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THE ROLE OF GLOBAL TOPICS AND SENTENCE TOPICS IN THE CONSTRUCTI--ETC(U)
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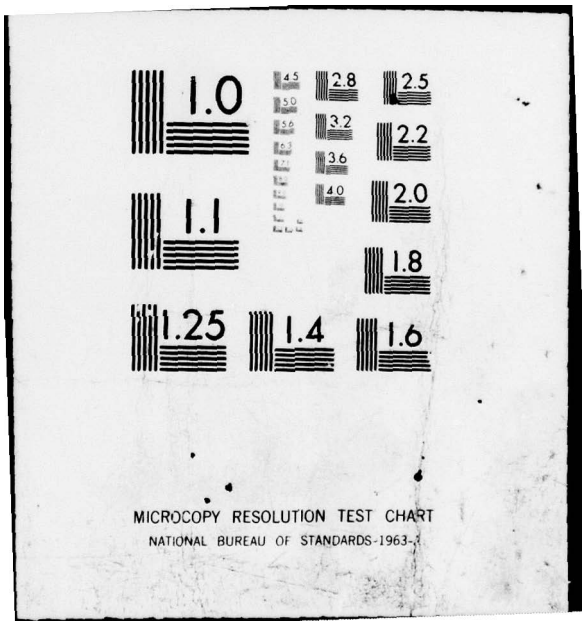
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The Role of Global Topics and Sentence Topics in the Construction of Passage Macrostructure

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Technical Report No. 4
July 30, 1979

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Two experiments are reported on the nature of global coherence in technical passages. Subjects were asked to state the topic of presented passages in the form of a noun phrase that designated a single object. The first experiment shows that whether the passage is organized around a single major referent has a powerful effect on the difficulty of identifying the topic. The second experiment shows that which referent appears as the surface subject of individual passage sentences is also a powerful determinant of the perceived passage topic.

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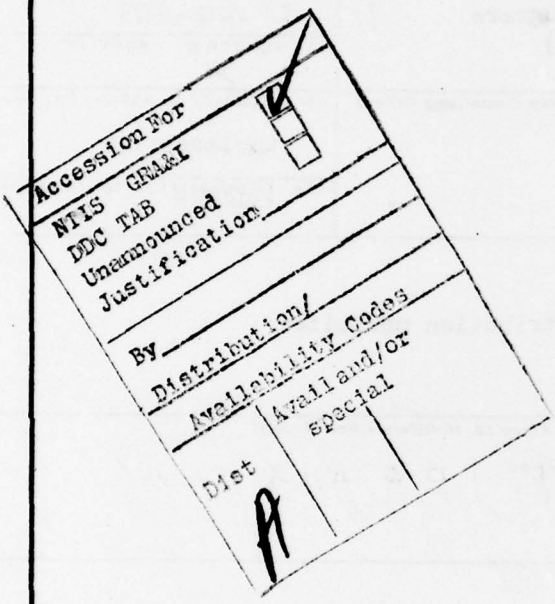
The results are discussed in terms of the reader's constructing a macrostructure for the passage, and selecting the central referent of the macrostructure for the statement of the topic. If the immediate propositional content or the surface structure of a passage does not allow a global topic to be selected, the reader must engage in time-consuming inferential processes to construct a suitable macrostructure for the passage.



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Abstract

Two experiments are reported on the nature of global coherence in technical passages. Subjects were asked to state the topic of presented passages in the form of a noun phrase that designated a single object. The first experiment shows that whether the passage is organized around a single major referent has a powerful effect on the difficulty of identifying the topic. The second experiment shows that which referent appears as the surface subject of individual passage sentences is also a powerful determinant of the perceived passage topic. The results are discussed in terms of the reader's constructing a macrostructure for the passage, and selecting the central referent of the macrostructure for the statement of the topic. If the immediate propositional content or the surface structure of a passage does not allow a global topic to be selected, the reader must engage in time-consuming inferential processes to construct a suitable macrostructure for the passage.

Acknowledgments

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The Role of Global Topics and Sentence Topics in the Construction of Passage Macrostructure

David E. Kieras

In their recent work on textual macrostructures, van Dijk and Kintsch (Kintsch & van Dijk, 1978; Kintsch, 1977; van Dijk, 1977a, 1977b) have stated that a well-formed passage must adhere to a rule of global coherence. That is, not only must the passage sentences be locally coherent by means of shared referents, but also they must refer to some global topic of discourse. In the theory of macrostructures advanced by van Dijk and Kintsch, this global topic is represented by a set of macro-propositions which are inferred or selected from the text by means of macro-rules that rely on long-term memory. If the text did not in fact conform very well to this rule of global coherence, the reader would find it difficult to apply the macro-rules to arrive at a single coherent macrostructure.

In the process of constructing the macrostructure for a passage, the reader will be searching for and making use of information that is relevant to the global discourse topic. van Dijk (1979) points out that there would be several levels at which a text would contain information relevant to the global topic. One of these, of course, is that of the discourse as a whole. Another is at the level of individual sentences. Within a single sentence, some of the information is presupposed, or given, while the other information is new (see Clark & Haviland, 1977); so a sentence consists of a topic and a comment. The sentence may be considered as being "about" the topic. Usually, the sentence topic appears as the surface subject noun phrase, although there are other devices, such as stress or cleft constructions, that are also used to differentiate topic from comment.

Normally the topic that the passage is "about" and the topics that the sentences in the passages are "about" are the same. But, according to van Dijk, the sentence level of topic marking by means of topic-comment assignment is strictly local, and so the passage topic determines the sentence topics. However, this analysis does not include how the reader identifies the global passage topic while reading. The sentence topics may in fact serve as a cue to the passage topic. If a

particular topic is repeatedly marked as topical by the passage sentences, it may be perceived as the passage topic as a result. Hence the relation between passage topic and sentence topics is a relatively strong one. Not only should the sentence topics refer to the global topic, but readers expect this to be the case, and so use the sentence-level topic-comment assignment as one source of information about what is the passage topic.

This paper contains two experiments. The first is on the issue of whether the requirement for global coherence has the processing implications implied by macrostructure theory. The second concerns whether sentential topics influence what readers consider to be the global topic. Two side results of the second experiment are evidence for frequency of reference and initial position as being two additional cues to topicality, as suggested by van Dijk's (1979) analysis.

Rather than the conventional approach of obtaining recall measures, these experiments used a direct measure of what subjects consider the topic of a passage to be. Namely, the subject simply reported in the form of a "title" noun phrase what the passage was about. This main item measure is a measure of the central, or most relevant, referent in the passage. Other aspects of the passage macrostructure could also be assessed. For example, as pointed out by van Dijk (1979), the passage could be about both a central referent and the major predications of this referent. This suggests that one could assess the main idea as well as the main item. The fact that the major predications are of the major referent implies that statements of the main idea would be about the main item, and thus statements of the major predication would contain the major referent as the surface subject noun phrase. This would occur because in composing a statement of the main idea, the subject would assign topic and comment of this statement on the basis of the perceived passage topic, and thus the global topic would appear as the topic of the statement (cf. Perfetti & Goldman, 1974, 1975). This hypothesized relation was obtained in a study by the author (Kieras, Note 1) in which statements of the main idea in the form of a simple sentence were compared with statements of the main item in the form of a noun phrase. The main ideas tended to contain popular main items as their subject noun phrase. Hence both main ideas and main item judgements can be studied. However, judgements of the main item were

used in these studies because the main referent is a theoretically simple aspect of macrostructure, and because topic-comment assignment operates most naturally at the level of referents, rather than propositions.

The approach used in the experiments is a standard one in psycholinguistic research: To determine whether a proposed linguistic convention is actually assumed or used by readers, performance is compared on materials that either adhere to or violate the convention. The assumption in this approach is that these conventions exist in order to compensate for the limitations of the human information-processing system; for example, global coherence is required because readers can only process and store a limited amount of information while reading a passage; knowing the global topic allows them to restrict their processing to selecting or inferring macropropositions about that single topic, and storing only the most important of those. Surface-level signals such as sentence topic-comment assignment would be used because they can be exploited with only a small amount of processing; if readers had to infer macrostructural content strictly on the basis of the deep content of a passage, they would suffer from the heavy processing load required at that level. Hence, these experiments involved not only measures of what subjects considered to be the passage topic, but also the times required to read the passage and select their response.

EXPERIMENT 1

This experiment was a simple one, intended to show first of all, that violation of the global coherence rule would result in processing difficulties for the reader. Subjects were asked to state a single topic for passages that had either one frequently mentioned referent, or three competing major referents. The effects of this violation of the global coherence convention were expected to show up in the form of less consistency of the judgements of the perceived passage topic, and longer reading and processing times. A second purpose of the experiment was to confirm that the task of judging the main item, or central referent, of the passage was a valid measure of what subjects thought the passage was about. This would be shown if the measure was sensitive to a manipulation that should, according to theory, affect the passage topic. To keep subjects reasonably close to the passage content, they were

urged to use as a "title" something that was actually mentioned in the passage. Previous work had shown that subjects actually interpret this instruction rather liberally; verbatim excerpts from the passage are rare. However, it does have the effect that it was intended to produce, that of reducing the frequency of overly general or inexplicable responses that unconstrained subjects sometimes give.

Method

Materials. Fourteen passages were prepared, each in two versions: a one-topic version, and a three-topic version. The one-topic versions began with a single topic, which was maintained throughout. The corresponding three-topic version began with the same topic, but about a third of the way through made a transition in a single sentence to a second topic, and about two-thirds of the way through, changed to a third topic. Although the three-topic passages are obviously "bad" passages, care was taken to make the transitions between topics locally coherent and reasonably plausible. The passages were composed and justified to occupy about 20 80-character lines. An example is shown in Table 1.

Design. The design was within-subjects and within-passages. Each subect saw one version of each of the fourteen passages. For each subject, the version used of each passage was determined at random, with consecutive pairs of subjects getting alternate versions, so that an even number of subjects would result in each passage appearing equally often in each version. The order of appearance of the passages was randomized for each subject.

Subjects. Thirty students of either sex recruited thourgh campus advertisements from the University of Arizona population served as subjects for $2.00 each.

Equipment and Procedure. The subjects were run individually or in groups of two using a laboratory computer to prepare the randomized passage set for each subject, display the passages, and record reading times (Kieras, 1979). Each subject sat at a booth containing a Teleray 3811 video terminal with an upper-/lower-case 24 lines by 80 character display driven at 9600 Baud.

Table 1
Example of One- and Three-Topic Versions of a Passage

One-Topic

The photon, the quantum of light and other electromagnetic radiation, is generally assumed to be a massless particle. The photon can carry energy and momentum from place to place, and it is deflected by the gravitational effects of large masses; but in the usual formulations of modern physics is assigned a "rest mass" of zero. This means that a photon cannot be brought to rest, light cannot stand still. If a photon's rest mass were greater than zero, it would be possible, at least in principle, to "catch" a photon and measure its mass. On what basis, then, is it assumed that the rest mass of a photon is zero? One argument is that the theory of magnetism prescribes zero mass for a photon. An equally consistent theory can be construed, however, for a photon of any arbitrary mass. The possibility that the photon has a large mass can readily be excluded; if it did the world would be a profoundly different place. If a photon had only a very small mass, less than that of an electron, but still greater than zero, the universe would differ only slightly from one containing only massless photons, and only by detecting those subtle differences could the photon's rest mass be discovered. Attempts to detect those subtle differences have been performed. None of the experiments have proved the rest mass of a photon to be zero, and indeed, such a proof may be impossible. An experiment that fails to find a photon's mass does not prove the mass is zero; it merely shows that the mass is less than the limit of accuracy of the experiment.

Three-Topic

The photon, the quantum of light and other electromagnetic radiation, is generally assumed to be a massless particle, even though it can carry energy and momentum from place to place and is deflected by the gravitational effects of large masses. The meaning of that assignment is that a photon cannot be brought to rest. Light cannot stand still. If the rest mass of a photon were greater than zero, it would be possible to "catch" a photon and measure its mass. Large numbers of photons are emitted when a star explodes, becoming a supernova. Supernovas are enormously interesting because the remnants and ejecta of such explosions are among the most interesting objects known to astrophysics today. It is believed that supernova explosions give rise to pulsars, black holes, high energy cosmic rays and high velocity "runaway" stars, hurtling through our galaxy at speeds approaching a million miles an hour. Supernovas are often obscured by dust, limiting the number visible to us. The last supernova occurred around 1600. Another important event, that occurred about the same time, was an energy crisis in Britain. The energy crisis was due to a severe wood shortage. In medieval Britain and Europe wood was used not only for construction, but also as a fuel for most domestic and industrial heating. Wood was replaced by coal as a source of fuel. England, in the period between the 17th and 18th centuries, developed the earliest coal burning economy. England was also the first nation to resolve a major energy crisis.

After reading a set of instructions, the subject viewed a passage on the terminal screen, and tapped the space bar when he or she was finished reading, which caused the passage to disappear. The time that the passage was left on the screen was recorded to the nearest second and used as a measure of the time required to read the passage and arrive at a response. Then the subject wrote down his or her response on a notepad, and then tapped the space bar again to view the next passage. The session required about an hour to complete.

Instructions. The subjects were told that their response should be like a title, and "should name the thing that ... best represents what the passage was about." It "must name a thing actually mentioned in the passage" rather than be something inferred or deduced. Hence they were "picking out one of the things actually described in the passage and using it as a title." The instructions required that this be a single item, and be expressed as a short phrase, and not as a sentence. They were asked not to waste time during the periods the computer was recording the time. One subject failed to follow the instructions by generating sentence-like responses, and so was replaced.

Results

The responses were scored blind, without knowledge of the experimental condition associated with the individual responses. Hence, any scoring biases or errors would not distort the results. The responses were scored using a simple categorization scheme, in which the responses for each passage were grouped into several categories on the basis of similarity of what they referred to. Then the response categories were labled in terms of whether they referred to the first, second, or third topics in the three-topic passage versions. Finally, the individual responses were separated by condition for tabulation. The distribution of responses is shown in Table 2. Category 1 corresponds to the first topic in the three topic version, or the single topic of the one-topic version. Categories 2 and 3 refer to the second and third topics of the three-topic versions. Categories 4 through 9 are simply arranged in order of decreasing frequency. Also shown in Table 2 are the reading times, obtained by averaging across passages for each subject to yield a mean reading time for each type of passage for each subject.

Table 2

Distribution of Reponses

	Category									
Version	1	2	3	4	5	6	7	8	9	RT(secs)
One-Topic	.73	.02	.00	.13	.06	.02	.01	.01	.01	66
Three-Topic	.21	.21	.03	.28	.12	.06	.03	.02	.02	93

Note. Category 1 is the topic of the one-topic passages, and also the first topic of the three-topic passages. Categories 2 and 3 are the second and third topics of the three-topic passages. The remaining categories are numbered in order of decreasing frequency.

Notice that category 1 is the overwhelming favorite response for the one-topic passages, whereas for the three-topic passages, the responses are much more spread out and less consistent. This was tested statistically be comparing the two distributions with a chi-square test, which yielded a value of 119.28 at 8 degrees of freedom, $p<.001$. Notice also that category 4 was the most popular response to the three-topic passages. These responses, like the other non-mentioned categories, tend to subsume in some way all three explicitly mentioned categories, such as Types of Energy for the passage shown in Table 1. A feature of Table 2 is that responses to three-topic passages tended to name one of the actually mentioned candidate topics less often than in the one-topic passages. That is, responses falling into categories 4 through 9 are more frequent for the three-topic passages that responses falling into categories 2 through 9 for the one-topic passages. This effect was tested by grouping the responses into two categories based on whether or not they were explicitly mentioned in the passage, and comparing the two distributions with a chi-square test. This yielded a chi-square value of 30.99 at 1 degree of freedom, $p<.001$.

Finally, notice that the reading times for the three-topic passages is almost 30 seconds *longer* than for the one-topic passages ($t(29)=7.894$, $p<.001$).

Discussion

The results show that the main item statement measure used was indeed sensitive to the linguistic properties of the passage in the desired way. The substantive result was that readers were strongly affected by the violation of the global coherence rule. However, it should be pointed out that in a sense, even the three-topic passages were globally coherent. Subjects were able to come up with single-referent responses the bulk of the time, for example, the category of Types of Energy for the example passage described above. The difference is that they could not simply pick the most frequently mentioned referent, nor could they always pick one of the major referents appearing in the passage. Rather they had to perform extensive memory search and inference processes to arrive at a single global topic, which was often one that was not mentioned in the passage, and so took much longer and were more likely to arrive at idiosyncratic

results. Hence there was slower reading time, less consistency in the responses, and fewer responses that made use of one of the actual topics appearing in the passages.

So the results are best characterized as follows: When there is only a single major referent, the passage macrostructure is built around this referent, and so supplying a statement of the main referent is a matter of simply selecting this central component of the macrostructure. However, when there several major referents, the macrostructure for these passages consists of several only thinly-connected parts, each built around its own central referent. In order to supply a single referent as the topic, the reader must engage in further macro-level processing to construct a higher-level set of macropropositions that are organized around a single referent and tie together the separate parts of the original macrostructure. This extra processing is time-consuming and subject to the variation in individual readers' knowledge.

EXPERIMENT 2

This experiment followed the same general approach as Experiment 1 with the major difference that the passage microstructure, or individual propositions, was left essentially intact. The manipulation consisted of altering the topic-comment assignment in the individual sentences. The goal was to determine if the topic-comment assignment at the sentence level influenced the perceived topic of the entire passage. The experiment actually consisted of two sub-experiments using different types of passages. One subexperiment used A-B passages, which contained two major referents, A and B, each described in each sentence. The manipulation consisted of making either A or B the subject of all of the sentences. It was expected that the referent marked as topical by the sentence-level topic-comment assignment would be the preferred passage topic, but there would be no difference in processing time, since the reader can construct a macrostructure around either of the major referents with equal ease. The other sub-experiment used A-X passages, in which there were four major referents, A, X, Y, and Z, which differed in how often and how early in the passage they appeared. The passages had item A appearing either as the subject of all of the sentences it was containing in, or as a constituent of the predicate. It was expected that repeatedly marking this major referent as the sentence topic would result in its being a very popular choice for the passage

topic. But, hiding it in the sentence predicate, marking it as comment, would result in fewer choices of it as the passage topic, and would also result in longer processing times for reasons similar to those in the three-topic passages in Experiment 1. That is, such passages would have three different major referents marked as topical by appearing as sentence subjects, and so would require extra macro-level processing to supply a single passage topic. Furthermore, choices of the other referents in the passages should conform to their frequency of mention and their position in the passage (see Kieras, 1978, Note 2, Note 3).

Method

Materials. Two types of passages were prepared, eight of the type labelled A-B, and 10 of the A-X type. In the A-B passages, every sentence contained two major referents, A and B, in such a way that each sentence could be reversed so that either A or B was the surface subject of all sentences, and appeared first in the sentence. The sentences were composed so that this reversal could be done without apparent alterations of the basic sentence content. The passive voice was used only as a last resort for this purpose to avoid monotony in the sentence structure. The passages each contained five sentences and were about eleven 80-character lines in length. An example appears in Table 3.

The A-X passages were somewhat more complicated, containing five sentences that mentioned a total of four main referents, each of which could appear in either the subject position or the predicate of the relevant sentences. In the first version, labelled A-X, three of the sentences had A as the surface subject, with two additional sentences which mentioned only the other referents. The first sentence had the form A-X, with A as the surface subject, and the referent X in the predicate. The five sentences of the entire passage thus had the forms A-X, X-Y, A-Y, Y-Z, and A-Z. The referent A appears three times, Y three times, X twice, and Z twice, while A appears as a subject in the first, third, and fifth sentences, X is the subject of the second sentence, Y is the subject of the fourth, and Z appears not at all as a subject. In the second version, labelled X-A, the sentences with A as a subject were reversed, producing passages with sentences of the form X-A, X-Y, Y-A, Y-Z, and Z-A. Note that the second and fourth sentences are not changed. In this version, A appears the same three times, but

Table 3
An A-B Passage and the Corresponding B-A Passage

Antigens are small areas with a specific and characteristic structure that are found on the surface of cells, like red blood cells. Antigens are found in large numbers on red blood cells, and each organism has its own unique pattern on every cell of its body. Antigens are under genetic control and so the pattern on red blood cells,the blood type, does not normally change in an individual because of environmental influences. Antigens are recognized by the body as either belonging to itself or as foreign so that during transfusions red blood cells of the wrong blood type will be tagged and destroyed. Antigens vary in the strength of the response that they provoke in a body to which they are foreign and so, while red blood cells of the wrong ABO type can kill the recipient, the wrong Kell type, for example, may have no bad effect at all.

Red blood cells, like other cells, have small areas on their surface called antigens that have a specific and characteristic structure. Red blood cells have large numbers of antigens and each organism has its own unique pattern on every cell of its body. Red blood cells have a blood type, the pattern of antigens, that, because the pattern is genetically controlled, does not normally change in an individual because of environmental influences. Red blood cells of the wrong blood type will be tagged and destroyed during transfusions because the body can recognize which antigens belong to itself and which are foreign. Red blood cells of the wrong ABO type can kill the recipient, while the wrong Kell type, for example, may have no bad effect at all because antigens vary in the strength of the response that they provoke in a body they are foreign to.

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never as a sentence subject. X appears twice as a subject in the first two sentences. Y appears later as a subject twice, and Z once at the end. These passages were carefully prepared so as to be reasonably readable in both versions, and were of the same length as the A-B passages. An example appears in Table 4, in which A is computers, X is microelectronics, Y is integrated circuits, and Z is random-access memories.

Subjects. Twenty-four students of either sex recruited via campus newspaper ads from the University of Arizona student population served as subjects. They were paid $2.00 for participating.

Design. The design was within-subjects and within-passages. Each subject read and responded to one version of each of the 18 passages. The version seen by each subject was determined at random, subject to the constraint that consecutive pairs of subjects would get alternate versions of each passage, so that an even number of subjects would result in each version being presented equally often.

Equipment and Procedure. The experiment was performed using the laboratory computer described in Experiment 1, with the addition that it was also used to record the subjects' statements of the passage topics.

The subject was first instructed in how to type on the terminal, using the backspace key for error correction. A short session of typing practice was then performed. Then the subjects read a set of instructions for the experiment, and after being checked for understanding of the instructions, began the experiment. Each passage appeared on the screen. After reading it, the subject tapped the space bar on the terminal, which erased the passage. The time the passage was left on the screen (the reading time) was recorded to the nearest second. Then the subject typed in his or her statement of the topic of the passage. Subjects who did not want to type wrote their responses on a notepad. The computer recorded the time spent entering the response (the typing time). After completing the response, the subject tapped the space bar again to proceed to the next passage.

Instructions. The subjects were told that their response should be like a title, and "should name the thing that ... best represents what the passage was about." It "must name a thing actually mentioned in the passage" rather than be something inferred or deduced. Hence they were

Table 4
An A-X Passage and the Corresponding X-A Passage

Computers have undergone dramatic changes since the first electronic one, ENIAC, was built in 1945, with much of the change being due to rapid advances in microelectronics. Microelectronics have advanced largely because of the development of the integrated circuit from the transistor. Computers of today use integrated circuits for almost all their functions and as a result are faster, cheaper and more reliable. Integrated circuits, which contain tens of thousands of elements on a pure silicon wafer, typically less than a quarter of an inch square, are used in random-access memories. Computers now frequently use random-access memories because they offer the same access time to any storage location, while in the future magnetic bubble and charge-coupled devices will be used more often as their technology also improves.

Microelectronics have advanced rapidly causing many of the dramatic changes that computers have undergone since the first electronic one, ENIAC, was built in 1945. Microelectronics have advanced largely because of the development of the integrated circuit from the transistor. Integrated circuits are used by today's computers for almost all their functions which are, as a result, faster, cheaper and more reliable. Integrated circuits which contain tens of thousands of elements on a pure silicon wafer, typically less than a quarter of an inch square, are used in random-access memories. Random-access memories offer the same access time to any storage location and so now they are frequently used by computers while in the future magnetic bubble and charge-coupled devices will be used more often as their technology also improves.

"picking out one of the things actually described in the passage and using it as a title." The instructions required that this be a single item, and be expressed as a short phrase, and not as a sentence. They were asked not to waste time during the periods the computer was recording the time. One subject failed to conform to the instructions, producing responses that were sentences rather than phrases, and so was replaced.

Results

The main item responses were scored for their similarity to each of the major referents in the original passages. The scoring was blind with regard to the version of the passage that produced the individual responses. Hence any scoring biases would not distort the results. The degree of similarity of the item named in the response to the referent was rated as being at one of three mutually exclusive levels: same referent, a shared concept, simply related, or unrelated. The same referent category was the strictest and least ambiguous, in that the response was judged to refer to the same thing as the candidate topic in the passage. Only the scores under this strict criterion are reported here.

The reading times for each subject were collapsed within passage types and versions, yielding for each subject four data points, a mean reading time for each of the A-B, B-A, A-X, and X-A passage types. The typing times were found not to vary with any experimental conditions and so will not be reported.

The proportion of reponses that referred to each of the major referents is shown in Table 5 along with the mean reading times for passages of each type. For the A-B versus B-A passage comparison, the table shows that A is chosen more often if it appears as surface subjects than if it appears in predicates, and the same is true of B. This difference was tested by a chi-square test for identical distributions of choices in the two conditions, which yielded a value of 17.68 at 2 degrees of freedom, $p<.001$. Notice that there is an overall preference for A; this will be discussed below. Finally, the reading times for A-B passages do not differ from those for B-A passages ($t(21)=.29$, $p>.1$).

Table 5

Distribution of Main Item Responses

	Response				
Version	A	B		other	RT(secs)
A-B	.86	.10		.04	45.6
B-A	.58	.32		.10	46.7

	Response					
Version	A	X	Y	Z	other	RT(secs)
A-X	.77	.09	.01	.02	.11	46.4
X-A	.48	.19	.12	.03	.21	54.9

For the A-X versus X-A passage comparison, it can be seen from Table 5 that the referent A was the most popular choice overall, but was chosen substantially more often when it appeared as the surface subject of its sentences than when it appeared only in a predicate. The next most popular choice was the referent X, which appeared as a surface subject near the beginning, especially in the X-A version. Also in the X-A version, the referent Y appeared twice as a surface subject, and so was chosen fairly often relative to Z. The reliability of this pattern of differences was tested by comparing the distribution of choices produced by the A-X and the X-A passages with a chi-square test; it yielded a value of 23.65 at 4 degrees of freedom, $p<.001$. Finally, the reading times for the X-A versions were larger than those of the A-X version ($t(21)=3.40$, $p<.01$).

Discussion

The predicted results were obtained in both passage types. In the A-B vs. B-A comparison, readers favored a given major referent more when that referent appeared as the surface subject of the passage sentences. Also as predicted, there was no reading time difference between the two versions, since the passage was well topicalized in either case; either referent could become the central referent in the passage macrostructure.

A problem with the A-B passage results is that one of the referents, the one labelled A, was generally preferred to the other referent. This is an artifact of the passage composition process and has been considered in detail for passages of this type in Kieras (Note 3). Suffice it to say here that during composing the passages, the A topic was normally worked out first, and then a B topic chosen to fit together with the A topic in the desired way. There is a tendency for the A topics to thus be conceptually superordinate in some way to the B topics. For example, the B topics tend to be examples or elaborative details of the A topics. As described in Kieras (Note 3), it is possible to reduce such preference artifacts by very careful passage construction and selection. However, the constraints on selection of passage topics imposed by the topic-comment reversability required for these experiments are so severe that it was necessary to allow this nuisance variable to be uncontrolled in order to be able to construct

passages in a reasonable amount of time.

In the A-X vs. X-A comparison, the predicted effects were obtained. The overall frequencies of choice of the passage referents corresponded to the degree of topic-comment marking, the frequency of mention, and the closeness to the initial portion of the passage (see Kieras, 1978, Note 2, Note 3). There is probably also a topic preference effect like that for the A-B passages that accounts for some of the popularity of topic A even in the X-A version. However, the strongest effect was that if one of the most frequent referents appeared in the first sentence as the sentence topic and reapppeared thereafter, it was very strongly perceived as the passage topic. If this was not the case, the reader had to perform more extensive processing in order to select a response. As in Experiment 1, this additional processing took more time and resulted in less consistency between subjects.

GENERAL DISCUSSION

The first experiment demonstrates that in a theory of comprehension, global coherence must refer not just to the availability of a macrostructure, but also to its ease of construction. A reader can, if pressed, come up with a global topic for even a very "bad" passage; however, global coherence in this situation is very difficult to perceive. While there are many different possible contributors to global coherence, the experiment shows the value of the presence of a unique major referent. If the passage is organized around a single main referent, it is easy for the reader to construct a macrostructure organized around this main rereferent, and then select this main referent as the passage topic. If not, the reader must work harder to form the macrostructure, and must make more use of his or her general knowledge. The product of the reader's time-consuming effort is again a single referent that can be stated as the topic, but it is likely to be more removed from the passage's explicit content, and more idiosyncratic.

While the passage topic may determine the sentence topics in the sense of generative linguistic theory or in discourse production, in comprehension, the reader must infer the discourse topic on the basis of what he or she encounters in the passage. While there are many possible topic-marking devices (see van Dijk, 1979; Clements, 1979), the second

experiment shows that the topic-comment assignment at the level of individual sentences can be an important influence on the reader's perception of the passage topic. If the sentence marking does not establish a single satisfactory passage topic, the reader must work harder to infer it on the basis of the semantic content of the passage, unaided by this simple surface structure cue.

Hence the macrostructure-building processes can be viewed as being based primarily on semantic content, but heavily guided by the surface form of the passage and passage sentences. In addition to sentence topic-comment assignment, other superficial features of the passage, such as what appears first (Kieras, 1978, Note 2, Note 3) and the other staging and signalling devices described by Clements (1979) and van Dijk(1979) would also play a role. Future work in this main item and main idea paradigm should uncover some of the detailed mechanisms and rules used by the macrostructure-building process.

Reference Notes

1. Kieras, D. E. The relation of topics and themes in naturally occurring technical paragraphs. Technical Report, University of Arizona, January, 1979.
2. Kieras, D. E. How readers identify topics in technical prose. Presented at the Psychonomic Society Meetings, San Antonio, November, 1978.
3. Kieras, D. E. Initial mention as a cue to the main idea and main item of a passage. Technical Report, University of Arizona, July, 1979.

References

Clark, H. H., & Haviland, S. E. Comprehension and the given-new contract. In R. O. Freedle (Ed.) Discourse processes: Advances in research and theory, Vol. 1. Norwood, New Jersey: Ablex Publishing Corporation, 1977.

Clements, P. The effects of staging on recall from prose. In R. O. Freedle (Ed.), New directions in discourse processing. Norwood, New Jersey: Ablex Publishing Corporation, 1979.

Kieras, D. E. Good and bad structure in simple paragraphs: Effects on apparent theme, reading time, and recall. Journal of Verbal Learning and Verbal Behavior, 1978, 17, 13-28.

Kieras, D. E. Doing it the vendor's way: Running multiple subjects in reading experiments using Data General's Diskette Operating System. Behavior Research Methods and Instrumentation, 1979, 11, 221-224.

Kintsch, W. On recalling stories. In M. Just & P. Carpenter (Eds.), Cognitive processes in comprehension. Hillsdale, N. J.: Lawrence Erlbaum Associates, 1977.

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

Perfetti, C. A., & Goldman, S. R. Thematization and sentence retrieval. Journal of Verbal Learning and Verbal Behavior, 1974, 13, 70-79.

Perfetti, C. A., & Goldman, S. R. Discourse functions of thematization and topicalization. Journal of Psycholinguistic Research, 1975, 4, 257-271.

van Dijk, T. A. Text and context. London: Longman, 1977. (a)

van Dijk, T. A. Semantic macro-structures and knowledge frames in discourse comprehension. In M. Just & P. Carpenter (Eds), Cognitive processes in comprehension. Hillsdale, N. J.: Lawrence Erlbaum Associates, 1977. (b)

van Dijk, T. A. Relevance assignment in discourse comprehension. Discourse Processes, 1979, 2, 113-126.

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