

# Words in a sentence become less accessible when an anaphor is resolved

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A noun that identifies an entity in a discourse becomes less accessible following an anaphoric reference to another entity. The phenomenon cannot be attributed to ad hoc strategies, memory decay, or context checking. It occurs for both common and proper nouns and for nouns that identify both characters and inanimate objects. It is stronger for nouns that identify important entities, as opposed to more peripheral ones.

Over the course of a discourse, an entity may be mentioned many times. Repeated reference to the entity is established by means of anaphoric expressions. When one of these expressions is encountered, it must be *resolved*—a precursor must be located in the prior discourse (Clark & Sengul, 1979; Garnham, 1985, 1987). In some cases, this is done without consideration of the content of the discourse; an *antecedent* is located in the surface trace (Murphy, 1985; Sag & Hankamer, 1984). In other cases, the content is considered; the anaphor is found to be *coreferential* with an earlier expression.

During the process of anaphor resolution, the relative accessibility of the different components of the discourse may be adjusted. Access of the antecedent and associated words may be *facilitated* (Cloitre & Bever, 1989; Corbett & Chang, 1983; Gernsbacher, 1989; O'Brien, 1987; O'Brien, Plewes, & Albrecht, 1990). Access of other words may be *inhibited* (Gernsbacher, 1989; MacDonald & MacWhinney, 1990).

In studying the accessibility adjustments that occur following the comprehension of an anaphor, researchers have often drawn a distinction between noun and pronoun anaphors. This distinction has been justified on the grounds that the two kinds of anaphor function differently (Greene, McKoon, & Ratcliff, 1992; Sanford & Garrod, 1981). In the present study, the accessibility adjustments that occur following the comprehension of noun anaphors are explored. The study extends work by Gernsbacher (1989).

Gernsbacher (1989) conducted a series of experiments, using the recognition probe methodology with short two-clause sentences as stimulus material. In the first clause of each sentence, two characters were introduced, identified with proper nouns. At the beginning of the second clause, one of the characters was mentioned anaphorically. On the trials that will be crucial here, the anaphor consisted of the proper noun that had originally been used to identify the referent character (e.g., Ann predicted that Pam would lose the track race, but Pam came in first very easily). The participant read the sentence and made a recognition judgment with respect to a probe that was presented either before or after the anaphor. The probe word was one of the proper nouns that had been used to identify the characters in the sentence (e.g., Ann, Pam).

The point of Gernsbacher's (1989) experiments was to track recognition times for the names of the characters. Comprehension of the anaphor was associated with a striking accessibility shift. The antecedent noun was recognized more quickly at the post- than at the preanaphor probe point. A complementary pattern was observed for the nonantecedent noun; it was recognized more quickly at the pre- than at the postanaphor probe point. Gernsbacher interpreted these results as evidence that the accessibility of antecedents and nonantecedents is adjusted during the resolution of a noun anaphor: Access of the anaphor's antecedent is facilitated; access of nonantecedents is inhibited.

But several issues are unresolved with respect to Gernsbacher's (1989) results. First, it is not clear that the results reflect active processes of accessibility adjustment, rather than less interesting phenomena. This concern is not particularly troubling with regard to the accessibility increment, because evidence has been obtained for anaphor-induced facilitation in other studies (Cloitre & Bever,

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**Table 1**  
**Sample Stimulus Passages**

**Experiment 1A**

The sergeant ordered the recruit to clean the latrine, and the ^ sergeant ^  
 Probe word: sergeant/recruit  
 Comprehension question: Did the sergeant clean the latrine?

**Experiment 1B***Common Noun Condition*

The sergeant ordered the recruit to clean the latrine, and the ^ sergeant ^  
 Probe word: recruit  
 Comprehension question: Did the sergeant clean the latrine?

*Proper Noun Condition*

Jason ordered Frank to clean the latrine, and ^ Jason ^  
 Probe words: Frank  
 Comprehension question: Did Jason clean the latrine?

**Experiment 2**

After being snubbed by the waitress at the bar, Jane waited for Mary  
 in the fancy lounge of the restaurant, but ^ Mary ^ was unfortunately  
 caught in traffic.

Probe words: bar/Jane

Comprehension question: Was Jane snubbed by Mary?

**Experiment 3**

The sergeant ordered the recruit to clean the smelly latrine, and the  
 ^ sergeant ^

Probe word: latrine

Comprehension question: Did the sergeant clean the latrine?

Note—^, probe points.

1989; Corbett & Chang, 1983; Dell, McKoon, & Ratcliff, 1983; O'Brien, 1987; O'Brien, Duffy, & Myers, 1986; O'Brien et al., 1990). The accessibility decrement is more problematic. It is possible to envision several accounts of this phenomenon that do not involve the active adjustment of accessibility. These alternative accounts are not as easily discounted as the ones for the accessibility increment, because there is less evidence for anaphor-induced inhibition from other sources. MacDonald and MacWhinney (1990) have presented some evidence that inhibition accompanies the resolution of pronoun anaphors. But there is little evidence that inhibition accompanies the resolution of noun anaphors. The first goal of the present study was to lay alternative accounts of the accessibility decrement to rest.

It is also important to clarify the boundary conditions of the accessibility decrement. In Gernsbacher's (1989) experiments, the probe words were always proper nouns that named important characters in sentences of narrative discourse. Does the accessibility decrement occur more generally than this? Does it occur for common nouns? Does it occur for nouns that identify less important discourse entities. Does it occur for nouns that identify important but inanimate discourse entities? The second goal of the present study was to address these questions.

## EXPERIMENT 1A

This experiment sought to rule out one alternative account of the anaphor-induced accessibility decrement and to extend its boundary conditions in one respect. The account in question attributes the accessibility decrement

to an ad hoc strategy emerging from an artificial laboratory situation. The crucial fact here is that the probe words in Gernsbacher's (1989) experiments were always proper nouns. As a result, participants may have focused their attention unduly on the proper nouns in the stimulus sentences, to the disadvantage of the other words. This ad hoc strategy may have fostered the accessibility decrement that was observed.

The experiment sought to replicate the accessibility decrement under conditions in which such an ad hoc strategy would be less likely to prevail. The experimental sentences were embedded in large numbers of filler sentences for which the probe words were not proper nouns or even nouns of any kind. Thus, participants had no motivation for focusing on the nouns in the sentences. If the decrement occurs in this situation, the ad hoc strategy account is discredited.

At the same time, the experiment sought to extend the boundary conditions of the accessibility decrement. Although Gernsbacher (1989) observed the effect for proper nouns, it should also occur for common nouns if it reflects a general process of accessibility adjustment. The experiment sought to show that this is the case.

The crucial sentences for the experiment were similar to the ones that Gernsbacher (1989) used, except that the characters were identified with common rather than proper nouns. In the first clause of each sentence, two characters were introduced. At the beginning of the second clause, the common noun that had been used to identify one of the characters reappeared as an anaphor. The participants read the passages word by word. A recognition probe was presented either immediately after the word that preceded the anaphor or immediately after the anaphor. The probe word was either the antecedent of the anaphor or the noun that had been used to identify the other character (the nonantecedent). (A sample passage is presented in Table 1.)

In summary, two independent variables were manipulated: (1) whether the probe word was the antecedent or the nonantecedent and (2) whether the probe came before or after the anaphor. The question of interest was whether the Gernsbacher (1989) pattern would be observed: in particular, whether the accessibility decrement would be observed—whether response time and/or error rate for nonantecedent probes would be smaller in the before than in the after condition. This result discredits the ad hoc account given earlier and suggests that the accessibility decrement generalizes to common nouns.

## Method

**Participants.** The participants were 32 students at George Washington University. They received extra credit in a psychology course in exchange for their efforts.

**Design.** The probe type and probe position variables were manipulated within participants and within items.

**Materials.** There were 32 experimental sentences, constructed according to the pattern described earlier (see Table 1). There were two versions of each sentence, differing as to which of the two common nouns reappeared as the anaphor. For each version, there were four sentence–probe pairings, differing as to (1) which of the two

**Table 2**  
**Results of Experiments 1–2**

Probe Type	Probe Position			
	Before		After	
	Response Time (msec)	Error Rate	Response Time (msec)	Error Rate
Experiment 1A				
Antecedent	1,116	.09	874	.02
Nonantecedent	1,057	.06	1,140	.08
Experiment 1B				
Proper Noun				
First	1,109	.06	1,178	.11
Second	1,167	.05	1,215	.08
Mean	1,138	.06	1,196	.10
Common Noun				
First	1,119	.06	1,208	.10
Second	1,170	.08	1,274	.07
Mean	1,144	.07	1,241	.08
Experiment 2				
Character	1,070	.08	1,143	.15
Background object	1,243	.17	1,258	.16

common nouns appeared as the probe and (2) whether the probe was presented before or after the anaphor. The two versions of the sentences were rotated through the four sentence–probe combinations in such a way as to produce eight materials sets. The experimental sentences were randomly intermixed with 80 filler sentences for which the probes were verbs, adjectives, and words from earlier sentences (to which a negative response was correct). To reduce the predictability of probe occurrence, many of the filler sentences were constructed so as to be either shorter or longer than the experimental sentences.

**Procedure.** The sentences were presented on a computer monitor, according to a procedure derived from Gernsbacher (1989). Each sentence was presented word by word, with successive words appearing alone in the middle of the screen for an amount of time that was calculated according to the formula: presentation time = (450 msec) + [(16.667 msec) × (number of letters)]. Gernsbacher used the same mode of presentation, except that the base time was 300 rather than 450 msec and an interword interval of 150 msec occurred between each successive pair of words. Thus, the only difference between the two presentation procedures is that the participant saw each word for 150 msec more in the present procedure, whereas he/she saw an extra 150 msec of blank screen between words in the Gernsbacher procedure. The rate of presentation was the same in the two cases.

At the probe point, the probe word appeared at the top of the screen in capital letters. The word remained on the screen until the participant responded. The sentence was then discontinued, and a yes/no comprehension question appeared at the bottom of the screen. This again remained on the screen until the participant responded. The participant was instructed to respond positively to the probe only if it had appeared in the current sentence. He/she was instructed to respond as quickly as possible to the probe, without sacrificing accuracy, but to strive only for accuracy in responding to the comprehension question. Notice that the presentation procedure differed from Gernsbacher's (1989) in that the sentence was discontinued after the probe was presented. Results to be reported for a later experiment should allay concerns about problems that may have arisen as a consequence of this procedural difference.

## Results and Discussion

Responses were faster to antecedent than to nonantecedent probes [ $F_1(1,28) = 6.99$ ,  $MS_e = 99,017$ ;  $F_2(1,28) =$

$7.37$ ,  $MS_e = 95,945$ ; for this and all other analyses, an alpha value of .05 was used;  $F_1$  and  $F_2$  report the results of analyses against the variability from participants and items, respectively]. There was a significant interaction of the effects of probe type and probe position in the response time and error rate data [RT:  $F_1(1,28) = 14.01$ ,  $MS_e = 123,618$ ;  $F_2(1,28) = 14.73$ ,  $MS_e = 124,686$ ; ER:  $F_1(1,28) = 10.93$ ,  $MS_e = 0.005$ ;  $F_2(1,28) = 5.99$ ,  $MS_e = 0.01$ ]. Responses to antecedent probes were faster and more accurate at the after than at the before probe point [RT:  $F_1(1,28) = 9.02$ ,  $MS_e = 212,261$ ;  $F_2(1,28) = 12.96$ ,  $MS_e = 138,940$ ; ER:  $F_1(1,28) = 15.72$ ,  $MS_e = 0.004$ ;  $F_2(1,28) = 9.91$ ,  $MS_e = 0.006$ ]. Responses to nonantecedent probes showed a trend toward being faster at the before than at the after probe point [the difference was not quite significant in the participants analysis;  $F_1(1,28) = 3.22$ ,  $MS_e = 71,009$ ;  $F_2(1,28) = 4.56$ ,  $MS_e = 72,351$ ; see Table 2].

One problem with these results is that different probe words appeared in the antecedent and the nonantecedent conditions. It was possible, however, to conduct a further analysis for which this was not the case. The key to this analysis was that each of the nouns that identified the characters in a given sentence appeared as the anaphor for a subset of the participants. It was therefore possible to reanalyze the data with each of the character nouns in a sentence appearing across participants in all four conditions. The reanalysis was conducted against item variability, with the two character nouns in each sentence being treated as separate items.

The reanalysis produced roughly the same results as the initial analysis. Responses were faster to antecedent than to nonantecedent probes [ $F_2(1,56) = 41.11$ ,  $MS_e = 28,041$ ]. There was a significant interaction of the effects of probe type and probe position in the response time and error rate data [RT:  $F_2(1,56) = 6.06$ ,  $MS_e = 141,216$ ; ER:  $F_2(1,56) = 18.27$ ,  $MS_e = 0.036$ ]. Responses to antecedent probes were faster and more accurate at the after than at the before probe point [RT:  $F_2(1,56) = 7.39$ ,  $MS_e = 123,552$ ; ER:  $F_2(1,56) = 20.36$ ,  $MS_e = 0.025$ ]. Responses to nonantecedent probes were more accurate at the before than at the after probe point [ $F_2(1,56) = 6.80$ ,  $MS_e = 0.029$ ]. It was not possible to do a parallel analysis as a function of participant variability.

This experiment produced roughly the same pattern of results as Gernsbacher (1989). However, the most important result, the difference between nonantecedent response times and/or error rates at the pre- and postanaphor probe points, was not conclusively significant. In addition, the response time difference was not as large as Gernsbacher observed. Thus, we cannot yet decisively reject the view that the Gernsbacher accessibility decrement reflects an ad hoc strategy under which the proper nouns in the sentences received an inordinate amount of attention. Nor can we conclusively extend the boundary conditions of the decrement to include common nouns. One other result should be noted: Performance was better for antecedent than for nonantecedent probes. This is because the former were subject to an increment in accessibility from the pre-

to the postanaphor probe point, whereas the latter were subject to a decrement in accessibility.

### EXPERIMENT 1B

This experiment sought to demonstrate more decisively that the ad hoc strategy account of the accessibility decrement is false and that the decrement occurs for common nouns. As in Experiment 1A, the experimental sentences were embedded in a large number of filler sentences for which the probe words were not nouns. Half of the crucial sentences resembled those used in Experiment 1A; the other half were identical to these, except that the characters were described with proper rather than common nouns. For each sentence, a recognition probe was presented either immediately after the word that preceded the anaphor or immediately after the anaphor. The probe word was always the nonantecedent noun. The object was to demonstrate an accessibility decrement and to directly compare the size of the decrement for proper and common nouns.

An additional manipulation was included as a validity check. It has been shown in other work that, at appropriate retention intervals, a noun that identifies a character in a sentence is more accessible if the character is the first one to be introduced into the sentence (Gernsbacher & Hargreaves, 1988; Neath & Knoedler, 1994). In an attempt to replicate this result, the sentences were constructed so that the anaphor referred to the first character half of the time and to the second character the rest of the time. As a consequence of this manipulation, the probe word identified the first character half of the time and the second character the rest of the time. (A pair of sample sentences is presented in Table 1.)

In summary, three independent variables were manipulated in the experiment: (1) whether the sentence contained proper or common nouns, (2) whether the probe word identified the first or the second character in the sentence, and (3) whether the probe came before or after the anaphor. The experiment asked (1) whether response time and/or error rate would be smaller at the before than at the after probe points, (2) whether differences of comparable size would be observed for proper and common nouns, and (3) whether probes for the first character would be more accessible than probes for the second character.

### Method

**Participants.** The participants were 40 students at George Washington University. They received extra credit in a psychology course in exchange for their efforts.

**Design.** The probe type, serial position, and probe position variables were manipulated within participants and within items.

**Materials.** There were 48 experimental sentences, constructed according to the pattern described earlier. There were four versions of each sentence, differing as to (1) whether the two characters were identified with proper or common nouns and (2) whether the anaphor referred to the first or the second character. For each version, there were two sentence-probe pairings, differing as to whether the probe was presented before or after the final anaphor. The four versions of the sentences were rotated through the two sentence-probe combinations in such a way as to produce eight materials sets.

**Procedure.** The procedure was the same as that for Experiment 1A.

### Results and Discussion

Responses were faster at the before than at the after probe point and showed a trend toward being more accurate at the before probe point [the effect in the items analysis was borderline; RT:  $F_1(1,32) = 12.62$ ,  $MS_e = 42,371$ ;  $F_2(1,44) = 6.64$ ,  $MS_e = 87,173$ ; ER:  $F_1(1,32) = 5.00$ ,  $MS_e = 0.016$ ;  $F_2(1,44) = 4.01$ ,  $MS_e = 0.013$ ]. Responses showed a trend toward being faster to first than to second position probes [the effect in the items analysis was not quite significant;  $F_1(1,32) = 4.28$ ,  $MS_e = 60,588$ ;  $F_2(1,44) = 3.23$ ,  $MS_e = 120,993$ ]. There was a hint of an interaction between the effects of probe position and probe type in the response time data, with the accessibility decrement being possibly larger for common than for proper noun probes. This interaction was not statistically significant, however [ $F_1(1,32) = 2.73$ ,  $MS_e = 70,095$ ,  $p > .10$ ;  $F_2(1,44) < 1$ ], although the experiment had sufficient power (.75) to have detected a moderately sized effect (100 msec) if one had been present. Furthermore, the effect in the error rate data was in the opposite direction. Here, the accessibility decrement was possibly larger for proper than for common noun probes [although the interaction was not at all significant;  $F_1(1,32) = 1.27$ ,  $MS_e = 0.017$ ;  $F_2(1,44) < 1$ ]. Thus, the overall pattern in the data suggests that the accessibility decrement was the same size for proper and common nouns (see Table 2).

The anaphor-induced accessibility decrement was observed despite the fact that the experimental sentences were embedded in a large number of filler sentences for which the recognition probes were not nouns. This is inconsistent with the ad hoc strategy account of the effect. The effect was as large for common as for proper nouns. Evidently, then, both kinds of noun are susceptible to it. The response time increases for both proper and common nouns were smaller than those that Gernsbacher (1989) observed. This discrepancy will be addressed in the General Discussion section. In other results, nouns showed a trend toward being more accessible if they identified the first rather than the second character in a sentence. A similar advantage for first mention has been reported elsewhere (Gernsbacher & Hargreaves, 1988). Reappearance here testifies to the validity of the present procedures.

One limitation of the experiment should be noted. A nonantecedent of a given type was always paired with an anaphor of the same type. Proper and common noun nonantecedents were always paired with proper and common noun anaphors, respectively. Nonantecedent type and anaphor type were confounded. Thus, the experiment did not independently assess the impact of the proper/common noun distinction with respect to nonantecedents and anaphors. Future work will address this issue.

### EXPERIMENT 2

This experiment sought to rule out two other alternative accounts of the anaphor-induced accessibility decre-

ment and to further delineate its boundary conditions. One alternative account holds that the decrement reflects nothing more than memory decay (MacDonald & MacWhinney, 1990). There is some evidence that the memory representation of a word decays with the passage of time following the word's comprehension in a discourse (Jarvella, 1971). Assuming this to be the case, the account holds that the representation of a nonantecedent probe decays more in the after than in the before condition. This is because more time passes in the after condition between the word's initial appearance and its presentation as a memory probe.

Another alternative account holds that the accessibility decrement reflects a context-checking process (MacDonald & MacWhinney, 1990). Such processes are of concern in any probe recognition task because they may displace true retrieval processes. Rather than attempting to retrieve a probe word, the participant may check the word against its immediate prior context; if the word seems to fit in its context, the participant emits a positive response; if the word does not seem to fit, the participant emits a negative response. A context-checking account is plausible here because the fit between a nonantecedent probe and the context in which it appears is better in the before than in the after condition of the Gernsbacher (1989) paradigm. As a noun, the nonantecedent probe forms a syntactically correct continuation of the stimulus sentence in the before condition, but not in the after condition (see Table 1).

One way of getting evidence against the decay and the context-checking accounts is to demonstrate that the accessibility decrement does not occur for all of the nonantecedent nouns in a sentence (for a similar use of this sort of control strategy, see Dell et al., 1983, and MacDonald & MacWhinney, 1990). The memory representations for all of the nouns in a sentence should be equally subject to memory decay. Similarly, all of the nouns in a sentence should be equally susceptible to context checking; all of the nouns make syntactically correct continuations of the stimulus sentence in the before condition, but not in the after condition. Thus, if it can be demonstrated that the decrement does not occur for all nonantecedent nouns, this counts as evidence against the decay and the context-checking accounts.

Experiment 2 sought to use this strategy to gather evidence against the decay and context-checking accounts of the anaphor-induced accessibility decrement. At the same time, the experiment sought to further delineate the boundary conditions of the accessibility decrement. The decrement is evidently equally strong for proper and common nouns. Is it equally strong for nouns in all discourse roles? To this point, the decrement has been shown for nouns that identify important characters. Does it occur as strongly for nouns that identify more peripheral discourse entities? This seems unlikely. Numerous such entities may be described in a discourse. It seems implausible that the accessibility decrement is as great for such

entities as for important entities. Experiment 2 sought to bear this out.

The experiment also attempted to deal with a potential concern regarding the results of Experiments 1A and 1B. The procedure for these experiments was, as has been noted, somewhat different than the one that Gernsbacher (1989) used. Whereas the sentences in her experiments resumed following the presentation of the probe and continued to a natural conclusion, the sentences in Experiments 1A and 1B were discontinued after the probe was presented. On the basis of the fact that the anaphor-induced accessibility decrement was observed in these experiments, in the presence of filler sentences, we have argued against the existence of an ad hoc strategy under which the proper nouns in the sentences received an inordinate amount of attention. But the "unnatural" procedure may have been somehow responsible for the observation of the accessibility decrement in these experiments. In the present experiment, the original Gernsbacher procedure was used. The object was to set to rest concerns about the results of Experiments 1A and 1B by replicating the accessibility decrement, in the presence of filler sentences, using a more "natural" procedure.

Each of the key sentences for the experiment featured two characters, identified with proper nouns. In addition, each sentence mentioned a background object, identified with a common noun. In a preliminary rating study, the proper noun characters were rated as being more important than the background object to the content of the sentence. The proper noun that was used to identify one of the characters reappeared as an anaphor toward the end of the sentence. A recognition probe was presented either immediately after the word that preceded the anaphor or immediately after the anaphor. In one condition, the probe word was the proper noun that identified the other (non-referent) character. In the other condition, the probe word was the common noun that identified the background object. (A sample passage is presented in Table 1.)

In summary, two independent variables were manipulated in the experiment: (1) whether the probe word identified a character or a background object and (2) whether the probe came before or after the anaphor. It was expected that response time and/or error rate would be smaller at the before than at the after probe point. The key question was whether the before–after differences would be equally large for characters and background objects. If equivalent differences are observed for the two probe types, this suggests that the accessibility decrement is equally strong for nouns that identify important and peripheral discourse entities. On the other hand, if the differences are larger for characters than for background objects, this suggests that the decrement is stronger for important than for more peripheral entities. If the latter result is observed, this argues, in addition, against the decay and the context-checking accounts that were described earlier. Finally, if before–after differences are observed for characters (or characters and background objects), this

reinforces the results of Experiments 1A and 1B, using a more “natural” procedure.

## Method

**Participants.** The participants were 52 students at the George Washington University. They received extra credit in a psychology course in exchange for their efforts.

**Design.** The probe type and probe position variables were manipulated within participants and within items.

**Materials.** There were 48 experimental sentences. Each consisted of three clauses. In the first two clauses of the sentence, the two characters were introduced, and the background object was mentioned. Near the beginning of the third clause, the proper noun that had been used to identify one of the characters appeared again as an anaphor, and the sentence continued to its conclusion. The probe word was either the proper noun that identified the nonreferent character or the common noun that identified the background object. The probed proper noun preceded the common noun in half of the sentences and followed it in the rest of the sentences.

Rating data were collected from 24 participants to verify that the characters were more important than the background objects to the content of the experimental sentences. A given participant read each of the sentences and then rated the crucial nouns for their importance in the sentence. The participants based their ratings on a 9-point scale, with 9 being *very important* and 1 being *very unimportant*. The proper nouns that identified the characters were rated as being more important than the common noun that identified the background object [ $F(1,23) = 34.38$ ,  $MS_e = 3.03$ ].

For each sentence, there were four sentence–probe combinations, differing as to (1) whether the probe identified a character or a background object and (2) whether the probe was presented before or after the anaphor. The sentences were rotated through the four pairings in such a way as to produce four materials sets. The experimental sentences were randomly intermixed with 45 filler sentences of the same sort as those used in Experiment 1A.

**Procedure.** The procedure was the same as that for Experiment 1A, except that each sentence resumed after the participant responded to the probe word and continued to its conclusion.

## Results and Discussion

Responses were faster and showed a trend toward being more accurate to character than to background object probes [the later difference was not significant in the items analysis; RT:  $F_1(1,48) = 51.40$ ,  $MS_e = 16,624$ ;  $F_2(1,44) = 48.58$ ,  $MS_e = 22,707$ ; ER:  $F_1(1,48) = 4.82$ ,  $MS_e = 0.009$ ;  $F_2(1,44) = 1.95$ ,  $MS_e = 0.02$ ]. Responses were more accurate at the before than at the after probe point [ $F_1(1,48) = 5.83$ ,  $MS_e = 0.010$ ;  $F_2(1,44) = 7.34$ ,  $MS_e = 0.007$ ]. The interaction of the effects of probe type and probe position was significant in the error rate but not in the response time data [RT:  $F_1(1,48) = 1.72$ ,  $MS_e = 15,349$ ;  $F_2(1,44) = 1.95$ ,  $MS_e = 14,631$ ; ER:  $F_1(1,48) = 4.43$ ,  $MS_e = 0.015$ ;  $F_2(1,44) = 6.00$ ,  $MS_e = 0.01$ ]. Planned comparisons revealed that responses to character probes were faster and more accurate at the before than at the after probe point [RT:  $F_1(1,48) = 7.36$ ,  $MS_e = 12,256$ ;  $F_2(1,44) = 6.01$ ,  $MS_e = 11,447$ ; ER:  $F_1(1,48) = 11.88$ ,  $MS_e = 0.01$ ;  $F_2(1,44) = 10.53$ ,  $MS_e = 0.011$ ] and that neither response time nor error rate for background object probes varied as a function of probe position [RT:  $F_1(1,48) < 1$ ,  $F_2(1,44) < 1$ ; ER:  $F_1(48) < 1$ ,  $F_2(1,44) < 1$ ; see Table 2].

The crucial result is that the anaphor-induced accessibility decrement was stronger for characters than for background objects. In Experiment 1B, when they both identified characters, proper and common nouns were equally susceptible to the decrement. In the present experiment, when proper nouns identified characters and common nouns identified background objects, proper nouns were more susceptible to the decrement than were common nouns. The implication is that nouns are more susceptible to the accessibility decrement if they play a more important discourse role. In other results, character nouns were more accessible than background object nouns. This probably reflected the greater salience of the “important” relative to the “peripheral” nouns. Also, a general advantage was observed for the preanaphor probe point. This reflected the fact that an accessibility decrement occurred for both types of probes.

One might object that the key result here is compromised by a floor effect. Perhaps background object probes showed a smaller accessibility decrement because they were already quite inaccessible at the preanaphor probe point. In response, Dopkins and Nordlie (2001) observed an anaphor-induced accessibility decrement for nouns that varied in position in the stimulus passage. Nouns that were less recent in the passage were less accessible at the preanaphor probe point, but they were no less susceptible to the accessibility decrement.

What, then, can we conclude from these results? In replicating the anaphor-induced accessibility decrement for character nouns, the present experiment reinforces the results of Experiments 1A and 1B. These earlier results argued against the ad hoc strategy account of the decrement by demonstrating the decrement in the presence of filler sentences. The present results reinforce the argument within the context of the more “natural” Gernsbacher (1989) procedure. In showing a smaller accessibility decrement for background objects than for characters, the experiment discredits the decay and context-checking accounts of the decrement. If the decrement reflects processes of decay or context checking, it should have been equally strong for background objects and characters. It seems, then, that the accessibility decrement may reflect an active process of inhibition. Finally, the present results clarify the boundary conditions of the accessibility decrement. Nouns are evidently more susceptible to the decrement if they identify important, as opposed to peripheral, discourse entities.

## EXPERIMENT 3

The boundary conditions of the accessibility decrement are still somewhat unclear, however. The decrement occurs for nouns that identify characters but is much weaker for nouns that identify background objects. We have no information about nouns that identify important objects. Thus, we cannot be sure whether the key condition is (1) that nouns identify important characters or

(2) that nouns identify important entities, inanimate as well as animate.

In Experiment 3, we sought to resolve this uncertainty by demonstrating the accessibility decrement for nouns that identified important objects. A single independent variable was manipulated in the experiment: whether the probe came before or after the anaphor. The probe word was always a nonantecedent noun that identified an object with a crucial discourse role. In the experiment, we sought to show that response time and/or error rate was smaller at the before than at the after probe point.

## Method

**Participants.** The participants were 50 students at George Washington University. They received extra credit in a psychology course in exchange for their efforts.

**Design.** The probe position variable was manipulated within participants and within items.

**Materials.** The 48 experimental sentences were modifications of the sentences used in Experiment 1A. Each sentence featured two characters and an object, with the characters and object all being identified by common nouns. The characters and the object were all crucial to the content of the sentence. At the end of the sentence, one of the character nouns reappeared as an anaphor. The probe word was the common noun that had been used to identify the object. (A sample sentence is presented in Table 1.)

There were two sentence–probe pairings for each sentence, differing as to whether the probe was presented before or after the anaphor. The sentences were rotated through the two pairings in such a way as to produce two materials sets. The experimental sentences were randomly intermixed with 68 filler sentences of the same sort as those used in Experiment 1A.

**Procedure.** The procedure was the same as that for Experiment 1A.

## Results and Discussion

Responses were faster and more accurate at the before than at the after probe point [before, 1,069 msec (.055); after, 1,140 msec (.08); RT:  $F(1,48) = 6.73$ ,  $MS_e = 18,380$ ;  $F_2(1,46) = 3.08$ ,  $MS_e = 35,898$ ; ER:  $F_1(1,48) = 4.02$ ,  $MS_e = 0.002$ ;  $F_2(1,46) = 3.74$ ,  $MS_e = 0.003$ ; the latter three differences would be significant with one-tailed tests].

These results further clarify the boundary conditions of the anaphor-induced accessibility decrement. In Experiments 1B and 2, the decrement occurred for nouns that identified important characters. In the present experiment, the decrement occurred for nouns that identified important objects. In Experiment 2, the decrement was much weaker for nouns that identified peripheral objects. The critical requirement appears to be that the entities in question be important to the content of the discourse.

## GENERAL DISCUSSION

Gernsbacher's (1989) anaphor-induced accessibility decrement was replicated here. The decrement was smaller here than in Gernsbacher's study. Whereas the decrement ranged from 122 to 127 msec in the earlier study, it ranged from 58 to 97 msec here (for words that identified important discourse entities). The relative modesty of the present decrement may be a reflection of the large numbers of filler

sentences that were used. Gernsbacher's decrement may have been inflated by the kinds of attentional strategies that were described in the introduction to Experiment 1A.

The present results discredit several uninteresting accounts of the accessibility decrement. The observation of the decrement in experiments with large numbers of filler sentences discredits the ad hoc strategy account. The failure to observe the decrement for nouns that identified peripheral objects discredits the decay and context-checking accounts. These results also help establish the boundary conditions of the decrement. It is evidently stronger for important entities (animate and inanimate) than for peripheral entities.

The present results may help us to relate the anaphor-induced accessibility decrement to broader ideas about the accessibility of information during discourse comprehension. They suggest that the process underlying the accessibility decrement serves primarily to adjust the accessibility of information that is important to the current discourse. Such information is often said to be in *focus* and is often found to be more accessible than other information (Grosz, 1981; Snider, 1983a, 1983b). What, then, is the relationship between the anaphor-induced accessibility decrement and focus? On one hand, the decrement might serve simply to reflect the withdrawal of focus. The accessibility increment that is seen for antecedents and the accessibility decrement that is seen for nonantecedents might correspond simply to the presence and absence of focus. Alternatively, the accessibility decrement might constitute an accessibility adjustment occurring within the focal domain. Dopkins and Nordlie (2001) recently observed evidence consistent with the latter point of view. They explored the situation in which two anaphoric references occurred in close succession, with each one picking out a distinct antecedent. Nouns that were antecedents of neither anaphor were inhibited as much following the second anaphor as following the first. This is inconsistent with the view that the anaphor-induced accessibility decrement reflects the withdrawal of focus; focus would have shifted away from the nouns in question after the comprehension of the first anaphor.

If the latter interpretation is correct, it suggests a revised view of the concept of focus. In this view, focused information is distinguished from unfocused information primarily in that it is more important to the comprehension of the discourse. Focused information is no longer always more accessible than unfocused information. In fact, focused information may be either more or less accessible than unfocused information. In general, it is subject to wider swings of accessibility than is unfocused information. Thus, there is more nuance and refinement within the state of focus than has previously been thought. Perhaps this broad range of accessibility is needed to distinguish entities within the crowded focal domain.

In summary, these results suggest that the anaphor-induced accessibility decrement reflects a true process of inhibition. Important discourse entities are more susceptible to the decrement than are peripheral entities.

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