

IX. LINGUISTICS

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A. CLAUSE BOUNDARY AND DOMINANCE EFFECTS ON SENTENCE PERCEPTION

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During the immediate perception of a sentence, listeners determine the location of grammatical clause boundaries, and may even infer more complex syntactic properties such as the dominance relations among clauses. These are the conclusions of several recent studies using the probe-latency method. This technique, as developed by Walker et al.¹ and Caplan,² involves presenting subjects with a series of sentences, each of which is immediately followed by a word (the "probe"). Subjects must decide whether the probe occurred in the sentence just presented. They indicate their decisions on a two-position response key; the experimenter measures Reaction Time (RT) as the interval between presentation of the probe and the subject's response.

Caplan used this paradigm in an experiment with two-clause sentences and found significant differences between mean responses to each clause; viz., listeners responded faster to probe words from the second clause than to probes from the first one, even though both words were equidistant from the end of the sentence, and were acoustically

(IX. LINGUISTICS)

the same. The following sentence pair illustrates his material:

- (a) Now that artists are working in /OIL, prints are rare. / $\frac{\text{Probe}}{\text{OIL}}$
(b) Now that artists are working fewer hours, /OIL prints are rare. / OIL

(Slants enclose identical sections of tape which were spliced onto the left-hand portion of each sentence.)

The RT difference was interpreted as a function of surface boundaries. But since nearly all the test sentences were of the form

- (a) Subord. X, main. x
(b) Subord., X main. x

(where X marks the position of the probe word in the sentence, and x denotes presentation of the probe immediately following each sentence), the effect could also be due to dominance relations between clauses, as represented in the surface and/or underlying phrase marker in the grammar.

In order to decide whether this RT effect is due to surface clause breaks or to dominance properties, we performed two probe-latency experiments (EXP. I and EXP. II). The material in these tests included sentences with both clause orders and probe positions: i. e.,

- (a) $\frac{\text{X}}{\text{subordinate}}$, $\frac{\text{main}}{\text{main}}$.
(b) $\frac{\text{subordinate}}{\text{subordinate}}$, $\frac{\text{X}}{\text{main}}$.
(c) $\frac{\text{main}}{\text{main}}$, $\frac{\text{X}}{\text{subordinate}}$.
(d) $\frac{\text{main}}{\text{main}}$, $\frac{\text{X}}{\text{subordinate}}$.

The clause boundary effect was highly significant in both studies, but the dominance effect only reached significance in EXP. II. Post hoc tests, however, revealed a strong materials effect in EXP. I that probably obscured the influence of dominance properties in that study.

The source of the materials problem seemed to be both semantic and pragmatic. Some sentences described events that were only loosely connected in meaning; the "semantic dependency" between clauses in such sentences was weak. Others contained clauses with strong semantic dependency but with limited plausibility; these sentences could be called "pragmatically" weak. Because of potential effects of these factors, the material was rewritten. The semantic dependency and plausibility of each sentence was

enhanced. When the revised material was tested on 88 subjects in EXP. II, all the main effects reached significance:

Dominance Effects:

(1) Kind of clause

$$\overline{RT}_{\text{main clauses}} < \overline{RT}_{\text{subordinate clauses}}$$

(F = 4.821; d. f. 1/21, $p < .04$)

(2) Order of clauses

$$\overline{RT}_{\text{main, subord.}} < \overline{RT}_{\text{subord., main}}$$

(F = 6.291; d. f. 1/21, $p < .015$)

Boundary Effect:

$$\overline{RT}_{\text{first clause}} > \overline{RT}_{\text{second clause}}$$

(F = 14+, d. f. 1/21, $p \ll .001$)

These results mean that both surface boundaries and dominance relations affect the early perceptual analysis of sentences; yet the nature of the dominance effects is still unclear. In particular, we need to determine whether the effect is syntactic, semantic, or possibly pragmatic. Actually there are several logical possibilities. The dominance effect could be a function of

- (1) exclusively semantic factors,
 - (2) both syntactic and semantic factors,
 - (3) exclusively syntactic properties (of clause relations in the grammar),
- or
- (4) pragmatic factors (such as plausibility of the events described in each sentence).

The contrast between the results of the two experiments argues in favor of a semantic and pragmatic influence ((1), (2), and (4)). Just because the semantic dependency and plausibility of the material were the only variables that were intentionally changed in EXP. II, they were probably responsible for the different results. Briefly, the syntactic effect of dominance did not show up until the semantic relations between clauses were emphasized, and the sense made more plausible.

This finding is important because it suggests that listeners determine much more than syntactic facts alone during immediate perception: viz., once listeners begin to assign semantic and syntactic structure to a sentence, they also make decisions

(IX. LINGUISTICS)

about pragmatic factors such as plausibility of events, speaker's intended sense, etc. Thus our results lead to a model of sentence perception that includes at least three stages:

- (1) Syntactic – segmentation into structural units like clauses;
- (2) Semantic – determination of meanings of lexical items and sense of clauses and entire sentences;
- and
- (3) Pragmatic – determination of speaker's meaning in uttering a sentence.

The problem now is to figure out the temporal order and sequence of these stages in actual processing. Logically, the listener could start making decisions on all three levels at the same time. This is particularly plausible with a constant feedback network. With more and more words entering the short-term memory of the listener, he could start determining phrase and clause structure, the meanings of individual words, and the sense of events described by the sentence. Another possibility is that he would first assign syntactic and semantic structure and then check to see whether the sentence made pragmatic sense. This model allows us to explain the contrasting results of the first two experiments: it might be that dominance distinctions become relevant only at the pragmatic state ((3) above). Additional tests are needed to evaluate this possibility.

Further Research

The results of these studies imply psychological reflexes of dominance relations among clauses, but the research is by no means conclusive. There must be more studies to evaluate the syntactic or semantic nature of the effects. For this purpose, it is essential to use other kinds of sentence material, especially since the stimuli in EXP. I and EXP. II illustrated only one kind of clause structure, i. e., main clause + overt surface adverbial clause. Because this kind of sentence differs from other kinds of sentences containing relatives or complements, there might well be effects of these syntactic differences on immediate perception.⁴ An experiment with several kinds of subordinate clauses is now in progress. Results from such a test should determine whether syntactic distinctions among subordinate clauses affect the initial perception of sentences.

References and Footnotes

1. E. Walker, "Grammatical Relations in Sentence Memory," Ph. D. Thesis, Department of Linguistics, Indiana University, Bloomington, Indiana, 1969.
2. D. Caplan, "Probe Tests and Sentence Perception," Ph. D. Thesis, Department of Linguistics, M. I. T., 1971.

3. Judith R. Kornfeld, "Clause Structure and the Perceptual Analysis of Sentences," Quarterly Progress Report No. 108, Research Laboratory of Electronics, M. I. T., April 15, 1973, pp. 277-280; "Syntactic Structure and the Perception of Sentences; Some Evidence of Dominance Effects," to appear in Proc. 9th Annual Meeting of the Chicago Linguistics Society, CLS, Department of Linguistics, University of Chicago, Chicago, Ill.
4. Specifically, adverbial clauses (such as those used in Experiments I and II) modify the entire sentence. In the tree structure, they are in a sense "free," since they are loosely adjoined to the topmost-S; whereas other types of subordinates are "bound," since they are attached to an NP or VP node. Thus "boundedness" is a syntactic property defined on tree-structure geometry. In our view, it can be considered a psychological concept. This approach to subordinate clause types allows us to predict the possible influence of boundedness on sentence processing: There should be little or no effect of dominance for two-clause sentences with adverbials (since they are loosely attached to the matrix-S); but there should be sizable effects with relative clauses and complements (since they are more tightly bound to a sentence constituent, as well as being more deeply embedded than adverbial clauses that modify the entire sentence).

