactically correct but are considered odd because drink has the feature (- solid) which conflict with bacon (+ solid). It should be stressed that semantic analysis into features is part of the ordinary speaker's intuitive behavior and not an artificial procedure.

In formulating a procedure of deleting semantically redundant items it is necessary to define units within and up to the sentence level. Immediate constituent analysis, as explained by Wells (1947) and used by syntacticians of all complexions, seems to be a workable method and reflects the speaker's own preconceptions of structure. It is convenient to adopt the formal notation of generative grammar as used by Yngve (1961, 1960) in his examination of surface structures as, for example in the sentence:

The sun, located in the center of our solar system is a star, a heavenly body that produces light and heat.

```
S
  NP
    The sun S'
      located in the center of our solar system
  VP
    is
    a star S'
      (which) (is) a heavenly body S'
        that produces light and heat
```
This analysis permits the distinction of levels as follows:

Level 1:

The sun, located ... system // is a star, a ... heat.

Level 2:

The sun / located ... system // is / a star, a ... heat.

Level 3:

The sun / located \ in the ... system // is / a star \ a heavenly body ... heat.

Level 4:

The sun / located \ in the center ) of ... system //

is / a star \ a heavenly body ) that produces light

and heat.

The purpose of the above analysis is to delimit word groups within which to calculate semantic redundancy. It is possible to analyze the small units first, and to delete redundancies. The process is then repeated at successively higher levels. In the above example, after syntactic deletion the following words remain:

sun / located \ in center ) solar

system // / star \ heavenly body ) produces light

heat.

No component cancellations occur at level 4; at level 3, no cancellations are possible, but at level 2 we have located ( + locative ) in ... center ( + locative + point ) and located is thus cancelled.
Similarly, *star* and *heavenly body* are synonymous in context, so we may cancel one or the other of them. At level 1, *sun* and *solar* share features and *solar* may be cancelled. Thus, what remains is:

... sun ... in center ... system ... star ... produces light ... heat.

It can be argued that *produces* is redundant. Its deletion, however, involves quite fine componential analysis which arbitrarily was not resorted to in the present procedure.

Along with semantic redundancies may be classed morphological redundancies, because they are lexical rather than syntactic. For example, in English, there are many compound verbs such as *to cross over*, *to look for*, *to set eyes upon*, *to entitle to*, *to embark upon*, in which the transitional dependency of the particle on the verb is very high. Accordingly, in compounds of this kind the predictable particle may be deleted. Examples from the stimulus passages are:

The sun rotates _____ its axis ... (on)

Astronomers have long speculated _____ the possibility (on)

The Spanish king fitted him _____ _____ a fleet ... (out with)

The cumulative result of deleting the lexical and morphological redundancies plus the syntactic redundancies can be observed by referring to form 4 of the stimulus passages in Appendix C. It should be recalled that the redundant words at the given level are not underlined.
Discourse (Anaphoric) Redundancy

The principle of deletion over discourse seems to be natural to language but it is difficult to formalize. Instead of repeating the same noun phrase in full, for example, it is usual to pronominalize or delete the subsequent occurrences: e.g. John was studying hard for John's exams. John had to pass or John would not have John's scholarship renewed, is certainly not very acceptable English, whereas, John was studying hard for his exams. He had to pass or would not have his scholarship renewed, is one of several possible pronominalization and deletion strategies which render the last discourse more acceptable. The characteristic which is illustrated by pronominalization and deletion is anaphora, a process of referring back to what has just been mentioned in the discourse. The process is not easy to formalize unless only one unit is repeated, as in the example above or in expository writing which is topic dominated in the sense that one paragraph presents information about one topic, in the form of sentences where the topic phrase is generally the first noun phrase, thus: (S₁) Topic¹ Comment¹. (S₂) Topic¹ Comment². (S₃) Topic¹ Comment³, etc. In fact, this kind of structure characterized one of the stimulus passages, "The Solar System", but was almost completely absent from the second passage, "The Age of Exploration," which was written in what frequently passes for a superior 'literary' style with constant lexical substitution and sentence structure variation.
In order not to impose undue strain on a reader's immediate memory an arbitrarily small upper limit was placed on anaphoric deletion unless a whole paragraph was structured in isomorphic sentences. Individuals may well vary considerably in the amount of anaphoric deletion they can cope with and, as discourse deletion was the third, and last, category of redundancy considered, a conservative approach was taken. As a cautious procedure, therefore, anaphoric references were scanned over a maximum of two juxtaposed sentences and deleted, the process being repeated for each successive pair. In some paragraphs this procedure left undeleted a small number of items which were recoverable from the paragraph's central topic, so these were also deleted, but, in the present state of the discourse analysis art, no formal procedure, motivated to the same degree as that for syntactic and semantic deletion, exists to justify this procedure. As a result of adopting a cautious approach, there were relatively few discourse deletions. The effect on the first paragraph of the science passage was that only the phrase, "solar system," in the second sentence, was deleted.

It will be noted that solar system was deleted from the second sentence because it occurs in the first sentence, whereas planets in the fourth sentence has not been deleted in spite of the fact that it occurs in the third sentence. The reason for the distinction is that the recurring items must be structurally similar in order for deletion to occur; solar system is genitive in the first and second sentences, but planets is nominative (subject) in the third and accusative (object).
in the fourth sentence. This constraint seems to be a natural one and is corroborated in Harris (1963). Space in the last line is deleted because it is recoverable from the sense of the whole paragraph.