Review article

Language comprehension as structure building[☆]

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1. Introduction

The main thrust of current research into language processing emphasizes the modularity of knowledge of language, and focuses on those aspects of language which are specific to our linguistic ability. In contrast, Morton Ann Gernsbacher's research attests that many aspects of language comprehension involve general cognitive processes and mechanisms. Gernsbacher adduces a vast array of data which suggest that these processes and mechanisms underlie both linguistic and nonlinguistic phenomena. Her findings show that language comprehension is strongly related to general cognitive systems.

Gernsbacher assumes that the goal of comprehension is to build a coherent mental representation of the information being processed. According to this structure-building hypothesis, in order to build a mental representation, comprehenders must first lay foundations for their mental structures. Next, they should develop their mental structures by mapping information onto it. When incoming information is less coherent with previous information, comprehenders shift and build a new substructure.

The building blocks of mental structures are memory cells. Memory cells are activated by incoming stimuli. Their initial activation forms the foundations of the mental structures. When incoming information coheres with the previous information, it is often mapped onto developing structures, and does not necessitate the activation of new memory cells. However, when incoming information does not overlap with the previous information, it is likely to activate different memory cells. The activation of these new memory cells forms the foundation of a new substructure.

Activated memory cells transmit processing signals which either enhance or suppress other cells' activation. Enhancement is a mechanism that highlights information necessary for further structure building. Suppression serves to dampen information that is no longer functional in structure building. The processes of laying the foundation, mapping, and shifting, and the mechanisms of enhancement and suppression explain a great deal of linguistic and nonlinguistic phenomena.[1]

2. The process of laying a foundation

Consider the following facts: Subjects spend more time viewing the first picture of a story or episode than viewing later occurring pictures (Gernsbacher, 1983); Subjects take longer to read the beginning sentence of an episode than later occurring sentences within that episode (Haberlandt, 1980, 1984; Haberlandt et al., 1980; Mandler and Goodman, 1982); Initial words in a sentence take longer to read than the same or other words occurring later in the sentence (Aaronson and Scarborough, 1976; Aaronson and Ferres, 1983; Chang, 1980); Target words or phonemes take longer to identify when they appear in clause-initial position than when they occur later (Cairns and Kamerman, 1975; Cutler and Foss, 1977; Foss, 1969, 1982; Hakes, 1971; Marslen-Wilson et al., 1978; Shields et al., 1974); First content words of a sentence elicit larger N400 brain wave than words occurring later in the sentence, suggesting that words occurring initially in the sentence are more difficult to understand than later occurring words. N400 is the negative component of the event-related brain wave that occurs about 400 ms after the stimulus. N400 brain waves are associated with difficulty of processing. They increase in response to low frequency words and unexpected words in a sentence (e.g., Kutas and Hillyard, 1982).

These facts suggest that comprehenders spend more cognitive effort processing information (both verbal and nonverbal) in discourse-initial position than later in the discourse. This, however, holds only for coherent discourses. Incoherent discourses do not manifest such a pattern (Foss and Lynch, 1969; Greeno and Noreen, 1974; Hakes and Foss, 1970; Van Petten and Kutas, 1987). Gernsbacher concludes that in a coherent discourse, comprehenders use initial information to lay a foundation for their representation of the entire discourse.

Gernsbacher views comprehension in terms of structure building. According to the structure-building hypothesis, the goal of comprehension is to build a coherent mental representation of the information processed. To build this mental structure, comprehenders must first lay the foundation onto which subsequent information will be mapped. However, the extra cognitive effort comprehenders spend at this stage will be offset by the advantage of first mention. Serving as a foundation onto which

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[1] In one of her notes Gernsbacher explains why she prefers quoting to paraphrasing: "My motivation is not laziness but the belief that paraphrasing is best reserved for investigating subjects' memory in laboratory experiments" (p. 242). When trying to review Gernsbacher's work, I tried paraphrasing despite my agreement with her view, but failed. My paraphrasing of Gernsbacher's work relies heavily on the original. Her book is so well written, every paraphrase of it must be second best.

subsequent information is added, first mentioned information must be more accessible than later occurring information. Findings indeed show that first mentioned participants are more accessible than second mentioned participants, regardless of either their semantic (agency) or syntactic (subjecthood) role, or whether they occupy sentence-initial position. Rather, the advantage of first mention must be due to the role first mentioned participants play in forming the foundations for their sentence level representation.

Regarding discourse comprehension, the structure-building hypothesis predicts that the first clause of a discourse should enjoy first mention advantage, and be more accessible than subsequent clauses, so that incoming information may be mapped onto it. At the same time, this same hypothesis predicts that any clause currently being processed (in its own substructure) should be foremost on the comprehender's mind. This seemingly contradictory advantage of first mention as opposed to recency must be resolved when the comprehender has processed the second clause. By then, the first clause (of a two-clause sentence) should be more accessible so that the second clause could be incorporated with it. Gernsbacher et al. (1989) indeed showed that while comprehending the second clause, subjects had greatest access to the information presented in the substructure they were currently building. When accessibility was measured 150 ms after the offset of the sentences' final words, the two clauses were equally accessible. However, when measured about a second or two later (after 1400 ms and 2000 ms), the first clause was shown to enjoy greater accessibility. According to the structure-building hypothesis, these two seemingly contradictory phenomena (of first mention as opposed to recency advantage) should not be mutually exclusive. While recent clause advantage is expected to be short-lived, first mention advantage should be long-lived.

Research into discourse structure provides support for the structure-building hypothesis. Linguistic markers of high accessibility (e.g., pronouns) are used to refer either to the recent NP (indicating that the previous/recent clause is highly accessible), or to the NP constituent of the discourse-topic proposition (indicating that the first clause in the discourse is highly accessible), as shown by Ariel (1990). Information in discourse-initial position provides the best cues for recalling the discourse as a whole (e.g., first words of a sentence or pictures of those words, as testified by Bock and Irwin, 1980; Prentice, 1967; Turner and Rommetveit, 1968, or the beginning of story episodes, as testified by Mandler and Goodman, 1982). When asked to recall the main idea of a discourse, comprehenders tend to select the initial sentence (Kieras, 1980). Indeed, discourse-initial position has been shown to be preferably preserved for the discourse-topic proposition. Dooling and Lachman (1971) and Garrod and Sanford (1977) showed that providing information about the discourse-topic at the beginning of a discourse activates the related schema or general knowledge which allow for incoming information to be integrated more easily. Bransford and Johnson (1972) showed that in certain cases, comprehension of texts is impossible without a discourse-topic mention in initial position (e.g., in the title). Giora (1985b) showed that discourses with a discourse-topic proposition in initial position are read significantly faster than identical discourses with discourse-topic mention in final position. George et al. (1994) demonstrated that discourse comprehension is facili-

tated when the discourse-topic enjoys initial mention. Subjects recalled titled dis-
courses better than untitled ones, and they searched for the discourse-topic proposi-
tion in the beginning of the text. They further found that words in the untitled para-
graphs elicited greater N400 amplitude than words in the titled paragraphs. Recall
that N400, the component of event-related brain potential, is associated with diffi-
culty of processing. Here it was shown to be sensitive to the absence of a discourse-
topic mention in initial position (e.g., a title).

Studies into aphasia further attest that mention of a discourse-topic proposition
in the beginning of a discourse facilitates comprehension. For example, Hough
(1990) showed that right hemisphere damaged patients have more difficulties
than other patients and normal subjects comprehending narratives whose dis-
course-topic sentences are shifted to the end of the narrative. Schneiderman et al.
(1992) showed that the presence of a discourse-topic proposition facilitates text
comprehension for left hemisphere damaged and non hemisphere damaged indi-
viduals. Right hemisphere damaged patients do not benefit from its presence.
Schneiderman and her colleagues interpret this deficit as stemming from a more
general impairment in formulating macrostructure. There is ample evidence,
then, that information in the beginning of a discourse tends to be functional in
laying the foundation for building the mental representation of the discourse as a
whole.

3. The processes of mapping and shifting

3.1. Mapping

According to the structure-building hypothesis, coherence should facilitate map-
ping. Findings concerning four types of 'coherence' (referential, temporal, locational
and causal) are cited in support of the claim. Below I will review the data as pre-
sented by Gernsbacher, criticize the notions of 'coherence' employed, and propose
an alternative view:

(i) Referential 'coherence' facilitates mapping: Sentences that maintain a referen-
tial link (e.g., 1) are more likely than sentences which do not refer to previously
mentioned entities (e.g., 2) to be mapped onto developing structures:

(1) We got some *beer* out of the trunk. The *beer* was warm.
(2) Andrew was especially fond of beer. The *beer* was warm.

However, Gernsbacher notes that counterexample (3), taken from Johnson-Laird
(1983: 379), suggests that a referential link is insufficient for creating coherence:

(3) My daughter works in a library in *London. London* is the home of a good
     museum of natural history. The *museum* is organized on the basis of cladistic
     theory ...

The problem is not alleviated even when the discourse manifests referential linking to one entity only (e.g., *Ida's husband*, as shown in Giora, 1985b):

(3.1) This first time she was married her *husband* came from Montana. *He* was the kind that when he was not alone *he* would look thoughtful. *He* was the kind that knew that in Montana there are mountains and mountains have snow on them. *He* had not lived in Montana. *He* would leave Montana. *He* had to marry Ida and *he* was thoughtful.
(Taken from *Ida* by Gertrude Stein)

In fact, as I show below, referential 'coherence' is not even necessary. The passage in (4) exhibits no referential 'coherence' yet it is coherent:

(4) Just how far have women risen in the film community? According to PM, who was at *Woman in Film* luncheon recently, it has actually been a very good year for women. "Demi Moore got $5 million for her part in *Indecent Proposal*. Uma Thurman earned $4 million in *Mad Dog and Glory*. Just three years ago, in *Pretty Woman*, Julia Roberts got – what was it? $3,000? "Women have had real progress" concluded PM.

   (ii) Temporal 'coherence' facilitates mapping: Sentences that manifest temporal 'coherence' in that the events they report occur in the same time frame (e.g., 6 in the context of 5) are more likely than sentences which are not temporally coherent (e.g., 7 in the context of 5) to be mapped onto developing structures. Data indeed support the claim: (6) is read faster than (7):

(5) a. I arrived at the start line at 7:45 a.m.
    b. I was the only female marathon runner.
    c. The marathon was scheduled to begin at 8:00.
    d. As I nervously awaited the start, I talked with other runners.
    e. I also tried to stretch and relax.
    f. At eight o'clock sharp the starter fired his pistol.[2]
(6) Half an hour later, it began to rain.
(7) Three days later, it began to rain.

However, temporal 'coherence', I claim, is neither sufficient nor necessary for discourse coherence. The sentence in (8), which is temporally incoherent, coheres with (5), and must be as easy to map onto (5) as (6), or at least easier to map than (7). (9) on the other hand, which is temporally coherent, is incoherent, and must be at least as difficult as (7) to map onto (5):

(8) A year later, two other women showed up at the marathon line. I felt much better.

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[2] Proposition (b) has been added to the original.

(9) Half an hour later, I regretted not going to the movies the previous night.

(iii) Locational 'coherence' facilitates mapping: Sentences which report events occurring at the same place (e.g., 11) are more likely to be mapped than sentences which are not locationally coherent (e.g., 12). Data support this prediction. (11) is read faster than (12) in the context of (10):

(10) a. Mike and I were standing in the hallway near my office.
     b. We were enthusiastically discussing some new data.
(11) In a nearby office, people had difficulty concentrating.
(12) In a nearby town, people had difficulty concentrating.

However, locational 'coherence', I claim, is neither sufficient nor necessary for discourse coherence. Consider (13) which, though locationally coherent, does not cohere with (10), and (14), which coheres with (10) despite lack of locational 'coherence':

(13) In a nearby office, a man was holding a receiver.
(14) In a nearby university/city, people wouldn't discuss data even behind closed doors.

(iv) Causal 'coherence' facilitates mapping: Sentences which are causally related to previous events (e.g., 15e in the context of each of 15a–c) should be read faster than sentences which are unlikely logical consequences thereof (e.g., 15e in the context of 15d). Data support the structure-building hypothesis (cf. Keenan et al., 1984):

(15)   *Context sentence*
     a. Joey's big brother punched him again and again.
     b. Racing down the hill, Joey fell off his bike.
     c. Joey's crazy mother became furiously angry with him.
     d. Joey went to a neighbor's house to play.
         Consequence sentence
     e. The next day, Joey was covered in bruises.

But causality, I argue, is not necessary (cf. 4 above). Nor is it sufficient. (16) is causally connected, yet incoherent:

(16) Dana hit Dan. He therefore cried. His shirt got wet as a result. So he went home to wash it. His mother was home, so he had to go on errands. He hated his mother. He was unhappy. He cried a lot. His mother hated that. He left her. He met Dina as a result. He fell in love with her. They got married years later. Dina had a baby. As a result, there was too much laundry. Now she was very tired. She dreamt all day. Therefore she wanted to have a career.

The conclusion one is to draw from these counterexamples is that referential, temporal, locational and causal 'coherence' do not satisfy the conditions for discourse

coherence. As a result, they cannot really support the claim that coherence facilitates mapping. To be able to maintain the claim that coherence facilitates mapping, a different, more global notion of discourse coherence is required.

3.2. Discourse coherence

In Giora (1985a,b,c, 1988, partly following Grice, 1975) I proposed to view discourse coherence in terms of Relevance to a discourse-topic and Graded Informativeness. Specifically, an informative discourse is coherent if and only if it

(a) conforms to the Relevance Requirement in that all its propositions are conceived of as related/similar to a discourse-topic proposition. The discourse-topic is a generalization, preferably made explicit, and placed in the beginning of the discourse. It functions as a reference point relative to which all incoming propositions are assessed and stored,

and

(b) conforms to the Granded Informativeness Condition which requires that each proposition be more (or at least not less) informative than the one that precedes it in relation to the discourse-topic. Along the lines suggested by e.g., Shannon (1951) and Attneave (1959), a message is considered informative to the extent that it has properties unshared by the previous proposition, which, in turn, allow it to reduce possibilites by half,

and

(c) marks any deviation from Relevance and Graded Informativeness by an explicit marker e.g., 'by the way', 'after all' (cf. Ariel, 1985, 1988).[3]

It has been shown that discourses which conform to the above conditions are the easiest to process (Giora, 1985b; Giora et al., 1995).[4]

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[3] I proposed (Giora, 1985b) that the conditions of discourse well-formedness are derived from more general constraints on storage of general knowledge in memory. Accordingly, a well-formed informative discourse is organized like a prototype-oriented category (e.g., the class of birds, cf. Rosch, 1973). The principle of organization is similarity (to a prototypical member). Consequently, the internal structure of the category is graded. It is stored relative to the least informative member in the set, and is ordered informatively from the least to the most informative member. Likewise, a well-formed informative discourse evolves gradually from the least to the most informative message. It begins with a generalization and becomes more informative as the discourse proceeds.

[4] Any deviation requires extra processing and is judged by speakers as less natural (Giora, 1988). Along the lines suggested by Grice (1975), overt violations of the requirements are intended to be recognized and trigger the generation of implicatures. They are aimed at achieving special effects or products, and are more difficult to process (Giora, 1990, 1993). In contrast, unintended violations constitute anomalies.

The theory of discourse coherence I propose explains why the four types of discourse connectivity (i–iv) considered by Gernsbacher, do not guarantee coherence. First, they do not block violation of the Relevance Requirement, since they allow for two sentences to cohere via only one sentence constituent. Given that the discourse-topic is a proposition (cf. Giora, 1985a, and (a) above), for a discourse to be coherent, both the argument and the predicate constituents of the discourse-topic proposition should control the various propositions of the discourse segment. Any reference to just one constituent of the discourse-topic proposition, be it an NP or a PP, will not suffice (cf. 3, 3.1 above).

The second problem with the set of 'coherence' conditions cited by Gernsbacher has to do with their scope. Being constraints on adjacent sentences only, referential, temporal, locational and causal 'coherence' fail to guarantee relevance to a discourse-topic. At best, they constitute local connectivity. In Giora (1985a,b,c) I showed that coherence is not a linear property of the discourse. Rather, coherence relations obtain between the various propositions of the discourse and a superordinate proposition (cf. 3 vs. 4 above). The counterexamples I propose above, which achieve coherence despite absence of cohesive (referential, temporal, locational and causal) links (e.g., 4), are all subsumable under a discourse-topic proposition, as required by the Relevance Condition ((a) above).

The structure-building framework has been verified only as far as adjacent sentences are concerned. However, regarding mapping, it seems safe to hypothesize that what is true of the second clause must be true of all subsequent clauses.[5] The third clause, for instance, must be most accessible while being processed in its substructure. A second or so later, though, the first clause must regain its superior accessibility. By then, the third clause, which has been fully comprehended, should be mapped onto the first clause, and so forth.

Given that comprehenders build a mental structure of a discourse in relation to the first clause, I propose that the theory of discourse coherence I delineate supports Gernsbacher's claim that coherence facilitates mapping. The processes of laying the foundation and of mapping incoming information onto developing structures constitute precisely (part of) the processing model predicted by the theory of discourse coherence in question. Put differently, the findings which support the structure-

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The discourse in (4) above is an example of a well-formed text. It obeys the Relevance Requirement in that it begins with a generalization ("it has ... been a very good year for women [in the film community]") which presents the set of properties (good year, for women, in the film community) shared by all the propositions in the text. The various propositions exhibit instances of women in the film community who had a good year financially. Therefore they can be included in the category "good year for women in the film community". In addition, the text conforms with the Graded informativeness Requirement. Each proposition (apart form the last one) adds some new information, e.g., mention of specific actresses, mention of specific instances of financial success, comparison with past success. The last proposition repeats information presented in the discourse-topic proposition. Repeated mention of the discourse-topic functions as a segmentation marker (Longacre, 1979; Giora, 1983, 1986, forthcoming).
[5] "The Structure Building Framework explicitly proposes that the cognitive process of laying a foundation occurs whenever comprehenders are building mental structures, regardless of whether the units are clauses, sentences, story episodes and regardless of modality" (p. 232).

building hypothesis also support the theory of discourse coherence I propose: Gerns-bacher's examples all obey the Relevance Requirement.

3.3. Shifting

According to the structure-building framework, when incoming information does not cohere with previous information, and cannot be mapped onto a developing structure, comprehenders shift and develop a new substructure. The structure-building framework is supported by theories of discourse coherence in this respect too. Various researches looking into how texts progress from sentence to sentence suggest that the introduction of new information triggers text segmentation (e.g., Daneš, 1974; Reinhart, 1980).

Discourse segmentation at the level of discourse units larger than a sentence (e.g., paragraphs) also falls out of the structure-building hypothesis. The conditions of discourse coherence I propose (cf. b above), require that discourse segments (e.g., paragraphs) should end at peaks of informativity. This means that the boundaries of a discourse segment are determined by the Relevance Requirement. An informative message that no longer bears relevance/similarity to the topic of a given discourse segment signals segment boundary, and starts a new segment. As required by condition (c) of the discourse coherence theory I propose above, a new substructure should be explicitly marked by a digressive marker, e.g., paragraphing, semantic connectors, adverbial phrases, etc.[6] Such markers signal digression from Relevance.[7]

However, since the structure-building framework deals primarily with relations between adjacent sentences, it does not predict discourse segmentation after the introduction of new information. I have shown (Giora, 1983a,b, 1986, 1988) that segmenting the text after introducing the next discourse-topic is a widespread phenomenon. For example, the future discourse-topic of the second paragraph of (17) below (*the chance discovery of penicillin*) appears in the final position of the first segment. It is still highly relevant to the discourse-topic under discussion presented in the first sentence of that paragraph (*The chance discovery of important scientific discoveries*). However, a highly informative description of it, which is introduced in the beginning of the next paragraph, is beyond the scope of the given discourse-

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[6] Note that a new discourse-topic may drastically diverge from the discourse-topic under discussion, or just mildly so. Various discoursal devices indicate the extent to which a newly introduced discourse topic is new. Unlike the notion of accessibility, whose graded nature has been widely acknowledged, the terrain of inaccessibility hardly knows any degree. The literature abounds in graded notions such as Awareness (Chafe, 1974, 1976), Givenness (Prince, 1981b), Accessibility (Ariel, 1990–1991; Gundel et al., 1993). It seems that a graded notion of newness which is a natural extension of the existing notions, has still to await research.

[7] Note, however, that these cohesive devices do not function exclusively as digression markers. Apart from introducing new discourse topics to the discourse, they have other functions. Hence the possibility of manipulating the cohesive devices (termed by Gernsbacher temporal, location, causal coherence) for the purpose of affecting both coherence and incoherence.

Consider also the possibility of ending a discourse segment by a coda ("And that's it", cf. Labov, 1972) or by repeated mention of the discourse-topic proposition which functions as a coda too.

topic. The theory of discourse coherence which I propose predicts that when a discourse-topic shifts, comprehenders should shift and develop a new structure. However, it is not clear why, according to the structure-building framework, comprehenders should shift when segmentation occurs after the introduction of the next discourse-topic. Under such circumstances, the last clause of the given segment is coherent with the given discourse-topic and with previous information, and the first clause of the next segment is coherent with previous information, placed in the end of the previous segment. Examples such as (17) suggest that comprehenders shift and build a new substructure when information no longer coheres with the given discourse-topic rather than with 'previous information':

(17) It has often occurred in the history of science that an important discovery was come upon by chance. A scientist looking into one matter, unexpectedly came upon another which was far more important than the one he was looking into. *Penicillin is a result of such a discovery.*

Penicillin was accidentally discovered by Fleming in 1928 ...

The suggestion that 'previous information' in the context of processing a whole discourse must mean 'the given discourse-topic' seems to follow from the structure-building framework. The process of mapping incoming information onto that clause which constitutes the foundation involves mapping information in the most recent clause onto the first clause.

Why do speakers and writers segment a text after the introduction of the next discourse-topic? Given the structure-building hypothesis, I propose that they do so to facilitate mapping: By placing the next discourse-topic at the end of a given paragraph, writers allow for the next paragraph to be mapped onto the previously developed substructure. Such concatenation of new discourse-topics must facilitate processing: It does not require the activation of new memory cells for the foundation of a new mental structure.

How do readers identify new discourse-topics when they are introduced in a previous substructure? In Giora (1983a,b), I suggested that segment-final position enhances recall, since it enjoys recency effect. Information in discourse-final position is foregrounded so as to be (as) highly accessible (as first mentioned information) for further discussion. But according to the structure-building hypothesis, this explanation cannot hold. Once this information is processed, it loses its superior accessibility (due to recency), and first mentioned information regains greater accessibility (cf. The process of laying the foundation). However, information in segment-final position must at least be more accessible than previously presented information (apart from first mentioned information).

In Giora (1988) I offered an alternative explanation which agrees with the structure-building hypothesis. Along the lines suggested by Gernsbacher, I proposed that highly informative messages enjoy a privileged cognitive status due to informativity. Informativity affects comprehenders's ability to access information (by the mechanism of enhancement and suppression to be discussed later on). Since information in

the final position of a discourse segment must be highly informative, if not the most informative in that segment (cf. b above), it must also be easier to access, relative to previously mentioned information (first mentioned information not included). This explains the segmentation in (17) above. *The chance discovery of penicillin*, a specific instance of *scientific chance discovery of some importance*, is introduced before paragraphing occurs. Its informativity (which suppresses the accessibility of previously mentioned information, as will be discussed below) allows it to be easy to access and selected for further discussion.

Shifting, then, occurs when new information, e.g., a new discourse-topic, is introduced to the discourse. Given the structure-building framework, I propose that segmentation strategies vary in accordance with the degree of 'newness'/(in)accessibility of incoming information. When incoming information coheres with the previous discourse-topic and requires little activation of new memory cells, text progression may proceed smoothly, with no explicit discourse connectors (cf. example 17 above). When a new discourse-topic is less coherent with the previous discourse-topic and requires activation of new memory cells, speakers/writers will cue comprehenders by means of explicit linguistic connectors (as required by (c) above and in accordance with the structure-building hypothesis).

4. The mechanisms of suppression and enhancement

Mental representations of discourse constituents in memory are equal but hierarchical. Some information enjoys enhanced recall, and some is less accessible. For instance, the time course of comprehension reveals that the advantage of first mention is long-lived, whereas the advantage of clause recency is short-lived. To build coherent mental structures, comprehenders should keep activated information that is functional in developing their mental structures. At the same time, they should suppress information that is no longer functional in developing these structures. Similarly, coherent mental structures require that relevant meanings be activated and retained, while irrelevant information be suppressed and dampened. According to the structure-building framework, it is the mechanisms of enhancement and suppression that are responsible for the activation and dampening of information.

How do the mechanisms of enhancement and suppression operate? Mental structures are represented in memory cells. Memory cells represent previously stored memory traces, and are automatically activated by incoming stimuli. According to the structure-building framework, activated memory cells transmit processing signals which either enhance or suppress the activation of other memory cells.

Gernsbacher capitalizes on the role the mechanisms of enhancement and suppression play in understanding ambiguous and unambiguous words, in improving the accessibility of concepts referred to by anaphoric and cataphoric devices, and in improving memory for thematic as opposed to surface level information.

According to many models of word understanding (e.g., Becker, 1976; Kintsch, 1988; Marslen-Wilson and Welsh, 1978; Norris, 1986; McClelland and Rumelhart, 1981), immediately after comprehenders hear or read an ambiguous word, multiple

meanings are activated. For example, research by Swinney (1979) showed that in understanding ambiguous words like *bug* (insect/listening device), both meanings are activated initially. This holds even if the context is biased in favor of one meaning, as in (18), which favors the 'insect' interpretation:

(18) The man was not surprised when he found several spiders, roaches, and other bugs ...

As sentence comprehension progresses, the appropriate meaning remains activated, while the inappropriate meaning becomes less activated. According to some theories (McClelland and Kawamoto, 1986; Waltz and Pollack, 1985), the inappropriate meanings are inhibited by the appropriate ones. The assumption is that concepts compete for a fixed amount of activation. Inappropriate meanings decrease in activation because appropriate meanings have increased. Gernsbacher's findings do not support this assumption: The appropriate meanings do not increase in their accessibility when the inappropriate meanings decrease.

According to other theories, inappropriate meanings simply decay, because they are not stimulated by the context (e.g., Anderson, 1983). These theories predict that in a neutral context (e.g., 21 below), both meanings should be less activated when activation is measured after a delay. However, if multiple meanings of neutral sentences are just as activated when measured immediately and after a delay, these results support the suppression hypothesis. According to the suppression hypothesis, multiple meanings of a neutral sentence should be just as activated after the delay as they are immediately, because there are no bases from which suppression signals can be transmitted. This is not true of inappropriate meanings. According to the suppression hypothesis, inappropriate meanings should become less activated via the mechanism of suppression. Memory cells representing the context transmit signals which dampen the inappropriate meanings.

Gernsbacher and Faust (1990, 1991) tested these hypotheses. They presented ambiguous words like *quack* in different sentence contexts: in a context that biased one meaning (*doctor*, as in 19), in a context that biased another meaning (*duck*, as in 20), and in a neutral context which is equally related to either meaning (as in 21):

(19) Pam was diagnosed by a quack ...
(20) Pam heard a sound like a quack ...
(21) Pam was annoyed by a quack ...

They showed that the appropriate and neutral meanings remained equally activated immediately after reading each of the above sentences, and at a delayed interval. However, the contextually inappropriate meanings remained equally activated only immediately. At a delayed interval (of about 1 second), the inappropriate meaning was less activated. These results support the suppression hypothesis, according to which only memory cells representing the inappropriate meaning should be suppressed.

The suppression mechanism may contribute to testing the difference between various figures of speech. For instance, in Giora (1991, 1995) I suggest that, among

other things, jokes differ from other figures of speech (e.g., irony, metaphor) in that their understanding involves suppressing the most probable (the so-called appropriate) meaning. Its suppression allows only for the atypical meaning of the ambiguous utterance to be retained. Indeed, Gernsbacher and Robertson (1995) suggest that understanding puns and jokes relies on comprehenders' ability to quickly suppress the prototypical meaning of such utterances. They show that lessskilled readers took longer to understand puns than more skilled readers, because they were slower at suppressing the typical meaning (e.g. the typical meaning of 'bar' in *Two men walk into a bar, and a third man ducks*).

The suppression mechanism is also functional in dampening irrelevant associations. Nonambiguous words may have multiple associations, some of which might be irrelevant. For instance, the association between the word *apple* and *tree* may be more relevant in the context of (23) than in the context of (22), in which *pie* will be more relevant:

(22) Jim baked the apples.
(23) Jim picked the apples.

Gernsbacher and Faust (1990) show that whereas multiple associations are activated immediately upon comprehending the sentence, only the relevant associations remain activated after a delay. The less relevant associations are suppressed after a brief period.

The claim that mental representations of discourse constituents in memory are hierarchical holds for representations of referents as well. According to the structure-building framework, for comprehenders to be able to access pronouns' referents, at some point following the mention of the pronouns, antecedents and nonantecedents must be activated at different levels. For instance, in (24), in which *Pam* is the antecedent of the anaphor *she, Pam* should be more activated than the nonantecedent *Ann*, after comprehenders finish reading the sentence. Findings indeed support this prediction (Corbett and Chang, 1983):

(24) Ann predicted that Pam would lose the track race, but **she** came in first very easily.

According to the structure building framework, the difference in levels of activations between antecedents and nonantecedents should increase relative to the informativeness or explicitness of the anaphor, i.e., the referring expression. The explicitness of the anaphor should enhance the accessibility of its own referent while suppressing others. Findings indeed show that explicit anaphors like *Pam* in (25) increase the level of activation of their referents as opposed to nonreferents, compared to less explicit anaphors like *she* in (24) (Corbett and Chang, 1983; Gernsbacher, 1989):

(25) Ann predicted that Pam would lose the track race, but **Pam** came in first very easily.

Furthermore, findings show that new concepts improve their referential accessibility by triggering suppression of previously mentioned concepts (Gernsbacher, 1989; Dell et al., 1983). Findings from the various studies support the Explicitness Principle:

"The more explicit the concept, the more likely it is to trigger the suppression of other concepts; when used anaphorically, the more likely it is to enhance its referent." (p. 133)

Explicit anaphors are used to retrieve referents which are relatively hard to access (see also Givón, 1983; Ariel, 1990, 1991). Gernsbacher mentions three conditions in which referents are hard for comprehenders to retrieve. First, she discusses referential distance. At long referential distances, referents are harder to access. There is ample evidence in the literature associating low accessibility and distance. However, Gernsbacher suggests that it is not distance, but rather the intervention of the other concepts which trigger suppression, and affect distant referents' accessibility. When the distance is not filled by intervening concepts, distant referents' accessibility is not affected (e.g., Carroll and Slowiaczek, 1987).

Second, she addresses the question of topicality. Topical concepts are easy to access, because they are enhanced by both the advantage of first mention (cf. The process of laying the foundation) and by frequent mention, which make them resistant to suppression. Less topical concepts are more difficult to access (e.g., Anderson et al., 1983), and require explicit anaphors for their retrieval (e.g., Chafe, 1974, 1976; Marslen-Wilson et al., 1982; Givón 1983; Ariel, 1985, 1990, 1991).

The third condition under which explicit anaphors are used is at episode boundaries (see Marslen-Wilson et al., 1982; Fox, 1986; Tomlin, 1987; Hofmann, 1989; Ariel, 1990, 1991). Beginnings of episodes and paragraphs are where new discourse-topics are introduced. Introduction of a new discourse-topic involves shifting (cf. Shifting) and triggers suppression of previous information. Previous information, therefore, is less accessible in segment-initial position, which explains why anaphors are expected to be more explicit at the beginning of a paragraph or a new episode.

However, it has been observed (Giora, 1983a,b, 1986; Giora and Lee, 1996) that anaphors also tend to be more explicit in segment-final position. One explanation follows from the theory of discourse coherence I propose. Segment-final position is the preferred position for the most informative message in the discourse. As mentioned above, this information may function cataphorically to introduce future discourse-topics. Hence their explicitness: Their enhanced cognitive status makes them highly activated and easier for comprehenders to access while they shift and build the next substructure. In addition, it has been proposed (e.g., Longacre, 1979; Giora and Lee, 1996) that explicit anaphors signal segmentation. Their explicitness and enhancement do not necessarily follow from the relative accessibility of their referents. Nor are they a function of their future role in the discourse. Rather, in segment-final position, explicit anaphors serve as a segmentation cue.

The mechanisms of enhancement and suppression play a role in improving the accessibility of concepts marked by cataphoric devices. Cataphoric devices enable comprehenders to access concepts to be subsequently mentioned. Gernsbacher and

Shroyer (1989) show that the unstressed indefinite *this* article, which introduces new concepts to the discourse (Prince, 1981a), makes them more highly activated than concepts introduced via 'a' or 'an'. They are better at suppressing the activation of other concepts, and they better resist suppression by other concepts (Gernsbacher and Jescheniak, 1995).

The mechanisms of enhancement and suppression play a role in improving memory for thematic versus surface information. As the text progresses, surface information (e.g., syntactic form) is always changing. As a result, new surface information suppresses old surface information. In contrast, thematic information is constantly being reintroduced, and is therefore repeatedly enhanced. The result is that thematic information is more activated than surface information, and is therefore more accessible.

5. Individual differences in structure building

The general cognitive processes and mechanisms underlying the structure-building framework also help explain individual differences. For instance, less skilled comprehenders are less able than more skilled comprehenders to remember recently comprehended information. According to the structure-building framework, they shift too often.

The differences in applying the mechanisms of suppression can explain why less skilled comprehenders are less able to reject contextually inappropriate meanings, incorrect forms of homophones, typical but absent members of nonverbal scenes, and why they ignore words written on pictures, and pictures surrounding words. However, less skilled comprehenders are not less able to appreciate contextually appropriate meanings of ambiguous words, and typical members of nonverbal scenes. These findings suggest that less-skilled comprehenders have deficient suppression rather than enhancement mechanisms.

The extent to which comprehenders use general cognitive processes in building mental representations while comprehending a discourse may further distinguish between skilled and less-skilled comprehenders. Research into general cognitive processes and text-specific strategies in comprehension (Giora et al., 1996) reveals that less-skilled readers are more likely than more skilled readers to use general cognitive processes. Skilled comprehenders, on the other hand, rely more heavily on text-specific strategies. The text-specific strategy we studied relies on coherence structure. When trying to comprehend a text, the skilled reader processes deeply only the first proposition of the passage, and then skims through the rest of it for disconfirmations. This implies little or no effect of the contents of the remainder of the passage on her comprehension. The less-skilled reader, on the other hand, employs the general comprehension strategy. She forms a representation of the whole text based on each and every proposition. The first proposition is still the most important one, since it lays the foundations for the representation (cf. The process of laying the foundation above). However, unlike the skilled reader, the less-skilled reader does not skim through the remaining propositions but reads them carefully.

These strategies explain the difference we found between skilled and less-skilled comprehenders. When the text was coherent, i.e., manifesting discourse-topic mention in initial position, skilled readers were more likely than less-skilled readers to identify the discourse-topic proposition. However, under the same condition, less-skilled rather than skilled readers benefitted from analogy. Less-skilled readers, who employ general-comprehension strategies, may benefit from each and every proposition they integrate into their mental representations, analogical comparisons included. However, skilled readers who employ text-specific strategies and process deeply only the first proposition, cannot benefit from analogical comparisons occurring later in the text.

Especially striking is the finding that spells out the cost of a skill: the most skilled and academically advanced readers performed worse even than the least skilled and academically advanced readers, when their strategy was no longer functional. When we manipulated text coherence by displacing the first proposition, less-skilled readers outperformed skilled readers by far. This manipulation is conceptually similar to that used by Gernsbacher et al. (1990), who compared subjects' memory for scrambled/incoherent and unscrambled/coherent materials. Gernsbacher et al. found that skilled comprehenders outperformed less-skilled comprehenders on unscrambled texts. However, the two groups performed similarly on the scrambled texts. According to the structure-building framework, comprehenders use the first proposition to lay the foundations for the representation structure. Incoming propositions are mapped onto that structure. However, when mapping is impossible, subjects shift to a new structure. Shifts involve poorer access to recently comprehended information, which results in poor comprehension. According to Gernsbacher and her associates, skilled and less-sklilled comprehenders differ in their shifting likelihoods. However, when these likelihoods are similar, differences among subjects disappear. Discourse scrambling increases the likelihood of shifting and therefore eliminates the skilled comprehenders' superiority.

However, Gernsbacher's structure-building framework does not predict less-skilled comprehenders' superiority under incoherence condition. In contrast, the use of structure-coherence strategy predicts such superiority. Furthermore, the use of structure-coherence strategy predicts skill but not general comprehension ability differences, as found. These and other aspects of the data, such as analogy effects, suggest that skilled readers do not identify discourse-topics by using general structure-building processes.

In sum, the structure-building framework can account for a great number of linguistic and nonlinguistic phenomena. The process of laying the foundation explains why comprehenders take long to process the first segment of a (verbal or nonverbal) discourse sequence; it explains the advantage of first mention which enhances the accessibility of this segment. The process of mapping accounts for discourse coherence, and the process of shifting explains why and how comprehenders shift and start a new substructure. The process of shifting accounts for comprehenders' poor memory for the exact form of recently comprehended information. The mechanisms of suppression and enhancement explain how irrelevant information that is not functional in structure building is dampened, while information involved in structure

building is enhanced. They further explain how skilled and less skilled comprehenders differ in their abilities. Gernsbacher's Language comprehension as structure building is a book linguists and discourse analysts have long been waiting for.

References

Aaronson, Doris and Steven Ferres, 1983. Lexical categories and reading tasks. Journal of Experimental Psychology. Human Perception and Performance 9: 675–699.

Aaronson, Doris and Hollis S. Scarborough, 1976. Performance theories for sentence coding: Some qualitative evidence. Journal of Experimental Psychology. Human Perception and Performance 2: 56–70.

Anderson, Anthony, Simon C. Garrod and Anthony J. Sanford, 1983. The accessibility of pronominal antecedents as a function of episode shifts in narrative text. Quarterly Journal of Experimental Psychology 35A: 427–440.

Anderson, J. Robert, 1983. The architecture of cognition. Cambridge, MA: Harvard University Press.

Ariel, Mira, 1985. The discourse function of given information. Theoretical Linguistics 12(2/3): 99–113.

Ariel, Mira, 1990. Accessing NP antecedents. London: Routledge.

Ariel, Mira, 1991. The function of accessibility in a theory of grammar. Journal of Pragmatics 16: 443–463.

Attneave, Fred, 1959. Applications of information theory of psychology. New York: Holt, Rinehart and Winston.

Becker, Curtis A., 1976. Semantic context and word frequency effects in visual word recognition. Journal of Experimental Psychology. Human Perception and Performance 2: 556–566.

Bock, J. Kathryn and David E. Irwin, 1980. Syntactic effects of information availability in sentence production. Journal of Verbal Learning and Verbal Behavior 19: 467–484.

Bransford, John D. and Marcia K. Johnson, 1972. Contextual prerequisites for understanding: Some investigations of comprehension and recall. Journal of Verbal Learning and Verbal Behavior 11: 717–726.

Cairns, Helen S. and John Kameran, 1975. Lexical information processing during sentence comprehension. Journal of Verbal Learning and Verbal Behavior 14: 170–179.

Carroll, Patrick J. and Maria L. Slowiaczek, 1987. Modes and modules: Multiple pathways to the language processor. In: J.L. Garfield, ed., Modularity in knowledge representation and natural language-understanding, 221–248. Cambridge, MA: MIT Press.

Chafe, Wallace L., 1974. Language and consciousness. Language 50: 11–133.

Chafe, Wallace L., 1976. Givenness, contrastiveness, definiteness, subjects, topics, and point of view. In: Charles N. Li, ed., Subject and topic, 25–56. New York: Academic Press.

Chang, Frederick R., 1980. Active memory processes in visual sentence comprehension: Clause effects and pronominal reference. Memory & Cognition 8: 58–64.

Corbett, Albert T. and Frederick R. Chang, 1983. Pronoun disambiguation: Accessing potential antecedents. Memory & Cognition 11: 283–294.

Cutler, Ann and Donald J. Foss, 1977. On the role of sentence stress in sentence processing. Language and Speech 21: 1–10.

Daneš, František, 1974. Functions of sentence perspective and the organization of the text. In: František Daneš, ed., Papers on functional sentence perspective, 106–128. The Hague: Mouton.

Dell, Gary S., Gail McKoon and Roger Ratcliff, 1983. The activation of antecedent information during the processing of anaphoric reference in reading. Journal of Verbal Learning and Verbal Behavior 22: 121–132.

Dooling, D. James and Roy Lachman, 1971. Effects of comprehension on retention of prose. Journal of Experimental Psychology 88: 216–222.

Foss, Donald J., 1969. Decision processing during sentence comprehension: Effects of lexical item difficulty and position upon decision times. Journal of Verbal Learning and Verbal Behavior 8: 457–462.

Foss, Donald J., 1982. A discourse on semantic priming. Cognitive Psychology 14: 590–607.

Foss, Donald J. and Richard H. Jr. Lynch, 1969. Decision processing during sentence comprehension: Effects of surface structure on decision times. Perception and Psychophysics 5: 145–148.

Fox, Barbara A., 1986. Local patterns and general principles in cognitive processes: Anaphora in written and conversational English. Text 6: 25–51.

Garrod, Simon and Anthony Sanford, 1977. Interpreting anaphoric relations: The integration of semantic information while reading. Journal of Verbal Learning and Verbal Behavior 16: 77–90.

George, Marie St., Suzanne Mannes and James E. Hoffman, 1994. Global semantic expectancy and language comprehension. Journal of Cognitive Neuroscience 6(1): 70–83.

Gernsbacher, Morton Ann, 1983. Memory for the orientation of pictures in nonverbal stories: Parallels and insights into language processing. Unpublished doctoral dissertation. Austin, TX: University of Texas at Austin.

Gernsbacher, Morton Ann, 1985. Surface information loss in comprehension. Cognitive Psychology 17: 324–363.

Gernsbacher, Morton Ann, 1989. Mechanisms that improve referential access. Cognition 32: 99–156.

Gernsbacher, Morton Ann and Mark E. Faust, 1990. The role of suppression in sentence comprehension. In: G.B. Simpson, ed., Understanding word and sentence, 97–128. Amsterdam: North-Holland.

Gernsbacher, Morton Ann and Mark E. Faust, 1991. The mechanism of suppression: A component of general comprehension skill. Journal of Experimental Psychology: Learning Memory and Cognition 17(2): 245–262.

Gernsbacher, Morton Ann and David J. Hargreaves, 1988. Accessing sentence participants: The advantage of first mention. Journal of Memory and Language 27: 699–717.

Gernsbacher, Morton Ann, David J. Hargreaves and Mark Beeman, 1989. Building and accessing clausal representations: The advantage of first mention versus the advantage of clause recency. Journal of Memory and Language 28: 735–755.

Gernsbacher, Morton Ann and Jorg-Dieter Jescheniak, 1995. Cataphoric devices in spoken discourse. Cognitive Psychology 29: 24–58.

Gernsbacher, Morton Ann and Suzanne Shroyer, 1989. The cataphoric use of the indefinite *this* in spoken narratives. Memory and Cognition 17: 536–540.

Gernsbacher, Morton Ann, Kathleen R. Varner and Mark E. Faust, 1990. Investigating differences in general comprehension skill. Journal of Experimental Psychology: Learning, Memory and Cognition 16: 439–445.

Gernsbacher, Morton Ann and Rachel W. Robertson, 1995. Reading skill and suppression revisited. Psychological Science 6: 165–169.

Giora, Rachel, 1983a. Segmentation and segment cohesion: On the thematic organization of the text. Text 3(2): 155–182.

Giora, Rachel, 1983b. Functional paragraph perspective. In: Janos S. Petöfi and Emel Sözer, eds., Micro and macro connexity of texts, 153–182. Hamburg: Buske.

Giora, Rachel, 1985a. Towards a theory of coherence. Poetics Today 6(4): 699–716.

Giora, Rachel, 1985b. A text-based analysis of non-narrative text. Theoretical Linguistics 12(2/3) 115–135.

Giora, Rachel, 1985c. What's a coherent text? In: Emel Sözer, ed., Text connexity, text coherence: Aspects, methods, results, 16–35. Hamburg: Buske.

Giora, Rachel, 1986. Principles of text segmentation: The case of the formally unsegmented text. Journal of Literary Studies 2(2): 15–28. [Reprinted in Hebrew Linguistics 1990: 28–30. Special issue on Stylistics and the literary text.]

Giora, Rachel, 1988. On the informativeness requirement. Journal of Pragmatics 12(5/6): 547–565. [Reprinted in Asa Kasher, ed., 1989. Cognitive aspects of language use, 63–96. Amsterdam: North-Holland.]

Giora, Rachel, 1990. On the so-called evaluative material in informative texts. Text 10(4): 299–320.

Giora, Rachel, 1991. On the cognitive aspects of the joke. Journal of Pragmatics 16(5): 465–486.

Giora, Rachel, 1993. On the function of analogies in informative texts. Discourse Processes 16: 591–611.

Giora, Rachel, 1995. On irony and negation. Discourse Processes 19: 239–264.

Giora, Rachel, Nachshon Meiran and Paz Oref, 1996. Identification of written discourse-topics by structure coherence and analogy strategies: General aspects and individual differences. Journal of Pragmatics 26(4).

Giora, Rachel and Cher Ieng Lee, 1996. Written discourse segmentation: The function of unstressed pronouns in Mandarin Chinese. In: Jeannette Gundel and Thorstein Fretheim, eds., Reference and reference accessibility. Amsterdam: Benjamins.

Givón, Talmy, 1983. Topic continuity in discourse: A quantitative cross language study. Amsterdam: Benjamins.

Greeno, James G. and David L. Noreen, 1974. Time to read semantically related sentences. Memory & Cognition 2: 117–120.

Grice, H. Paul, 1975. Logic and conversation. In: Peter Cole and Jerry Morgan, eds., Syntax and semantics, Vol. 3: Speech Acts, 41–58. New York: Academic Press.

Gundel, Jeannette K., Nancy Hedberg and Ron Zacharski, 1993. Cognitive status and the form of referring expressions in discourse. Language 69(2): 274–407.

Haberlandt, Karl, 1980. Story grammar and reading time of story constituent. Poetics 9: 99–118.

Haberlandt, Karl, 1984. Components of sentence and word reading times. In: David E. Kieras and Marcel A. Just, eds., New methods in reading comprehension research, 219–252. Hillsdale, NJ: Erlbaum.

Haberlandt, Karl, Claire Berian and Jennifer Sandson, 1980. The episode schema in story processing. Journal of Verbal Learning and Verbal Behavior 19: 635–650.

Hakes, David T., 1971. Does verb structure affect sentence comprehension. Perception and Psychophysics 10: 229–232.

Hakes, David T. and Donald J. Foss, 1970. Decision processes during sentence comprehension: Effects of surface structure reconsidered. Perception and Psychophysics 8: 413–416.

Hofmann, Thomas R., 1989. Paragraphs & anaphora. Journal of Pragmatics 13: 239–250.

Hough, Monica S., 1990. Narrative comprehension in adults with right and left hemisphere-damage: Theme organization. Brain and Language 38. 253–277.

Johnson-Laird, Philip Nicholas, 1983. Mental models. Cambridge, MA: Harvard University Press.

Keenan, Janice M., Susan D. Baillet and Polly Brown, 1984. The effects of causal cohesion on comprehension and memory. Journal of Verbal Learning and Verbal Behavior 23: 115–126.

Kieras, E. David, 1980. Initial mention as a cue to the main idea and the main item of a technical passage. Memory and Cognition 8: 345–353.

Kintsch, Walter, 1988. The role of knowledge in discourse comprehension. Psychological Review 95: 163–182.

Kutas, Marta and S.A. Hillyard, 1982. The lateral distribution of event-related potentials during sentence processing. Neuropsychologia 20(5): 579–590.

Labov, William, 1972. The transformation of experience in narrative syntax. Language in the inner city, 354–405. Philadelphia, PA: University of Pennsylvania Press.

Longacre, Robert, E., 1979. The paragraph as a grammatical unit. In: Talmy Givón, ed., Syntax and semantics, Vol. 12: Discourse and syntax, 69–135. New York: Academic Press.

Mandler, Jean M. and Marsha S. Goodman, 1982. On the psychological validity of story structure. Journal of Verbal Learning and Verbal Behavior 21: 507–523.

Marslen-Wilson, William, Elena Levy and Lorrain Tyler, 1982. Producing interpretable discourse: The establishment and maintenance of reference. In: Robert J. Jarvella and Wolfgang Klein, eds., Speech, place and action, 328–339. New York: Wiley.

Marslen-Wilson, William, Lorrain Tailer and Mark Seidenberg, 1978. Sentence processing and the clause boundary. In: Willem J.M. Levelt and Giovanni B. Flores d'Arcais, eds., Studies in the perception of language, 219–246. New York: Wiley.

Marslen-Wilson, William and A. Welsh, 1978. Processing interaction and lexical access during word recognition in continuous speech. Cognition 10: 29–63.

McClelland, James L. and Alan H. Kawamoto, 1986. Mechanisms of sentence processing: Assigning roles to constituents of sentences. In: James L. McClelland and David E. Rumelhart, eds., Parallel distributed processing: Explorations of the microstructure of cognition. Vol. 1: Foundations, 272–325. Cambridge, MA: MIT Press.

McClelland, James L. and David E. Rumelhart, 1981. An interactive activation model of context effects in letter perception. Part 1: An account of basic findings. Psychological Review 88: 375–407.

Norris, Dennis, 1986. Word recognition: Context effects without priming. Cognition 22: 93–136.

Prentice, John L., 1967. Effects of cueing actor vs. cueing object on word order in sentence production. Psychonomic Science 8: 163–164.

Prince, Ellen F., 1981a. On inferencing of the indefinite-this NPs. In: Aravind Joshi, Bonnie Webber and Ivan Sag, eds., Elements of discourse understanding. Cambridge: Cambridge University Press.

Prince, Ellen F., 1981b. Toward a taxonomy of given–new information. In: Peter Cole, ed., Radical pragmatics, 223–255. New York: Academic Press.

Reinhart, Tanya, 1980. Conditions for text coherence. Poetics Today 1(4): 161–180.

Rosch, Elinor, 1973. On the internal structure of perceptual and semantic categories. In: T.E. Moore, ed., Cognitive development and the acquisition of language, 111–144. New York: Academic Press.

Schneiderman, Eta I., Kuniko G. Murasugi and Douglas J. Saddy, 1992. Story arrangement ability in right hemisphere-damaged patients. Brain and Language 43(1): 107–120.

Shannon, C.E., 1951. Prediction and entropy of printed English. Bell System Technical Journal 30: 50–64.

Shields, Joyce L., Astrid McHugh and James J. Martin, 1974. Reaction time to phoneme targets as a function of rhythmic cues in continuous speech. Journal of Experimental Psychology 102: 250–255.

Swinney, David A., 1979. Lexical access during sentence comprehension: (Re)consideration of context effects. Journal of Verbal Learning and Verbal Behavior 18: 645–659.

Tomlin, Russel S., 1983. On the interaction of syntactic subject, thematic information and agent in English. Journal of Pragmatics 7: 411–432.

Turner, Elizabeth A. and Ragnar Rommetveit, 1968. Focus of attention in recall of active and passive sentences. Journal of Verbal Learning and Verbal Behavior 7: 543–548.

Van Dijk, Teun A., 1975. Recalling and summarizing complex discourse. Ms., University of Amsterdam.

Van Dijk, Teun A., 1977. Text and context. London: Longman.

Van Petten, Cyma and Marta Kutas, 1987. Ambiguous words in context: An event related potential analysis of the time course of meaning activation. Journal of Memory and Language 26: 188–208.

Waltz, David L. and Jordan B. Pollack, 1985. Massively parallel parsing: A strongly interactive model of natural language interpretation. Cognitive Science 9: 51–74.