Mechanisms that improve referential access*

MORTON ANN GERNSBACHER
University of Oregon

Received April 1988, final revision accepted December 1988

Abstract


Two mechanisms, suppression and enhancement, are proposed to improve referential access. Enhancement improves the accessibility of previously mentioned concepts by increasing or boosting their activation; suppression improves concepts' accessibility by decreasing or dampening the activation of other concepts. Presumably, these mechanisms are triggered by the informational content of anaphors. Six experiments investigated this proposal by manipulating whether an anaphoric reference was made with a very explicit, repeated name anaphor or a less explicit pronoun. Subjects read sentences that introduced two participants in their first clauses, for example, "Ann predicted that Pam would lose the track race," and the sentences referred to one of the two participants in their second clauses, "but Pam/she came in first very easily." While subjects read each sentence, the activation level of the two participants was measured by a probe verification task. The first two experiments demonstrated that explicit, repeated name anaphors immediately trigger the enhancement of their own antecedents and immediately trigger the suppression of other (nonantecedent) participants. The third experiment demonstrated that less explicit, pronoun anaphors also trigger the suppression of other nonantecedents, but they do so less quickly—even when, as in the fourth experiment, the semantic information to identify their antecedents occurs prior to the pronouns (e.g., "Ann predicted that Pam would lose the (rack race. But after winning the race, she ... "). The fifth experiment demonstrated that more explicit pronouns—pronouns that match the gender of only one participant—trigger suppression more powerfully. A final experiment demonstrated that it is not only

*This research was supported by National Science Foundation grant BNS 85-101196 and was reported at the annual meeting of the Psychonomic Society, Seattle, November, 1987. I am indebted to Doug Hintzman and Peter Jusczyk for challenging me to conduct Experiment 1, to Judy Petersen for assisting with Experiments 3 through 5, to KaBy Varner for assisting with Experiment 2, and to Mike Posner, Gary Dell, and an anonymous reviewer for thoughtfully commenting on an earlier version of this manuscript. Requests for reprints should be sent to Dr. M.A. Gernsbacher, Department of Psychology, University of Oregon, Eugene, OR 97403-1227, USA.

rementioned participants who improve their referential access by triggering the suppression of other participants; newly introduced participants do so too (e.g., “Ann predicted that Pam would lose the track race, but Kim ...”). Thus, both suppression and enhancement improve referential access, and the contribution of these two mechanisms is a function of explicitness. The role of these two mechanisms in mediating other referential access phenomena is also discussed.

Comprehending a narrative requires knowing who’s doing what to whom. But how do comprehenders successfully track who or what is being referred to? Like all languages, English has a variety of devices for referring back to previously mentioned concepts. Such devices are called anaphors, and the concepts they refer back to are called antecedents. For example, to refer to the antecedent John in the sentence, “John went to the store,” one of several anaphoric devices could be used: a repeated noun phrase, such as John, a definite noun phrase, such as the guy, or a pronoun, such as he.

How language users negotiate anaphora has been the focus of a growing body of psycholinguistic research. Why has anaphora captured so much attention? One reason is that anaphors are very common linguistic devices. Consider only pronoun anaphors; in English, they are some of the most frequently occurring lexical units (Kucera & Francis, 1967). To study the comprehension of anaphors is, therefore, to study the comprehension of very common words.

Moreover, the process of understanding anaphors presents an interesting case of lexical access: Perhaps more than other lexical units, the meanings of some anaphors greatly depend on the context in which they occur. Consider the pronoun, it. Its meaning is constrained only to the extent that the concept be inanimate and singular; beyond that, it can take on a host of different meanings. For instance, in just the present paper, the lexical unit it has over 50 different antecedents. Some anaphors seem to be, in a sense, lexically transparent.

Despite the ubiquity and transparency of some anaphors, for each

\[\text{anaphor, a comprehender's words, comprehenders' words, Sengul, 1979; van Dijk & Kintsch, 1976; Kintsch & Mross, 1983; Dell, McKoon, & Rumelhart, 1981; Neely, 1983.}\]

Let us consider how comprehenders resolve anaphors. Commonly, this process has been described in terms of a traditional sense of indirect reference, in which a pattern of an initial recognition phrase and an antecedent are strongly activated. The comprehension of anaphors then involves a representation that the core representation which is accessed by lexical, semantic, syntactic, and pragmatic mechanisms of the core representation (Kintsch & Mross, 1981; Neely, 1983).

The process of comprehending anaphors has also been considered by Dell, McKoon, & Rumelhart (1981), who argue that the meaning of a word, the lexical unit, is composed by the activation of several lexical units (Kintsch, 1988; Walker, 1988).

Behavioral data support the notion that the meaning of anaphors is acquired very easily.

The antecedent of the anaphor, Ann, is what I measured after comprehension; that is, the antecedent’s level of activation was measured after comprehension. The antecedent of the anaphor, Par. Ann (Corbett & Chang, 1979; van Dijk, 1983).

But how does an anaphor resolve? Two cognitive mechanisms belong to the process of understanding anaphors:

\[\text{1Note that I am not suggesting that comprehension of anaphors is a function of indirect reference. Rather, I am suggesting that comprehenders' words, comprehenders' words, Sengul, 1979; van Dijk & Kintsch, 1976; Kintsch & Mross, 1983; Dell, McKoon, & Rumelhart, 1981; Neely, 1983.}\]

\[\text{2This is not the case in other languages, such as Mandarin Chinese (Li & Thompson, 1979, 1981), Japanese (Hinds, 1978), or Spanish (Huang, 1984). In those languages, zero anaphora (e.g., “John went to the store and I bought a quart of milk”) is more often the rule and pronoun anaphora the exception. In fact, an English text would require ten times the number of pronouns as its Chinese translation (Li & Thompson, 1979).}\]

\[\text{3In some situations, animacy and number constraints are relaxed. For example, it is often used to refer to animate when the gender is unclear, as in “What a beautiful baby. Is it a boy or a girl?” And they is often used to refer to individuals when the gender is unimportant, as in “I asked someone how to get to Straub Hall, but they didn't know where it was either.” (Gernsbacher, 1986).}\]
Referential access 101

Referential access by triggering the participants do so too (e.g., but Kim...). Thus, both access, and the contribution of these two phenomena is also discussed.

An anaphor, a comprehender must access an appropriate antecedent; in other words, comprehenders must access each anaphor's unique referent (Clark & Sengul, 1979; van Dijk & Kintsch, 1983). How does this happen?

Let us consider how a typical, nonanaphoric word is uniquely accessed. Commonly, this process is described in terms of activation (either in the traditional sense of individual nodes becoming activated or in the distributed sense in which a pattern of activation represents an individual word). During an initial recognition phase, information provided by the word activates various candidates. Then, during an identification phase, constraints provided by lexical, semantic, syntactic, and other sources of information alter the candidates' levels of activation. Eventually, one candidate becomes most strongly activated. The most strongly activated candidate is the lexical representation that the comprehender can most easily access, and that is the representation which is incorporated into the comprehender's developing discourse representation (these proposals are culled from the models of Becker, 1976; Kintsch & Mross, 1985; Marslen-Wilson & Welsch, 1978; McClelland & Rumelhart, 1981; Norris, 1986).

The process of comprehending anaphors could proceed similarly. This process has also been conceived of in terms of activation (Corbett & Chang, 1983; Dell, McKoon, & Ratcliff, 1983; McKoon & Ratcliff, 1980). Like the meaning of a word, the identity of an anaphor—its antecedent—is presumably the candidate representation that becomes the most strongly activated (Kintsch, 1988; Walker & Yckovich, 1987).

Behavioral data support this proposal. Consider the following sentence:

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

The antecedent of the pronoun, she, is the participant, Pam; the other participant, Ann, is what I shall refer to as a nonantecedent. When activation is measured after comprehenders have finished reading this sentence, the pronoun's antecedent, Pam, is indeed more activated than the nonantecedent, Ann (Corbett & Chang, 1983).

But how does an anaphor's antecedent become the most activated concept? Two cognitive mechanisms might play a role in this process. These two mechanisms belong to a framework I have proposed that describes some

Note that I am not suggesting that once an anaphor's antecedent is accessed, comprehenders then activate that antecedent. Rather, I am suggesting that because an anaphor's antecedent is activated, it can then be accessed (and incorporated into the developing discourse representation). Consider again the analogy with word identification: Comprehenders do not figure out the identity of a word, and then activate that word. Rather, it is because the lexical representation is activated that the word can be accessed.
general, cognitive processes involved in comprehension (Gernsbacher, 1985, 1989). According to the framework, the goal of comprehension is to build a coherent mental representation or "structure." The two proposed mechanisms enable building these structures by moderating the activation of mental representations. One mechanism, enhancement, increases or boosts activation; the other mechanism, suppression, dampens or decreases activation. Although these mechanisms are considered general, cognitive mechanisms, they potentially play a role in many language comprehension phenomena.

For instance, I have suggested that the mechanism of suppression plays a role in how comprehenders disambiguate homographs. Immediately after comprehenders hear or read a homograph such as bug, multiple meanings are often activated—even when a particular meaning is specified by the preceding semantic context (e.g., "spiders, roaches, and other bugs," Swinney, 1979), or the preceding syntactic context (e.g., "I like the watch" versus "I like to watch," Tanenhaus, Leiman, & Seidenberg, 1979). However, after a quarter of a second, only the more appropriate meaning remains activated. What happens to the inappropriate meanings? One explanation is that a suppression mechanism, triggered by the semantic and syntactic context, decreases the less appropriate meanings' activation (Gernsbacher, Varner, & Faust, 1989; Kintsch, 1988; Swinney, 1979).

The mechanism of suppression as well as enhancement might also play a role in how comprehenders access the appropriate antecedent for an anaphor. The role they play might be to improve an antecedent's accessibility by modifying the activation levels of mental representations. Perhaps an antecedent becomes more accessible because it is enhanced, that is, its activation level is increased. Perhaps an antecedent also becomes more accessible because other concepts are suppressed. That is, a rereferenced concept might rise to the top of the queue of potential referents because the activation levels of other concepts are decreased. So, enhancement might increase the antecedent's activation, and suppression might decrease the activation of nonantecedents. The two mechanisms' net effect would be that an anaphor's antecedent would become substantially more activated than other concepts; therefore, the antecedent could be easily accessed and incorporated into the comprehender's developing discourse structure. The experiments reported here examined this proposal.

But what triggers the mechanisms of suppression and enhancement? In the case of anaphoric reference, they are most likely triggered by information that specifies the antecedent's identity. The most available source of such information is the anaphor itself. However, anaphors differ in how much information they provide about their antecedents. Some anaphors, such as repeated noun phrases (e.g., "John went to work"), provide more explicit antecedents, such as the potential antecedents of more explicit anaphors comes only from sentence context.

Intuitively, more explicit anaphors; empirically, more explicit anaphors come more rapidly than contexts (Haviland & Clark, 1989) to antecedents of more explicit than less explicit anaphors.

For instance, consider sentence (2):

(2) Ann predicted that Pam. This is an example.

In sentence (2), the information in the sentence (e.g., the name of the referent) provides considerably less explicit information than the information in the preceding sentence (e.g., the name of the referent). This finding suggests that the more explicit anaphor’s antecedent's accessibility increases from other information in the sentence; the less explicit anaphor's antecedent's accessibility increases from other information in the sentence.

This finding supports the idea that the more explicit anaphor’s antecedent's accessibility increases from other information in the sentence; the less explicit anaphor's antecedent's accessibility increases from other information in the sentence. Some might argue that certain information about the antecedent's identity comes only from sentence context. However, it seems more plausible that the more explicit anaphor’s antecedent's accessibility increases from other information in the sentence; the less explicit anaphor's antecedent's accessibility increases from other information in the sentence. Some might argue that certain information about the antecedent's identity comes only from sentence context.

In sentence (2), the information in the sentence (e.g., the name of the referent) provides considerably less explicit information than the information in the preceding sentence (e.g., the name of the referent). This finding suggests that the more explicit anaphor’s antecedent's accessibility increases from other information in the sentence; the less explicit anaphor's antecedent's accessibility increases from other information in the sentence. Some might argue that certain information about the antecedent's identity comes only from sentence context. However, it seems more plausible that the more explicit anaphor’s antecedent's accessibility increases from other information in the sentence; the less explicit anaphor's antecedent's accessibility increases from other information in the sentence. Some might argue that certain information about the antecedent's identity comes only from sentence context.
Comprehension (Gernsbacher, 1985, p. 3) is to build a representation that increases or boosts activation or decreases activation of other concepts. The two proposed strategies for moderating the activation of non-antecedent concepts are suppression and enhancement.

Suppression is an automatic and unconscious process that reduces activation of non-antecedent concepts. Enhancement, on the other hand, is a strategic process that increases activation of antecedent concepts.

In languages, immediate activation plays a role in comprehension. Immediately after reading a word like "bug," multiple meanings are activated (e.g., "insects" and other "bugs," Swinney, 1979): However, after a meaning remains activated.

In the case of anaphors, the antecedent's accessibility by modulation of suppression plays a role. For example, the repeated noun phrase "John went to the store. John bought a quart of milk." contains an anaphor, "John." This is an example of a very explicit anaphor; it matches its antecedent exactly. In contrast, the pronoun, "she," is considerably less explicit. It could refer to either participant, and only the semantic information in the second clause identifies its unique antecedent. When Corbett and Chang (1983) measured activation after comprehenders read these two types of sentences, the antecedents were more activated than the non-antecedents (as mentioned above). Perhaps more intriguing, this difference was considerably larger when the anaphors were explicit proper names rather than less explicit pronouns.

This finding suggests that the information content of an anaphor affects its antecedent's accessibility. And it does so by separating its antecedent's activation level from other concepts' activation levels. One way this would happen is if the information available in an anaphor triggers the mechanisms of suppression and enhancement.

The experiments reported here examined this proposal. How does an anaphor trigger the mechanisms of suppression and enhancement? If we consider an anaphor as analogous to a retrieval cue, we can draw upon models of recognition memory to illuminate this process. According to some models of recognition memory, a retrieval cue (an anaphor) triggers the mechanisms of suppression and enhancement. These mechanisms separate the activation level of the antecedent from the activation levels of other concepts. If the anaphor's information is more explicit, it is more likely to trigger the mechanisms of suppression and enhancement.

Some might argue that certain syntactic strategies, for instance, a preference for parallel structure, provide information about the antecedent's identity (Cowan, 1980; Sheldon, 1974).
many models, a retrieval cue makes previously represented traces accessible in the same way that a tuning fork evokes vibrations from tuning forks of similar frequencies. Indeed, Ratcliff (1978) describes retrieval as “resonance” (and uses the tuning fork analogy), and Hintzman (1987, 1988) describes it as a “probe” evoking an “echo.”

Furthermore, in such models, the more similar a retrieval cue is to a previously experienced trace, the greater the resonance or the more intense the echo. In other words, accessibility (through retrieval) is a function of the similarity between a retrieval cue and a memory trace. Simulations and experiments confirm this assumption (these proposals are culled from the models of Bower, 1967; Hintzman, 1987, 1988; McClelland & Rumelhart, 1986; Raaijmakers & Shiffrin, 1981; Ratcliff, 1978).

In a similar way, an anaphor might evoke (or trigger) the mechanisms of suppression and enhancement in order to improve its antecedent’s accessibility. If so, the greater the similarity between an anaphor and its antecedent—in other words, the more explicit the anaphor is—the more powerfully the anaphor should trigger suppression and enhancement.

Information about an antecedent’s identity also comes from sources beyond the anaphor, just as factors beyond the nature of the retrieval cue affect retrieval, and para-lexical (e.g., semantic and syntactic) information affects the recognition of nonanaphoric words. Presumably, information from these other sources also triggers suppression and enhancement, but most likely it does so more slowly (or perhaps less powerfully). The experiments reported here examined this proposal.

In essence, the model sketched above suggests that comprehenders access the appropriate antecedents for anaphors somewhat similarly to how they access the appropriate meanings of nonanaphoric words. In both cases, comprehenders access the most activated mental representations. The novel proposal is that two mechanisms play a role in this process by modifying activation. Suppression decreases the activation of other, nonantecedent concepts, while enhancement increases the antecedents’ activation. The model also suggests that the mechanisms of suppression and enhancement are triggered by information that specifies the antecedents’ identity. Foremost is the information provided by the anaphors. Therefore, more explicit anaphors should trigger more suppression and enhancement, just like more explicit retrieval cues evoke more resonance. Information from other sources (e.g., semantic and pragmatic information) should also trigger suppression and enhancement, but more slowly. Thus, the role of the two mechanisms is to improve a referent’s accessibility. Comprehenders can then access that referent and incorporate it into their developing discourse structures.

### Experiment 1

The first experiment immediately triggers the activation levels of antecedents before verification. Subjects read two clause of each sentence: "Pam are introduced in the clause of each sentence referenced by either (1) or a more explicit anaphor:"

Experiment immediately before verification task: Subjects read faster verification task: Subjects verified whether their reading. Faster verification was the activation level of antecedents (e.g., Ann). Three variables were tested immediately before. The variable was also measured participants, Np2 experimental set.

### Method

Subjects
The subjects were all the following exp. can English speakers.
Experiment 1

The first experiment investigated whether more versus less explicit anaphors immediately trigger suppression or enhancement. To investigate this, the activation levels of antecedents versus nonantecedents were measured immediately before, versus immediately after comprehenders read explicit versus less explicit anaphors.

Subjects read two clause sentences such as (1) or (2) above. In the first clause of each sentence, two participants were introduced, just as Ann and Pam are introduced in the first clauses of sentences (1) and (2). In the second clause of each sentence, one of those two participants was anaphorically referenced by either a less explicit, pronoun anaphor, such as she in sentence (1) or a more explicit, repeated name anaphor, such as Pam in sentence (2).

Immediately before and immediately after subjects read these anaphors, the activation levels of the anaphors' antecedents (e.g., Pam) and nonantecedents (e.g., Ann) was measured. This was accomplished through a probe verification task: Subjects were presented with a probe word, and they rapidly verified whether the probe word had occurred in the sentence they were reading. Faster verification latencies reflect higher levels of activation (Ratcliff, Hockley, & McKoon, 1985). For the experimental sentences, the probe words were the names of the antecedents (e.g., Pam) or nonantecedents (e.g., Ann).

Three variables were manipulated: anaphor type (whether the anaphors were names or pronouns), probe name (whether the probe names were the antecedents or nonantecedents), and test point (whether the probe names were tested immediately before or immediately after the anaphors). A fourth variable was also manipulated; it was antecedent position (whether the antecedents were the first-mentioned participants, NP₁'s, or the second-mentioned participants, NP₂'s, in the first clause). An example of an NP₁ and an NP₂ experimental sentence appears in Table 1.

Method

Subjects

The subjects were 128 undergraduates at the University of Oregon. As in all the following experiments, the subjects participated as a means of fulfilling an introductory psychology course requirement; they were all native American English speakers, and no subject participated in more than one experiment.
Table 1. Example stimulus sentences for Experiments 1, 2, and 3

<table>
<thead>
<tr>
<th>NP1 type sentence</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PRONOUN - ANTECEDENT (BILL)</td>
<td>Bill handed John some tickets to a concert but <em>he</em>[^1-3] took the tickets back immediately.3</td>
<td></td>
</tr>
<tr>
<td>NAME - ANTECEDENT (BILL)</td>
<td>Bill handed John some tickets to a concert but <em>Bill</em>[^1-3] took the tickets back immediately.3</td>
<td></td>
</tr>
<tr>
<td>PRONOUN - NONANTECEDENT (JOHN)</td>
<td>Bill handed John some tickets to a concert but <em>he</em>[^1-3] took the tickets back immediately.3</td>
<td></td>
</tr>
<tr>
<td>NAME - NONANTECEDENT (JOHN)</td>
<td>Bill handed John some tickets to a concert but <em>John</em>[^1-3] took the tickets back immediately.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NP2 type sentence</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PRONOUN - ANTECEDENT (PAM)</td>
<td>Ann predicted that <em>Pam</em> would lose the track race but <em>she</em>[^1-3] came in first very easily.3</td>
<td></td>
</tr>
<tr>
<td>NAME - ANTECEDENT (PAM)</td>
<td>Ann predicted that <em>Pam</em> would lose the track race but <em>Pam</em>[^1-3] came in first very easily.3</td>
<td></td>
</tr>
<tr>
<td>PRONOUN - NONANTECEDENT (ANN)</td>
<td>Ann predicted that <em>Pam</em> would lose the track race but <em>she</em>[^1-3] came in first very easily.3</td>
<td></td>
</tr>
<tr>
<td>NAME - NONANTECEDENT (ANN)</td>
<td>Ann predicted that <em>Ann</em> would lose the track race but <em>Ann</em>[^1-3] came in first very easily.3</td>
<td></td>
</tr>
</tbody>
</table>

Note: For each sentence, the probe name appears in parentheses, the antecedent appears in boldface, the anaphor is in italics, and the two test points are superscripted with the experiment's number.

Materials and design

Sixty-four experimental sentences were constructed. All contained two clauses, mentioned two participants in the first clause (NP1 and NP2), and rementioned one of those two participants in the second clause. Many were modifications of Corbett and Chang’s (1983) experimental sentences but with two additional properties controlled. The first property was the distance between the first mention of the NP2s in the first clause and the anaphors in the second clause (for example, the distance between *John* and either the pronoun *he* or the rementioned name *Bill* in the first sentence shown in Table 1). Six words always intervened between those two points. The second property was the distance between the anaphors and the ends of the sentences. Five words always intervened between those two points.

To ensure that the information in the second clauses identified a unique antecedent, the following normative data were collected. Fifty subjects at the University of Texas, whose judgments reported here were 90% agreement with the anaphorph forms (e.g., “the tickets back immediately”). To ensure that the information in the second clauses identified a unique antecedent, the following normative data were collected. Fifty subjects at the University of Texas, whose judgments reported here were 90% agreement with the anaphor forms (e.g., “the tickets back immediately”).

In each sentence, the probe names were matched with those used in the experimental sentences. Half of the names were common names; half were names commonly used in female names. Five words always intervened between the two test points and the ends of the sentences.

To encourage comprehension, 48 sentences were tested relatively early in the list, and 16 were tested relatively late. Forty-eight lure sentences (four each of the following three syntactic structures) were included: (i) 16 were identical to the experimental sentences with half the anaphors being pronouns, (ii) 16 were identical to the experimental sentences with half the anaphors being pronouns, and (iii) 16 were identical to the experimental sentences with half the anaphors being pronouns.
In each sentence, the two participants’ names were typical, American first names that were matched for perceived familiarity and length in letters. They were names commonly ascribed to only one gender (for instance, names such as “Pat” were avoided). Across all the sentences, half the names were stereotypically female, and half were stereotypically male. But within each sentence, the two names were stereotypic of the same gender.

To encourage comprehension, each experimental sentence was followed by a two-alternative WH question, with the two answers being the two participants’ names. Half the questions were about the first clause, and half were about the second clause. When the anaphors were pronouns, the questions were about the second clause. This served the purpose of discovering whether subjects understood who the pronouns referred to. Examples of this type of question for the NP₁ and NP₂ sentences in Table 1 are “Who took the tickets back immediately?” and “Who came in first very easily?”, respectively. When the anaphors were names, the questions were about the first clauses. And, as a finer division, half the questions were about the first-mentioned participants’ activity in the first clause (e.g., “Who handed someone some tickets?” or “Who predicted that someone would lose a race?”), and half were about the second-mentioned participants’ activity in the first clause (e.g., “Who was handed some tickets?” or “Who was predicted to lose the race?”).

Forty-eight lure sentences were constructed. A lure sentence was one in which the probe name did not occur. The lure sentences had one of the following three syntactic forms: (i) 16 were identical to the NP₁ experimental sentences with half the anaphors being pronouns and half being the names of NP₁, (ii) 16 were identical to the NP₂ experimental sentences with half the anaphors being pronouns and half being the names of NP₂, and (iii) 16 had first clauses identical to the experimental sentences, but the anaphors were the plural pronoun they, for example, “Bobby saw David walking over to the library, and they decided to walk there together.” In these lure sentences, the probe names were tested at one of four different locations. In 12 lure sentences (four each of the three syntactic forms), the probe names were tested relatively early in the sentence; in another 12 sentences, the probe names were tested relatively late in the sentence; in another 12, the probe names were tested immediately prior to the anaphors (just like the experi-
mental sentences) and in the final 12, the probe names were tested immediately after the anaphors (again, just like the experimental sentences).

Eight material sets were formed. Within a material set, there was an equal number of experimental sentences in the eight experimental conditions. Across material sets, each experimental sentence occurred in all eight of its experimental conditions. Twelve subjects were randomly assigned to each material set; thus, each subject was exposed to an experimental sentence in only one of its conditions. The lure sentences occurred in the same randomly selected order in each material set.

**Procedure**

The stimulus sentences appeared word-by-word in the center of a video display monitor. How long each word remained on the screen was a function of its length plus a constant. The function was 16.667 ms per character, and the constant was 300 ms. For example, a five-letter word was shown for 383.3 ms. These timing parameters were based on the reading times produced by 12 subjects, who were otherwise uninvolved with the experiment, and who read self-paced, word-by-word through the experimental materials. Even the slowest of these 12 subjects read comfortably faster than the rate produced by the above function.

Each trial began with a warning signal, which was a plus sign that appeared for 750 ms in the center of the screen. After that, each word of the sentence appeared with an interword interval of 150 ms. When the probe names were tested, they appeared in capital letters at the top of the screen. When the probe names were tested before the anaphors, they appeared 150 ms after the offset of the word immediately prior to the anaphors. When they were tested immediately after the anaphors, they appeared 150 ms after the offset of the anaphors. The probe names remained on the screen until either the subjects responded or 2.5 seconds elapsed. Subjects responded with their dominant hand, pressing one key with their index finger and another with their middle finger.

After each experimental sentence, the word Test appeared for 750 ms toward the bottom of the screen to warn subjects that a comprehension question would appear next. Appearing along with the comprehension question were its two answer choices (i.e., the two participants’ names). One answer choice appeared in the bottom left corner, and the other in the bottom right corner. The answer choice in each corner was correct half the time. The questions and answer choices remained on the screen until either the subjects responded by pressing one of two response keys, or 10 s elapsed. After responding, the subjects were given feedback about their accuracy.

Subjects were replaced if they failed to meet the following criteria: 90% accuracy at responding (correct response), 90% accuracy at responding (incorrect response), and 85% accuracy at responding (comprehension questions).

**Results**

The following is true of the experiments: The computer analysis of variance (ANOVA) effect; in the second-order interaction, the effect reported here are based on a significance level of $p < .05$ or $10^{-6}$.

For Experiment 1, the Type: name vs. probe, $2 \times 2$ (Test Point: between the two participants’ names $NP_1$ vs. $NP_2$). In the items’ analysis, responses were evaluated.

One main effect was the Antecedent: the probe names were the antecedent for the responses $minF'(1,120) = 24.0$ than the nonantecedent probe names.

Four interactions were significant: (NP$_1$ vs. NP$_2$) and (NP$_1$ vs. NP$_2$) $minF'(1,151) = 37.5$ than the nonantecedent probe names.

In the items’ analysis, responses were evaluated.

This advantage for the first-mentioned participants’ names was too $minF'(1,120) = 24.0$ than the second-mentioned participants’ names. The probe names were tested after the second-mentioned participants’ names, and the probe names were tested after the first-mentioned participants’ names. However, even in Experiment 2, within-items, the same
accuracy at responding to experimental probe names (requiring a "yes" response), 90% accuracy at responding to lure probe names (requiring a "no" response), and 85% accuracy at answering the two-choice comprehension questions.

Results
The following is true of all the analyses reported for this and the subsequent experiments: The correct response times were analyzed in two sets of analyses of variance (ANOVAs). In the first set, subjects was treated as a random effect; in the second, items was treated as a random effect. The results reported here are based on the minF' statistic (Clark, 1973) and a significance level of p < .05 or lower.

For Experiment 1, the design of both sets of ANOVAs was 2 (Anaphor Type: name vs. pronoun) × 2 (Probe Name: antecedent vs. nonantecedent) × 2 (Test Point: before vs. after the anaphors) × 2 (Antecedent Position: NP1 vs. NP2). In the subjects’ analysis, all four factors were within-subjects. In the items’ analysis, antecedent position (NP1 vs. NP2) was a between-items factor.

One main effect was significant: Responses were faster when the probe names were the antecedents (M = 861) than the nonantecedents (M = 905), minF' (1,120) = 24.69; in other words, the antecedents were more activated than the nonantecedents. This effect replicates Corbett and Chang (1983).

Four interactions were significant. One was between antecedent position (NP1 vs. NP2) and probe name (antecedent vs. nonantecedent), minF' (1,151) = 37.59. This interaction is actually an effect of order of mention: Responses were significantly faster when the probe names were the first-mentioned participants (i.e., the antecedent position was NP2 and the probe names were the antecedents, or the antecedent position was NP1 and the probe names were the nonantecedents) than when the probe names were the second-mentioned participants (i.e., the antecedent position was NP2 and the probe names were the antecedents, or the antecedent position was NP1 and the probe names were the nonantecedents). In other words, first-mentioned participants were verified more rapidly (M = 853) than second-mentioned participants (M = 913).

This advantage for first-mentioned participants has been observed before (Corbett & Chang, 1983; Stevenson, 1986; Von Eckardt & Potter, 1985). Among its more trivial explanations is the notion that the first-mentioned participants’ names (although assigned randomly) were more salient. However, even in Experiment 4 when antecedent position was manipulated within-items, the same advantage held. The source of this advantage will be
discussed in the General Discussion.

Of the three other significant interactions, one was between anaphor type and probe name, \( \text{min} F'(1,160) = 43.51 \), and one was between probe name and test point, \( \text{min} F(1,127) = 37.26 \). However, both of these interactions were qualified by the remaining significant interaction, a three-way interaction involving anaphor type (name vs. pronoun), probe name (antecedent vs. nonantecedent), and test point (before vs. after the anaphors), \( \text{min} F'(1,162) = 53.74 \). This three-way interaction is illustrated in Figure 1.

Consider first what happened when the anaphors were explicit, repeated names. As illustrated in Figure 1, when the anaphors were names, probe name interacted with test point, \( \text{min} F'(1,157) = 103.26 \), in the following way:

Figure 1. Subjects' mean response times in Experiment 1.

Responses to the first anaphors (\( M = 990 \)) were faster than responses to the other anaphors (\( M = 803 \)).

This is the pattern of nonantecedent probes: responses to less activated immaterial antecedents were faster than responses to more activated immaterial antecedents. However, repeated name anaphors were faster than repeated name anaphors by triggering both of these effects.

However, as also was the case with proper names anaphors, but not with repeated name anaphors were pronouns. In fact, \( F'_1(1,1) = 0.00 \), and this was true for all three-way interactions and the three-way interaction. In fact, responses times were indistinguishable from responses to repeated pronouns, and this was true for all three-way interactions and the three-way interaction.

In other words, as a result of subjects reading the text, the anaphors were faster to the antecedents' accessibly.

Discussion

Experiment 1 demonstrated the subjects' antecedents' accessibility.

The evidence that name anaphors were more accessible than other nonantecedent antecedents was considered. Evidence that name anaphors were more accessible than other nonantecedent antecedents came from the fact that name antecedents came from the more activated antecedents. This was that the antecedents' accessibility; thus, the antecedents' accessibility.
Responses to the nonantecedents were 122 ms slower after the name anaphors ($M = 990$) than before ($M = 868$), $minF'(1,155) = 66.90$. On the other hand, responses to the antecedents were 76 ms faster after the name anaphors ($M = 803$) than before ($M = 879$), $minF'(1,117) = 22.60$.

This is the pattern one expects if name anaphors trigger both the suppression of nonantecedent participants—which is why the nonantecedents were less activated immediately after the anaphors than before—as well as the enhancement of their own antecedents—which is why the antecedents were more activated immediately after the anaphors than before. Thus, explicit, repeated name anaphors appear to improve their antecedents’ accessibility by triggering both of the proposed mechanisms.

However, as also illustrated in Figure 1, this is what happens with explicit name anaphors, but not necessarily less explicit pronouns. Indeed, when the anaphors were pronouns, the probe name by test point interaction was far from reliable, $F_1(1,127) = 0.04$, $F_2(1,62) = 0.03$ (which was the basis of the three-way interaction between anaphor type, probe name, and test point). In fact, response times after the pronouns ($M = 885$) were statistically indistinguishable from response times before the pronouns ($M = 877$), both $Fs < 1$, and this was true for both the antecedents and the nonantecedents, both $minFs < 1$. In other words, there was no immediate change in activation as a result of subjects reading the pronouns.

**Discussion**

Experiment 1 demonstrated that explicit name anaphors immediately improve their antecedents’ accessibility by both suppression and enhancement. The evidence that name anaphors immediately trigger the suppression of other nonantecedent participants came from the finding that the nonantecedents were considerably less activated after the names than before; the evidence that name anaphors immediately trigger the enhancement of their antecedents came from the finding that the antecedents were considerably more activated after their anaphors than before. The two mechanisms’ net effect was that the antecedents and nonantecedents differed markedly in their levels of activation; thus, together the two mechanisms greatly improved their antecedents’ accessibility.\(^5\)

\(^5\) An alternative explanation for the name anaphor data is that responses immediately following the name anaphors were faster to the antecedents than the nonantecedents because the name anaphors and the antecedents were visually identical. First, the two stimuli were not identical as all the probe words were presented in upper case while the anaphors, like all the words in the sentences, were presented in lower case with the proper names having capitalized initial letters. Second, this visually identical explanation cannot explain why...
In contrast to explicit name anaphors, less explicit pronouns do not appear to immediately trigger either suppression or enhancement. This contrast suggests that the anaphors' informational content (their explicitness) affects how rapidly (and possibly how powerfully) they affect their antecedents' accessibility. More explicit anaphors, such as repeated names, appear to immediately trigger suppression and enhancement; less explicit anaphors, such as pronouns that match the gender, number, and case of multiple participants, do not immediately affect the activation of either their antecedents or nonantecedents.

Indeed, in Experiment 1, the pronouns' antecedents and nonantecedents were just as activated before the pronouns as immediately after. This suggests that both the antecedents and nonantecedents were already activated before the pronouns, and they simply remained at that level of activation immediately afterward. Although this finding conflicts with many psycholinguists' assumption that pronouns immediately "reactivate" their antecedents, it confirms many functional linguists' assumption that speakers and writers use pronouns to refer to concepts that are already activated in their listeners' and readers' mental representations.

For instance, according to Karmiloff-Smith (1980), "anaphoric pronounization functions as an implicit instruction for the addressee not to recompute for retrieval of an antecedent referent, but rather to treat the pronoun as the default case for the thematic subject of a span of discourse." Similarly, in Chafe's (1974) view, pronouns are used to refer to "given information" about which he writes: "If the exploration in terms of consciousness is correct, it is misleading to speak as if the addressee needs to perform some operation of recovery for given information. The point is rather that such information is already on stage in the mind." In recent work, Chafe (1987) has translated his conception of "on stage in the mind" into cognitive psychologists' nomenclature of "already active."

Other behavioral data corroborate Experiment 1 and thereby support functional linguists' assumptions, as Wilson (1982), subjects.

(3) The sailor tried
Each sentence introduced one of two pairs (boat and
and nonantecedents were responded to substantially more slowly immediately after the name anaphors than immediately before; that is, it fails to explain the effect attributed to suppression, which was substantially larger than the effect attributed to enhancement (and hypothetically accounted for by visual identity). Third, the visual-identity explanation cannot explain why the nonantecedents were responded to more slowly immediately after the name anaphors than immediately after the pronouns; the nonantecedents were as visually dissimilar to the name anaphors as they were to the pronouns. And fourth, the visual-identity explanation cannot explain why, in Experiment 3, when activation was measured at the ends of the sentences, neither the name anaphors' antecedents nor their nonantecedents became more or less activated across the sentences' second clauses; that is, there was no change in activation from the test point immediately after the anaphors to a test point at the ends of the sentences. If the enhancement effect was due to visual-identity, one would surely expect the visual-identity advantage to be stronger immediately after the anaphors than at the ends of the sentences.
it pronouns do not appear enhancement. This contrast (their explicitness) affects their antecedents' activated names, appear to immediately after. This suggests that speakers and writers activated in their listeners' (1980), "anaphoric pro-
for the addressee not to refer to "given infor-
tance needs to perform some point is rather that such "the mind" into cognitive and thereby support func-
tional linguists' assumption. For instance, in a study by Tyler and Marslen-Wilson (1982), subjects heard sentences such as

(3) The sailor tried to save the cat, but he/it fell overboard instead.

Each sentence introduced a human and a nonhuman participant (e.g., sailor and cat), and in the second clause of each sentence, one of the participants was referred to with a human versus nonhuman pronoun (e.g., he or it). While listening to each sentence, comprehenders made lexical decisions to probe words, which on the experimental trials were related to one of the two participants. For instance, the probe word for sentence (3) might have been boat or dog.

The probe words were responded to more rapidly when they were related to one of the two participants than when they were presented during control (unrelated) sentences. But it did not matter whether the probe words were tested before versus after the pronouns; neither did it matter whether the probe words were related to the pronouns' antecedents or the nonantecedents. The same level of semantic facilitation was observed in each case. In other words, like Experiment 1, there was evidence that both the antecedents and nonantecedents were already activated prior to the pronouns, and like Experiment 1, this level of activation did not change immediately because of the pronouns.

Indeed, Tyler and Marslen-Wilson (1982) concluded that "the analysis that fits the results best is that both [participants] are activated early in the second clause, and remain activated for at least the next few words" (p. 281).

So, the Tyler and Marslen-Wilson (1982) data, as well as Experiment 1, demonstrate that less explicit, pronoun anaphors do not immediately trigger suppression or enhancement to improve their antecedents' accessibility. But surely, at some point, the pronouns' antecedents and nonantecedents must differ in their activation level. How else would comprehenders access the pronouns' unique referents? Experiments 3, 4, and 5 in this series explored how and when this occurs.

Before turning toward those experiments, an alternative explanation for one aspect of Experiment 1's results needs elimination. Perhaps the before-the-anaphor test point demonstrated that the antecedents and nonantecedents were already activated because that test point occurred at the beginning of a clause. Perhaps, at the beginning of a clause, recently mentioned concepts are automatically reactivated. Such a hypothesis falls out of certain processing models that treat clauses as their processing units. In such models, it seems advantageous if—at the beginning of a new processing cycle (e.g., a clause)—concepts from the prior cycle were made more accessible. Experiment 2 attempted to rule out this explanation and while doing so provided an opportunity to replicate Experiment 1.
Experiment 2

Experiment 2 was identical to Experiment 1 except that the before-the-anaphor test point was moved up one word. Recall that in Experiment 1, the before-the-anaphor test point was immediately after the conjunctions and, therefore, after the first words of the second clauses. In Experiment 2, the before-the-anaphor test point was immediately after the last words of the first clauses, that is, immediately prior to the conjunctions. This revised test point is indicated in Table 1 with the superscript 2. As indicated in Table 1, the after-the-anaphor test point was identical to Experiment 1.

Method

The only methodological difference between Experiment 2 and Experiment 1 was that when the probe names were tested before the anaphors, they appeared 150 ms after the offset of the first clauses' final words. Ninety-six subjects participated.

Results

The design of the ANOVAs was the same as in Experiment 1, and the results were identical. Responses were faster when the probe names were the antecedents ($M = 922$) than the nonantecedents ($M = 974$), $minF'(1,108) = 20.13$. This replicates both Experiment 1 and Corbett & Chang (1983). In addition, antecedent position ($NP_1$ vs. $NP_2$) interacted with probe name, $minF'(1,106) = 23.39$, again, demonstrating that, in general, first-mentioned participants were verified more rapidly ($M = 920$) than second-mentioned participants ($M = 976$).

Furthermore, as in Experiment 1, three other interactions were significant. One interaction was between anaphor type and probe name, $minF'(1,139) = 35.68$, and another was between probe name and test point, $minF'(1,116) = 10.23$. However, both interactions were again qualified by a three-way interaction involving anaphor type, probe name, and test point, $minF'(1,87) = 8.26$, and this three-way interaction is shown in Figure 2.

As illustrated in Figure 2, when the anaphors were names, probe name (antecedent vs. nonantecedent) strongly interacted with test point (before vs. after the anaphors), $minF'(1,116) = 34.64$. And the pattern of this interaction was identical to Experiment 1: Responses to the nonantecedents were 127 ms slower after the name anaphors ($M = 1069$) than before ($M = 942$), $minF'(1,114) = 34.81$. On the other hand, responses to the antecedents were
except that the before-the-conjunctions did not include the conjunctions and, but in Experiment 1, the after-the-conjunctions did. In Experiment 2, the last words of the first conjunctions. This revised test point is indicated in Table 1, the Experiment 1.

Experiment 2 and Experiment 1, and the results for Experiment 1, was the antecedent probe name, \( \text{minF}'(1,106) = 20.13 \), Chang (1983). In addition, firstly-mentioned participants and second-mentioned participants were names, \( \text{minF}'(1,139) = 14.19 \).

85 ms faster after the name anaphors \( (M = 864) \) than before \( (M = 949) \), \( \text{minF}'(1,124) = 14.19 \).

As in Experiment 1, this pattern suggests that name anaphors immediately trigger both the suppression of nonantecedents—which is why the nonantecedents were less activated after the anaphors than before—and the enhancement of their antecedents—which is why the antecedents were more activated after the anaphors than before. So, like Experiment 1, Experiment 2 provided evidence that explicit, repeated name anaphors improve their antecedents' accessibility by immediately triggering both of the proposed mechanisms.

However, also like Experiment 1, this evidence was observed only for the name anaphors. Indeed, when the anaphors were less explicit pronouns, the
probe name by test point interaction was far from reliable, $minF' < 1.0$. That is, response times after the pronouns ($M = 942$) were statistically indistinguishable from response times before the pronouns ($M = 937$), both $Fs < 1$. And again, this was true for both the antecedents and the nonantecedents, both $minFs < 1$. Thus, there was no immediate change in activation as a result of subjects reading the pronouns.

**Discussion**

Experiment 2 perfectly replicated Experiment 1 in demonstrating that explicit name anaphors immediately improve their antecedents' accessibility by both suppression and enhancement. Experiment 2 also perfectly replicated Experiment 1 in demonstrating that, in contrast to explicit name anaphors, less explicit pronouns do not trigger suppression or enhancement immediately. As in Experiment 1, the pronouns' antecedents were activated at the same level as their nonantecedents both before and after the pronouns. This pattern again suggests that the two sentence participants were already activated prior to the anaphors, and the pronouns did not alter those activation levels. Furthermore, Experiment 2 demonstrated that when this pattern was observed in Experiment 1, it was not due to the participants being reactivated at the beginnings of their second clauses.

But, as mentioned before, surely at some point following the pronouns, their antecedents and nonantecedents should be activated at different levels. How else would comprehenders access the pronouns' unique referents? Indeed, when Corbett and Chang (1983) measured activation at the ends of the sentences, they found that the pronouns' antecedents and nonantecedents differed in activation.

Perhaps the semantic information presented in the second clauses combines with information provided by the pronouns. This combined information might also trigger suppression or enhancement, but it might do so less quickly or less powerfully than if the information was explicitly provided by the anaphor. Experiment 3 investigated this proposal by measuring activation immediately after the anaphors (as in Experiments 1 and 2) and at the ends of the sentences (as in Corbett & Chang's study, 1983).

---

6I am using the term "semantic information" very loosely. Actually, this information can only be interpreted by employing the "real world" or model-based (Johnson-Laird & Garnham, 1980) knowledge. For instance, comprehenders must know that the person who comes in first very easily is typically the person about whom a prediction was made rather than the person who made the prediction.

**Experiment 3**

Experiment 3 was identical to Experiment 1 except that the probes were measured immediately after the anaphors. These two points are far from reliable, $minF' < 1$. That is, activation immediately after the anaphors were presented either before or after the offset of the final test point, creating the opportunity to document any changes in activation at the ends of the sentences to make the point.

**Method**

Experiment 3 used the same anaphors from Experiment 1, the final test point was also identical, and the antecedents and nonantecedents were presented either before or after the offset of the final test point, allowing the two to intervene between the anaphors and the ends of the sentences to make the point.

**Results**

The design of the A-B-C-C design main effects were significant ($M = 849$) than the responses were faster at the ends of the sentence.

Three interactions demonstrated this proposal: a two-way interaction in demonstrating that, second, probe name by antecedent position in demonstrating that, more rapidly ($M = 890$).

But this two-way interaction: a three-way interaction is the test point, $minF'(1,10.28)$, creating the f...
Experiment 3

Experiment 3 was identical to Experiments 1 and 2 except that activation was measured immediately after the anaphors and at the ends of the sentences. These two points are indicated in Table 1 with the superscript 3. Measuring activation immediately after the anaphors provided the opportunity to replicate the after-the-anaphor test point data from Experiments 1 and 2; measuring activation at the ends of the sentences provided the opportunity to replicate Corbett and Chang (1983). Comparing the two test points provided the opportunity to document what happens over the second clauses of the sentences to make the pronouns' antecedents more accessible.

Method

Experiment 3 used the same materials as Experiments 1 and 2. The procedure was also identical, with the following major exception: The probe names were presented either 150 ms after the offset of the anaphors or 150 ms after the offset of the final words of the sentences. Ninety-six subjects participated.

Results

The design of the ANOVAs was the same as in Experiments 1 and 2. Two main effects were significant. First, responses were faster to the antecedents (M = 849) than the nonantecedents (M = 947), minF'(1,95) = 40.54. Second, responses were faster immediately after the anaphors (M = 891) than at the ends of the sentences (M = 914), minF'(1,116) = 5.55.

Three interactions were significant. First, as in Experiments 1 and 2, antecedent position interacted with probe name, minF'(1,99) = 23.88, again demonstrating that, in general, first-mentioned participants were verified more rapidly (M = 870) than second-mentioned participants (M = 936).

Second, probe name interacted with anaphor type, minF'(1,143) = 86.21. But this two-way interaction was qualified by the only other significant interaction: a three-way interaction involving probe name, anaphor type, and test point, minF'(1,120) = 7.47. This three-way interaction is shown in Figure 3.

As illustrated in Figure 3, when the probe names were the nonantecedents, anaphor type (name vs. pronoun) interacted with test point, minF'(1,119) = 10.28, creating the following effect: The difference between response times
when the anaphors were names versus pronouns was much larger immediately after the anaphors (134 ms) than at the ends of the sentences (55 ms), although both differences were reliable, \( \text{minF}'(1,121) = 49.87 \), and \( \text{minF}'(1,119) = 11.03 \), respectively. On the other hand, when the probe names were the antecedents, anaphor type did not interact with test point, \( \text{minF}' < 1 \); the difference between response times when the anaphors were names versus pronouns was about the same immediately after the anaphors as at the ends of the sentences.

Another way to think about this three-way interaction is that the effect of test point was greatest on one particular combination of anaphor type and probe name. That combination was when the anaphors were pronouns, and the probe names were nonantecedents. For that combination, and that combination alone, the difference between the two test points was reliable (all other \( \text{minFs} < 1 \)). This difference arose because responses to the pronouns' nonantecedents were significantly slower at the ends of the sentences (\( M = 933 \)) than they were immediately after the anaphors (\( M = 866 \)), \( \text{minF}'(1,106) = 12.49 \).

In other words, one changed as subjects read was that the interpretation of this noun, combined with the clauses, triggered the nonname anaphors, suppression, but they do so much more when the anaphors were pronouns immediately after the probe names.

Further analyses conducted in Experiments 1 and 2, and Corbett and Weisberg's (1985) demonstration came at the ends of the sentences, where the antecedents were names versus pronouns. Again, this suggested that this difference was due to the suppression of the antecedents.

Finally, consider the data from Experiments 1 and 2. Those data and analyses in Experiments 1 and 2 suggested that this difference was due to the suppression of the antecedents.

**Discussion**

Experiment 3 further demonstrates that the anaphors play a role in improving responses to both the anaphors and their antecedents.
In other words, only the activation level of the pronouns' nonantecedents changed as subjects read the second clauses. As illustrated in Figure 3, the change was that the pronouns' nonantecedents became less activated. One interpretation of this change is that the information provided by the pronouns, combined with the semantic information available in the second clauses, triggered the suppression of the nonantecedents. Thus, like repeated name anaphors, semantically-biased pronouns also appear to trigger suppression, but they do so more slowly and less powerfully.

Further analyses compared Experiment 3 with Experiment 1, Experiment 2, and Corbett and Chang (1983). First, consider the data collected immediately after the pronouns in Experiment 3. Those data perfectly replicated Experiments 1 and 2. All three experiments found that response times to the pronouns' antecedents versus nonantecedents were statistically indistinguishable \( (\text{min} F' < 1 \text{ for Experiment 3}) \). So, again, there was no evidence that pronouns immediately affect the activation of either their antecedents or nonantecedents.

Next, consider the data collected immediately after the names in Experiment 3. Those data also perfectly replicated Experiments 1 and 2. All three experiments demonstrated that immediately after the more explicit name anaphors, the antecedents and nonantecedents were activated at considerably different levels. In Experiment 3 this difference was 191 ms; in Experiment 1 it was 187 ms; and in Experiment 2 it was 202 ms. Experiments 1 and 2 suggested that this difference arose because name anaphors immediately trigger both the suppression of their nonantecedents and the enhancement of their antecedents.

Finally, consider the data collected at the ends of the sentences in Experiment 3. Those data perfectly replicated Corbett & Chang (1983). In both studies, anaphor type interacted with probe name. That is, the difference between the antecedents versus nonantecedents was greater when the anaphors were explicit names than it was when they were less explicit pronouns. Again, this suggests that the more explicit the anaphor—that is, the more information it provides about its antecedent—the more likely it is to trigger suppression and enhancement.

Discussion

Experiment 3 further illustrated the role that the mechanism of suppression plays in improving referential access. Experiment 3 demonstrated that semantically-biased pronouns also trigger the suppression of nonantecedents. This demonstration came from the following effect: Immediately after the pronouns, the antecedents and nonantecedents did not differ in activation (re-
plicating Experiments 1 and 2), but by the ends of the sentences, they did (replicating Corbett & Chang, 1983). As illustrated in Figure 3, this difference arose because the nonantecedents lost activation. So, it appears that pronouns also improve their antecedents' referential access by triggering the suppression of other concepts, but they do so more slowly (and perhaps less powerfully).

Why do pronouns trigger suppression more slowly than name anaphors? One explanation is that pronouns are less explicit than repeated name anaphors. That is, even though—as in the sentences presented in these experiments—semantic information often helps disambiguate pronouns, pronouns per se are less explicit than other forms of anaphora. So, the suppression mechanism is triggered more slowly, perhaps because information has to be gathered from other sources.

Unfortunately, this assumption is hard to test directly with the sentences used in Experiment 3 because it was not until the second clauses that the semantic information occurred: That factor alone could explain why the effects of suppression were not observed until the test point at the end of the sentences. A stronger test of this proposal could be made if the semantic information occurred prior to the pronouns, and the second clauses were neutral. If suppression is still triggered more slowly, this would suggest that information available in the anaphors is what primarily triggers the mechanism of suppression during referential access. Experiment 4 explored this proposal.

**Experiment 4**

In Experiment 4, the two-clause sentences of Experiments 1, 2, and 3 were expanded into sentence pairs. The first sentence of each pair introduced the two participants and created a context, as in

(4) Bill lost a tennis match to John.

These first sentences remained constant across all the conditions. The second sentence of each pair began with a participial phrase. These preposed phrases were what provided the semantic information to further identify the anaphors, as in

(5) Accepting the defeat, he walked quickly toward the showers.
(6) Enjoying the victory, he walked quickly toward the showers.

The second sentence of each pair had two versions. In one version, the participial phrases referred to the first-mentioned participants (NP1), as in

| NP1 version | PRONOUN: Bill lost a tennis match. Accepting the defeat.
| NAME - AN' Accepting the defeat.
| PRONOUN: Bill lost a tennis match. Accepting the victory.
| NAME - NO: Accepting the victory. |

| NP2 version | ANTECIDE: Bill lost a tennis match. Enjoying the defeat.
| ANTECEO: Bill lost a tennis match. Enjoying the victory.
| NONANTEC: Bill lost a tennis match. Enjoying the defeat.
| NONANTEC: Bill lost a tennis match. Enjoying the victory. |

Note: For each boldface, the number.

Table 2.  

Example stimuli

| PRONOUN: Bill lost a tennis match. Accepting the defeat.
| NAME - AN' Accepting the defeat.
| PRONOUN: Bill lost a tennis match. Accepting the victory.
| NAME - NO: Accepting the victory. |

| NP2 version | ANTECIDE: Bill lost a tennis match. Enjoying the defeat.
| ANTECEO: Bill lost a tennis match. Enjoying the victory.
| NONANTEC: Bill lost a tennis match. Enjoying the defeat.
| NONANTEC: Bill lost a tennis match. Enjoying the victory. |

Note: For each boldface, the number.
If the sentences, they did
in Figure 3, this difference
was
work. So, it appears that pro-
nouns, pronouns
presented in these exper-
iments were intended to be
neutral vis-a-vis the anaphors' identities. In this way, the semantic information was
restricted to the preposed participial phrases (i.e., the information occurring
before the anaphors).

Table 2.

<table>
<thead>
<tr>
<th>Example stimulus sentences for Experiment 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP _ version _ _ _ _ _ _ _ _ _ _ _</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRONOUN _ ANTECEDENT (BILL)</th>
<th>NAME _ ANTECEDENT (BILL)</th>
<th>PRONOUN _ NONANTECEDENT (JOHN)</th>
<th>NAME _ NONANTECEDENT (JOHN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bill lost a tennis match to John.</td>
<td>Accepting the victory, he walked slowly toward the showers.</td>
<td>Bill lost a tennis match to John.</td>
<td>Accepting the victory, he walked slowly toward the showers.</td>
</tr>
<tr>
<td>NAME _ ANTECEDENT (BILL)</td>
<td>NAME _ ANTECEDENT (BILL)</td>
<td>PRONOUN _ NONANTECEDENT (JOHN)</td>
<td>NAME _ NONANTECEDENT (JOHN)</td>
</tr>
<tr>
<td>Bill lost a tennis match to John.</td>
<td>Accepting the victory, John walked slowly toward the showers.</td>
<td>Bill lost a tennis match to John.</td>
<td>Accepting the victory, John walked slowly toward the showers.</td>
</tr>
<tr>
<td>NAME _ ANTECEDENT (BILL)</td>
<td>NAME _ ANTECEDENT (BILL)</td>
<td>PRONOUN _ NONANTECEDENT (JOHN)</td>
<td>NAME _ NONANTECEDENT (JOHN)</td>
</tr>
<tr>
<td>Bill lost a tennis match to John.</td>
<td>Accepting the victory, he walked slowly toward the showers.</td>
<td>Bill lost a tennis match to John.</td>
<td>Accepting the victory, he walked slowly toward the showers.</td>
</tr>
</tbody>
</table>

*Note: For each sentence, the probe name appears in parentheses, the antecedent appears in
boldface, the anaphor is in italics, and the two test points are superscripted with the experiment's
number.*
As in Experiment 3, the variables anaphor type (whether the anaphors were names or pronouns), probe name (whether the probe names were the antecedents or nonantecedents), and test point (whether the probe names were tested immediately after the anaphors or at the ends of the sentences) were also manipulated. An example experimental sentence appears in Table 2.

**Method**

**Subjects**
The subjects were 192 undergraduates at the University of Oregon.

**Materials and design**
Sixty-four experimental sentence pairs were constructed. As mentioned above, a sentence pair comprised a context-setting sentence that introduced the two participants, followed by a sentence that referred to only one of the two participants. The second sentences began with one of two participial phrases. The two participial phrases were as similar in form as possible, and, although they were not identical in length, they typically varied by only a couple of characters. The distance between the anaphors and the ends of the sentences was always five words.

To make sure that the preposed participial phrases did indeed refer to only one of the participants, the following normative data were collected. Fifty subjects at the University of Texas, who were otherwise uninvolved with any of the experiments reported here, read the experimental sentence pairs with the second sentence of each pair in its pronoun-anaphor form. For example, the subjects read, “Bill lost a tennis match to John. Accepting the defeat, he walked quickly toward the showers.” Or they read, “Bill lost a tennis match to John. Enjoying the victory, he walked quickly toward the showers.” The subjects indicated which of the two participants the pronouns referred to. Only sentence pairs that elicited more than 90% agreement with the experimenter were used in Experiment 4.

In addition, to make sure that the information following the anaphors was neutral, normative data were collected. Another group of 50 subjects at the University of Texas, who were otherwise uninvolved with the experiments, also read the sentences in their pronoun forms. But for these subjects, the second clauses of the second sentences were replaced with ellipses. For example, these subjects read, “Bill lost a tennis match to John. Accepting the defeat, he . . . .” Or they read, “Bill lost a tennis match to John. Enjoying the victory, he . . . .” Again, subjects indicated which of the two participants the pronouns referred to. Only sentence pairs that received the sentences more than 90% agreement between this condition and the normative data were used in Experiment 4. The 64 experimental sentence pairs were stereotypically named; the pronouns were stereotypically antecedent.

Also as in Experiment 3, the experimental sentence pairs consisted of two answers were always about the second sentences. The experimental sentence pairs were about the second sentences. The first sentences. Another group of 50 subjects at the University of Texas, who were otherwise uninvolved with the experiments, also read the experimental sentence pairs with the second clauses of the second sentences replaced with ellipses. For example, these subjects read, “Bill lost a tennis match to John. Accepting the defeat, he . . . .” Or they read, “Bill lost a tennis match to John. Enjoying the victory, he . . . .” Again, subjects indicated which of the two participants the pronouns referred to.

Forty-eight lure sentences were constructed. The sentences were stereotypic of the normative forms: (i) 16 were identical to the experimental sentence pairs and half the anaphors were identical to the pronouns of the second sentences identical to the experimental sentence pairs. These questions tested whether subjects were about the second sentences were about the second sentences referring to the new computer they received the sentence pairs of.

Sixteen material sets of the new computer were constructed. Across material sets, each subject was given equal number of experimental sentence pairs. Twelve subjects received the new computer to indicate whether the pronouns were about the second sentences were about the second sentences referring to the new computer they received the sentence pairs of.

**Procedure**
The procedure was
the pronouns referred to. Only sentence pairs that elicited over 95% agreement between this second group of subjects and the first group (who had received the sentence pairs with their final clauses intact) were used in Experiment 4. The 64 experimental sentence pairs appear in Appendix B.

As in Experiments 1, 2, and 3, the names of the two participants in each sentence pair were matched for perceived familiarity and length in letters and were stereotypically of only one gender. Across all sentence pairs, half the names were stereotypically female, and half were stereotypically male.

Also as in Experiments 1, 2, and 3, to encourage comprehension, each experimental sentence was followed by a two-alternative WH question. The two answers were the two participants. Half the questions were about the first sentences (the context-setting sentences), and half were about the second sentences. When the anaphors were pronouns, the questions were about the second sentences. And, as a finer division, half were about the participial phrases; for example, for the sentence in Table 2, these questions were “Who enjoyed the victory?” and “Who accepted the defeat?” The other half were about the main clauses (e.g., “Who walked quickly toward the showers?”). These questions tested whether subjects had identified who the pronouns referred to. When the anaphors were names, the questions were about the first sentences. And, as a finer division, half were about the first-mentioned participants’ activity (e.g., “Who lost a tennis match?”), and the other half were about the second-mentioned participants’ activity (e.g., “Who won a tennis match?”).

Forty-eight lure sentence pairs were constructed with the following syntactic forms: (i) 16 were identical to the NP

1

experimental sentence pairs, with half the anaphors being pronouns and half being the names of NP

1

and (ii) 16 were identical to the NP

2

experimental sentence pairs, with half the anaphors being pronouns and half being the names of NP

2

and (iii) 16 had first sentences identical to the experimental sentence pairs, but the anaphors in the second sentences were the plural pronoun they, for example, “Bobby showed the new computer to David. After setting it up, they wanted to try it out.”

Sixteen material sets were formed. Within a material set, there was an equal number of experimental sentences in the 16 experimental conditions. Across material sets, each sentence occurred in all of its experimental conditions. Twelve subjects were randomly assigned to each material set; thus, each subject was exposed to an experimental sentence in only one of its conditions. The lure sentences occurred in the same randomly selected order on each material set.

Procedure

The procedure was identical to that of Experiment 3.
Results

The design of both the subjects' and items' ANOVAs was a 2 (Anaphor Type: name vs. pronoun) × 2 (Probe Name: antecedent vs. nonantecedent) × 2 (Test Point: immediately after the anaphors vs. at the ends of the sentences) × 2 (Antecedent Position: NP₁ vs. NP₂). In both sets of ANOVAs, all four factors were within-subjects (or items) factors.

Two main effects were significant, the same ones as in Experiment 3. Responses were faster to the antecedents (M = 888) than the nonantecedents (M = 989), minF'(1,133) = 171.18. And responses were faster immediately after the anaphors (M = 920) than at the ends of the sentences (M = 958), minF'(1,129) = 29.08.

Three interactions were also significant. First, as in Experiments 1, 2, and 3, antecedent position (NP₁ vs. NP₂) interacted with probe name, minF'(1,137) = 52.03, again demonstrating that, in general, first-mentioned participants were verified more rapidly (M = 909) than second-mentioned participants (M = 969).

The second significant interaction also replicated Experiment 3. It was between probe name and anaphor type, minF'(1,170) = 128.66. And again it was qualified by the only other significant interaction, a three-way interaction involving probe name, anaphor type, and test point, minF'(1,127) = 6.881. The three-way interaction is shown in Figure 4.

As illustrated in Figure 4, when the probe names were the nonantecedents, anaphor type (name vs. pronoun) interacted with test point (immediately after the anaphors vs. at the ends of the sentences), minF'(1,133) = 6.746, in the following way: The difference between response times when the anaphors were names versus pronouns was larger immediately after the anaphors (102 ms) than at the ends of the sentences (49 ms). In contrast, when the probe names were the antecedents, anaphor type did not interact with test point, minF' < 1; the difference between response times when the anaphors were names versus pronouns was about the same immediately after the anaphors as at the ends of the sentences.

This three-way interaction suggests, as it did in Experiment 3, that the combination of anaphor type and probe name most affected by test point was when the anaphors were pronouns, and the probe names were the nonantecedents. In other words, the activation of the pronouns' nonantecedents changed the most across the second clauses of the sentences. As illustrated in Figure 4, this change resulted from the pronouns' nonantecedents becoming less activated. One interpretation of this change is that the information provided by the pronouns, combined with the semantic information provided by the participial phrases, triggered the suppression mechanism.

Discussion

Experiment 4, like Experiment 3, also demonstrated that...
OVAs was a 2 (Anaphor type: antecedent vs. nonantecedent) vs. at the ends of the sentences. In both sets of ANOVAs, test point was a within-subjects factor.

In Experiment 3, the nonantecedents were faster immediately after the sentences ($M = 958$), whereas in Experiments 1, 2, and 4, probe name, in general, first-mentioned antecedents ($M = 128.66$) than second-mentioned antecedents.

In Experiment 3, it was suggested that it was not the semantic information alone that triggered suppression. Had that been the case, the pronouns' nonantecedents should have been less activated at the earlier test point, because the semantic information had already occurred by then. However, at the early test point, response times to the pronouns' antecedents versus nonantecedents were statistically indistinguishable, $minF'(1,206) = 1.365, p > .25$. In contrast, by the ends of the sentences, responses were significantly slower to the pronouns' nonantecedents than their antecedents, $minF'(1,152) = 5.749$.

Discussion

Experiment 4, like Experiment 3, further illustrated the role that the mechanism of suppression plays in improving referential access. Experiment 4 also demonstrated that semantically-biased pronouns improve their antecedent. Further analyses suggested that it was not the semantic information alone that triggered suppression. Had that been the case, the pronouns' nonantecedents should have been less activated at the earlier test point, because the semantic information had already occurred by then. However, at the early test point, response times to the pronouns' antecedents versus nonantecedents were statistically indistinguishable, $minF'(1,206) = 1.365, p > .25$. In contrast, by the ends of the sentences, responses were significantly slower to the pronouns' nonantecedents than their antecedents, $minF'(1,152) = 5.749$.

Discussion

Experiment 4, like Experiment 3, further illustrated the role that the mechanism of suppression plays in improving referential access. Experiment 4 also demonstrated that semantically-biased pronouns improve their antecedent.
dents' accessibility by triggering the suppression of nonantecedents. In fact, Experiment 4 replicated Experiment 3, even though in Experiment 4 the semantic information occurred before the pronouns. However, like Experiment 3, the pronouns' nonantecedents were not observably suppressed until the test point at the ends of the sentences. This suggests that semantic information alone is insufficient to trigger suppression. Rather, semantic information must be combined with information provided by the anaphor. And because pronouns—even pronouns biased by a previous semantic context—are less explicit than repeated name anaphors, suppression is triggered more slowly.

What if the pronouns were made more explicit? What if they matched the gender of only one of the two participants? If the mechanism of suppression is primarily triggered by the informational content of the anaphor, then gender-explicit pronouns should trigger suppression more rapidly or more powerfully.

Existing data support this prediction. For instance, a pronoun's antecedent is overtly identified more rapidly when the pronoun matches the gender of only one participant, as in

(7) John phoned Susan because he needed some information.

than when the pronoun matches the gender of more than one participant, as in

(8) John phoned Bill because he needed some information.

(Caramazza, Grober, Garvey, & Yates, 1977; Erhlich, 1980; Vonk, 1985). Similarly, clauses containing gender-explicit pronouns (like the second clause of sentence (7)) are read more rapidly than identical clauses containing less explicit pronouns (like the second clause of sentence (8)) (Garnham & Oakhill, 1985). These data demonstrate that the antecedents of gender-explicit pronouns are more accessible.

Perhaps they are more accessible because gender-explicit pronouns trigger suppression more rapidly or more powerfully. More data to support this prediction come from a study by Chang (1980). Chang (1980) measured activation at the ends of sentences and found that the nonantecedents of gender-explicit pronouns were no more activated than the nonantecedents of repeated name anaphors. To account for Chang's data, one can assume that the gender-explicit pronouns' nonantecedents were never activated. Or one can assume that they were once as activated as the antecedents, but by the ends of the sentences they had been suppressed very powerfully. Experiment 5 empirically examined these alternatives.

Experiment 5

Experiment 5 was identical to Experiment 3, in each sentence differed in the gender of only one antecedent. Materials, method, and subjects were identical.

Method

The design of the ANOVA used in Experiment 3 by assigning antecedents and a stereotype matched for perceived gender at each antecedent position. Each of the 12 subjects participated in all five experiments.

Results

The design of the ANOVA used in Experiment 3 by assigning antecedents and a stereotype matched for perceived gender at each antecedent position. Each of the 12 subjects participated in all five experiments.

As shown in Figure 1, the anaphor type interacted with the following effect: The nonantecedents of names versus pronouns (M = 5.27 ms) than at the ends of sentences. This three-way interaction is best understood by examining the interaction between anaphor type and the difference between antecedent position in the sentence.
of nonantecedents. In fact, though in Experiment 4 the anaphors were nonantecedents. However, like Experiment 1, veridical clauses containing less information. 

And be-cause semantic context—are sometimes observably suppressed until they are in-formation.

What if they matched the anaphor, then genera-ly speaking, a pronoun's antecedent can matches the gender of one participant, as shown in Experiment.

Translation.

Garnham & D'Enhonge (1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-
vation time (8) (Garnham & D'Enhonge, 1980) measured acti-

Experiment 5

Experiment 5 was identical to Experiment 3 except that the two participants in each sentence differed in gender. (And therefore the pronouns matched the gender of only one participant). In all other respects, the two experiments were identical.

Method

The materials used in Experiment 5 were modified from those used in Experiment 3 by assigning a stereotypically female name to one of the two participants and a stereotypically male name to the other. The two names were matched for perceived familiarity and length in letters. Half the antecedents at each antecedent position were female, and half were male. Sixty-four subjects participated.

Results

The design of the ANOVAs was identical to Experiment 3. Two main effects were significant, the same two as in Experiments 3 and 4. First, responses were faster to the antecedents (M = 882) than the nonantecedents (M = 971), min F'(1,118) = 47.37. Second, responses were faster immediately after the anaphors (M = 912) than at the ends of the sentences (M = 941), min F'(1,99) = 4.409.

Three interactions were significant. As in the first four experiments, an-
tecedent position interacted with probe name, min F'(1,118) = 8.068, again demonstrating that, in general, first-mentioned participants were verified more rapidly (M = 907) than second-mentioned participants (M = 946).

The second significant interaction was also the same as in Experiments 3 and 4. It was between probe name and anaphor type, min F'(1,116) = 45.56. And, as in Experiments 3 and 4, it was qualified by a three-way interaction involving probe name, anaphor type, and test point, min F'(1,118) = 6.564. This three-way interaction is illustrated in Figure 5.

As shown in Figure 5, when the probe names were the antecedents, anaphor type interacted with test point, min F'(1,117) = 7.925, creating the following effect: The difference between response times when the anaphors were names versus pronouns was greater immediately after the anaphors (101 ms) than at the ends of the sentences (25 ms). In contrast, when the probe names were the antecedents, anaphor type did not interact with test point, both Fs < 1; the difference between response times when the anaphors were
names versus pronouns was about the same immediately after the anaphors as at the ends of the sentences.

Further analyses examined the data from the pronoun conditions only. Immediately after the pronouns, response times to the pronouns' antecedents versus nonantecedents were statistically indistinguishable, both $F$s < 1. Thus, despite a strong cueing by gender, the pronouns had no immediate effect on either their antecedents or nonantecedents. This finding corroborates Tyler and Marslen-Wilson (1982), who found that pronouns matching the human status of only one participant did not immediately affect the activation of their antecedents or nonantecedents.

In contrast, by the ends of the sentences in Experiment 5, responses were significantly slower to the pronouns' nonantecedents than their antecedents, $F_1(1,56) = 5.256, F_2(1,62) = 3.778$. In other words, by the ends of the sentences, the pronouns' antecedents and nonantecedents differed in their levels of activation. As in the pattern is that the immediate semantic information of the nonantecedent position that had been suppressed by the antecedent's pronoun triggered the suppression in the nonantecedent position.

Discussion

Experiment 5 further displays in improving gender-explicit pronouns and when compared to gender-ambiguous pronouns.

How general is the mechanism's role in referential access? To this end, we compared their accessibility by the ends of the sentences in Experiment 1; in fact, in contrast to the Experiment 5.

(9) Bill handed John immediately.
of activation. As in Experiments 3 and 4, the clearest interpretation of this pattern is that the information provided by the pronouns, combined with the semantic information provided by the second clauses, triggered the suppression of the nonantecedents.

However, in contrast to Experiments 3 and 4, the data collected at the ends of the sentences replicate Chang (1980). Recall that Chang found that at the ends of the sentences the pronouns' nonantecedents were activated at the same level as the names' nonantecedents. Similarly, at the ends of the sentences in Experiment 5, responses to the pronouns' nonantecedents versus the names' nonantecedents differed by only a marginally significant 25 ms, \( \text{min}F'(1,86) = 3.22, p < .10 \). Actually, Chang's data can be approximated even more closely by considering only the Experiment 5 data for the antecedent position that he tested; for those data, the difference was a nonsignificant 12 ms. Thus, the pronouns' greater explicitness more powerfully triggered the suppression of their nonantecedents.

**Discussion**

Experiment 5 further illustrated the role that the mechanism of suppression plays in improving referential access. Experiment 5 demonstrated that gender-explicit pronouns also trigger the suppression of their nonantecedents, and when compared to Experiments 3 and 4, they do so more powerfully than gender-ambiguous pronouns.

How general is the role that the suppression mechanism plays in improving referential access? That is, is it only rementioned participants who improve their accessibility by triggering the suppression of other participants? Or is the mechanism's role more general so that simply the most recently mentioned participants—regardless of whether they are reinstated or novel—trigger suppression in order to improve their accessibility? Experiment 6 answered these questions.

**Experiment 6**

The experimental sentences in Experiment 6 were similar to those in Experiment 1; in fact, in one condition of Experiment 6, the sentences were identical to the Experiment 1 name-anaphor sentences, for example:

(9) Bill handed John some tickets to a concert, but *Bill* took the tickets back immediately.
However, in another condition, the sentences were modified: Instead of one of the two original participants being rementioned at the beginning of their second clause, a new participant was introduced, as in

(10) Bill handed John some tickets to a concert, but Mark said the tickets were counterfeit.

Three variables were manipulated. In the interest of simplicity, though not accuracy, one will be referred to as “anaphor” type. This variable simply refers to who the subjects of the second clauses were. Half the time the “anaphors” were repeated, anaphoric, or what will be referred to as “old” names. An example is the rementioned Bill in sentence (9) above. The other half of the time the “anaphors” were new names, for example, the newly introduced Mark in sentence (10) above. In this second situation, the label “anaphors” was clearly a misnomer, Manipulating this variable revealed whether introducing a new participant (e.g., Mark) had the same effect on the other participant (e.g., John) as rementioning an old participant (e.g., Bill).

The second variable was probe name: The probe names were the names of either the antecedents or the nonantecedents. This variable also lost its meaning when the “anaphors” were new names. Given that the new names were not truly anaphors, they had neither antecedents nor nonantecedents. So the distinction boiled down to a comparison between the two original participants. When the “anaphors” were the new names, no differences between response times to the two original participants were expected. But the distinction was preserved in the interest of a balanced experimental design. Finally, the third variable was antecedent position: The antecedents were either the NP₁ or the NP₂ of the first clause.

To summarize, the three variables were “anaphor” type (whether the “anaphors” were old names or new names), probe name, and antecedent position. Unlike the previous five experiments, test point was not manipulated. Because the experimental question was whether the effects on previously mentioned participants are the same after introducing new participants versus rementioning old participants, response times were measured at only one test point: immediately after the “anaphors” (i.e., immediately after either NP₁ or NP₂ was repeated or NP₃ was introduced). An example experimental sentence of both antecedent position types appears in Table 3.

<table>
<thead>
<tr>
<th>Table 3. Example sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP₁ type sent</td>
</tr>
<tr>
<td>OLD NAME</td>
</tr>
<tr>
<td>Bill handed John</td>
</tr>
<tr>
<td>NEW NAME</td>
</tr>
<tr>
<td>Bill handed John</td>
</tr>
<tr>
<td>OLD NAME</td>
</tr>
<tr>
<td>Ann predicted</td>
</tr>
<tr>
<td>NEW NAME</td>
</tr>
<tr>
<td>Ann predicted</td>
</tr>
</tbody>
</table>

Note: For each NP₁ type sentence, the label probe name is the name of the antecedent, and the label question is the question the subject was asked to answer. The labels are repeated in Table 4.

Materials and design
The materials were created in the following ways. First, each clause was written in the following ways.

- The second clause was written in the following ways.
- Second, the comparisons were about the antecedents’ names. And, as a first mention of participants, participants, and then the “Who was handed tickets?”), and half were.

<table>
<thead>
<tr>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
</tr>
<tr>
<td>The subjects were 48 undergraduates at the University of Oregon.</td>
</tr>
</tbody>
</table>
Table 3. Example stimulus sentences for Experiment 5

<table>
<thead>
<tr>
<th>Type Sentence</th>
<th>OLD NAME - ANTECEDENT (BILL)</th>
<th>NEW NAME - &quot;ANTECEDENT&quot; (BILL)</th>
<th>OLD NAME - NONANTECEDENT (JOHN)</th>
<th>NEW NAME - &quot;NONANTECEDENT&quot; (JOHN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1 type sentence</td>
<td>Bill handed John some tickets to a concert but Bill took the tickets back immediately.</td>
<td>Bill handed John some tickets to a concert but Mark said the tickets were counterfeit.</td>
<td>Bill handed John some tickets to a concert but Bill took the tickets back immediately.</td>
<td>Bill handed John some tickets to a concert but Mark said the tickets were counterfeit.</td>
</tr>
<tr>
<td>NP2 type sentence</td>
<td>Ann predicted that Pam would lose the track race but Pam came in first very easily.</td>
<td>Ann predicted that Pam would lose the track race but Jan predicted that Pam would win.</td>
<td>Ann predicted that Pam would lose the track race but Pam came in first very easily.</td>
<td>Ann predicted that Pam would lose the track race but Jan predicted that Pam would win.</td>
</tr>
</tbody>
</table>

Note: For each sentence, the probe name appears in parentheses, and the “anaphor” is in italics.

Materials and design

The materials were modified from the sentences used in Experiment 1 in the following ways. First, for each experimental sentence, an alternative second clause was written that introduced a new participant. The new participant's name matched the original two participants' names in perceived familiarity, length in letters, and gender. Second, the comprehension questions were reconstructed. Half the questions were about the first clause, and half were about the second clause. The questions were about the first clause whenever the “anaphors” were the new names. And, as a finer division, half of these questions were about the first-mentioned participants’ activity (e.g., “Who handed someone some tickets?”), and half were about the second-mentioned participants’ activity (e.g., “Who was handed some tickets?”). The questions were about the second
clause whenever the “anaphors” were the old names (e.g., “Who took the tickets back immediately?”).

Third, 24 of the 48 lure sentences were reconstructed so that they too introduced a third participant. In addition, in 12 of the lure sentences the probe names were tested toward the ends of their sentences, and, in another 12, the probe names were tested toward the beginnings of their sentences. As in Experiments 1 and 2, this variation was intended to discourage subjects from expecting the probe names to be tested always in the middle of the sentences.

Four material sets were formed. Within a material set, there was an equal number of experimental sentences in each of the four experimental conditions. Across material sets, each sentence occurred in all four experimental conditions. Twelve subjects were randomly assigned to each material set so that each subject was exposed to an experimental sentence in only one of its experimental conditions. The lure sentences occurred in the same randomly selected order on each material set.

Procedure

The procedure was identical to Experiment 1, with the major exception that all the probe names were presented 150 ms after the offset of the “anaphors.”

Results

The subjects' average correct response times are shown in Table 4. The design of both the subjects' and items' ANOVAs was a 2 (“Anaphor” Type: old name vs. new name) × 2 (Probe Name: antecedent vs. nonantecedent) × 2 (Antecedent Position: NP1 vs. NP2). In the subjects' analysis, all three factors were within-subjects factors. In the items' analysis, antecedent position was a between-items factor.

Two main effects were significant. The first was an effect of probe name: Responses were faster to antecedents ($M = 928$) than nonantecedents ($M = 1013$), $minF'(1,106) = 1007$, $p < .01$. Responses were faster if the antecedent name was greater when it was an old name than when it was a new name, $minF'(1,103) = 35.0$, $p < .001$. There was no effect of probe name by antecedent position by probe name interaction that, in general, was statistically indistinguishable from zero ($< 1$). As mentioned in Experiment 5, there were new names, as in several studies, and nonantecedents that were old names, respectively. $minF'(1,93) = 1$, $p = .31$. This suggests that name size likely by triggering the suppression mechanism.

Other planned contrasts of anaphoric names; identical to Experiment 1. That is, responses to antecedents were statistically indistinguishable from responses to antecedents or the probe names. As expected, responses to antecedents were faster than responses to nonantecedents, $minF'(1,103) = 10$, $p < .01$, respectively.

Discussion

Experiment 6 further suggests that the suppression mechanism plays in improving responses to nonmentioned participants. This suggests that triggering the suppression mechanism to improve responses to nonmentioned participants. Most likely this mechanism is the one that supports this experiment.

Table 4. Average correct response times in Experiment 6

<table>
<thead>
<tr>
<th>“Anaphor” type</th>
<th>Probe type</th>
<th>Antecedent</th>
<th>Nonantecedent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old name</td>
<td>851</td>
<td>1018</td>
<td></td>
</tr>
<tr>
<td>New name</td>
<td>1005</td>
<td>1009</td>
<td></td>
</tr>
</tbody>
</table>
1013), $minF'(1,106) = 29.95$. The second was an effect of "anaphor" type: Responses were faster following old names ($M = 934$) than new names ($M = 1007$), $minF'(1,104) = 33.10$.

Two interactions were significant. The first was the familiar antecedent position by probe name interaction, $minF'(1,101) = 10.81$, again demonstrating that, in general, first-mentioned participants were verified more rapidly ($M = 943$) than second-mentioned participants ($M = 998$).

The other interaction was between "anaphor" type and probe name, $minF'(1,103) = 35.51$. This interaction indicated that the effect of probe name was greater when the "anaphors" were old names than it was when they were new names. In fact, when the "anaphors" were new names, there was no effect of probe name: Response times to the antecedents were statistically indistinguishable from response times to the nonantecedents, both $Fs < 1$. As mentioned above, this was expected as when the "anaphors" were new names, as in sentence (10) above, the distinction between antecedents and nonantecedents was meaningless. On the other hand, when the anaphors were old names, responses were faster to the antecedents than the nonantecedents, $minF'(1,93) = 59.64$. Replicating the previous five experiments, this suggests that name anaphors improve their antecedents' accessibility, most likely by triggering the mechanisms of suppression and enhancement.

Other planned comparisons suggested that suppression was not limited to anaphoric names; introducing new participants also triggered the mechanism. That is, response times to the nonantecedents following old names were statistically indistinguishable from response times to either the new-name antecedents or the new-name nonantecedents, all $Fs < 1$. Although, of course, responses to the antecedents following old names were significantly faster than responses to either the new-name antecedents or the new-name nonantecedents, $minF'(1,102) = 60.01$ and $minF'(1,106) = 56.78$, respectively.

**Discussion**

Experiment 6 further illustrated the role that the mechanism of suppression plays in improving referential access. Experiment 6 demonstrated that mentioned participants are not the only ones who gain a privileged status by triggering the suppression of other participants. Rather, simply the most recently mentioned participants, regardless of whether they are new or old, use this mechanism to improve their referential access.

In fact, this suppression mechanism is probably not limited to participants either. Most likely the mechanism is triggered by concepts in general. Several studies support this proposal.
For instance, data from Dell et al. (1983) can be interpreted as demonstrating that new concepts trigger the suppression of previously mentioned concepts. In their study, subjects read four-sentence texts whose first lines contained a critical noun phrase, for example, a burglar as in

(11) A burglar surveyed the garage set back from the street.

In one condition, the texts' fourth lines contained an anaphoric noun phrase, which was a semantic superordinate of the critical noun phrase, for example,

(12) The criminal slipped away from the street lamp.

Responses to the critical noun phrases (e.g., burglar) were slightly (12 ms) faster immediately after subjects read the anaphors (e.g., criminal) than immediately before. In other words, the noun phrase anaphors appeared to trigger the enhancement of their antecedents.

In a second condition, the anaphoric noun phrases in the fourth line were replaced with novel noun phrases, for example, a cat as in

(13) A cat slipped away from the street lamp.

In this condition, responses to the antecedents (e.g., burglar) were 32 ms slower immediately after the novel noun phrases (e.g., cat) than immediately before. This pattern can be interpreted in terms of suppression: Perhaps the novel noun phrases (a cat) triggered the suppression of other concepts, including the antecedent (burglar).

In fact, explicitly introducing a new topic—as opposed to implicitly maintaining an old topic—makes other concepts less accessible. For instance, when a new topic is introduced, as opposed to an old topic being maintained, sentence segments containing pronouns that refer to the old topic are read more slowly (Clifton & Ferreira, 1987) and the old topics are less strongly activated (O'Brien, Duffy, & Meyers, 1986). Perhaps this effect is also attributable to the mechanisms of suppression (see also O'Brien et al.'s baseline, preanaphor, and semantic control conditions, as they too introduced or elaborated on new topics).

The mechanism of suppression might also explain Clark and Sengul's (1979) "discontinuity effect." Clark and Sengul found that reading times for sentences containing anaphors increased according to how far back in the text the anaphors' antecedents occurred. However, their data demonstrated a sharp discontinuity: Reading times were fastest if the antecedents were mentioned only one sentence or clause back, but distances beyond that did not matter; the antecedents could occur either two or three sentences or clauses back, and reading times were equally slow. If each sentence or clause introduced a new concept, it is possible that each new concept triggered the suppression of its prior concept introduced in the last clause before that would be read.

In sum, Experiments 1 and 2 suggest that the mechanisms of suppression and enhancement play a powerful role in maintaining topic accessibility. It is perhaps the case that new topics explicitly introduced or elaborated on will keep track of the who with less effort than if the new topic is explicitly maintained.

General discussion

This series of experiments demonstrates that the mechanisms of suppression and enhancement play a powerful role in maintaining topic accessibility. In addition, it suggests that the explicitness of the new topic can play a powerful role in these mechanisms.

Although the experiments demonstrated the role of explicitness, data from Experiments 1 and 2 also demonstrates an explicitness effect. According to the explicitness effect, the more explicitly a new topic is introduced, the more likely they are to trigger suppression effects. For instance, when the novel noun phrase anaphors (e.g., cat) triggered the suppression of other concepts, including the antecedent (burglar).

For instance, the novel noun phrases in the fourth line were replaced with novel noun phrases, for example, a cat as in

(13) A cat slipped away from the street lamp.

In this condition, responses to the antecedents (e.g., burglar) were 32 ms slower immediately after the novel noun phrases (e.g., cat) than immediately before. This pattern can be interpreted in terms of suppression: Perhaps the novel noun phrases (a cat) triggered the suppression of other concepts, including the antecedent (burglar).

Indeed, in Experiment 2, the suppression effect anaphorically introduced or elaborated on a 127 ms suppression effect anaphorically introduced or elaborated on a 127 ms suppression effect.

Less explicit than explicitly introduced topics typically, the relation between topic concepts by saying something about who. According to the explicitness effect, the more explicitly a new topic is introduced, the more likely they are to trigger suppression effects. For instance, when the novel noun phrase anaphors (e.g., cat) triggered the suppression of other concepts, including the antecedent (burglar).

Because virtually all topics typically are maintained rather than do proper noun phrases typically. When subjects comprehend when the antecedent (burglar) is introduced or elaborated on, they are less likely to trigger suppression effects. For instance, when the novel noun phrase anaphors (e.g., cat) triggered the suppression of other concepts, including the antecedent (burglar).
nterpreted as demonstrative, previously mentioned contexts whose first lines contain an anaphoric noun phrase, for example, the street.

un anaphoric noun phrase, for example, cat as in

lar) were slightly (12 ms) vs (e.g., criminal) than im-
use anaphors appeared to

aces in the fourth line were
cat as in

anaphoric noun phrase, for example, the burglar) were 32 ms

pression of its prior concept. The net result would be that the concepts intro-
duced in the last clauses would be the most accessible, but concepts occurring
before that would be equally less accessible.

In sum, Experiments 4, 5, and 6, plus the experiments reviewed above,
suggest that the mechanism of suppression very commonly improves referen-
tial access. It is perhaps the primary mechanism by which comprehenders
keep track of the whos and whats in discourse.

General discussion

This series of experiments demonstrated that the mechanisms of suppression
and enhancement play a role in referential access: They improve concepts' accessi-

ty. In addition, the experiments demonstrated that how rapidly and
c
powerfully these two mechanisms are triggered is a function of the concepts' explicitness.

Although the experiments reported here investigated only three levels of

c
explicitness, data from other experiments flesh out a continuum that illus-

trates an explicitness principle: The more explicit the concepts, the more likely they are to trigger the suppression of other concepts, and, when used

anaphorically, the more likely they are to enhance their antecedents.

For instance, the most explicit concepts examined in this series of experi-

ments were proper names. Only rarely do proper names lead to referential

ambiguity. When they do, speakers and writers usually disambiguate the

concepts by saying something like "the Fred Jones who lives down the street.

According to the explicitness principle, proper names should most powerfully

trigger the suppression of other concepts and, when used anaphorically, they

should most powerfully trigger the enhancement of their own antecedents.

Indeed, in Experiment 1, the proper name anaphors produced a 122 ms

suppression effect and a 76 ms enhancement effect; in Experiment 2, they

produced a 127 ms suppression effect and an 84 ms enhancement effect.

Less explicit than proper names are common nouns. When used anaphor-
ically, the relation between common noun phrases and their antecedents is

typically synonymy (e.g., "John threw the stone. The rock was heavy") or

semantic superordination (e.g., "John fed the robin. The bird was hungry").

Because virtually all words have at least a few synonyms and semantic subordi-

nates, common noun phrase anaphors have more potential antecedents than do proper name anaphors. In fact, noun phrase anaphors are easier to

comprehend when they are more general than their antecedents, rather than

vice versa (Garnham, 1981, 1984; Garrod & Sanford, 1977; Sanford & Gar-

rod, 1980). For example, reading times are faster for the sequence,
(14) John fed the robin. The bird was hungry.

(15) John fed the bird. The robin was hungry.

Given that an anaphor such as the bird can refer to the robin, the sparrow, the canary, or even the chicken, noun phrase anaphors are obviously less explicit than proper name anaphors.

According to the explicitness principle, noun phrase anaphors should less powerfully suppress their nonantecedents and less powerfully enhance their antecedents. This prediction is supported by Dell et al.'s (1983) data: With noun phrase anaphors, their data illustrate a 32 ms suppression effect and a 12 ms enhancement effect. Both effects are numerically smaller than the comparable effects observed with proper name anaphors in Experiments 1 and 2.

Pronouns are less explicit than common noun phrases. Even in a language such as English, with its variety of pronouns, each pronoun can have a myriad of potential antecedents. So, according to the explicitness principle, pronouns should be considerably less powerful at triggering suppression and enhancement. Indeed, as Experiments 1 and 2 demonstrated, pronouns do not immediately trigger either suppression or enhancement.

However, as Experiments 3, 4, and 5 demonstrated, pronouns do eventually trigger suppression, and how rapidly they do is a function of their explicitness: More explicit pronouns—for instance, pronouns that match the gender of only one of their sentences' participants—trigger suppression more powerfully. By the ends of their sentences, the nonantecedents of gender-explicit pronouns are activated at about the same level as the nonantecedents of very explicit, proper name anaphors. Less explicit pronouns—for instance, pronouns that match the gender, number, and case of two participants—trigger suppression less powerfully. By the ends of their sentences, their nonantecedents are still highly activated relative to how activated they are when the anaphors are more explicit, proper names.

Finally, the least explicit of all referential forms is zero anaphora (e.g., “John went to the store and 0 bought a quart of milk”). Although the present series of experiments did not include a zero anaphora manipulation, Corbett & Chang's (1983) Experiment 1 did, and their data perfectly support the explicitness principle: Zero anaphors trigger even less suppression than ambiguous pronouns. That is, by the ends of their sentences, the nonantecedents of zero anaphors are substantially more activated than the nonantecedents of ambiguous pronouns.

Anaphoric explicitness is not simply physical similarity. Anaphoric explicitness must also incorporate definiteness, as the following examples illustrate.
A physically similar pair like (16) and (17) seem coreferential:
(16) The waitress was counting the money.
(17) The waitress was daydreaming about getting off early.

However, an equally similar pair like (18) and (19) seem less coreferential:
(18) A waitress was counting the money.
(19) A waitress was daydreaming about getting off early.

(For experimental demonstrations that support this intuition, see Guindon, 1985; Haviland & Clark, 1974; Murphy, 1984; de Villiers, 1974; Yekovich & Walker, 1978.) Thus, anaphoric explicitness depends on definiteness.

**Suppression and enhancement and other referential access phenomena**

At least three properties of discourse affect how easily comprehenders can access antecedents. These same three properties are related to speakers' and writers' choices of how explicit an anaphor to use. Because these properties both affect referential accessibility and correlate with anaphoric explicitness, their relations might be mediated by the mechanisms of suppression and enhancement. These three properties are listed in Table 5.

<table>
<thead>
<tr>
<th>Table 5. Three discourse properties and their relations with anaphoric explicitness and referential accessibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Referential distance</strong></td>
</tr>
<tr>
<td>Relation between referential distance and anaphoric explicitness: At longer distances, anaphors are more explicit</td>
</tr>
<tr>
<td>Relation between referential distance and referential accessibility: At longer distances, antecedents are less accessible</td>
</tr>
<tr>
<td><strong>Topicality</strong></td>
</tr>
<tr>
<td>Relation between topicality and anaphoric explicitness: For more topical concepts, anaphors are less explicit</td>
</tr>
<tr>
<td>Relation between topicality and referential accessibility: For more topical concepts, antecedents are more accessible</td>
</tr>
<tr>
<td><strong>Episode structure</strong></td>
</tr>
<tr>
<td>Relation between episode structure and anaphoric explicitness: At the beginnings of episodes, anaphors are more explicit</td>
</tr>
<tr>
<td>Relation between episode structure and referential accessibility: At the beginnings of episodes, antecedents are less accessible</td>
</tr>
</tbody>
</table>
**Referential distance**

One property that correlates with anaphoric explicitness and affects referential access is referential distance. Referential distance is the distance between an anaphor and its antecedent. A wealth of cross-linguistic, text-count data document the following relation: The longer the distance between an anaphor and its antecedent, the more explicit the anaphor. Consider, for instance, the least explicit anaphors in English, zero anaphors; in only 2% of Givón's (1983) sample of spoken English are the antecedents of zero anaphors farther back than one clause. In contrast, some antecedents of more explicit, noun phrase anaphors occur as far back as 15 clauses (see also Clancy, 1980; Hinds, 1978).

Furthermore, a wealth of psycholinguistic (reading time) data document the following relation between referential distance and referential accessibility: The longer the distance between an anaphor and its antecedent, the less accessible the anaphor (Clark & Sengul, 1979; Erhlich, 1983; Erhlich & Rayner, 1983; Frederiksen, 1981).

Why is referential access harder at longer referential distances? And why do speakers and writers use the most explicit forms of anaphora at longer referential distances? One explanation draws on the following probability: The longer the distance between an anaphor and its antecedent, the higher the probability that other concepts intervene. Because mentioning new concepts suppresses older concepts, it might not be distance (or time) per se that underlies these relations. Rather, it might be the intervention of other concepts and the mechanism of suppression.

Indeed, referential distance does not always affect accessibility (e.g., Carroll & Slowiaczek, 1987); sometimes it is only when the distance is filled by introducing other concepts (Clifton & Ferreira, 1987; Friedrich, 1980; Lesgold, Roth, & Curtis, 1979). The relation between anaphoric explicitness and referential distance might also be attributable to the intervention of other concepts and the mechanism of suppression. Thus, the mechanism of suppression may mediate the relations among referential distance, anaphoric explicitness, and referential accessibility.

**Topicality**

A second property that correlates with anaphoric explicitness and affects referential access is topicality: The more topical the antecedent, the less explicit the anaphor (Chafe, 1974, 1976; van Dijk & Kintsch, 1983; Fletcher, 1984; Givón, 1983; Marslen-Wilson, Levy, & Tyler, 1982). For example, when comprehenders join two sentences that share their topic, as in

(20) Pete intended to go bowling last night.
(21) Pete broke his leg.

they typically refer to Pete using the most explicit form of anaphora.

In contrast, when the antecedent is less topical, comprehenders typically use less explicit anaphora, as in

(22) Pete intended to go bowling last night.
(23) Sam broke his leg.
(24) Pete intended to go bowling last night.
(25) Sam broke his leg.

Why is referential access harder when the antecedent is less topical? Why is referential access harder at longer referential distances? Why do speakers and writers use the most explicit forms of anaphora at longer referential distances? One explanation draws on the following probability: The longer the distance between an anaphor and its antecedent, the higher the probability that other concepts intervene. Because mentioning new concepts suppresses older concepts, it might not be distance (or time) per se that underlies these relations. Rather, it might be the intervention of other concepts and the mechanism of suppression.

Indeed, referential distance does not always affect accessibility (e.g., Carroll & Slowiaczek, 1987); sometimes it is only when the distance is filled by introducing other concepts (Clifton & Ferreira, 1987; Friedrich, 1980; Lesgold, Roth, & Curtis, 1979). The relation between anaphoric explicitness and referential distance might also be attributable to the intervention of other concepts and the mechanism of suppression. Thus, the mechanism of suppression may mediate the relations among referential distance, anaphoric explicitness, and referential accessibility.

**Episode structure**

A third property that correlates with anaphoric explicitness and affects referential access is episode structure. A narrative is a sequence of events that are related to each other in some way (Chafe, 1976; Blackman, 1979). The activation of a topic is strongly enhanced by preceding the topic with other topics, and it is strongly suppressed by other concepts. The mechanism of suppression may mediate the relations among topic-relatedness, anaphoric explicitness, and referential accessibility.

**Episode structure**

A third property that correlates with anaphoric explicitness and affects referential access is episode structure. A narrative is a sequence of events that are related to each other in some way (Chafe, 1976; Blackman, 1979). The activation of a topic is strongly enhanced by preceding the topic with other topics, and it is strongly suppressed by other concepts. The mechanism of suppression may mediate the relations among topic-relatedness, anaphoric explicitness, and referential accessibility.
Explicitness and affects referential accessibility is the distance between an anaphor and its antecedent. Consider, for example, the antecedents of zero anaphors; in only 2% of cases do they antecedents of zero anaphors, some antecedents of which as 15 clauses (see also (Fletcher, 1984)). Furthermore, the more topical the antecedent, the more accessible the anaphor; that is, sentences containing references to more topical antecedents are read more rapidly than sentences containing references to less topical antecedents (Anderson, Garrod, & Sanford, 1983; Clifton & Ferreira, 1987; Crawley, 1986; Lesgold et al., 1979; Yekovich, Walker, & Blackman, 1979).

Why is referential access easier for topical concepts? And why do speakers and writers use less explicit forms of anaphora for topical concepts? One key to understanding these relations is understanding what it means for a concept to be topical. Typically, it is because the concept is mentioned frequently (Givon, 1979) or because it occurs in the privileged first position of a sentence (Li & Thompson, 1981) or the privileged first or "foregrounded" position of a narrative (Chafe, 1976). In fact, experimental studies often manipulate topicality by manipulating frequency of mention (Crawley, 1986) or primacy of mention (Fletcher, 1984; Lesgold et al., 1979).

It is obvious how frequency of mention can improve referential access through suppression and enhancement: Each time a concept is mentioned, its activation is enhanced, and other concepts are suppressed. As for primacy of mention, the present six experiments demonstrated that it, too, improves referential access via suppression and enhancement. I shall comment further on this effect below, but briefly put: First-mentioned concepts are more strongly enhanced by their antecedents and are more resistant to being suppressed by other concepts. Thus, the mechanisms of suppression and enhancement may mediate the relations among topicality, anaphoric explicitness, and referential accessibility.

Episode structure
A third property that correlates with anaphoric explicitness and that affects referential accessibility is episode structure: At the beginnings of episodes they typically refer to the common topic with a pronoun, as in

(22) Pete intended to go bowling but he broke his leg.

In contrast, when the two sentences do not share topics, as in

(23) Pete intended to go bowling with Sam last night.
(24) Sam broke his leg.

comprehenders typically refer to these less topical antecedents with a name anaphor, as in

(25) Pete intended to go bowling with Sam, but Sam broke his leg.

(Fletcher, 1984). Furthermore, the more topical the antecedent, the more accessible the anaphor; that is, sentences containing references to more topical antecedents are read more rapidly than sentences containing references to less topical antecedents (Anderson, Garrod, & Sanford, 1983; Clifton & Ferreira, 1987; Crawley, 1986; Lesgold et al., 1979; Yekovich, Walker, & Blackman, 1979).

Why is referential access easier for topical concepts? And why do speakers and writers use less explicit forms of anaphora for topical concepts? One key to understanding these relations is understanding what it means for a concept to be topical. Typically, it is because the concept is mentioned frequently (Givon, 1979) or because it occurs in the privileged first position of a sentence (Li & Thompson, 1981) or the privileged first or "foregrounded" position of a narrative (Chafe, 1976). In fact, experimental studies often manipulate topicality by manipulating frequency of mention (Crawley, 1986) or primacy of mention (Fletcher, 1984; Lesgold et al., 1979).

It is obvious how frequency of mention can improve referential access through suppression and enhancement: Each time a concept is mentioned, its activation is enhanced, and other concepts are suppressed. As for primacy of mention, the present six experiments demonstrated that it, too, improves referential access via suppression and enhancement. I shall comment further on this effect below, but briefly put: First-mentioned concepts are more strongly enhanced by their antecedents and are more resistant to being suppressed by other concepts. Thus, the mechanisms of suppression and enhancement may mediate the relations among topicality, anaphoric explicitness, and referential accessibility.

Episode structure
A third property that correlates with anaphoric explicitness and that affects referential accessibility is episode structure: At the beginnings of episodes
and paragraphs, speakers and writers typically use the most explicit forms of anaphora (Fox, 1986; Marslen-Wilson et al., 1982; Tomlin, 1987).

Furthermore, although I am unaware of data that specifically demonstrate this, I strongly predict that referential access is harder at the beginnings of episodes. This is because comprehending episode boundaries leads to processing shifts (Gernsbacher, 1984, 1985). During a processing shift, comprehenders shift from actively constructing one substructure of their mental representation and begin developing another. After a processing shift, information represented in the previous substructure is less accessible. Thus, one hypothesis is that referential access is more difficult across episode boundaries because anaphors are less able to trigger the enhancement of their antecedents when the two are represented in different structures.

However, another explanation for why more explicit anaphors are used at episode beginnings and why referential access is more difficult at episode beginnings is the potential intervention of other concepts. Paragraph and episode beginnings are prime locations for introducing new topics and reintroducing old ones. Consider, for example, the speaker that Marslen-Wilson et al. (1982) studied. He typically used the most explicit anaphoric forms at what Marslen-Wilson et al. referred to as “event boundaries.” These event boundaries were also places where “the narrative was shifting focus among the main actors” (p. 355). Because introducing new concepts and reintroducing old concepts both trigger the suppression of other concepts, it might not be episode boundaries per se that underlie these relations; it might be the mechanism of suppression.

Suppression and enhancement and the advantage of the first-mentioned participant

In all six of the experiments reported here, at all test points, for antecedents, nonantecedents, proper names, and pronouns, the following effect was observed: First-mentioned participants were verified more rapidly than second-mentioned participants. On the average, first-mentioned participants enjoyed a 60 ms advantage. In other words, first-mentioned participants were more strongly enhanced and more resistant to being suppressed. What is the basis of this advantage? It does not arise from the tendency in English for first-mentioned participants to be agents. That is, the same advantage holds when the first-mentioned participants are semantic agents, as Ann is in

(26) Ann beat Pam in the state tennis match.

as when the first-mentioned participants are semantic patients, as Ann is in

(27) Ann was beaten.

Neither is the advantage found in second-mentioned participants to be semantic agents nor patients.

(28) Ann and Pam are.

In fact, the advantages are no longer the semantic ones.

(29) According to A.

Finally, the advantages in the somewhat new the first-mentioned stimulus sentences an adverbial phrase.

(30) Two weeks ago.

or whether the phrase.

(31) Ann mailed Par.

or whether the phrase.

(32) Ann mailed Par.

Thus, the advantage the other participant (Hargreaves, 1988).

We have suggested occur normally during press. Given that the phrasal of the information b foundation of this st participants, the first information, including must be added onto tioned participant. privileged place in this privileged position that improve referen... and they are more st...
the most explicit forms of
(Tomlin, 1987).

Let specifically demonstrate
order at the beginnings of
boundaries leads to pro-
ting new topics and rein-
the first-mentioned participants to be syntactic subjects; the advantage maintains when the first-
and second-mentioned participants share subjecthood, as *Ann* and *Pam* do in

(28) Ann and Pam argued with one another at the party.

In fact, the advantage maintains even when the first-mentioned participants are no longer the syntactic subjects of their sentences, as in

(29) According to Ann, Pam was a terrible loser.

Finally, the advantage is not due to the fact that in all the previous experiments in which the advantage was observed—including the six reported here—the first-mentioned participants were also the initial words of their stimulus sentences. That is, the advantage maintains regardless of whether an adverbial phrase such as *two weeks ago* is preposed, as in

(30) Two weeks ago Ann mailed Pam a box full of clothes.

or whether the phrase is postposed, as in

(31) Ann mailed Pam a box full of clothes two weeks ago.

or whether the phrase does not occur at all, as in

(32) Ann mailed Pam a box full of clothes.

Thus, the advantage must depend on each participant's position relative to the other participants (all of these findings are reported in Gernsbacher & Hargreaves, 1988).

We have suggested that the advantage arises from cognitive processes that occur normally during comprehension (Gernsbacher & Hargreaves, 1988, in press). Given that the goal of comprehension is to build a mental structure of the information being comprehended, initial information must form the foundation of this structure (Gernsbacher, 1989). In a sentence about two participants, the first-mentioned participant serves as the foundation; other information, including information about the second-mentioned participant, must be added onto the developing structure via connections to the first-mentioned participant. This process affords first-mentioned participants a privileged place in comprehenders' mental representations, and, because of this privileged position, they are affected in a special way by the mechanisms that improve referential access: They are more resistant to being suppressed and they are more strongly enhanced.
Suppression and enhancement as general cognitive mechanisms

Suppression and enhancement are *general* cognitive mechanisms; that is, I assume that they play a role in language comprehension processes other than referential access. For example, as mentioned earlier, suppression might contribute to a process I refer to as “fine tuning” the activation of lexical concepts, for instance, fine tuning the contextually appropriate meanings of ambiguous words (Gernsbacher, 1989; Gernsbacher & Faust, in press).

Suppression might also help fine tune the multiple associations of more typical, nonambiguous words. That is, even though all concepts have multiple associations, some associations are more relevant in certain contexts. For example, the association between *apple* and *pie* is more relevant in the context

(33) James baked the apples.

whereas the association between *apple* and *tree* is more relevant in the context

(34) James picked the apples.

Just like the multiple meanings of ambiguous words, multiple associations of unambiguous words are immediately activated. But after a brief period, only the more relevant association remains activated (Gernsbacher & Faust, in press). Again, the less relevant association’s loss of activation (like the less appropriate meaning’s loss of activation) might be attributable to the mechanism of suppression. Indeed, the inability to quickly get rid of the inappropriate association—which might result from a less efficient suppression mechanism—characterizes less-skilled comprehenders (Gernsbacher et al., 1989).

The mechanisms of suppression and enhancement might also underlie the loss of “surface” information as opposed to thematic information (Sachs, 1967, 1974). To understand how these mechanisms can account for this phenomenon, one must consider what surface information is. Typically, surface information is defined as information about a stimulus that does not contribute to its meaning. But another definition is that the surface properties of any stimulus are those that change the most rapidly. For example, consider a passage of text: If well composed, each sentence conveys the same thematic idea, but each sentence does not present the same syntactic form. Because the passage’s syntactic form changes more rapidly than its thematic contact, its syntactic form is considered surface information, while its thematic content is not.

Based on this definition, the mechanisms of suppression and enhancement explain why surface information is typically less accessible than thematic information. Because surface information is constantly changing, the newer

**Appendix A: Stimuli**

**NP1 sentences**

Bill handed John a bouquet of flowers immediately.

Jan went to visit Sara in New York.

Ned saw Dan standing in the rain.

Sharon walked Dan’s dog outside in the rain.

Jim poured a drink for his visiting mother.

Chuck saw that Dan had missed his chance for some help.

Carol took over for Dan, but it was a much better rainy day.

Helen interviewed Dan for a better news program.

Sara tutored Ann to her high school English test.

Fred loaned Mike a clump of cash for school long.

Greg watched Neil’s reaction to the stage curtain.
mechanisms

mechanisms; that is, I
tension processes other than
activation of thematic con-
tent, suppression might con-
trive to activate of thematic con-
lation. For example, assoc
for associations of more
concepts have multiple
in certain contexts. For
relevant in the context

surfaces, multiple associations of
after a brief period, only
Gernsbacher & Faust, in
activation (like the less
in a less efficient suppres-
Gernsbacher et

mg might also underlie the
information (Sachs, 1984). Processes can account for this
information is. Typically, sur-
a stimulus that does not
that the surface properties
. For example, consider
conveys the same thematic
syntactic form. Because
while its thematic content
pression and enhancement
accessible than thematic in-
stantly changing, the newer

surface information is constantly suppressing the old. In contrast, because
thematic information is constantly being reintroduced, it gets repeatedly en-
hanced. The net result is that thematic information is activated at a consider-
ably higher level than surface information.

Moreover, I propose that the mechanisms of suppression and enhancement
are so general that they underlie nonlinguistic skills as well. This commonality
might arise because—as Lieberman (1984) and others have suggested—lan-
guage comprehension evolved from other nonlinguistic cognitive skills. Or
the commonality might arise simply because the mind is best understood by
reference to a common architecture (e.g., a connectionist architecture). Both
proposals support the orientation that mechanisms that play a crucial role in
language comprehension—such as improving referential access—are general,
cognitive mechanisms.

Appendix A: Stimulus sentences for Experiments 1, 2, and 3

NP1 sentences

Bill handed John some tickets to a concert but Bill/he took the tickets back
immediately.

Jan went to visit Sue during the hospital’s visiting hours and Jan/she brought
a bouquet of flowers.

Ned saw Dan standing on the river bank and Ned/he waved hello from his
kayak.

Sharon walked Debbie over to the dentist’s office but Sharon/she waited
outside in the lobby.

Jim poured a drink for Don that was really quite strong and Jim/he poured
a drink for himself.

Chuck saw that Danny was in very serious trouble and Chuck/he ran quickly
for some help.

Carol took over for Ellen all the household laundry chores and Carol/she did
a much better job.

Helen interviewed Julie about cheating in college courses but Helen/she re-
used to answer some questions.

Sara tutored Anna in history, math, and English and Sara/she charged ten
dollars an hour.

Fred loaned Mike a blue ball point pen but Fred/he wanted it back before
long.

Greg watched Neil act in a broadway play and Greg/he applauded at the final
curtain.
Shawn saved Brent from drowning in the creek and Shawn/he quickly became a hero.
Alice received from Jenny one of those chain letters but Alice/she did not continue the chain.
Thomas wanted to tell Edward the exciting and unexpected news but Thomas/he couldn't find a nearby phone.
Paula borrowed a book from Vicky all about the Civil War but Paula/she never even gave the book back.
Susan stood up until Nancy had brought in another chair then Susan/she sat down on the new chair.
David saw that Brian was fixing a flat tire and David/he stopped to offer some help.
Cindy described to Janet how life was in Detroit but Cindy/she didn't mention the terrible pollution.
Cathy wouldn't accept from Donna a check for the amount but Cathy/she would accept a credit card.
Amy inherited from Kim a very substantially large fortune and Amy/she spent all the money foolishly.
Alex broke a leg while skiing with Hank at a very expensive resort and Alex/he had to leave on crutches.
Jill lost to Ruth in the state tennis match but Jill/she accepted the major defeat gracefully.
James saw Keith outside stealing a parked car but James/he did not call the police.
Margaret was being tickled by Cheryl while they were watching TV but Marsha/she managed not to laugh aloud.
George aimed a pistol at Robert that looked like a toy but George/he did not pull the trigger.
Richard wrapped a gift for Charles that was a big surprise and Richard/he hid it away in the closet.
Betty was knitting a scarf for Diane for an early Christmas present but Betty/she did not have enough yarn.
Randy was amusing Jerry by doing some fancy acrobatics but Randy/he slipped and broke an arm.
Phil made sure that Dick was already very sound asleep and Phil/he tiptoed quietly out of the house.
Tina bought a car from Lisa that was eight years old and Tina/she was pleased with its performance.
Linda made Debra a rich chocolate pound cake and Linda/she used an old fashioned recipe.
Sam handed Ray the telephone in the den after Sam/he had gotten tired of talking.

NP₂ sentences

Ann predicted that Frank wouldn't pose for her very easily.
Andy tried to beat Gary of course every time.
Penny accused Wendell of being convicted of the crime.
Jane waited for Mary to arrive half hour late.
Peg gave Eve some dancing lessons.
Barb wanted a snapshot of them but she wouldn't pose for it.
Ron spilled a drink onto his shirt and he had to change clothes immediately.
Fay found out that Bill's knee needed a speedy recovery.
Dawn asked Cher to join her in the pool.
Stan pitched Russ a winning set.
Rob blamed Ted for his failure.
Joel loaned Kent some money a week later.
Patty sent Becky a check immediately.
Walter expected Ron to change trains.
Sally asked Karen to cancel other plans.
Donald sent Michael a box of chocolates with several saccharine notes.
Michelle called Shirlie to order the third ring.
Tommy passed the football to his brother in for a touchdown.
Brenda urged Patsy to trade them.
Ralph went to visit Linda on a vacation.
Sandra gave Elaine the advice seriously.
Shawn/he quickly became  
bers but Alice/she did not  
pected news but Thomas/  
Civil War but Paula/she  
chair then Susan/she sat  /h stopped to offer some  
Cindy/she didn't mention  
e amount but Cathy/she  
ge fortune and Amy/she  
y expensive resort and  /she accepted the major  
James/he did not call the  
watching TV but Marsha/  
a toy but George/hc did  
surprise and Richard/he  
ristmas present but Betty/  
robatics but Randy/he slip-  
sleep and Phil/he tiptoed  
and Tina/she was pleased  
and Linda/she used an old  
un/he had gotten tired of  

$NP_2$ sentences

Ann predicted that Pam would lose the track race but Pam/she came in first  
very easily.  
Andy tried to beat Gary in a game of chess but Gary/he managed to win  
evry time.  
Penny accused Wendy of committing a big robbery and Wendy/she was con­  
victed of the crime.  
Jane waited for Mary in the fancy restaurant lounge and Mary/she arrived a  
half hour late.  
Peg gave Eve some directions to the zoo and Eve/she had no trouble following  
them.  
Barb wanted a snapshot of Lynn in front of the museum but Lynn/she  
wouldn't pose for the camera.  
Ron spilled a drink on Joe at the New Year's party and Joe/he went home  
to change clothes.  
Fay found out that Meg was feeling a little sick but Meg/she made a very  
speedy recovery.  
Dawn asked Cher to pick out a card and Cher/she drew the ace of diamonds.  
Stan pitched Russ a very fast curve ball and Russ/he hit it into the outfield.  
Rob blamed Ted for causing the car accident but Ted/he was really not at  
fault.  
Joel loaned Kent some tools for the garden and Kent/he returned them a  
week later.  
Patty sent Becky a check for twenty dollars and Becky/she cashed the $20  
check immediately.  
Walter expected Ronald to arrive on the train but Ronald/he was not on the  
train.  
Sally asked Karen to play a round of golf but Karen/she had already made  
other plans.  
Donald sent Michael to do the grocery shopping and Michael/he returned  
with several sacks.  
Michelle called Shirley on a special wats line and Shirley/she answered on the  
third ring.  
Tommy passed the football to Ricky on a third down play and Ricky/he ran  
it in for a touchdown.  
Brenda urged Patsy to apply to law school and Patsy/she got accepted in the  
fall.  
Ralph went to visit Larry onc rainy afternoon in July but Larry/he was away  
on a vacation.  
Sandra gave Elaine some truly heart felt advice but Elaine/she didn't take  
the advice seriously.
Harold tied Arnold to a chair in the basement but Arnold/he was able to get loose.

Steven locked Clarke out of the house accidentally and Clarke/he broke in through a window.

Lucy mailed Suzy a package of top secret information and Suzy/she received it within a week.

Kate thought that Joan was hard at work studying but Joan/she had gone to a movie.

Bob punched Tim during a bar room brawl and Tim/he got a terrible black eye.

Dave tried to amuse Rick with a somewhat off-color joke but Rick/he didn’t even laugh at it.

Jeff begged Paul to play a game of handball and Paul/he reluctantly agreed to play.

Kay gave Bev a very long and nagging lecture and Bev/she listened to it very patiently.

Tom scratched Ken with a pocket knife accidentally and Ken/he started bleeding from the wound.

Lois cleaned the house for Rita for several hours one day while Rita/she took a nap on the sofa.

Abe threw a pie at Roy that was big and gooey but Roy/he ducked before it could hit.

Tina invited Lisa to a party. After extending the invitation, Tina/she was very happy.

After accepting the invitation, Lisa/she was very happy.

Kay painted a portrait of Ellen for her birthday. After painting for several hours, Kay/she was very tired.

After posing for several hours, Ellen/she was very tired.

Carol tempted Ellen with ice cream. After providing the temptation, Carol/she felt very guilty.

Giving in to the temptation, Ellen/she felt very guilty.

Dick beat Phil in a game of cards. Being a horrible winner, Dick/she was very pleased.

Being a terrible loser, Phil/she was very unhappy.

Kate repeated the question to Joey. Not having spoken clearly, Kate/she started talking very loudly.

Not having heard clearly, Joey/she started talking very loudly.

Thomas watched Edward watch a movie. After watching several minutes, Thomas/she was bored.

After watching several minutes, Edward/she was bored.

Bob borrowed some money from Ken. Grateful for the loan, Bob/she gave Ken a dollar.

Generous with the loan, Ken/she gave Bob a dollar.

Gina greeted Judy with a big hug. While giving the welcome, Gina/she was very happy.

While giving the welcome, Judy/she was very happy.

Lucy laughed very loudly. Out of breath from laughter, Lucy/she was very happy.

Annoyed by being laughed at, Lucy/she was very unhappy.

Doug rescued Mark from drowning. Enjoying being a hero, Doug/she gave Mark a kiss.

Eternally grateful, Mark/she gave Doug a kiss.

John aimed a water gun at Bill. Ready to shoot, John/she was very happy.

Ready to duck, Bill/she was very unhappy.
Arnold he was able to get y and Clarke he broke in tion and Suzy she received but Joan she had gone to 'im got a terrible black for joke but Rick he didn't Paul he reluctantly agreed Bev she listened to it very mentally and Ken he started it Roy he ducked before it

Tina invited Lisa to a dinner party.
After extending the invitation, Tina she hoped it would be fun.
After accepting the invitation, Lisa she hoped it would be fun.
Kay painted a portrait of Bev.
After painting for several hours, Kay she was pleased with the portrait.
After posing for several hours, Bev she was pleased with the portrait.
Carol tempted Ellen with a box of candy.
After providing the temptation, Carol she thought about all the calories.
Giving in to the temptation, Ellen she thought about all the calories.
Dick beat Phil in a game of chess.
Being a horrible winner, Dick he talked about the game forever.
Being a terrible loser, Phil he talked about the game forever.
Kate repeated the question for Joan.
Not having spoken clearly the first time, Kate she tried even harder to concentrate.
Not having heard clearly the first time, Joan she tried even harder to concentrate.
Thomas watched Edward jog around the park.
After watching several laps, Thomas he got a drink of water.
After jogging several laps, Edward he got a drink of water.
Bob borrowed some money from Tim.
Grateful for the loan, Bob he felt a sense of comradery.
Generous with the loan, Tim he felt a sense of comradery.
Gina greeted Judy with hugs and smiles.
While giving the warm welcome, Gina she began to get teary eyed.
Surprised by the warm welcome, Judy she began to get teary eyed.
Lucy laughed very loudly at Suzy.
Out of breath from laughing, Lucy she got quiet for minute.
Annoyed by being laughed at, Suzy she got quiet for a minute.
Doug rescued Mark from a burning building.
Enjoying being a hero, Doug he talked about it for years.
Eternally grateful, Mark he talked about it for years.
John aimed a water pistol at Bill.
Ready to shoot, John he thought of a better idea.
Ready to duck, Bill he thought of a better idea.
Jack taught Dave how to paint a house.
Being a good teacher, Jack/he made the job seem easy.
Being a good student, Dave/he made the job seem easy.

Jeff handed the telephone to Paul.
After letting go of the receiver, Jeff/he sat down on a chair.
After taking hold of the receiver, Paul/he sat down on a chair.

Sally saw Karen fall down some stairs.
Running for the doctor, Sally/she needed to find some help.
Calling out in pain, Karen/she needed to find some help.

Alex mowed the front lawn for Hank.
After finishing the mowing, Alex/he trimmed all of the hedges.
While the yard was being mowed, Hank/he trimmed all of the hedges.

Alan nominated Gary for class president.
After making the nomination, Alan/he was excited about the future.
After winning the election, Gary/he was excited about the future.

Jill angrily yelled at Ruth.
Feeling guilty for yelling, Jill/she was sorry the incident occurred.
Not enjoying being yelled at, Ruth/she was sorry the incident occurred.

Lois cleaned the house for Rita.
After finishing the housework, Lois/she took an afternoon nap.
While the housework was being done, Rita/she took an afternoon nap.

Barb promised Lynn that the tickets would be picked up early in the morning.
Not remembering the promise until afternoon, Barb/she drove to the box office.
After realizing the promise had been broken, Lynn/she drove to the box office.

Ron gave Joe a ride to school.
While parking the car in the lot, Ron/he was thinking about first period.
While getting out at the corner, Joe/he was thinking about first period.

Abe found a pen that belonged to Roy.
After realizing who it belonged to, Abe/he looked around for another pen.
After realizing that it was missing, Roy/he looked around for another pen.

Arnold told Harold about the new movie.
After giving the review, Arnold/he daydreamed about being the hero.
After hearing the review, Harold/he daydreamed about being the hero.
Amy picked up the cleaning for Kim.
Glad to do the favor, Amy/she thought about their special friendship.
Appreciating the favor, Kim/she thought about their special friendship.

Ann scared Pam by sneaking up.
Not meaning to cause an alarm, Ann/she started feeling a little foolish.
After calming down considerably, Pam/she started feeling a little foolish.

Fred lit a cigarette for Mike.
Blowing out the match, Fred/he watched the smoke flow upwards.
Puffing on the cigarette, Mike/he watched the smoke flow upwards.

Stan visited Russ in the hospital.
Hating to even visit hospitals, Stan/he was not feeling very talkative.
Having just had major surgery, Russ/he was not feeling very talkative.

Anna mailed a package to Sara.
Sending the package first class, Anna/she hoped it would arrive quickly.
Eager to receive the package, Sara/she hoped it would arrive quickly.

Sharon told Debbie the awful truth.
After having said it, Sharon/she hoped it wouldn't be repeated.
After having heard it, Debbie/she hoped it wouldn't be repeated.

Andy threw a big cream pie at Rick.
Not being a good aim, Andy/he watched the pie hit the wall.
Not being a good target, Rick/he watched the pie hit the wall.

Rob convinced Ted to apply to college.
After spending several hours convincing, Rob/he waited to hear the decision.
After spending hours on the application, Ted/he waited to hear the decision.

Deb loaned twenty dollars to Liz.
Able to spare the cash, Deb/she felt good about the transaction.
Needing to pay some bills, Liz/she felt good about the transaction.

Joel accused Kent of denting the car.
Strongly repeating the charges, Joel/he began to get very angry.
Strongly denying the charges, Kent/he began to get very angry.

Neil broke a glass that belonged to Greg.
After offering to replace it, Neil/he looked around for the broom.
After saying not to worry about it, Greg/he looked around for the broom.

Jerry locked Billy out of the house.
After realizing the mistake was made, Jerry/he put a key under the mat.
After breaking in through a window, Billy/he put a key under the mat.
Dan always read the newspaper to Ned. 
Though hating to read out loud, Dan/he liked knowing about current events. 
Having been blind since birth, Ned/he liked knowing about current events.

Laura dunked Alice in the swimming pool. 
After doing such a mean thing, Laura/she reached for the pool side. 
After coming up from the water, Alice/she reached for the pool side.

Cindy sang an original song for Janet. 
Carefully listening to the words, Janet/she wanted to cherish the meaning. 
Carefully pronouncing the words, Cindy/she wanted to cherish the meaning.

Cheryl told Evette a very important secret. 
After telling just that one person, Cheryl/she kept the secret strictly confidential. 
After swearing not to tell anyone, Evette/she kept the secret strictly confidential.

Cathy received a chain letter from Donna. 
After having sent the letter weeks ago, Donna/she practically forgot all about it. 
After trying to figure out who it was from, Cathy/she practically forgot all about it.

Walter built Ronald a bird feeder. 
After finishing the feeder, Walter/he hoped the birds liked it. 
After receiving the feeder, Ronald/he hoped the birds liked it.

Donald carried a heavy box for George. 
Being strong enough to lift it, Donald/he wondered what could be inside. 
Being too weak to lift it, George/he wondered what could be inside.

Jeffrey congratulated Michael on the successful deal. 
After accepting the congratulations, Michael/he bought a round of drinks. 
After offering the congratulations, Jeffrey/he bought a round of drinks.

Susan made a chocolate cake for Nancy. 
Using an old fashioned recipe, Susan/she knew it would taste good. 
Receiving the old fashioned gift, Nancy/she knew it would taste good.

Brenda fixed Sherry up on a blind date. 
Enjoying being a match-maker, Brenda/she looked forward to the date. 
Enjoying being matched up, Sherry/she looked forward to the date.

David got a postcard from Robert. 
Though jealous about the vacation, David/he enjoyed staying in touch with friends.

While vacationing in friends.

Michelle cooked Sherry up enough.

Seeing all that had prepared the

Danny splashed Larry down the

After setting down the

James passed the food

After offering the

Paula helped Patty in the

After being kindly

Peggy saved a place

After taking the saved

Lilly read Denise the

After finishing the story

Frank scolded the dog

While hearing the scolded

Clark embarrassed Richard

Watching his friend's

Feeling his cheeks be

Richard called the fire

After calling for the fire

Waiting to be rescued.
While vacationing in Mexico, Robert he enjoyed staying in touch with friends.

Michelle cooked Shirley a seven course meal. While preparing the huge meal, Michelle she hoped everyone was hungry enough. Seeing all that had been prepared, Shirley she hoped everyone was hungry enough.

Helen picked some flowers to give to Julie. After gathering a bouquet, Helen she liked the way it smelled. After receiving the bouquet, Julie she liked the way it smelled.

Danny splashed Larry with the garden hose. After setting down the hose, Danny he ran off across the lawn. After getting completely soaked, Larry he ran off across the lawn.

James passed the football to Keith. After watching the touchdown, James he envisioned the possibility of victory. After running for a touchdown, Keith he envisioned the possibility of victory.

Paula helped Patty across the stream. After offering assistance, Paula she looked back across the stream. After being kindly assisted, Patty she looked back across the stream.

Peggy saved a place in line for Maria. After standing in line for an hour, Peggy she hoped the play was enjoyable. After taking the saved place in line, Maria she hoped the play was enjoyable.

Lilly read Denise the tragic novel. After finishing the story, Lilly she began reflecting upon life's hardships. After hearing the story, Denise she began reflecting upon life's hardships.

Frank scolded the puppy for chewing a shoe that belonged to Wayne. After scolding the dog, Frank he examined the torn up shoe. While hearing the scolding, Wayne he examined the torn up shoe.

Clark embarrassed Ralph in a group of people. Watching his friend's cheeks turn red, Clark he wished nothing had ever been said. Feeling his cheeks begin to turn red, Ralph he wished nothing had ever been said.

Richard called the firemen to save Charles. After calling for the rescue, Richard he was eager for their arrival. Waiting to be rescued, Charles he was eager for their arrival.
Steve showed Randy how to build a fire.
Having known how for years, Steve/he appreciated a good warming fire.
Never having known how, Randy/he appreciated a good warming fire.
Sam bought a birthday present for Ray.
Wrapping the present, Sam/he was pleased with the selection.
Opening the present, Ray/he was pleased with the selection.
Sue poured a cup of coffee for Jan.
Filling the cup too full, Sue/she spilled the coffee all over.
Reaching for the cup too soon, Jan/she spilled the coffee all over.
Opening the present, Rand/she appreciated a good warming fire.

References

a good warming fire.

bed a cocktail olive.

for dinner.

bed a cocktail olive.

a good warming fire.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.

a good warming fire.

coff ee all over.

a good warming fire.

stabbed a cocktail olive.

bed a cocktail olive.

for dinner.

for dinner.

the selection.

the selection.

the selection.

the selection.


Résumé

Deux mécanismes, la suppression améliore l'accessibilité de l'information améliore l'accessibilité de l'information. On peut supposer que c'est le cas pour la suppression améliore l'accessibilité de l'information. Six expériences ont été utilisées pour vérifier cette hypothèse.
Résumé

Deux mécanismes, la suppression et l'augmentation sont proposés pour améliorer l'accès référentiel. L'augmentation améliore l'accessibilité de concepts déjà mentionnés en accroissant ou accentuant leur activation; la suppression améliore l'accessibilité de certains concepts en diminuant ou atténuant l'activité d'autres concepts. On peut supposer que ces mécanismes sont déclenchés par le contenu informationnel des anaphores. Six expériences ont étudiées cette proposition en utilisant une référence anaphorique constituée soit d'un nom
très explicite ou d’un pronom moins explicite. Les sujets lisaient des phrases qui présentaient deux participants dans leur première proposition, par exemple, “Ann annonça que Pam perdrait la course” et ce référaient à l’un des deux participants dans leur seconde proposition, “mais Pam/elle arriva très facilement la première.” Pendant la lecture de chaque phrase, le niveau d’activation des deux participants était mesuré par un test de vérification de cible. Les deux premières expériences ont montré que les anaphores constituées de noms explicites répétés déclenchent immédiatement l’activation de leurs propres antécédents et la suppression des autres participants (non-antécédents). La troisième expérience a montré que les anaphores constituées de pronoms moins explicites déclenchent également la suppression des autres non-antécédents, mais qu’ils le font plus lentement, même lorsque, comme dans la quatrième expérience, l’information sémantique nécessaire pour identifier les antécédents se situe avant les pronoms (ex. : “Ann annonça que Pam perdrait la course. Mais après avoir gagné la course, elle ...”). La cinquième expérience a montré que des pronoms plus explicites—pronoms qui correspondent au genre d’un seul participant—provocuent la suppression de manière plus efficace. La dernière expérience a montré que les participants qui avaient déjà été cités n’étaient pas les seuls à améliorer leur accès référentiel par le déclenchement de la suppression des autres participants, les participants venant d’être présentés provoquant le même phénomène (ex. : “Ann annonça que Pam perdrait la course, mais Kim ...”). Ainsi, la suppression et l’augmentation améliorent l’accès référentiel et la contribution de ces deux mécanismes dépend du caractère plus ou moins explicite de la référence. Le rôle de ces deux mécanismes dans d’autres phénomènes relatifs à l’accès référentiel est également discuté.

Received June 1988; final re

Abstract

Martin, R.C., Wetzel, W.F., and van Grunsven’s (1988) syntactic comprehension deficits were evaluated who showed memory deficits as the predicted worse perfor

This research was supported by National Institute of Communicative Disorders and Stroke. Reproductions should be addressed to William Badecker and Steven L. Cognition, 32 (1989) 157-191.

M. A. Gernsbacher