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Accessing Sentence Participants: The Advantage of First Mention

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We investigate the following finding concerning the order in which participants are mentioned in sentences: In a probe recognition task, probe words are responded to considerably more rapidly when they are the names of the first- as opposed to the second-mentioned participants. Seven experiments demonstrated that this advantage is not attributable to the tendency in English for first-mentioned participants to be semantic agents; neither is it due to the fact that in many of our experiments, the first-mentioned participants were also the initial words of their stimulus sentences. Furthermore, the advantage is not attenuated when the first- and second-mentioned participants share syntactic subjecthood, or even when the first-mentioned participants are not the syntactic subjects. In sum, the effect does not appear to be attributable to linguistic factors. We suggest instead that it is the result of cognitive processes: Building a coherent mental representation requires first laying a foundation and then mapping subsequent information onto the developing representation. First-mentioned participants are more accessible because they form the foundations for their sentence-level representations and because it is through them that subsequent information gets mapped onto the developing representations.

Primacy effects are frequently documented in the psychological literature. They emerge in domains varying from impression formation—attributes encountered first figure more prominently in the impression that is formed of a novel person (Srull & Wyer, 1979)—to verbal learning—items presented first in a list have the highest probability of being remembered (Murdock, 1962).

In this paper we investigate a very robust primacy effect. We believe that this effect says something about how people construct mental representations of sentences. We admit, however, that when we first observed the effect, we considered it more a nuisance than a finding. Perusing the literature, we discovered that a handful of other researchers had observed the same effect, considered it in the same light, and therefore mentioned it only in passing.

The effect emerges from the following experimental task: Subjects read or hear a series of sentences, and at some point, they read or hear a probe word. Their job is simply to verify whether the probe word occurred in the previous material, and their verification latencies compose the dependent variable (Caplan, 1972; Chang, 1980; Corbett & Chang, 1983; McKoon & Ratcliff, 1980).

One of us recently used this task as a tool for understanding how comprehenders deal with anaphora (Gernsbacher, 1988). The stimulus sentences in that study always involved two participants who were initially referred to by first names (e.g., *Tina, Lisa*), and often re-referred to by anaphoric pronouns. After reading each sentence, subjects respond to a probe word, which on the experimental trials was the name of one of the two participants.

Across six experiments, several factors were manipulated that affected how smoothly subjects comprehended the anaphoric pronouns. Yet, despite these various manipulations, and in addition to the various results observed about anaphora, the

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following effect appeared again and again: Names of the first-mentioned participants were responded to dramatically faster—an average 60 ms faster—than names of the second-mentioned participants.

We were preceded in this discovery by Corbett and Chang (1983) and Von Eckhardt and Potter (1985). We want to point out that Corbett and Chang (1983) reported the same effect even though they included filler trials in which the probe words were words other than participant names. So the effect does not depend on subjects explicitly monitoring for the names of sentence participants.

Structure Building and Order of Mention

One explanation of this effect is based on the framework described by Gernsbacher (1984; 1985). According to this framework, the goal of comprehension is to build a coherent mental representation or "structure" of the information being comprehended. To build this structure, the comprehender first lays a foundation based on the information he or she initially receives. After laying the foundation, the comprehender develops the structure. If incoming information is congruent with or related to the previous information, it is mapped onto the developing structure. However, if the incoming information is less congruent, it is less likely to be mapped onto the developing structure. Instead, the comprehender might shift and initiate a substructure branching off from the original structure. Thus, the mental representation of the entire stimulus usually comprises several substructures.

Presumably, laying a foundation consumes cognitive capacity that should be manifested behaviorally in increased comprehension time. A large body of converging data supports this assumption. For instance, word-by-word reading times demonstrate that the initial words of a sentence take longer to read than subsequent words (Aaronson & Ferres, 1983; Chang, 1980). In fact, the same word is read more slowly when it occurs at the beginning of a sentence or phrase than when it occurs at the end (Aaronson & Scarborough, 1976).

Similarly, sentence-by-sentence reading times demonstrate that initial sentences of a paragraph take longer to read than subsequent ones (Cirilo, 1981; Cirilo & Foss, 1980; Glanzer, Fischer, & Dorfman, 1984; Graesser, 1975; Haberlandt, 1980, 1984; Haberlandt, Berian, & Sandson, 1980; Haberlandt & Bingham, 1978; Olson, Duffy, & Mack, 1984). This effect is observed regardless of where the paragraph's topic sentence occurs (Greeno & Noreen, 1974; Kieras, 1978, 1981). In addition, the first sentence of a story's subepisode or constituent takes longer to read than other sentences in the constituent (Haberlandt, 1980, 1984, Haberlandt et al., 1980; Mandler & Goodman, 1982).

Finally, with auditory comprehension, latencies to detect a target phoneme or word are also longer when the target occurs during the beginning of a sentence or phrase than later (Cairns & Kamerman, 1975; Cutler & Foss, 1977; Foss, 1969; 1982; Hakes, 1971; Marslen-Wilson et al., 1978; Shields, McHugh, & Martin, 1974).

All of these data display the pattern expected if comprehenders use initial stimuli (words or sentences) to lay a foundation for their mental representations of phrases, sentences, story constituents, or paragraphs. But this pattern is not displayed when the stimuli do not lend themselves to coherent mental representations—for example, when the sentences or paragraphs are self-embedded or extensively right branching (Foss & Lynch, 1969; Greeno & Noreen, 1974; Hakes & Foss, 1970; Kleras, 1978, 1981).

In addition, sentences are recalled better when cued by their first content words or by pictures of those first content words than when cued by later occurring words (Bock & Irwin, 1980; Prentice, 1967; Turner & Rommetveit, 1968); similarly, story constituents are recalled better when cued by their first as opposed to later occurring sentences (Mandler & Goodman, 1982). Such data support the proposal that initial stimuli form the foundation onto which subsequent information is added. In fact, initial stimuli play such a fundamental role in organizing mental structures that when asked to recall the main idea of a paragraph, subjects are most likely to select the initial sentence even when the actual theme is a later occurring sentence (Kieras, 1980).

We suggest that the processes involved in building mental structures—in particular, the processes of laying a foundation and mapping subsequent information onto that foundation—underlie the primacy effect we spoke about earlier: Participants mentioned first in a sentence are more accessible than participants mentioned second. This is because foundations can be based only on the information that comprehenders initially receive; thus, first-mentioned participants serve as the foundation for their sentence-level representations. In addition, after a foundation is laid, subsequent information must be mapped onto that foundation. Thus, first-mentioned participants achieve even more accessibility because it is through them that subsequent information—including information about the second-mentioned participants—becomes represented.

To reiterate, we propose that the greater accessibility of first-mentioned participants is a function of the way that comprehenders build their mental structures: First-mentioned participants form the foundation of sentence-level representations, and therefore the remainder of the sentences is represented vis-à-vis those initial participants.

Our proposal resembles the following idea advanced by MacWhinney (1977) in a paper aptly titled, *Starting Points:* "The speaker uses the first element in the English sentence as a starting point for the organization of the sentence as a whole. Similarly, the listener uses the first element in a sentence as a starting point in comprehension. Both the speaker and the listener seem to use special techniques for attaching the body of the sentence to the starting point" (p. 152).

However, there are other reasons why first-mentioned participants might be more accessible. For instance, it may well be a manifestation of the linguistic structure of English: First-mentioned participants in declarative sentences are virtually always the syntactic relation known as "subject," and typically also the semantic role considered "agent." Our goal in the present research was to untangle linguistic and other factors from a factor we called simply "order of mention."

To do this, we conducted seven experiments using the laboratory task described above. That is, subjects read sentences about two participants, and after each sentence, they rapidly verified whether a probe word had occurred.

Experiment 1

The first factor that we wanted to untangle from order of mention was semantic role. In all our previous studies, the first-mentioned participants were always their sentences' agents. Perhaps the effect we observed for order of mention was actually an effect of agency. Agents might gain a privileged place in comprehenders' mental representations because of several linguistic and psycholinguistic reasons. Experimental data suggest that agents tend to be more animate (Clark, 1965; Johnson, 1967), more active (Osgood, 1971), more imaginable (James, 1972; James, Thompson, & Baldwin, 1973), more positively evaluated (Johnson, 1967), and so forth. Because of these characteristics, several theorists have suggested that agents are more likely to attract attentional focus (Zubin, 1979), stimulate empathy (Kuno & Kabaraki, 1977), and match the speaker or listener's perspective (MacWhinney, 1977). Descriptive data also suggest that agents are more likely

to be their sentences' subjects (Greenberg, 1963), topics (Givón, Ed., 1983), and themes (Tomlin, 1983).

In sum, on many dimensions, agents hold an advantage over patients. Given that only rarely (outside of psycholinguistic experiments) are agents not first mentioned, it could well be that the effect we observed for order of mention is really an effect of agency.

We investigated this possibility in Experiment 1 by manipulating two variables: semantic role, whether the probe words were the names of the agents versus the patients, and order of mention, whether the probe words were the names of the first- versus the second-mentioned participants. In other words, we took advantage of the active versus passive construction in English.

Method

Subjects. The subjects were 96 undergraduates at the University of Oregon. Like all the subjects in the following experiments, they were native English speakers who participated in return for course credit or pay.

Materials and design. We constructed 32 sentence sets; an example appears in Table 1. Each sentence set comprised four versions of a prototype sentence. In two of the four versions, the probe names were the agents (AGT) and either the first- or second-mentioned participants. We shall refer to these two versions as AGT 1 and AGT 2, respectively. In the other two versions, the probe names were the patients (PAT) and either the first- or second-mentioned participants. We shall refer to these two versions as PAT 1 and PAT 2, respectively.

TABLE 1
EXAMPLE SENTENCE SET FOR EXPERIMENTS 1 AND 2

Version	Example sentence
AGT 1	Tina beat Lisa in the state tennis match.
AGT 2	Lisa was beaten by Tina in the state tennis match.
PAT 1	Tina was beaten by Lisa in the state tennis match.
PAT 2	Lisa beat Tina in the state tennis match.

Note. The example probe word for all sentences is Tina.

Like the example shown in Table 1, all 32 sentence sets had the structure, NP_1 *Ved* NP_2 *Adverbial,* when the agents were the first-mentioned participants, and NP_1 *was Ved by* NP_2 *Adverbial* when the agents were the second-mentioned participants. The adverbials were five-word temporal or locative phrases.

Two common, American, first names were randomly assigned to each sentence set. As in all the experiments reported here, the two names were matched for gender, perceived familiarity, and relative length (in number of characters and syllables). Across all experimental 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. One name of each pair was randomly selected as the probe name.

Thirty-two lure sentences were constructed whose probe names had not occurred in their respective sentences. The lure sentences resembled the experimental sentences in syntactic form: Half (16) were in the active voice, and half were in the passive voice.

To ensure adequate comprehension and to encourage subjects to attend to all aspects of the sentences (not just the participants' names), each experimental sentence was followed by a two-alternative WH-question. A third of the questions asked about the temporal or locative setting of the action (i.e., the adverbial). For example, for the sentence set given in Table 1 this type question would be "When did Tina beat Lisa?" or "When did Lisa beat Tina?" Another third of the questions asked about the action that the participants edged in, for example, "What did Tina do?" or "What did Lisa do?" And the final third asked about the identity of the agents or patients, for example, "Who did Tina beat?" or "Who did Lisa beat?"

Four material sets were formed by randomly assigning one of the four versions of each sentence set to each material set. Therefore, across the four material sets, each prototype sentence occurred in all four of its versions. But within each material set, each prototype sentence occurred in only one of its four versions. There were eight different AGT 1, AGT 2, PAT 1, and PAT 2 type sentences in each material set. Twenty-four subjects were randomly assigned to each material set; in this way, each subject was exposed to only one version of a sentence set.

Procedure. A trial began with a warning signal, which was a plus sign appearing for 750 ms in the center of the screen. After the warning signal disappeared, each word of the sentence appeared (also in the center of the screen). The display time for each word was a function of its number of characters plus a constant. The constant was 300 ms and the function was 16.667 ms per character. The interval between words in the sentences and between the last word in each sentence and its probe name was 150 ms. The probe names appeared in capital letters at the top of the screen and remained on the screen until the subjects responded or 3 s elapsed. Subjects responded by pressing one of two response keys; one was labeled "yes," the other labeled "no."

For each experimental sentence, 250 ms following the offset of the probe name, the word *Test* appeared toward the bottom of the screen to warn subjects of an upcoming comprehension question. This warning signal remained on the screen for 750 ms, after which the comprehension question appeared and, below it, two answer choices. One answer choice was positioned toward the left side of the screen, and the other toward the right side. Subjects pressed the left-most response key to select the answer on the left or the right-most response key to select the answer on the right. The correct answer choices appeared equally often on each side of the screen. The questions and answer choices remained on the screen until either the subjects responded or 10 s elapsed. After responding, the subjects were given feedback about their accuracy.

Subjects responded with their dominant hand, using their index finger to press one key and middle finger to press another key. Subjects were replaced if they failed to meet the following criteria: 90% accuracy at responding to experimental probe names (requiring a "yes" response), 90% accuracy at responding to lure probe names (requiring a "no" response), and 75% accuracy at answering the two-choice comprehension questions.

Results

The means of the subjects' average correct responses are graphed in Fig. 1. These average response times were submitted to a repeated measures analysis of variance (ANOVA), as were the average response times for each sentence set. The results we report are based on the *minF'* statistic (Clark, 1973).

A 2 (semantic role: agent vs. patient) by 2 (order of mention: first vs. second) ANOVA revealed only a reliable main ef-

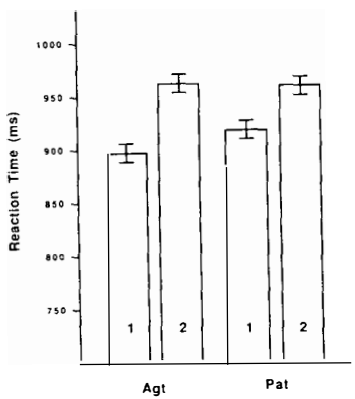

FIG. 1. Subject's average correct response times from Experiment 1.

fect of order of mention: First-mentioned participants were responded to 54 ms faster than second-mentioned participants, $minF'(1,99) = 8.940$, $p < .005$. The main effect of semantic role was not reliable, $minF'(1,89) = .44$; neither was the interaction between the two variables, $minF'(1,127) = 1.060$, $p > .25$.

Although the statistical interaction was not reliable, the data hinted that the first-mentioned participants' advantage might be weaker for the patients (42 ms) than the agents (67 ms). And, although we felt confident in our sample sizes of 96 subjects and 48 sentences, we entertained the possibility that we might be prematurely accepting the null hypothesis. So, as a conservative measure, we conducted the following replication experiment.

Experiment 2: Replication

We tested an additional 120 subjects using the same materials and procedures as we used in Experiment 1. We analyzed the data in the same fashion, and the results were identical. The interaction between order of mention and semantic role was still not reliable according to conventional standards, $minF'(1,89) = 2.138$, $p > .10$. Neither was the main effect of semantic role, $minF'(1,155) = 0.68$. In contrast, the main effect of order of mention was again highly reliable: First-mentioned participants were responded to 76 ms faster than second-mentioned participants, $minF'(1,143) = 30.47$, $p < .00001$.

From the results of Experiments 1 and 2, we draw two simple conclusions: First, comprehenders' mental representations must be constructed in such a way that first-mentioned participants are reliably more accessible than second-mentioned participants. Second semantic role does not appear to be the factor underlying the advantage. In other words, the greater accessibility of first-mentioned participants is not because of their tendency to be agents in English sentences.

Experiment 3

The second factor that we wanted to untangle from order of mention was what we shall call roughly "initial position in the sentence." In all the experiments in which we observed an advantage of first mention, the first-mentioned participants were also the first words of their respective sentences. We wondered whether that was the basis of their advantage. If so, it was possible that our laboratory paradigm was accentuating this effect, given that the first word of each sentence was always preceded by an attention-getting warning signal, which was itself preceded by a brief blank period.

So in Experiment 3 we investigated whether the first-mentioned participants' advantage arose simply from their occurring as the initial words in their stimulus sentences. (We admit this was one of our less interesting hypotheses, but it clearly deserved investigation.) We investigated this by manipulating the position of an adverbial phrase in an active sentence. The adverbials were preposed (at the beginning of the sentences), postposed (at the end of the sentences), or they did not occur at all. When the adverbials were preposed, the first-mentioned participants were no longer the initial words of their sentences. But they regained that status when the adverbials were postposed or omitted. Again we manipulated order of mention, whether the probe names were the first- versus second-mentioned participants.

Method

Subjects. The subjects were 96 undergraduates at the University of Oregon.

Materials and design. We constructed 48 sentence sets; an example appears in Table 2. Each sentence set comprised six versions of a prototype sentence. In two of the six versions, the adverbial phrases were preposed (PRE), and the probe names were either the first- (PRE 1) or second- (PRE 2) mentioned participants. In two other versions, the adverbials were postposed (POST), and the probe names were either the first- (POST 1) or second- (POST 2) mentioned participants. In the remaining two versions, there were no adverbial phrases (ZERO), but again the probe names were either the first- (ZERO 1) or second- (ZERO 2) mentioned participants.

TABLE 2
EXAMPLE SENTENCE SET FOR EXPERIMENTS 3 AND 4

Version	Example sentence
PRE 1	Two weeks ago Tina mailed Lisa a box full of clothes.
PRE 2	Two weeks ago Lisa mailed Tina a box full of clothes.
POST 1	Tina mailed Lisa a box full of clothes two weeks ago.
POST 2	Lisa mailed Tina a box full of clothes two weeks ago.
ZERO 1	Tina mailed Lisa a box full of clothes.
ZERO 2	Lisa mailed Tina a box full of clothes.

Note. The example probe word for all sentences is Tina.

Like the example in Table 2, all 48 sentence sets had the structure, [*Adverbial*] NP_1 *Ved* NP_2 NP_3 [*Adverbial*]. NP_1 was always an agent/subject while NP_2 was a recipient/direct object (i.e., a promoted indirect object). NP_3 was an inanimate object described by a five-word phrase. The adverbials were always three-word locative or temporal phrases.

Forty-eight lure sentences were constructed in which the probe names had not occurred in their respective sentences. The lure sentences resembled the experimental sentences in syntactic form: A third had preposed adverbials, a third had postposed adverbials, and a third were without adverbials.

Six material sets were formed by randomly assigning one of six versions of each sentence set to a material set. Across the six material sets, each prototype sentence occurred in each of its six versions. Within each material set, there were eight different PRE 1, PRE 2, POST 1, POST 2, ZERO 1, and ZERO 2 type sentences. Sixteen subjects were randomly assigned to each material set, and in this way, each subject was exposed to only one version of a sentence set.

To ensure adequate comprehension and to discourage subjects from selectively attending to parts of the sentences, each experimental sentence was followed by a two-alternative WH-question. A third of the questions asked about the identity of the transferred item. (For example, such a question for the sentence set shown in Table 2 would be, "What did Tina mail to Lisa?"). Another third asked about the adverbial (e.g., "When did Tina mail Lisa a box full of clothes?"). And the final third asked about the identity of the agent or recipient (e.g., "Who was mailed a box full of clothes?" or "Who mailed a box full of clothes?").

Procedure. The procedure was identical to that of Experiment 1.

Results

The means of the subjects' average correct response times are graphed in Fig. 2. A 3 (adverbial position: pre vs. post vs. zero) by 2 (order of mention: first vs. second)

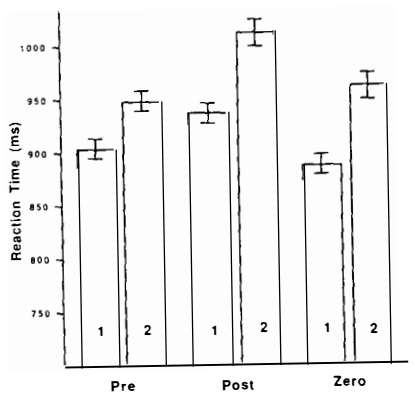

FIG. 2. Subject's average correct response times from Experiment 3.

ANOVA revealed a reliable main effect of adverbial position, $minF'(2,196) = 8.054$, $p < .0001$. When we examined this effect further, we discovered that it was due to response times being slower when the adverbials were postposed ($M = 975$ ms) rather than either preposed ($M = 924$ ms) or omitted ($M = 922$ ms) [$minF'(1,87) = 9.805$, $p < .005$, for the POST versus PRE comparison; $minF'(1,98) = 11.34$, $p < .005$, for the POST versus ZERO comparison; but $minF'(1,47) = 0.06$, for the PRE versus ZERO comparison]. This effect most likely reflects some awkwardness that subjects experienced with the postposed constructions: The double object constructions—the adverbials following a five-word inanimate direct object phrase—seem to force the adverbials into an aposition status.

More interestingly, the original ANOVA also revealed a reliable main effect of order of mention: First-mentioned participants were responded to 69 ms faster than second-mentioned participants, $minF'(1,107) = 18.85$, $p < .0001$. Order of mention did not, however, interact with adverbial position: That is, the advantage held by first-mentioned participants was statistically equivalent despite the position or occurrence of the adverbials, $minF'(2,94) = 0.73$.

However, despite the failure of the interaction to reach statistical significance, we were again in a situation like Experiment 1 where numerically the data hinted that the first-mentioned participants' advantage might be somewhat weaker in one condition—namely, the preposed condition when the first-mentioned participants were not the initial words of their sentences. So again, to avoid prematurely accepting the null hypothesis, we conducted a replication experiment.

Experiment 4: Replication

We tested an additional 120 subjects using the same materials and procedures as we used in the original experiment. The results were identical. The interaction between adverbial position and order of mention was still not statistically reliable, $minF'(2,221) = 0.590$. But like the original experiment, each of the main effects was. The main effect of adverbial position, $minF'(2,192) = 3.593$, $p < .05$, was again due to response times being slower when the adverbials were postposed ($M = 909$ ms) rather than either preposed ($M = 884$ ms) or omitted ($M = 875$ ms) [$minF'(1,94) = 3.856$, $p < .07$, for the POST versus PRE comparison; $minF'(1,98) = 6.022$, $p < .025$, for the POST versus ZERO comparison; but $minF'(1,97) = 0.51$, for the PRE versus ZERO comparison]. And, more importantly, the main effect of order of mention, $minF'(1,148) = 50.87$, $p < .00001$, was due to first-mentioned participants being responded to 74 ms faster than second-mentioned participants.

The conclusions we draw from Experiments 3 and 4 are straightforward. First, the advantage we observed for first-mentioned participants suggests that comprehenders' mental representations are constructed in such a way that first-mentioned participants are reliably more accessible than second-mentioned participants. Second, this advantage is not dependent on the first-mentioned participants being the initial words of their sentences. The advantage must depend more on each participant's position relative to the other participant.

Experiment 5

In our previous experiments, including the first four experiments reported here, the first-mentioned participants were always their sentences' syntactic subjects. This is the normal situation in a relatively strict SVO (Subject–Verb–Object) language such as English (Greenberg, 1963). However, in Experiments 5, 6, and 7, we attempted to tease apart the effects of order of mention from those of subjecthood. We did this in Experiment 5 by having the two participants share subjecthood, as opposed to the first-mentioned participants being the sole subjects. In other words, our sentences had conjoined-subject constructions, as in

(1) Tina and Lisa argued during the meeting.

as opposed to single-subject constructions, as in

(2) Tina argued with Lisa during the meeting.

Our stimulus sets comprised three types of sentences. The first type was built around what we called lexical reciprocal verbs. These verbs described actions in which the two participants engaged in mutually complementary actions, and both participants were agents. For example, *argue, debate,* and *converse* are lexical reciprocal verbs. In the conjoined-subject condition, both participants were subjects, as in sentence (1) above. In the single-subject construction, as in (2) above, first-mentioned participants were subjects, and second-mentioned participants were objects of the preposition *with*.

The second type of sentences in our stimulus sets involved reciprocal anaphors. These sentences contained transitive verbs that could occur with reciprocal anaphoric expressions such as *each other* or *one another* as direct objects. When used this way, both participants were subjects, as in

(3) Tina and Lisa annoyed one another at the conference.

However, when used without the reciprocal anaphoric expression, first-mentioned participants were agents/subjects while second-mentioned participants were patients/direct objects, as in

(4) Tina annoyed Lisa at the conference.

The third type of sentences, the comitatives, contained simple intransitive verbs that did not involve reciprocal actions. When used in a conjoined-subject construction, the verbs connoted that the two participants acted simultaneously, but not reciprocally. An example is (5) below.

(5) Tina and Lisa hiked in the mountains.

To summarize, in Experiment 5, we manipulated two variables: subject status, whether the probe names were conjoined versus single subjects, and order of mention, whether the probe names were the first- versus second-mentioned participants.

Method

Subjects. The subjects were 120 undergraduates at the University of Oregon.

Materials and design. For each of the three sentence types, we constructed 24 sentence sets. An example sentence set for each type is shown in Table 3. For the Lexical Reciprocal and Reciprocal Anaphor sentences, each sentence set comprised

TABLE 3
EXAMPLE SENTENCE SETS FOR EXPERIMENT 5

Version	Example sentence
	Lexical reciprocals
CONJ 1	Tina and Lisa argued during the meeting.
CONJ 2	Lisa and Tina argued during the meeting.
SING 1	Tina argued with Lisa during the meeting.
SING 2	Lisa argued with Tina during the meeting.
	Reciprocal anaphors
CONJ 1	Tina and Lisa annoyed one another at the conference.
CONJ 2	Lisa and Tina annoyed one another at the conference.
SING 1	Tina annoyed Lisa at the conference.
SING 2	Lisa annoyed Tina at the conference.
	Comitatives
CONJ 1	Tina and Lisa hiked in the mountains.
CONJ 2	Lisa and Tina hiked in the mountains.

Note. The example probe word for all sentences is Tina.

four versions of a prototype sentence. In two of the four versions, the probe names occurred as conjoined subjects and as either the first- (CONJ 1) or second-mentioned participants (CONJ 2). In the other two versions, the probe names occurred as single subjects and as either the first- (SING 1) or second-mentioned participants (SING 2). For the Comitative sentences, each sentence set consisted of two versions of a prototype sentence: The probe names were always conjoined subjects, but in one version they were the first-mentioned participants (CONJ 1), and in the other, they were the second-mentioned participants (CONJ 2).

Like the example in Table 3, the Lexical Reciprocal sentence sets had the structure, *NP_1 and NP_2 Ved Adverbial* when the probe names were conjoined subjects, and *NP_1 Ved NP_2 Adverbial* when they were single subjects. The Reciprocal Anaphor sentence sets had the structure, *NP_1 and NP_2 Ved {one another/each other} Adverbial* when the probe names were conjoined subjects, and *NP_1 Ved NP_2 Adverbial* when they were single subjects. The Comitative sentence sets all had the structure, *NP_1 and NP_2 Ved Adverbial.*

Sixty-four lure sentences were constructed that resembled the experimental sentences in form: 24 resembled the Lexical Reciprocal sentences; 24 resembled the Reciprocal Anaphor sentences; and 16 resembled the Comitatives. Each experimental sentence was followed by a two-alternative WH-question that asked about either the temporal or locative setting of the action, or the identity of one of the participants. Four material sets were formed and 30 subjects were randomly assigned to each, so that each subject was exposed to only one version of a sentence set.

Procedure. The procedure was identical to that of Experiment 1.

Results

The means of the subjects' average correct response times are graphed in Fig. 3. For sentences containing Lexical Reciprocals, a 2 (subject status: conjoined vs. single) by 2 (order of mention: first vs. second) ANOVA revealed only a reliable main effect of order of mention: First-mentioned participants were responded to 87 ms faster than second-mentioned participants, $minF'(1,48) = 19.38$, $p < .0001$. This effect did not interact with subject status; that is, the first-mentioned participants' advantage was equally strong regardless of whether they shared their subjecthood, $minF'(1,77) = 0.02$.

We observed the same pattern with the Reciprocal Anaphor sentences. These data are also shown in Fig. 3. Again, a 2 (subject status: conjoined vs. single) by 2 (order of mention: first vs. second) ANOVA revealed only a reliable main effect of order of

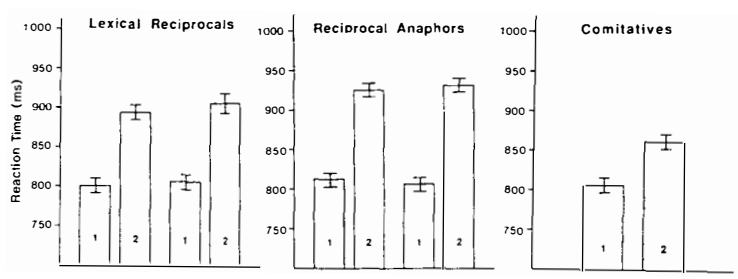

FIG. 3. Subject's average correct response times from Experiment 5.

mention: First-mentioned participants were responded to 115 ms faster than second-mentioned participants, $minF'(1,48) = 30.40$, $p < .00001$. Again, this effect did not interact with subject status, $minF'(1,49) = 0.16$.

Finally, we observed the same pattern with the Comitative sentences: First-mentioned participants were responded to 67 ms faster than second-mentioned participants, $minF'(1,53) = 8.463$, $p < .01$.

Thus, the three sentence types behaved identically. In fact, an ANOVA conducted on the data from the three conjoined-subject conditions, a 3 (sentence type: lexical reciprocal vs. reciprocal anaphor vs. comitative) by 2 (subject status: conjoined vs. single) by 2 (order of mention: first vs. second) ANOVA, showed only a reliable main effect of order of mention, $minF'(1,72) = 44.62$, $p < .00001$. Neither the main effect of sentence type, $minF'(2,79) = 1.208$, $p > .25$, nor any of its interactions were reliable, all $minF' < 1.0$.

These data allow three conclusions. First, there is a clear advantage for first-mentioned participants. Second, this advantage is not attenuated when the first-mentioned participants share their subjecthood. And third, this advantage does not seem to arise from semantic role. Recall that we found no differences among the three types of sentences even though their verbs placed their participants in different semantic roles. In this way, Experiment 5 corroborates Experiments 1 and 2 in which we found that semantic role, namely agent versus patient, neither accounted for nor attenuated the first-mentioned participants' advantage. In Experiment 5, like Experiments 1 and 2, only order of mention affected participants accessibility.

EXPERIMENT 6

Our goal in Experiment 6 was again to separate the effects of order of mention from subjecthood. We did this by taking one of the participants out of its main clause and placing it in a complex prepositional phrase (Huddleston, 1984). These complex prepositional phrases were either postposed, in which case the first-mentioned participants were the syntactic subjects, as in

(6) Tina was evicted from the apartment because of Lisa.

Or the complex prepositional phrases were preposed, in which case the first-mentioned participants were not the syntactic subjects, as in

(7) Because of Lisa, Tina was evicted from the apartment.

So, in Experiment 6, we manipulated two variables: position of the complex prepositional phrase, whether they were preposed versus postposed, and order of mention, whether the probe names were the first- versus second-mentioned participants.

Method

Subjects. The subjects were 72 undergraduates at the University of Oregon.

Materials and design. We constructed 32 sentence sets; each comprised four versions of a prototype sentence. In two of the four versions, the complex prepositional phrases were preposed, and the probe names were either the first- (PRE 1) or second- (PRE 2) mentioned participants. In the other two versions, the complex prepositional phrases were postposed, and the probe names were either the first- (POST 1) or second- (POST 2) mentioned participants. We used four different complex prepositional phrases: *because of, according to, compared to,* and *except for.* An example sentence set for each is shown in Table 4.

Like the examples shown in Table 4, the main clauses of the *because of* sentence sets had the structure, *NP was Ved Adverbial.* The main clauses of the *according to* sentence sets had the structure, *NP was an ADJ Agentive.* The main clauses of the

TABLE 4
EXAMPLE SENTENCE SETS FOR EXPERIMENTS 6 AND 7

Version	Example sentence
PRE 1	Because of Tina, Lisa was evicted from the apartment.
PRE 2	Because of Lisa, Tina was evicted from the apartment.
POST 1	Tina was evicted from the apartment because of Lisa.
POST 2	Lisa was evicted from the apartment because of Tina.
PRE 1	According to Tina, Lisa was an inspiring teacher.
PRE 2	According to Lisa, Tina was an inspiring teacher.
POST 1	Tina was an inspiring teacher according to Lisa.
POST 2	Lisa was an inspiring teacher according to Tina.
PRE 1	Compared to Tina, Lisa was a tidy housekeeper.
PRE 2	Compared to Lisa, Tina was a tidy housekeeper.
POST 1	Tina was a tidy housekeeper compared to Lisa.
POST 2	Lisa was a tidy housekeeper compared to Tina.
PRE 1	Except for Tina, Lisa was the oldest member of the club.
PRE 2	Except for Lisa, Tina was the oldest member of the club.
POST 1	Tina was the oldest member of the club except for Lisa.
POST 2	Lisa was the oldest member of the club except for Tina.

Note. The example probe word for all sentences is Tina.

compared to sentence sets had the structure, *NP was an ADJ Agentive*. And, the main clauses of the *except for* sentence sets had the structure, *NP was the ADJ Noun Adverbial*.

Thirty-two lure sentences were constructed that resembled the experimental sentences in syntactic form; an even number contained each of the four complex prepositional phrases. Each experimental sentence was followed by a two-alternative WH-question. For the *because of* and *according to* sentence sets, half the questions asked about the participant in the main clause (e.g., "Who caused someone to be evicted?" or "Who was an inspiring teacher?"), and half asked about the participant in the complex prepositional phrases (e.g., "Who was evicted?" or "Who said someone was an inspiring teacher?"). For the *compared to* sentence sets, one-fourth of the questions asked about the participant in the main clause (e.g., "Who was the better housekeeper?"), one-fourth asked about the participant in the complex prepositional phrase (e.g., "Who was the worse housekeeper?"), and the remaining half asked about the adjective in the main clause (e.g., "What kind of housekeeper was Tina/Lisa?"). For the *except for* sentence sets, all the questions asked about the nonparticipant noun phrase in the main clause (e.g., "What type of members were Tina and Lisa?" or "What were Tina and Lisa?").

Four material sets were formed and 18 subjects were randomly assigned to each. Within each material set, there were two PRE 1, PRE 2, POST 1, POST 2 type sentences for each of the four complex prepositional phrases.

Procedure. The procedure was identical to that of Experiment 1.

Results

The means of the subjects' average correct response times are graphed in Fig. 4. A 2 (complex prepositional phrase position: pre vs. post) by 2 (order of mention: first vs. second) ANOVA revealed—in contrast to all our previous experiments—that the effect of order of mention was not reliable, $minF'(1,51) = 1.57$. However, there was an effect of the position of the prepositional phrase: Response times were 46 ms slower when the phrases were preposed than postposed, $minF'(1,63) = 7.31$, $p < .01$. Furthermore, the interaction between the two variables was marginally reliable, $F_1(1,71) = 5.756$, $p < .02$ and $F_2(1,31) = 3.337$, $p < .08$.

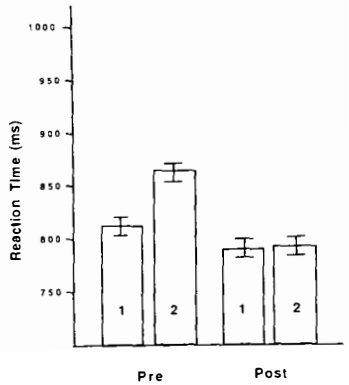

FIG. 4. Subject's average correct response times from Experiment 6.

This interaction bore the following pattern: When the prepositional phrases were preposed, the order of mention effect was reliable: First-mentioned participants were responded to 51 ms faster than second-mentioned participants, $minF'(1,57) = 3.956$, $p < .05$. This 51-ms advantage is in the same ballpark as the advantages we have observed in our other experiments. In contrast, when the prepositional phrases were postposed, only a nonsignificant 1-ms "advantage" occurred, both F_1 and $F_2 = 0.0$.

The results of Experiment 6 are surprising. It is the first time in 12 experiments (including those of Gernsbacher, 1988) that we failed to observe a main effect of order of mention. One explanation is that the advantage of first mention is actually an advantage of syntactic subjecthood. But the data do not support this explanation. If we compare the POST 1 response times to the PRE 2 response times, we see a significant 72-ms advantage for first mention—even though in both cases, the probe names were the subjects. In addition, if we get a mean of those two conditions, in which the probe names were subjects, and compare that mean to the mean of the remaining two conditions, in which the probe names were not subjects, we actually find a 24-ms disadvantage for subjects (i.e., $M = 806$ for nonsubjects, and $M = 830$ for subjects). Thus, it is unlikely that subjecthood is the factor underlying the advantage of first mention.

Still, the lack of a main effect of order of mention is puzzling. Recall that there was an effect when the complex prepositional phrases were preposed, just not when they were postposed. So something about the post position attenuated the first-mentioned participants' advantage. If we expect the two postposed conditions to resemble the two preposed conditions, the data cell that doesn't match is the POST 2 condition (when the prepositional phrases were postposed, and the probe names were the second-mentioned participants). In that condition, and that condition alone, the second-mentioned participants' names were also the final words of their sentences. They were therefore the very last words to occur prior to the probe words. So perhaps the reason why we failed to observe our typical first-mentioned participants' advantage in the postposed conditions is that recency (POST 2) was competing with primacy (POST 1).

We have no doubt that there are recency effects in sentence memory. In fact, an entire literature documents that words from the most recently heard or read clause are more accessible than words from preceding clauses (Caplan, 1972; Chang, 1980; Jarveila, 1979). However, we wonder whether these recency effects are as a long-lived as the primacy effect we have observed in our experiments.

We are also a little suspicious of this particular recency effect. In all of our other experiments, the second-mentioned participants were—by definition—more recent than the first-mentioned participants; yet we never before witnessed an advantage of recency. Perhaps this particular recency effect is caused by the probe names being identical to, literally, the most recent words in their sentences. If so, the effect should

disappear if we simply increase the interval between the offset of the sentences and the onset of the probe names.

Experiment 7

Method

Experiment 7 differed from Experiment 6 in the following way: in Experiment 6, the probe names appeared 150 ms after the offset of their sentences' final words. In Experiment 7, the words *Test Name* appeared 250 ms after the offset of their sentences' final words. This warning signal remained on the screen for 750 ms. Then, 400 ms after it disappeared, a probe name appeared. So, in Experiment 7, each probe name occurred 1400 ms after the offset of the last word of its sentence. In all other respects, the two experiments were identical. Eighty subjects participated in Experiment 7.

Results

The means of the subjects' average correct response times are graphed in Fig. 5. A 2 (prepositional phrase position: pre vs. post) by 2 (order of mention: first vs. second) ANOVA revealed a marginally reliable effect of phrase position: Like Experiment 6, response times were faster when the complex prepositional phrases were postposed, although in Experiment 7 this effect was much smaller, $F_1(1,79) = 5.779$, $p < .02$, and $F_2(1,31) = 4.322$, $p < .05$, $minF'(1,78) = 2.474$, $p > .10$.

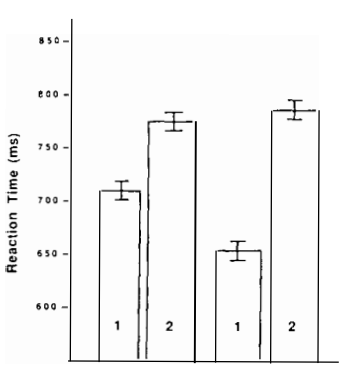

FIG. 5. Subject's average correct response times from Experiment 7.

But unlike Experiment 6, the effect of order of mention in Experiment 7 was very reliable: First-mentioned participants were responded to 94 ms faster then second-mentioned participants, $minF'(1,110) = 45.59$, $p < .00001$. And again, the interaction between phrase position and order of mention was reliable, $minF'(1,75) = 6.643$, $p < .02$.

However, the pattern of this interaction differed from the one in Experiment 6. In Experiment 7, the order of mention effect was reliable both when the complex prepositional phrases were preposed and postposed. But the effect was nearly doubled when the phrases were postposed: With the preposed phrases, first-mentioned participants enjoyed a 69-ms advantage, $minF'(1,93) = 8.178$, $p < .01$. With the postposed phrases, they enjoyed a 130-ms advantage, $minF'(1,99) = 44.36$, $p < .00001$.

This larger effect is not an additional advantage of subjecthood. If we compare the two conditions in which the probe names were the subjects (namely, POST 1 and PRE 2), we still see a reliable 115-ms advantage for first mention. Similarly, if we compare the two conditions where neither probe name was the subject (namely, PRE 1 and POST 2), we also see a reliable 74-ms advantage for first mention. And finally, if we compare the two conditions were the probe names were the second-mentioned participants, but they were the subjects in one condition (PRE 2) but not the other (POST 2), we see only an unreliable 15-ms difference, $minF'(1,71) = 0.657$.

If we expect the two postposed conditions to resemble the two preposed conditions, the data cell that does not match in the POST 1 condition (when the phrases were postposed, and the probe names were the first-mentioned participants). One descriptive aspect of those sentences is that their first-mentioned participants remain relatively independent throughout an entire clause. In fact, in both postposed conditions, the complex prepositional phrase read almost like an afterthought tacked onto an already completed expression. So perhaps the larger effect of order of mention that we observed for the POST 1 condition is due to the first-mentioned participants seeming to be the sole participants through the majority of their sentences.

General Discussion

We will begin our discussion by reviewing our findings. In Experiments 1 and 2, we found that the first-mentioned participants' advantage was not due to their being the semantic agents of their sentences. Rather, the advantage held even when the first-mentioned participants were patients. In Experiments 3 and 4, we found that the first-mentioned participants' advantage did not derive simply from their being the initial words in their stimulus sentences. Rather, the advantage depended on each participant's position relative to the other participants. In Experiment 5, the first-mentioned participant's advantage was not attenuated when they shared subjecthood with the second-mentioned participants. In fact, in Experiments 6 and 7, the advantage was not attenuated even when the first-mentioned participants were no longer their sentences' syntactic subjects.

We conclude that the advantage of first mention does not arise from any of the linguistic factors that we investigated.[1] We suggest, instead, that the advantage arises because comprehension requires building a mental representation or structure. This entails both laying a foundation and mapping subsequent information onto that foundation. First-mentioned participants are more accessible because it is through them that subsequent information is mapped onto the developing representation.

Given the privileged role that initial information plays in comprehenders' mental representations, speakers and writers should seriously confront what Levelt (1981) has dubbed the *linearization problem:* "what to say first, what to say next, and so on" (p. 305). Indeed, functional grammarians argue that different orders of mention code different pragmatic dimensions; therefore, speakers' and writers' selection of a specific order serves a communicative function (Chafe, 1976; Firbas, 1974; Givón, 1979, Halliday, 1967).

However, opinions differ over which dimension initial mention codes and which function speakers and writers intend to accomplish when they select among the grammatical forms that involve different orders of mention. According to one perspective, initial mention codes importance and functions to attract attention (Givón, 1986). According to another perspective, first mention codes givenness and functions to create a context for subsequent comprehension (Clark & Clark, 1977).

Both perspectives are supported by studies employing a range of different experimental tasks designed to simulate sentence production, for example, elicited sentence formulation, oral sentence recall, sentence acceptability, sentence ratings, and sentence verification (of pictures, for instance). Those studies that have manipulated importance via perceptual salience,

[1] We have been asked whether the effect of order mention is attributable to the first-mentioned participants being either their sentences' *topics* (Chafe, 1976; Li & Thompson, 1976) or *centers* (Grosz, Joshi, & Weinstein, 1983; Joshi & Weinstein, 1981). It is true that topics are more likely to be first- than second-mentioned participants because, as Li and Thompson have written, "the surface coding of the topic in all the languages we have examined always involve the sentence-initial position" (p. 465). However, when the first-mentioned participants were in the conjoined-subject conditions of Experiment 5, they were not topics according to Li and Thompson's criteria; yet, they were still more accessible. As for whether the first-mentioned participants are centers, again the data from the conjoined-subject conditions of Experiment 5 suggest against the possibility as the first-mentioned participants in these constructions would fail the criteria for being a center.

animacy, definiteness, or other markers have shown that important concepts are mentioned first (see reviews by Anisfeld & Klenbort, 1973; Bock, 1982; and MacWhinney, 1977). Similarly, those studies that have manipulated givenness via explicit prior mention, verbatim or pictorial cueing, or implicit presupposition have shown that given concepts are mentioned first (see reviews by Bates & MacWhinney, 1982; and Bock, 1982).

Both perspectives are also supported by descriptive, linguistic studies of languages that allow a freer word order arrangement than English. For example, like English, the Uto–Aztecan language, Papago, has no case marking morphology on nouns; however, unlike English, Papago has no strongly preferred order of subject, object, and verb (Payne, 1987). Even so, initial information—information preceding the verb—tends to be of two types: new information that will be important in the subsequent discourse or old (given) information that appears in contrastive, focused, or information–question constructions. Thus, the Papago data, like the English data, support both the perspective that initial mention codes importance and the perspective that initial mention codes givenness. In addition, the Papago data demonstrate that the use of initial mention to code these two pragmatically relevant dimensions is not restricted to languages with rigid word order or nominal case marking (see also Sridhar, 1988).

However, one cannot adopt the two perspectives simultaneously without entering into a paradox. That is, initial mention can only code importance and givenness simultaneously if one assumes that new information is always less important or that important information is always old. Both assumptions seem unintuitive. Thus, the two perspectives conflict. As Bock (1982) points out, nowhere is this conflict more apparent than in the exchange between Costermans and Hupet (1977) and Johnson-Laird (1977).

Bock (1982) discusses a few resolutions to this conflict from the sentence production point of view. We will not attempt to resolve this conflict for comprehension; instead, we will only point out how our structure building account accommodates both functions. If first mention is selected in order to signal importance, then the function is accomplished because—by virtue of being first mentioned—initial information gets represented at the core or foundation of the structure. As we have mentioned before, this privileged position leads to greater accessibility, and presumably the goal of marking information as important is to gain this greater accessibility. On the other hand, if first mention is selected in order to signal givenness, then the function is also accomplished because—by virtue of being first mentioned—initial information organizes the representation of subsequent information. That is, subsequent information get mapped onto the developing structure vis-à-vis the initial information. Presumably, the mapping process proceeds more smoothly when new (subsequent) information is being mapped onto given (initial) information, rather than the other way around.

We are suggesting that although speakers and writers exploit grammatical forms to accomplish two different communicative functions, one set of cognitive processes—namely, those involved in structure building—is responsible for both desired effects.

We end by acknowledging another conflict in the literature. All of the experiments reported here appear to contradict another set of experiments, namely, those demonstrating the well-known clause recency effect (Caplan, 1972; Chang, 1980; Von Eckhardt & Potter, 1983). Those previous experiments also used a probe recognition task. However, instead of finding a primacy effect, those experiments found a recency effect: Probe words were recognized more rapidly when they were from a most recently heard or read clause. Gernsbacher, Hargreaves, and Beeman (1988) resolve this apparent conflict by investigating the time course of recognizing sentence participants from first versus second clauses. Again, the structure building framework accounts for the resulting data.

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