

Discourse Context and Sentence Perception*

MICHAEL K. TANENHAUS
Center for the Study of Cognitive Processes
Wayne State University

and

MARK S. SEIDENBERG
McGill University

Three experiments investigated the influence of a context sentence on the processing of a subsequent sentence. Experiments 1 and 2 demonstrated that clauses with pronoun subjects functioned as processing units only when preceded by a context sentence that established a referent for the pronoun. Experiment 3 suggested that listeners make inferences which link definite noun phrases to a preceding context as soon as the definite noun phrase is encountered. The result suggests that context can affect within-sentence processes in comprehension.

DISCOURSE CONTEXT AND SENTENCE PERCEPTION

Although many psycholinguists have recently turned their attention to questions related to discourse, most research on language comprehension has focused on the processes by which listeners understand single sentences (see Levelt, 1978, for review). The reasons for this emphasis on the sentence as the object of inquiry are largely historical, since at the time this research was initiated, the dominant linguistic theory, transformational generative grammar provided a rich analysis of sentence structure. A great deal of early psycholinguistic research attempted to test the psychological reality of various aspects of transformational grammar. While attempts to directly incorporate transformational grammars into models of language comprehension were soon abandoned, much research has continued to be guided by the assumption that at some point in the comprehension process, the listener understands a sentence in terms of a representation isomorphic with its lin-

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guistic deep structure (see Fodor, Bever, & Garrett, 1974; Fodor, Fodor, & Garrett, 1975). For example, Fodor et al. (1975) argue,

It seems that any psychological model of such [communication] exchanges must recognize some formal object which captures the notion of the message standardly communicated by uttering a sentence. The view we are considering here—which, in fact, we endorse—requires that this object be among the structural descriptions that the grammar assigns to the sentence. (p. 516)

This assumption is incorporated into the clausal model of sentence perception proposed by Fodor et al. (1974), which integrates much of the sentence perception literature of the 1960's and early 1970's. The clausal model proposes that syntactically well-formed clauses (which correspond to deep structure sentences in standard theory) are the primary processing units in sentence perception. As a clause is heard, the listener uses perceptual mapping rules or strategies (Bever, 1970) to develop potential representations of the clause by mapping each word onto its deep structure role. Once the clause ends, it is recoded into a more abstract form which frees limited capacity resources to process subsequent input (Bever, Garrett, & Hurtig, 1973; Fodor et al. 1974).

Both the perceptual operations in language comprehension and the representation that the listener assigns a sentence are closely tied to the grammatical structure of the sentence in the clausal model. Since grammatical structure is invariant across discourse contexts, it is not surprising that research in this tradition tended to ignore discourse variables.

It has recently been argued that this view is a consequence of examining the processing of individual sentences extracted from their natural discourse contexts. Research on discourse processing has instead emphasized the constructive nature of the comprehension process (Bransford, Barclay, & Franks, 1972). The representation that the listener assigns to a sentence in a discourse is assumed to derive not merely from information that is explicitly stated within the sentence, but also from information provided in the linguistic and extra-linguistic contexts, and from listener-generated information derived from knowledge of the world. The representation that is the output of the comprehension process is thought to depend heavily upon inferences which are drawn in order to link propositions in the discourse and fill in missing information. While it is difficult to cast a net around all existing theories of discourse processing, there is general agreement with the following observation by Barclay (1973):

...comprehension is a constructive process in which semantic representations derive from the interplay of sentential information, the context of knowledge to which the information is assimilated, task demands, and the assimilation processes themselves, including interpretive and logical operations. These semantic representations in turn serve as memory representations. (p. 231-232)

Thus, two different views of the comprehension process emerge. Researchers in the sentence perception tradition have tended to view the initial stages of the

comprehension process as closely tied to the grammatical structure of the clause or sentence, and relatively invariant across contexts. Researchers interested in discourse have assumed that the initial stages in comprehension are heavily influenced by the extended context. Unfortunately, these different points of view are correlated with differences in method. Most research on the early stages in processing has examined isolated sentences, ignoring discourse variables, while research on discourse has tended to use memory paradigms that may not reflect the representations that are initially derived. As a result we do not have a clear answer to the question: Do discourse variables influence processes involved in the immediate analysis of a clause or sentence?

The few studies which addressed this question have provided equivocal or contradictory results. Many of these studies involve the processing of ambiguous utterances. Bever, Garrett, & Hurtig (1973) presented subjects with complete and incomplete clauses that were structurally ambiguous (e.g., "Although the solution was clear. . ."). Their task was to produce a continuation which formed a complete sentence. Sentence completion times were longer to ambiguous fragments compared to unambiguous fragments only when they were incomplete clauses. Bever et al. argued that these results were obtained because listeners compute multiple readings of ambiguous fragments and select one at the clause boundary. Following incomplete ambiguous clauses, subjects had to choose between two alternate readings before completing the sentence. Following complete clauses, only one reading was available, and no choice was required. Hurtig (1978) found that this difference between clause types was also obtained when the ambiguous stimuli were placed in discourse contexts which were biased toward one reading. He concluded that clausal processing strategies are not influenced by discourse context. Tyler & Marslen-Wilson (1977) presented listeners with structurally ambiguous fragments such as "flying planes" preceded by a clause that biased one reading (e.g., "If you walk too near a runway" or "Even if you are a trained pilot"). Each fragment was followed by a target word, either *is* or *are*, which was presented visually. The context clause determined whether *is* or *are* was the grammatical continuation of the phrase "flying planes." Reaction times to read the target word were faster when the word was a contextually appropriate continuation, suggesting that listeners were making use of the context prior to the clause boundary. Thus the Hurtig (1978) and Tyler & Marslen-Wilson (1977) studies lead to opposite conclusions about the role of context on within-clause processing.¹

¹In Hurtig's (1978) study, the biasing information was presented in a context sentence which preceded the fragment, while in Tyler & Marslen-Wilson's (1977) study, the biasing information was in a subordinate clause which was part of the same sentence as the ambiguous fragment. Tanenhaus & Carroll (1975) have proposed that the information in subordinate clauses is maintained in immediate memory to aid integration with the main clause. Supporting evidence comes from Townsend & Bever (1979). This suggests that the disambiguating information would have been more accessible to guide further processing in the Tyler and Marslen-Wilson study than in the Hurtig study.

A closely related issue is where in the comprehension process listeners and readers draw inferences that link explicitly-stated information. In a sequence such as (1), the listener or reader must infer that *the beer*

- (1) Horace got some picnic supplies out of the car. The beer was warm.
- (2) Horace got some beer out of the car. The beer was warm.

is among the picnic supplies mentioned earlier. In (2), however, no inference is required, since the antecedent is explicitly stated. According to a model in which within-sentence processing proceeds without regard to discourse context, the listener would assign an initial representation to the sentence "The beer was warm" in (1), and then seek a referent for the definite noun phrase. The same initial representation would also be assigned in (2), where no subsequent search is required. In contrast, a model in which context can effect within-sentence processing might predict that listeners attempt to establish a referent for the definite noun phrase immediately after it is encountered, rather than waiting for the end of a major grammatical unit. On this view, "The beer is warm" is assigned different initial representations in (1) and (2).

Haviland & Clark (1974) examined comprehension times to target sentences beginning with definite noun phrases (such as "The beer was warm") when preceded by a context sentence which either provided a direct antecedent (as in (2)), or required an inference (as in (1)). Comprehension times were longer when the inference was required. They proposed that on encountering a definite noun phrase, the listener immediately searches memory for an antecedent. If none is found, an inference is drawn in order to establish one.

Haviland and Clark's results establish that listeners generate linking inferences, and that this process can take time. However, they do not reveal when, in the sequence of processing events, such inferences are generated. In particular, their results are also consistent with models such as Hurtig (1978) and Fodor et al. (1975), in which linking inferences are not made until the end of a clause or sentence. Similar arguments hold for other studies (e.g., Kintsch & Keenan, 1973; Carpenter & Just, 1977) which demonstrate that inferences are made in the comprehension of text or discourse.

The present article addresses two questions concerning the influence of discourse context on sentence processing. They are, does context influence clausal processing strategies, and do listeners make certain types of context-based inferences prior to the end of a sentence? These two questions provide a natural starting point for an investigation of the influence of discourse context on sentence perception, given the importance of clausal processing and inferencing in current comprehension models.

EXPERIMENT 1

A great deal of research has concentrated on identifying the major processing unit in sentence perception. A guiding assumption has been that this unit must correspond to a theoretically-defined linguistic structure. Various candidates have in-

cluded phrases, surface structure clauses, and clauses corresponding to deep structure sentences (for review, see Carroll, Tanenhaus, & Bever, 1978). Since each of these structures is invariant across discourse contexts, there was little reason to expect that the nature of the processing unit would be influenced by context. More recent work, however, suggests that syntactically well-formed clauses may differ in the extent to which they function as processing units. For example, the functional clause hypothesis proposed by Carroll and Tanenhaus maintains that clauses that contain a complete and fully specified set of grammatical relations (e.g. (3)), function as better processing units than "functionally incomplete" clauses with unspecified or deleted grammatical relations, such as (4) and (5) respectively (see Carroll et al., 1978;

(3) After the tall boy returned home, . . .

(4) After he returned home, . . .

(5) After returning home, . . .

Tanenhaus & Carroll, 1975). The functional clause hypothesis predicts that the listener will hold clauses such as (4) and (5) in working memory until information is presented to complete the clause, or until working memory limits are approached.

Supporting evidence comes from several recent studies. Carroll & Tanenhaus (1978) found that clicks were mislocated at clause boundaries more frequently following complete clauses than clauses with deleted grammatical relations. Carroll et al. (1978) demonstrated that cued recall was faster when the cued word came from a clause with deleted grammatical relations than when the word came from a complete clause. Finally, Carroll (1979) demonstrated that memory load was greater following clauses with deleted grammatical relations. These results suggest that clauses with deleted grammatical relations are maintained in a more literal form than clauses with a complete set of fully specified grammatical relations.

Marslen-Wilson, Tyler, & Seidenberg (1978) examined the processing of clauses with pronouns. They presented subjects with a cue word followed by a bi-clausal sentence which began with a clause containing either a pronoun or specific noun. The subject's task was to monitor for a word which either rhymed with or was a category exemplar of the cue word (rhyme and category monitoring). For example, if the target word was CAT, the cue was either BAT or ANIMAL. Targets were either the final word in the first clause or the initial word in the second clause. Performance on both monitoring tasks was similar. For targets at the end of the first clause, monitor latencies did not differ for clauses with pronouns and clauses with specific nouns. For targets beginning the second clause, however, monitor latencies were faster following clauses with pronouns. Marslen-Wilson et al. interpreted this pattern of results as evidence that clauses with pronouns are poorer processing units than clauses with specified subjects. The logic of their interpretation is based on the fact that rhyme and category monitoring becomes faster as contextual information builds within a clause. If the clause is treated as a processing unit, then it will be recoded and removed from working memory. The information in the clause is less available to facilitate processing of the words be-

ginning the next clause. Thus, monitoring times will increase following a clause which is a complete processing unit. If the clause is not recoded, then the information in the clause is still available in working memory and no clause effect should obtain. This is exactly the pattern found by Marslen-Wilson et al. for clauses with pronouns.

Experiment 1 used the rhyme monitor task to investigate whether clauses containing pronouns become better processing units in contexts that provide antecedents. Subjects heard two-clause sentences in which the subject of the first clause was either referential (6a) or pronominal (6b). Following Marslen-Wilson et al. (1978), these will be termed *determinate* and *indeterminate*, respectively. Each target sentence appeared with two context sentences, which either provided a plausible antecedent for the pronoun (*informative* contexts such as 7a) or did not (*neutral* contexts such as 7b).

Targets:

(6a) When adults are cruel, kids often grow up to be maladjusted.

(6b) When they are cruel, kids often grown up to be maladjusted.

Contexts:

(7a) Some adults are extremely insensitive.

(7b) Even though I haven't studied much there is one thing I know.

The rhyme word was always the first word of the second clause in the second sentence (e.g. KIDS). In neutral contexts, monitor times should be faster following indeterminate clauses compared to determinate clauses. An indeterminate clause preceding the target should not function as a processing unit because the subject cannot be identified. Because the listener is seeking the missing information, recoding of the clause will be postponed. Thus, it will be available in working memory to facilitate processing of the target. If listeners use the information in the context sentence to assign the pronoun a referent prior to the completion of the clause, the facilitation in rhyme detection following indeterminate clauses should be eliminated by the informative contexts.

Subjects.

Thirty-two members of the Columbia University community served as subjects and were paid \$3.50.

Materials.

Twenty sets of two-sentence discourses were derived from sentences such as (6-7). Each set contained four discourses:

1. A neutral context sentence followed by a sentence beginning with a determinate clause;
2. A neutral context sentence followed by a sentence beginning with an indeterminate clause;
3. An informative context sentence followed by a sentence beginning with a determinate clause; and

