On the preference for global organization strategies

in discourse comprehension

Walter Kintsch

University of Colorado

At any point in processing a text the reader is subject to constraints at various levels, from the most global ones down to the lexical level. Each proposition generates its own constraints, but then propositions are often organized in frames, which in turn may be organized by higher order schemata. It is possible, of course, that all of these constraints are equally active all the time. It is also possible, however, that some of these constraints take precedence over others, i.e. that the system prefers constraints at one level, e.g. global ones, and that it tries to organize the input at some chosen level of organization, neglecting possible alternative organizations. This would certainly simplify processing a great deal and greatly reduce the processing load.

Chunking appears to be a pervasive principle in cognitive processes. Suppose comprehenders select their level of organization so as to maximize chunking. There seem to be a number of problems hidden in that phrase, but some straight-forward predictions are obvious: if people are given a chance, they ought to prefer organizing a text in terms of some frame or higher order schema, rather than in terms of propositional and lexical constraints. If no suitable frame is available to organize the text, then they should drop down to the lower level alternatives, and attempt to organize the input around propositional or lexical constraints. Thus, we hypothesize that people have a strategy to try the most global organization first.

The constraints that are effective in reading a text can be evaluated by means of an assessment of the continuations that readers make when presented with an incomplete text. Thus, if a reader says that he expects the text to continue in such and such a way, we conclude that the organization that the reader has formed at that point in the comprehension process is the source of

his expectations. Continuations reveal the constraints under which the comprehension processes operate.

Consider a critical sentence S; if subjects read S out of context and are asked what they expect might come after S in some unspecified text, they will generate some common answers. What these answers are is determined by the propositions used in S and by the lexical items in S, i.e. by sentence level constraints.

Suppose S is embedded into a text that can be organized around some conventional frame, and that S itself fits into that frame. We hypothesize that if readers are asked for their expectations after reading S in a frame-context, they will respond with statements derived from the constraints of the over-all frame organization of the text, rather than from the sentence alone. On the other hand, if S is embedded in a text that is not suitable for organization in terms of some superordinate frame, then the readers' expectations will be determined by the sentence-level constraints, just as in the case where the sentence was presented alone.

Readers always will form expectations easily, because they always operate under some constraints in the comprehension process. The critical prediction is that these constraints will be global ones if subjects are able to form global, frame based organizations, but that they will be local, sentence based, if a text is too ill-structured for frame based organizational processes.

Consider the following sentence: "Last year, Eva Benassi became seriously ill with peritonites". A group of subjects will state how this sentence could be continued after reading it out of context. A second group of people will read a short paragraph that is lacking in structure and that does not have a clearcut topic, and they, too, will continue the target sentence. We hypothesize that these two groups of subjects will respond with similar expectations about

how the text would continue: in both cases, these expectations should reflect

the sentence-level constraints effective at this point in the comprehension

process, with some intrusions from the paragraph content when the sentence is

read in the context of an unorganized paragraph. On the other hand, if the same

target sentence is embedded into a paragraph discussing miracles, we predict that

the subject's expected continuations will reflect the over-all organization of

the paragraph in terms of a miracle-frame, and will therefore be quite different

from the earlier two cases.

EXPERIMENT I

Three texts of this kind were developed. They are shown in the Appendix.

A Cognitive Psychology Class in the Fall of 1979 participated in the experiments.

Each of the 32 students were given a booklet containing three text fragments,

one from each of the paragraphs shown in the Appendix (Eva, Complaints, & Brakes),

and one from each of the conditions (Sentence Alone, Sentence Framed, Sentence

Unframed). Subjects were instructed to read each text carefully, and then to

write down, in a sentence or phrase, what they think would be a likely continua-

tion of the paragraph fragment they had just read. They were told that there

were no "correct" answers, but that the experimenter was interested in their

intuitions about these texts. They were also asked to rate their confidence

in their response on a 5 point scale, and, finally, to write down a word or brief

phrase that in their opinion best indicates the topic of the text. Enough time

was given to complete this test.

The subjects responses were assigned to three classes: those related to the

sentence-alone constraints, those related to the frame constraints, and other

responses (including failures to respond). Five percent of the responses fell

into this third category, which will be neglected in all further analyses.
For the "Eva" paragraph, sentence-based constraints would lead subjects to
respond with something that was in some way related to her illness (a description,
consequences, or treatment), while frame-based constraints would elicit some-
thing about miracles. Similarly, for the "Brakes" text, the sentence alone
elicited continuations concerned with driving a car or with wildlife, while in
the frame context something about accidents was appropriate. The third text,
"Complaints" was somewhat different: out of context, the normal continuation
would deal with some further specification of the complaints (e.g. explanation,
justification, etc.); in context, however, if subjects were correctly organizing
this text as a part of the method section of an experimental report, the
continuation should deal with the results of the experiment. Of course, this
kind of organization could be expected only to the extent that upperclass under-
graduates are familiar with the conventions of the "psychological report schema".

The predicted shift in the expectations away from the sentence level
constraints in the presence of a higher order organizational principle (knowledge
frame or report schema) was indeed obtained in the experiment (Figure 1, Table 1).
The results almost perfectly corresponded to the predictions for the "Eva" text:
all subjects responded with something about "illness" when they read the sentence
alone, and all but one did so when the sentence was read in the unframed context.
In contrast, all subjects mentioned miracles in their continuation in the framed
continuation. The "Brakes" paragraph gave similar results, though they were
somewhat attenuated. The "Complaints" text showed that the subject population
in this experiment was not really familiar with the "report schema": the schema
effect in this case was considerably reduced, compared with the other two texts.
In all cases, however, were the obtained interaction effects statistically

significant, with $\chi^2(2)$=19.63, 14.47, and 16.07 for "Eva", "Complaints" and "Brakes", respectively, all significant at the .001 level.

Table 2 shows the average confidence ratings that subjects gave to their responses as a function of text and experimental condition. The most interesting thing here is the absence of a main effect for condition: averaged over the three texts, subjects gave equally high ratings to their continuation responses, whether they worked from the sentence alone, or with the framed and unframed texts. This is instructive: if the reader does not have a global organization, he is not necessarily lost - he merely drops down a level and works with the more local constraints of the text. Unfortunately, this fascinating conclusion needs to be tempered a bit, because of the presence of a significant text x conditions interaction in the confidence ratings, (F4,81)=4.23, p=.004, which limits the generality of the claim just made. However, that interaction reflects mostly the low confidence subjects had in the framed condition when they read the "Complaints" text - they were not at all sure about the use of the report schema! Presumably, with graduate students or faculty, one could get cleaner results with this text.

The final measure collected in this experiment was topic generation. As Table 3 shows, this measure parallels the expectation data in Figure 1, but is considerably less sensitive. Subjects gave much cleaner data when asked to state their expectations than when asked to state a topic. The proportion for "other or no" responses is .37 for the topic responses, compared with .05 for the expectation responses. Similarly, the frame versus no-frame interaction, although still present, is reduced in magnitude, with a corresponding reduction in the statistical significance level (only "Eva" is still significant at the .001 level, "Complaints" is significant at the .01 level, and "Brakes" only at the .05 level). Also, while the expectations were practically identical in the sentence-alone

and the unframed conditions (Table 1), the topics were perceived to differ in the sentence alone and unframed conditions. This certainly was the case for the "Complaints" text (p=.0002), but occurred to some extent also with "Eva" (p=.165) and "Brakes" (p=.102). Clearly, stating expectations was a better method for our purpose than choosing a topic.

Experiment I confirms the chunking hypothesis: if readers have available a global principle of organization such as a paragraph topic, they tend to base their expectations on it, rather than on more local sentence properties. On the other hand, if they cannot discern a global topic, they readily fall back on the sentence topic and use it to form some ideas about where the text is going. However, these conclusions are based on the responses of relatively few subjects, and on only three texts. Furthermore, the method of analysis used leaves open a number of questions, especially about the continuations in the unframed condition: if they can't form a paragraph topic, readers revert to the sentence level - but with longer and more varied texts it would be surprising if they always chose to concentrate exclusively on the last sentence they had read. Thus, a replication of Experiment I was performed with new and more varied texts, and a somewhat different scoring scheme to find answers to the questions raised here.

EXPERIMENT II

Ten different texts were constructed on a variety of topics, both narrative and descriptive. Each text was written in three versions; only the last sentence was the same in all three versions. In the ALONE condition, the text consisted of the critical sentence alone; in the FRAMED condition, the target sentence came at the end of a paragraph 100-150 words long which had a clear, easily identifiable topic (This was verified informally by having several people identify the topics

of the ten paragraphs); finally, in the UNFRAMED condition, the target sentence came at the end of a 100-150 word long paragraph that was globally incoherent, i.e. it did not possess an easily identifiable topic but consisted merely of a sequence of loosely related or unrelated sentences.

Sixty-two subjects participated in the experiment in groups of 4-6, 22 in condition ALONE, and 20 each in the other two experimental conditions. Each subject received a booklet which contained all ten texts, plus several practice texts. All texts in a booklet were presented in the same context condition. Subjects were assigned randomly to the three context conditions, ALONE, UNFRAMED, and FRAMED. Subjects in the UNFRAMED condition were warned that the texts they had to work with were sometimes strange, but asked to do as well as they could. Subjects were asked to read each fragment carefully and to write down in a sentence or phrase, what they thought a likely continuation of the paragraph fragment might be. The subjects were told to think of themselves as the author of each text and to produce what would be the most logical continuation. The continuations were not to be generalizations or predictions but rather actual anticipated sentences or phrases. The subjects were informed that the experimenters were interested in their intuitions about the texts and that there were no correct answers. Second, they were asked to give a confidence rating, ranging from 1 indicating no confidence with 5 being very confident, to their written expectations for each fragment.

The continuations produced by the subjects were scored by comparing them with the words in the target sentence: if a continuation involved only content words that already appeared in the target sentence or words that were judged to be closely related topically to the target sentence, the response was assigned to the category SENTENCE-ALONE. If a response contained content words unrelated to the target sentence alone, it was classified as SENTENCE-PLUS. In the FRAMED

context, this additional material could either be related to the paragraph topic, or it could be something else, either some detail from the earlier sentences in the paragraph, or an extra-paragraph intrusion. In the UNFRAMED context, of course, all SENTENCE-PLUS responses must belong to the latter two categories, while in the ALONE condition only intrusion responses could be made.

A single judge performed the original scoring, while a second judge checked it. In 2% of the cases responses could not be scored, or were missing.

The results of the experiment are shown in Table 4. If readers have a well formed paragraph to work with, their continuation responses are predominantly based on material derived from that paragraph as a whole; indeed, 83% of the responses were based on the paragraph topic, while the other 6% were based on some other detail from the paragraph. In only 10% of the cases was the paragraph topic neglected and the text continued on the basis of the last sentence only. Of course, if subjects were given only that last sentence, that was all they could do and did in fact do. Only in a few cases (3%) did they use extraneous material unrelated to the sentence topic. Subjects in the UNFRAMED condition were intermediate between these extremes: for the most part, they ignored the ill-formed, disorganized paragraph and concentrated on the last sentence, just like subjects who only had this sentence to work with. On the other hand, we now find many responses that are based wholly or partially on the paragraph: In 11% of all cases, a continuation was based on some salient detail picked up from an earlier sentence in the paragraph, while in 19% of the cases subjects used material from the target sentence as well as from earlier sentences in the paragraph.

As in Experiment I, there was a slight tendency to be more confident of continuation responses in the FRAMED context than in either the ALONE or UNFRAMED context, but once again the difference was small and did not reach statistical

significance, t(60)=1.73,p=.09. The mean confidence ratings in the ALONE, UNFRAMED, and FRAMED conditions were 2.46, 2.42, and 2.63, respectively.

GENERAL DISCUSSION

The results of these two experiments can be summarized quite simply. If subjects read an incomplete text and are asked to write down a likely continuation for it, their responses depend on how much context they have, and how good that context is. If they are working with a good, well-formed paragraph that has a clearly discernible topic, they use that topic for continuing the text. If, on the other hand, they are given an ill-formed, disorganized paragraph, they don't have a topic to base their continuations on, and must rely instead on some salient detail that they find in the paragraph. Most often, they simply use the last sentence, but sometimes they pick up on some salient detail in an earlier sentence, or try to integrate the last sentence with earlier material in the paragraph. If all they have is a single sentence, they use it to construct a continuation. The important point here is that in all these cases subjects produce continuations readily, and with about the same level of confidence. They have a bias for the paragraph topic, but if they don't have one, they are by no means lost, but just revert to some sentence level detail.

This simple observation has considerable theoretical significance, in that it allows us to identify an important constraint in discourse processing. The task of constructing a continuation for an incomplete text can be considered as an indicator for the way the reader is organizing the text at that moment. The theoretical framework presumed here is that of van Dijk & Kintsch (forthcoming). The semantic units of a text are organized on the basis of some propositional schema, and that propositional schema provides a basis for constructing a plausible

continuation active of the text. Thus, if one reads a paragraph about "miracles",
the propositional schema very likely is the knowledge source "miracles", which
has many possible elements, among them a slot for "instances of miracles"; if
we then see a sentence that might be the precondition of a miracle (Eva's dying
of peritonites), we might very well regard it as part of the description of a
miracle, and continue the text accordingly.

On the other hand, if a reader receives an incoherent paragraph that cannot
be organized globally, some other basis for a continuation response must be found,
e.g. the last text proposition, or an earlier text proposition that contained
some salient detail.

Thus, one can conclude that readers have a bias for global over local
principles of organization. This provides an important constraint on discourse
processes, for at every moment in comprehension there are many alternative ways
possible to organize a text. We have identified here a principle that helps us
select among these alternatives: select more global frames over local ones. Of
course, this principle is just one among many that govern discourse processes.
In isolation, such a principle would lead us to unwanted levels of generalization
and abstraction. However, since in the van Dijk & Kintsch model generalization
is limited by other factors not under discussion here, there is no difficulty
here. Nevertheless, the chunking strategy must always be considered in the
context of other discourse strategies.

REFERENCES

van Dijk, T.A. & Kintsch, W. Strategies of Comprehension. New York:

Academic Press, forthcoming.

TABLE 1

Percent Continuations Involving Sentence Topic
or Paragraph Topic as a Function of Context

		Continuations:		
		Sentence Topic	Paragraph Topic	Unclassifiable or No Response
	Alone	93	0	7
Contextual Condition:	Unframed	90	3	7
	Framed	10	81	9

TABLE 2

Mean Confidence Ratings

		Text:			
		Eva	Brakes	Complaints	
	Alone	3.09	2.64	2.62	2.78
Condition:	Unframed	2.80	2.28	2.91	2.66
	Framed	3.10	4.08	2.00	3.06

TABLE 3

Percent Topic Choices Appropriate to Sentence

and Paragraph Topics as a Function of Context

		Topic Choice:		
		Sentence Alone	Paragraph Topic	Unclassifiable or No Response
Contextual Condition:	Alone	71	4	25
	Unframed	21	3	76
	Framed	6	81	13

TABLE 4

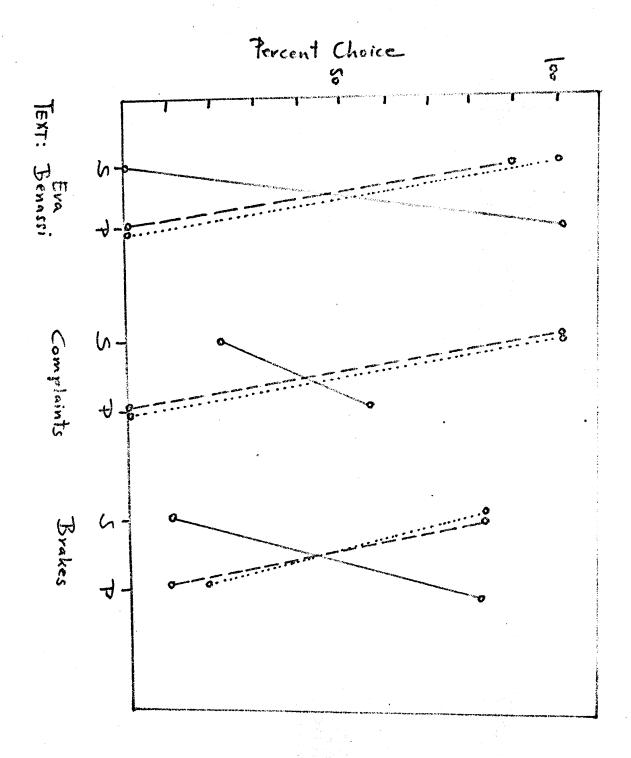### Percent Continuations Based on Sentence Alone and Sentence-Plus-Paragraph as a Function of Context

		Continuation Based on:		
		Sentence Alone	Sentence-Plus-Paragraph	Unclassifiable or No Response
Context Condition:	Alone	93	3	4
	Unframed	69	30	1
	Framed	10	89	1

Figure Legend

Figure 1. Percent choices of sentence (S) and paragraph topics (P) for continuation responses for three texts in Experiment I and three context conditions: ALONE (dotted line), UNFRAMED (broken line), and FRAMED (continuous line).

Percent Choice

TEXT: Eva Benassi

S   P   Eva Benassi

S   P   Complaints

S   P   Brakes

APPENDIX

Texts Used in Experiment I

Text 1: "Eva"

Sentence Alone:

Last year, Eva Benassi became seriously ill with peritonitis.

Unframed:

Settled amidst wooded hills in the backcountry of Ohio is the town of Plattsville. Its high school was opened only a few years ago. Eva Benassi was one of the students in its first freshman class. Last year, Eva became seriously ill with peritonitis.

Framed:

While most miracles that the Church acknowledges occurred in times past, quite a few are claimed in our own days. Ardent prayer sometimes helps miraculously in all kinds of misfortunes. Last year, Eva Benassi became seriously ill with peritonitis.

Text 2: "Brakes"

Sentence Alone:

John Park stepped hard on the brake when he saw his first moose.

Unframed:

John Park and his family were among the 2.4 million visitors who visited Yellowstone Park last year. Yellowstone has more active geysers than any other place in the world as well as an abundant wildlife. Most attractions in the park can be visited by car. John Park stepped hard on the brake when he saw his first moose.

Framed:

Many automobile accidents occur when they are least expected. Sudden, unpredictable stops are a case in point. John Park and his family drove all the way from Chicago to see the wildlife in Yellowstone Park. He stepped hard on the brake when he saw his first moose.

Text 3: "Complaints"

Sentence Alone:

Many students complained about the length of the session.

Unframed:

Highway accident rates have reached higher levels than ever before
during the past decade, especially in the Rocky Mountain States where
snow and mountain roads make driving difficult. Skilled drivers must
be able to handle all kinds of road conditions, even ice. All high
school students in five Rocky Mountain states were given a compulsory
2-hour lesson in driver education. Many students complained about the
length of the session.

Framed:

An experiment was performed to investigate the accuracy and speed with
which people can detect different types of printing errors while
proof reading. Errors occurred either in the beginning, middle or end
of words, half of which were function words and half content words.
Twenty college students participated in a 2-hour experimental session
during which they were required to proofread a 5,000 word text. Many
students complained about the length of the session.