Pronoun Resolution Without Pronouns: Some Consequences of Memory-Based Text Processing

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A memory-based processing approach to discourse comprehension emphasizes the rapid deployment of information in memory to facilitate understanding of the text that is currently being read. S. B. Greene, R. J. Gerrig, G. McKoon, and R. Ratcliff (1994) demonstrated that when a text described the reunion of 2 characters who had previously discussed a 3rd character, the accessibility of the 3rd character increased, and the use of an unheralded pronoun (R. J. Gerrig, 1986) to refer to that character was felicitous. In experiments in this article, the authors demonstrate that concepts related to the referent of the unheralded pronoun also increase in accessibility and that those concepts form associations in memory with concepts present in the discourse at the time the pronoun is used. The authors also show that the increase in accessibility for the referent of the pronoun, as well as the appropriate long-term memory associations, occurs even in the absence of the pronoun.

A New Yorker profile of Supreme Court Justice Clarence Thomas described a scene in which Thomas limped on stage to appear on a conservative talk show with host Mark Larson (Toobin, 1993).

The studio audience applauded enthusiastically as Thomas, already on crutches from his basketball accident, squeezed past Larson to make his way to his designated position in front of the camera. As Thomas hobbled by, Larson quipped, "I know what people are thinking right now: Boy, the Committee was really tough with those hearings, and now this .... " As Thomas settled into place, Larson said, "She just won't let up, will she?" (p. 45).

Who is she? Members of the audience were certainly meant to know as the article went on to say " 'She just won't let up, will she?' " There was no need to use the name. Even two years later, even in front of the Justice's friends, Anita Hill remained the ever-present "She" in Clarence Thomas's life (Toobin, 1993, p. 45).

We have labeled pronouns like Larson's "she" unheralded pronouns (Gerrig, 1986; Greene, Gerrig, McKoon, & Ratcliff, 1994). What sets unheralded pronouns apart from run-of-the-mill pronouns is that their referents cannot be found in the immediate discourse environment. Larson used she without an explicit, local, linguistic antecedent. For the audience to understand she in the absence of an explicit local antecedent, the discourse context must have evoked a uniquely salient woman. Our goal in the current research is to understand the underlying mechanisms of comprehension that make this process seem effortless.

We attempt to understand the mechanisms of pronoun comprehension by means of a theoretical view we call memory-based text processing. It was our hope that an investigation of unheralded pronouns through experiments guided by the memory-based processing view would shed light on the mechanisms of pronoun comprehension and at the same time test the validity of the ideas that define memory-based processing. The experiments presented in this article were designed to work simultaneously toward both of these goals. In the paragraphs immediately below, we first describe the memory-based processing view and then show how it provides a guide to investigation of pronoun comprehension.

Memory-Based Text Processing

The central tenet of memory-based text processing is that comprehension is enabled by information in memory. Whether for text being read or for speech being heard, each new piece of linguistic information is understood in terms of the information that it evokes from memory. The process by which new information evokes old information is described by the resonance metaphor (Lockhart, Craik, & Jacoby, 1976; Ratcliff, 1978) that forms the foundation of current models of how information is retrieved from memory. The notion embodied in these models is that information retrieval is a fast, passive process by which cues in short-term memory interact with all information in long-term memory in parallel (cf. Gillund & Shiffrin, 1984; Hintzman, 1988; Kintsch, 1988; Murdock, 1983; Ratcliff, 1978; Ratcliff & McKoon, 1988). This fast, easy process accesses all of the information in memory, but the
degree to which any specific cue in short-term memory evokes any specific piece of information in long-term memory depends on how strong an association exists in memory between the two, so that some things in memory will be evoked to a greater degree than others.

Theoretical origins of the memory-based text processing view can be seen in Kintsch's (1988) context-integration model and in McKoon and Ratcliff's (1992) minimalist hypothesis. Both invoke a passive and global retrieval mechanism to provide comprehension processes with fast and easy access to long-term memory information. In Kintsch's model, all incoming textual propositions and concepts passively interact with all previous propositions and concepts and general knowledge to allow connections to be formed among propositions and to allow new propositions to be constructed. McKoon and Ratcliff's minimalist hypothesis relies on fast and easy retrieval processes to provide the information necessary to support inferences.

There are also empirical results consistent with the memory-based processing view. McKoon and Ratcliff (1992) showed that pieces of information about a character in a narrative were connected to each other even though they were widely separated in the text. They concluded that a definite description of a character "served to make available other information encoded about him earlier in the story" (McKoon & Ratcliff, 1992, p. 455). Other researchers have also examined connections between widely separated pieces of text information (Albrecht & O'Brien, 1993; Huitema, Dopkins, Klin, & Myers, 1993; Myers, O'Brien, Albrecht, & Mason, 1994; O'Brien & Albrecht, 1992). For example, in a story from Albrecht and O'Brien's (1993) study, a character refuses to eat anything fried or cooked in grease but later orders a cheeseburger and fries. These two pieces of information were separated from each other in the story, yet it appeared that associations among the concepts fried, cooked, grease, cheeseburger, and fries served to connect the two pieces of information together so that readers noticed the inconsistency.

Although the memory-based processing view of comprehension is grounded in widely accepted principles of memory retrieval and has received some empirical backing, the view does not enjoy broad support (cf. Graesser, Singer, & Trabasso, 1994; Singer, Graesser, & Trabasso, 1994). Most germane to the topic of this article is the constructionist alternative. According to some advocates of this view, discourse comprehension depends on the reader or hearer's "need to know" (Singer et al., 1994, p. 438). The reader-hearer forms goals with which to approach a discourse, and what is understood from the discourse depends in large part on those goals and on the mental model formed to pursue those goals.

The difference between the constructionist view and memory-based processing is highlighted by unheralded pronouns like she used to reference Anita Hill in the anecdote recounted above. From the memory-based view, an unheralded pronoun presents no problem to comprehension if memory-based processes have passively and routinely made accessible the required information, as they typically have in natural and felicitous occurrences like the reference to Anita Hill. But an unheralded pronoun presents a much greater challenge from the constructionist point of view: In this view, the association between Anita Hill and Clarence Thomas is not automatically made a part of comprehension prior to the occurrence of the unheralded pronoun. According to Graesser et al. (1994, p. 382), a noun concept such as Anita Hill could be instantiated only as the result of multiple converging information sources, not simply as an associate of Clarence Thomas. Moreover, the comprehender would have no need to know the association between Hill and Thomas until actually encountering the pronoun. Thus, the comprehension of an unheralded pronoun would be predicted to be difficult.

Unheralded pronouns also provide an opportunity to distinguish between memory-based processing's account of pronouns and accounts in which pronoun comprehension depends on searching through surface structures to find antecedents. According to those accounts, a pronoun is supposed to instigate a search back through its discourse for its antecedent, sorting through all the possible nouns that could be its antecedent (Clark & Sengul, 1979; Fodor, 1989; Hobbs, 1978; Matthews & Chodorow, 1988). Such a search would probably be time consuming and would, by assumption, not be successful in the case of an unheralded pronoun. Again, this is a very different description of comprehension from the one provided by memory-based processing. The memory-based view proposes that pronouns are uttered in circumstances in which the discourse and cues from the discourse to memory have already made the entity in question accessible. A pronoun does not create accessibility for itself—it confirms accessibility that already exists.

Our earlier investigations of unheralded pronouns (Greene et al., 1994) pointed toward the memory-based processing view. Those investigations, however, were focused on the processing consequences of the accumulation of common ground and not on the mechanisms of comprehension. In this article, we focus directly on the mechanisms that allow unheralded pronouns to be understood and show that memory-based processing provides an appropriate description of those mechanisms.

Overview of Experiments

These experiments were designed to investigate unheralded pronouns in discourse circumstances in which the pronouns were felicitous. We begin describing the experiments with an example story. Table 1 shows a story that introduces Jane and Gloria, who are discussing a third person: Jane's cousin, Marilyn. This example is typical of all the stories used in the experiments in that it begins with two characters making mention of a third. We labeled this third character the outsider, because the outsider does not participate in the introductory and final scenes of the story. At the end of the introduction in the example, Jane and Gloria separate from each other. There are two versions of the middle of the story, one in which the cousin is present in the action with Jane (outsider present) and one in which Gloria is alone (outsider absent). The story concludes when Jane and Gloria reunite without the cousin. One of them, Gloria, refers to the cousin with a pronoun—"Did she play you old disco records?" For the version in which the cousin is present throughout, the person to whom the pronoun refers has been mentioned relatively recently in the text. For the version in which the cousin is absent, she has not
Table 1

An Example Story: The Outsider Is the Cousin, Marilyn

| Introduction                                                                 |
|_Anim: Jane was dreading her dinner with her cousin, Marilyn. She complained loudly to her roommate Gloria. "Every time I go to dinner at my cousin's I get sick." Gloria asked, "Why did you agree to go?"
| Separate: Jane said, "Because I'm too wimpy to say no."                      |

<table>
<thead>
<tr>
<th>Outsider present</th>
<th>Outsider absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>When she arrived, Marilyn was just finishing the cooking. &quot;You're in luck,&quot; she said, &quot;we're having fried squid.&quot; Jane knew she was in for a wonderful evening. The two of them sat down to dinner. After dinner, they talked for a while, and then Jane left.</td>
<td>Gloria decided to cook something nice for herself for dinner. &quot;As long as I'm home alone,&quot; she thought, &quot;I'll eat well.&quot; Gloria searched her refrigerator for ingredients. She found enough eggs to make a quiche. After dinner, she put the dishes in the dishwasher.</td>
</tr>
</tbody>
</table>

| Reunion sentence: Gloria was still up when Jane arrived home about midnight. |
| Pronoun sentence: Gloria asked Jane, "Did she play you old disco records?" |
| Final sentence: Jane chuckled and said, "I can't get 'Disco Inferno' out of my mind." |

Table 1

<table>
<thead>
<tr>
<th>Section 1: Memory-Based Processes and Unheralded Pronouns</th>
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In Experiments 1, 2, and 3, we conducted tests of the memory-based processing account of pronoun comprehension...
in the situation in which there was an explicitly mentioned unheralded pronoun, as in the example in Table 1. We concluded from these experiments that the mechanisms of memory-based processing provided a good explanation of the data, and so we tested them further in the experiments of Section 2 (Experiments 4–8) by using modified stories in which there was no explicit pronoun. The experiments of Section 1 expanded on our previous work (Greene et al., 1994), and so we begin with a review of the critical results from that research.

The story shown in Table 1 is an example of the stories used by Greene et al. (1994). The reunion sentence mentions Gloria and Jane and indicates that they have come back together again as they were at the beginning. The pronoun sentence refers to the outsider character from the beginning of the story. Greene et al. (1994, Experiment 3) showed that this configuration of cues increased the accessibility of the outsider. The social role label for the outsider (e.g., cousin) was used as a recognition test word. It was tested immediately before the reunion sentence, immediately after the reunion sentence, and immediately after the pronoun sentence. The results are shown in Figure 1A. With the outsider-present version of the text, the outsider is maintained as an active player in the discourse throughout the story, and accessibility is high throughout. In the outsider-absent middle part, the outsider disappears from the action; as a result, its accessibility drops but then rises with the reunion and pronoun sentences. This pattern is shown by a large difference in response times between the outsider-present and the outsider-absent conditions before the reunion sentence, which changes to a small difference as response times in the outsider-absent condition speed up after the reunion and pronoun sentences.

**Experiment 1**

The data from Greene et al. (1994) depicted in Figure 1 show that the configurations of cues in the reunion and pronoun sentences led to an increase in the accessibility of the referent of the unheralded pronoun, cousin (the outsider). However, the cues should evoke all the concepts from the introduction, not just cousin. We tested this prediction in Experiment 1 with a concept that was associated with the main characters but, unlike the outsider, was not explicitly or implicitly mentioned at the end of the story. For the example story in Table 1, shown again in schematic form in Table 2, we used the test word dreading from the second sentence of the story. Participants read the stories one sentence at a time. For the outsider-present version, response times to dreading should stay relatively fast throughout the story because the associated concepts Jane and the cousin and their dinner play active roles throughout the middle part. But after the outsider-absent version of the middle part, response times to dreading should be relatively slow because most concepts associated with dreading have not played a recent role in the story. However, after the reunion and pronoun sentences, the difference in response times for dreading between the outsider-present and outsider-absent versions should become smaller as response times to dreading in the outsider-absent condition speed up relative to the outsider-present condition. This pattern of response times should replicate the pattern Greene et al. (1994) observed for the test word that was the referent of the unheralded pronoun (cousin).

**Method**

**Materials.** The experimental materials for all of the experiments consisted of 42 stories that ranged in length from 13 to 16 sentences (the same stories as those used in Greene et al., 1994, Experiment 3). The first section of each story (4–6 sentences) introduced two characters, referring to each of them with a proper name (e.g., Jane and Gloria). These two characters then discussed or interacted with a third character, who was designated by a social role (e.g., cousin, professor, bartender, senator). For purposes of describing the experiments, we call this character the outsider character to distinguish it from the other two characters. (This is a different and more convenient label for present purposes than the one we used in Greene et al., 1994.) After the introduction and discussion of the outsider character, the story described the two other characters (Jane and Gloria) separately. In the outsider-present versions of the materials, the following 5 or 6 sentences continued the action of the introduction and described interaction between the outsider character and one of the other characters (e.g., the cousin and Jane). In the outsider-absent versions of the materials, the 5 or 6 sentences described the actions of the other character who was alone (e.g., Gloria). Both the outsider-present and the outsider-absent versions were followed by the same reunion sentence in which the two original characters were brought back together (with no mention of the outsider character). The reunion sentences explicitly mentioned both characters except in 6 stories where the reunion sentence mentioned one of the characters, and the pronoun sentence mentioned the other. In the next sentence, the pronoun sentence, one of the original characters spoke to the other and used a pronoun to refer to the outsider character. Other than the original characters and the pronoun, this sentence did not explicitly repeat any content word that had appeared earlier in the story. A final sentence concluded the story. In Experiment 1, for each story there was one test word (e.g., dreading). It was a word that appeared once in the introductory sentences of the story and was not repeated again. Each story also had associated with it a sentence used for a true–false comprehension test.

In addition to the experimental items, there was a set of 32 filler stories, of which 26 were used in Experiment 1. These varied in length from 8 to 13 sentences and described two or more characters interacting. These stories were similar in style to the experimental items but did not follow the same sequence of events in the characters’ interactions. Each filler story had three test words and one true–false sentence associated with it.

**Design and participants.** There were two factors in the experiment: (a) a test word was presented either immediately before the reunion sentence (i.e., immediately after the last sentence of whichever middle version was used), or it was presented after the pronoun sentence, and (b) a story was presented in either the outsider-present or outsider-absent versions. These two factors were combined with 40 of the experimental stories and 20 participants in a Latin square design with four groups of participants (5 per group) and four groups of stories (10 per group). The participants in all of these experiments participated for credit in an introductory psychology class at Northwestern University.

**Procedure.** In all of the experiments described here, the stories and test items were presented on a personal computer (PC) screen, and responses were collected from the PC’s keyboard. Each experimental session began with 30 lexical decision test items to give participants practice with the response keys on the keyboard.

After the lexical decision practice, the experiment proper began. Stories were presented in blocks of six stories, the 1st block containing
only filler stories and the remaining 10 blocks each containing four experimental and two filler stories. Each story was presented one sentence at a time. Participants were instructed to press the space bar when they finished reading a sentence. Pressing the space bar cleared the PC screen and brought up either the next sentence of the story or a test word. When a test word was displayed, it appeared alone on the screen in all capital letters. It remained on the screen until a response key was pressed: */ for "yes, the word had appeared in the story" or Z for "no, the word had not appeared in the story." An incorrect response was followed by an error message: the word ERROR presented for 1,500 ms. Participants were encouraged to respond quickly and accurately to the test words; responses slower than 1,200 ms were followed by the message TOO SLOW. After each block of six stories, the true–false test sentences for those stories were presented. Incorrect true–false responses were followed by the error message, ERROR, presented for 1,500 ms. Except for the constraints mentioned, stories were presented in a random order, with a new random order used for every other participant.

Figure 1. Response times (RTs) and error rates (Err) for test words from an experiment by Greene, Gerrig, McKoon, and Ratcliff (GGMR, 1994, Experiment 3) shown at the top and from Experiments (Exp) 1, 4, 5, and 6 in this article.
Table 2
Schematic for Experiments 1, 2, and 3

<table>
<thead>
<tr>
<th>Separate:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jane, Gloria, and the cousin. . .</td>
</tr>
<tr>
<td>Jane was dreading her dinner with her cousin, Marilyn. . .</td>
</tr>
<tr>
<td>Jane went off to have dinner.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Middle versions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outsider present</strong></td>
</tr>
<tr>
<td>Jane and the cousin (fried, squid)</td>
</tr>
<tr>
<td><strong>Outsider absent</strong></td>
</tr>
<tr>
<td>Gloria alone (eggs, ingredients)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reunion sentence: Gloria was still up when Jane arrived home about midnight.</td>
</tr>
<tr>
<td>Pronoun sentence: Gloria asked Jane, “Did she play you old disco records?”</td>
</tr>
<tr>
<td>Final sentence: Jane chuckled and said, “I can’t get Disco Inferno out of my mind.”</td>
</tr>
</tbody>
</table>

Experiment 1
Test word: dreading

Experiments 2 and 3
Target: disco
Introduction prime: dreading
Middle primes, outsider present: fried, squid
Middle primes, outsider absent: eggs, ingredients

Each experimental story had only one test word. Each filler story had three test words, with one word tested in each third of the story (beginning, middle, and end). Correct responses to those words tested in the first two thirds of the stories were half positive and half negative, and those tested in the final third were all negative.

Results

For all the experiments reported here, mean reading times for sentences and mean percentages of correct responses and response times for test words were calculated for each participant and each item in each condition, and means of these means are shown in the tables or in Figure 1. For test-word response times, the slowest 5% (approximately) of responses were excluded from the analyses. Reading times for sentences were excluded from the analyses of reading times if they occurred after a test word. Analyses of variance (ANOVAs) were performed with both participants and items as random variables, and the significance level was set at $p < .05$. The standard errors on means that are reported were calculated from the mean squared error terms from the participants' ANOVAs.

In the outsider-absent version of a story, the reunion sentence brings the two main characters of the story (e.g., Gloria and Jane) back together after a separation, and the following pronoun sentence refers to the outsider character (e.g., the cousin) with a pronoun. The prediction was that these cues would increase the accessibility of the tested concept *dreading* from the beginning of the story. The data shown in Figure 1B indicate that they did. Before the reunion sentence, responses for the test word were slower after the outsider-absent middle than the after outsider-present middle. After the reunion and pronoun sentences, this difference disappeared (and in fact even reversed). This interaction between test point and which of the two versions was read was significant, $F_1(1, 19) = 4.6$ and $F_2(1, 36) = 5.2$. No other response-time effects were significant ($Fs < 2.5$). The standard error of the response-times means was 11 ms. There were no significant effects on error rates ($Fs < 2.8$).

It should be noted that it is not possible to predict whether response times speed up overall from the test point before the reunion sentence to the test point after the pronoun sentence. There might be differences in these test points that cause differences in response time for all test words, independent of their relative degrees of accessibility. For example, all test words might be more difficult after the pronoun sentence than before it for some reason outside the scope of our research. For our purposes, overall differences between test points are irrelevant. We simply predict that, relative to the outsider-present condition, response times to the critical test word in the outsider-absent condition speed up from before the reunion sentence to after the pronoun sentence.

After the outsider-absent middle, the reunion sentence reading time averaged 1,815 ms, and the pronoun sentence reading time averaged 2,013 ms. After the outsider-present middle, the corresponding means were 1,910 ms and 1,953 ms. The only significant effect was in the participants' analysis, which showed that pronoun sentences took significantly longer to read than the reunion sentences, $F_1(1, 19) = 5.9$ (all other $Fs < 1.4$). The standard error of the reading-time means was 52 ms. Although there were no differences relevant to our hypotheses among reading times in any of the experiments reported in this article, we report them to show the general speed of reading by the participants in the experiments.

Experiment 2

Our interpretation of the results of Experiment 1 is that a concept from the beginning of the story becomes accessible at a distant point when concepts associated with it are mentioned. Coupled with the results of the experiments reported by Greene et al. (1994), this provides support for the memory-
Method

Materials. Twenty-eight of the experimental texts were used in this experiment. For each text, six test words were chosen. One was designated the “target” and was chosen from the last section of the text, either from the pronoun sentence or the final sentence. The other five test words were used as primes for the target. One of these was chosen from the introduction section of the text. Two of the others were chosen from the middle section of the outsider-absent version, and the other two were chosen from the middle section of the outsider-present version. None of the test words were the names or social roles of any of the characters. There were also 30 filler texts with four test words each.

Procedure. The experiment consisted of 15 study and test-list blocks. The first was a practice block with two filler stories to study and 24 test words. For the remaining 14 blocks, each study list was made up of two experimental stories and two fillers followed by 26 test words in the test list. The four studied stories were presented in random order, except that an experimental story could not occur in the last study position.

Each study list began with an instruction displayed on the PC screen to press the space bar to begin the list. Then, after a 1-s pause, the four stories were displayed one at a time for 28 s each with a 1,500 ms pause between each. After the four stories, a row of asterisks (displayed for 2 s) signaled the beginning of the test list. Each word of the test list was presented individually; it remained on the screen until the participant made a response by pressing the “?” key for “yes, the word had appeared in one of the stories just read” or the “Z” key for “no, it had not.” A correct response was followed by a 100-ms pause and then by the next test word. An incorrect response was followed by the word error displayed for 2 s and then by the next test word.

Within the test list, the targets for the experimental stories were placed in random positions later than the fourth position, and their prime words were placed in the positions immediately preceding them. For each experimental story, there was also one other test word from the story that was placed in some randomly chosen list position later than the target. With the 8 test words from the filler stories (placed randomly in the test list), there was a total of 14 positive test words. The remaining 12 test positions were filled by words that did not appear in any story in the experiment. The random orders of words in test lists and of stories in the study lists were changed after every 2 participants in the experiment.

Design and participants. There were four conditions in the experiment, which were formed by crossing the story-version factor (outsider present or outsider absent) with whether the prime word for a target was from the introductory section of the story or from a middle section. These four conditions were crossed with groups of participants and groups of stories in a Latin square design.

When the prime was from the introductory section, the prime word was exactly the same word regardless of which version of the story was studied, but when the prime was from a middle section, different prime words were used for the two versions. One set of middle primes with one prime for each version (e.g., fried and ingredients) was used for 24 participants, and the second set (e.g., squid and ingredients) was used for another 24 participants.

Results

We expected that there would be no significant difference in the facilitation given to responses to the targets by the primes from the beginnings of the stories, whether a text was read in its outsider-present or outsider-absent version. With the outsider-present version, a concept from the beginning is carried through to the end of the story, and so there are plentiful opportunities for the associations measured by priming to be formed. With the outsider-absent version, concepts from the beginning are less likely to be carried through, but they are evoked by cues from the end, and so associations should also
be formed in this condition. Our expectation was confirmed (see Table 3); target response times were about the same in the two conditions. In contrast, prime words from the middle sections in the two versions should not be equally connected to the targets. A prime from the outsider-absent middle section should give less facilitation than a prime from the outsider-present middle section, and this is what the data show.

The interaction just described was significant, $F_1(1, 47) = 8.3$ and $F_2(1, 24) = 6.4$. No other effects were significant in the response-time analyses ($Fs < 1.0$). Of importance, the results did not differ between the two sets of middle prime words ($Fs < 1.3$). The standard error of the mean for response times was 14 ms. Planned tests showed that a prime from the outsider-absent middle gave less facilitation than a prime from the outsider-present middle, $F_1(1, 47) = 5.5$ and $F_2(1, 24) = 5.2$, and showed that there was no significant difference in facilitation for primes from the beginnings of the stories, $F_1(1, 47) = 1.6$ and $F_2(1, 24) = 1.5$. There were no significant effects on error rates ($Fs < 2.6$).

**Experiment 3**

In our interpretation of these results, we assume that responses to targets primed by words from the beginning of their stories are facilitated relative to what the responses would have been without those primes, but these data do not actually show this because we had no control condition against which to compare the response times. To provide such data, we conducted a control experiment, Experiment 3. The outsider-present versions of the stories were used, and there were two conditions: The target word from the end of a story was primed by the word from the introduction of the same story or by a word from the introduction of a different story. If the primes from the beginnings of the stories actually had facilitated their targets in Experiment 2, then that facilitation should be observed relative to the prime from different stories in Experiment 3. In all respects of design and procedure that are not mentioned, the experiment was the same as Experiment 2. There were 20 participants.

The results are shown in Table 3. Clearly, the introduction word from the same story facilitated responses to a target more than the introduction word from a different story did, $F_1(1, 19) = 10.4$ and $F_2(1, 26) = 10.1$ (standard error of the means was 15 ms). There was also an almost significant effect on error rates, $F_1(1, 19) = 4.0$ and $F_2(1, 26) = 4.5$, with the standard error of the error-rate means being .02.

In this article, we discuss response-time results as showing different amounts of facilitation from primes to targets. There is, of course, nothing in our data to show that it is facilitation that is varying across conditions and not inhibition. However, other studies with the same procedures have found that a prime from a story facilitates responses to a target from that same story, rather than inhibiting responses to a target from another story (cf. Ratcliff & McKoon, 1981), so we infer that it is facilitation and not inhibition that operated in the experiments reported here. It has also been shown that under the test conditions used in the priming experiments reported here processing can be assumed to be “automatic” rather than “strategic” (cf. Ratcliff & McKoon, 1981).

**Section 2: Memory-Based Processes in the Absence of Unheralded Pronouns**

The results of Experiments 1, 2, and 3 give a picture of the pertinent interactions between cues in the reunion and pronoun sentences and information from the beginning of the story. For the outsider-absent versions of the stories, reading the reunion and pronoun sentences results in increased accessibility of concepts from the beginning and it is associated with connections in long-term memory between information from the beginning of the story and information from the end. As predicted by the memory-based processing view, these connections involve not only the concept referenced by the unheralded pronoun but also other concepts from the story’s beginning.

In Experiments 4–8, we turn to another series of tests of the memory-based processing view. These tests were guided by the strong assumption that the referent of an unheralded pronoun is made accessible by discourse cues that precede the pronoun in the discourse. Greene et al.’s (1994) results (Figure 1A) provided one piece of support for this assumption, and the current experiments were designed to provide more. Experiments 4–8 were based on the reasoning that if the accessibility of the referent of a pronoun depends only on discourse cues and not on the pronoun, then the accessibility of the referent concept should be increased by those cues even where there is no pronoun. In Experiments 4, 5, and 6, we looked at on-line accessibility, and in Experiments 7 and 8 we looked at the associations in memory on which that accessibility depends according to memory-based processing.

**Experiments 4, 5, and 6**

For each of our stories, we wrote a new sentence as shown by the example in Table 4. The new sentence was a replacement for the pronoun sentence, and it was called the allusion sentence because it alluded to what had happened when the two main characters (Gloria and Jane) were apart. It did not have a pronoun that referred to the outsider character, and it did not refer in any other direct way to the outsider. We also modified the pronoun sentence so that it would contain exactly the same information as the allusion sentence except for the addition of the pronoun. For the story about the cousin, in the
allusion sentence Gloria asked Jane whether the evening was unbearable, and in the pronoun sentence the question was whether she made the evening unbearable.

As shown in Table 4, there were now two versions of the conclusion of a story: the reunion sentence followed by the allusion sentence followed by the final sentence, and the reunion sentence followed by the pronoun sentence followed by the final sentence. In both versions, the cues provided by the discourse to memory were the same—except for the pronoun. According to the memory-based processing view, this difference should matter little to the accessibility of the referent of the pronoun or to the associations among concepts on which the accessibility depends.

Experiments 4, 5, and 6 examined the accessibility of the outsider (the cousin). We needed to measure its accessibility through the conclusion of the story and to compare its accessibility in the outsider-present and the outsider-absent versions of the story both with and without the pronoun. This entailed test points before the reunion sentence, after the reunion sentence, after the allusion sentence, and after the pronoun sentence. We could not include all of these conditions in one experiment, so they were spread over Experiments 4, 5, and 6 (as illustrated in Figure 1). Repetitions of some of the conditions between experiments provided replicability of the results.

Experiment 4 used the outsider-present and the outsider-absent versions of the middle of a story, and the outsider was tested for recognition either before the reunion sentence or after the allusion sentence. Experiment 5 also used both middle versions, and the outsider was tested before the reunion sentence, after the allusion sentence, and after the pronoun sentence, allowing a direct comparison of pronoun versus no pronoun. Experiment 6 used only the outsider-absent middle versions and tested before and after the reunion sentence, after the allusion sentence, and after the pronoun sentence, allowing comparison of the effect of the reunion sentence alone against the effect of the reunion plus the pronoun sentence and the reunion plus the allusion sentence.

**Method**

Forty stories were used in Experiments 4 and 6, and 42 stories were used in Experiment 5. For each story, a new allusion sentence was constructed to take the place of the pronoun sentence. The allusion sentence described an utterance made by one of the original characters to the other. The utterance alluded to the activity of one of the original characters with the outsider but did not specifically mention the outsider or use any words that had previously been used to describe the outsider's activity. The mean length of the allusion sentences was nine words. The original pronoun sentence for each story was modified so that, except for the addition of the pronoun, it used the same content words as the allusion sentence. A single final sentence was created for each story to be consistent with the new pronoun and allusion sentences. The test word for each story was the social role of the outsider (cousin). Twenty-six filler stories were used, each with three test words as in Experiment 1. The procedure for Experiments 4 and 6 was the same as for Experiment 1, and the procedure for Experiment 5 was the same as for Experiment 1, except that the stories were blocked into groups of one filler and three experimental stories instead of into groups of six stories.

In Experiment 4, there were two factors in the design: The outsider was tested either immediately before the reunion sentence or immedi-

<table>
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<th>Table 4</th>
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<tr>
<td><strong>Schematic for Experiments 4, 5, 6, 7, and 8</strong></td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
</tr>
<tr>
<td>Jane, Gloria, and the cousin. . .</td>
</tr>
<tr>
<td>Jane was dreading her dinner with her cousin, Marilyn. . .</td>
</tr>
<tr>
<td>Separate:</td>
</tr>
<tr>
<td>Jane went off to have dinner.</td>
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<tr>
<th><strong>Middle versions</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Outsider present</strong></td>
</tr>
<tr>
<td>Jane and the cousin (fried, squid)</td>
</tr>
<tr>
<td><strong>Outsider absent</strong></td>
</tr>
<tr>
<td>Gloria alone (eggs, ingredients)</td>
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<tr>
<th><strong>Conclusion</strong></th>
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<tbody>
<tr>
<td><strong>Reunion sentence:</strong></td>
</tr>
<tr>
<td>Gloria was still up when Jane arrived home about midnight.</td>
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<tr>
<td><strong>Pronoun sentence:</strong></td>
</tr>
<tr>
<td>Gloria asked Jane, &quot;Did she make the evening unbearable?&quot;</td>
</tr>
<tr>
<td><strong>Final sentence:</strong></td>
</tr>
<tr>
<td>Jane chuckled and said, &quot;I just want to get some sleep.&quot;</td>
</tr>
<tr>
<td>Or</td>
</tr>
<tr>
<td><strong>Reunion sentence:</strong></td>
</tr>
<tr>
<td>Gloria was still up when Jane arrived home about midnight.</td>
</tr>
<tr>
<td><strong>Allusion sentence:</strong></td>
</tr>
<tr>
<td>Gloria asked Jane, &quot;Was the evening unbearable?&quot;</td>
</tr>
<tr>
<td><strong>Final sentence:</strong></td>
</tr>
<tr>
<td>Jane chuckled and said, &quot;I just want to get some sleep.&quot;</td>
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<table>
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<tr>
<th><strong>Experiments 4, 5, and 6</strong></th>
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<tr>
<td><strong>Test word:</strong> cousin</td>
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<th><strong>Experiments 7 and 8</strong></th>
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<tr>
<td><strong>Target:</strong> sleep</td>
</tr>
<tr>
<td><strong>Introduction prime:</strong> dreading</td>
</tr>
<tr>
<td><strong>Middle primes, outsider present:</strong> fried, squid</td>
</tr>
<tr>
<td><strong>Middle primes, outsider absent:</strong> eggs, ingredients</td>
</tr>
</tbody>
</table>
ately after the allusion sentence, and the stories were presented in either the outsider-present or outsider-absent versions. The two factors were crossed in a Latin square design, with four groups of participants (9 per group) and four groups of stories (10 per group).

Experiment 5 used a $2 \times 3$ design. One factor was whether a story was presented in its outsider-present or outsider-absent version. The second factor was the location of the test word. The conclusion of a story either used the pronoun sentence followed by the final sentence or used the allusion sentence followed by the final sentence. The outsider character was tested either before the reunion sentence, after the allusion sentence, or after the pronoun sentence. In the first case, which ending of the story was used (pronoun or allusion) was chosen randomly. The two factors of story version and test position were crossed, and these six conditions were combined in a Latin square with six groups of participants (4 per group) and six groups of items (seven per group).

In Experiment 6, all stories were presented in their outsider-absent version. The conclusion used either the allusion or the pronoun sentence. The outsider was tested immediately before the reunion sentence, immediately after the reunion sentence, immediately after the allusion sentence, or immediately after the pronoun sentence. If the test location was before or immediately after the reunion sentence, which next sentence (allusion or pronoun) was used was decided randomly. The four conditions were combined in a Latin square with four groups of participants (6 per group) and four groups of items (10 per group).

**Results**

**Experiment 4.** The question asked by Experiment 4 was whether the reunion plus allusion sentences would serve to increase the accessibility of the outsider character after the accessibility had declined in the outsider-absent middle part of the story relative to the outsider-present middle. The data show that they did (Figure 1C). The difference in response times between the outsider-absent and outsider-present versions of the stories decreased from before the reunion sentence to after the allusion sentence.

The interaction between test position and story version was significant, $F_1(2, 46) = 5.8$ and $F_2(2, 72) = 4.3$. Overall, response times were slower for the outsider-absent versions of the stories than for the outsider-present versions, $F_1(1, 35) = 18.8$ and $F_2(1, 36) = 11.3$. The main effect of test position was not significant ($F$s < 2.1). The standard error of the response-time means was 12 ms. There were significantly more errors with the outsider-absent than with the outsider-present stories, $F_1(1, 35) = 8.7$ and $F_2(1, 36) = 30.9$. No other effects on error rates were significant ($F$s < 1.1). The standard error of the error-rate means was .04.

The mean reading times for the reunion sentences were 1,735 ms after the outsider-present middle and 1,776 ms after the outsider-absent middle. The mean reading times for the allusion sentences in the same two conditions were 1,767 ms and 1,807 ms. There were no significant effects for reading times ($F$s < 1.2). The standard error of the reading-times means was 34 ms.

**Experiment 5.** The main result of Experiment 4 was that the reunion and allusion sentences increased the accessibility of the outsider even though they did not refer directly to the outsider. In Experiment 5, we asked whether the reunion plus allusion sentences increased the accessibility as much as the reunion plus pronoun sentences did. It appears that they did; the data are shown in Figure 1D. The difference in response times between the outsider-absent and outsider-present versions decreased from before the reunion to after the allusion, and the amount of the decrease was actually numerically greater than the decrease from before the reunion to after the pronoun sentence.

The interaction of test position and story version was significant, $F_1(2, 46) = 6.2$ and $F_2(2, 72) = 3.8$. Overall, response times were slower for the outsider-absent versions of the stories, $F_1(1, 23) = 7.7$ and $F_2(1, 36) = 4.0$. Test position did not significantly affect response times ($F$s < 1.0). The standard error of the response-time means was 13 ms. For error rates, the interaction of test position and story version was also significant, $F_1(2, 46) = 7.8$ and $F_2(2, 72) = 6.4$, as was the main effect of story version, $F_1(1, 23) = 6.8$ and $F_2(1, 36) = 8.4$. The main effect of test position was not significant ($F$s < 2.5). The standard error of the error-rate means was .06.

The critical statistical comparison for the main hypothesis was the difference between the two versions of the stories (outsider present and outsider absent) at the before-reunion test position versus the difference between the two versions at the later two test positions. A planned test showed that the difference between the two story versions was significantly larger at the before-reunion test position than at the later two positions, $F_1(1, 46) = 13.0$ and $F_2(1, 72) = 7.2$.

Consistent with their shorter length, the allusion sentences were read more quickly than the reunion or pronoun sentences. Mean reading times for the allusion sentences in the outsider-present and outsider-absent conditions were 1,822 ms and 1,777 ms, respectively. The same two means for the reunion sentences were 1,979 ms and 1,957 ms, and for the pronoun sentences, they were 1,985 ms and 1,925 ms. The main effect of sentence (reunion, allusion, or pronoun) was significant, $F_1(2, 46) = 8.9$ and $F_2(2, 72) = 3.5$. Other effects on reading times were not significant ($F$s < 1.3). The standard error of the reading-time means was 37 ms.

**Experiment 6.** The results of Experiment 5 indicate that the accessibility of the outsider increases as much without direct reference to the outsider as with direct reference. This supports Greene et al.'s (1994) result that accessibility increased even before the pronoun sentence, that is, by the end of the reunion sentence. Experiment 6 showed both of these patterns of data in the same experiment, thus providing strong replication (see Figure 1E).

With only the outsider-absent versions of the stories, we could not look at how response times for the outsider test word differed between the two versions or at how this difference changed across test positions. However, because test position did not have a significant main effect on response times in Experiments 1, 4, or 5, we felt safe in comparing response times directly across the positions.

As predicted, responses to the outsider test word were faster after the reunion than before it, and they did not significantly decrease further in speed after that. The main effect of test position was significant, $F_1(3, 69) = 8.3$ and $F_2(3, 117) = 6.2$. The standard error of the response-time means was 9 ms. There were no significant effects on error rates. (The standard error of the error-rate means was .06). The mean reading times for the reunion, allusion, and pronoun sentences were 1,829...
Experiments 7 and 8

In the data of Experiments 4, 5, and 6, we can see the waxing and waning of accessibility for the outsider character. With the outsider present through the middle section of a story, its accessibility stays relatively high from beginning to end. With the outsider absent from the middle of the story, its accessibility declines but then rises again after the reunion and allusion sentences even though these sentences do not directly mention the outsider. The memory-based processing explanation of how these sentences increase the accessibility of the outsider is that concepts in the conclusion sentences interact with concepts from the beginning of the story. If this is correct, then we should see evidence of these associations in priming effects in delayed recognition, just as in Experiment 2 where the outsider character was directly mentioned with a pronoun.

In Experiment 7, we examined associations between concepts from the beginning of the story and concepts from the end of the story (see Table 4). A story was read in either the outsider-present or the outsider-absent version, and the conclusion of the story was the reunion sentence followed by the allusion sentence and the final sentence. In Experiment 8, we examined the same associations using the conclusion with the pronoun sentence as well as the conclusion with the allusion sentence in order to compare them. Table 4 shows the materials in schematic form with the prime word from the beginning of the story (dreading) and its target word from the end of the story (sleep). Experiment 7 also included middle-to-end-of-story priming conditions as in Experiment 2: A word from the outsider-absent middle was expected to be less closely associated with a word from the end than a word from the outsider-present middle was.

Method

Twenty-eight experimental stories were used in these experiments. In Experiment 7, only the conclusions with the allusion sentences were used, and in Experiment 8, both the pronoun- and allusion-sentence conclusions were used. As in Experiment 2, there were six test words for each story: a target word from the final sentence, a prime word from the introduction, two prime words from the middle outsider-absent version of the story, and two prime words from the middle outsider-present version of the story (Table 4). The same filler stories and the same procedure were used as in Experiments 2 and 3.

In all conditions of Experiment 7, the target word was the word from the end of the story. A story was presented in either its outsider-present or outsider-absent version, and the target word was primed either by the word from the introduction or by a word from the middle part of the story. The first middle prime from each version was used for 27 participants, and the second middle prime was used for 13 participants. The two factors, story version and introduction versus middle prime, were combined in a Latin square with four groups of participants (10 per group) and four groups of stories (seven per group).

In all conditions of Experiment 8, the target was the word from the end of the story, and the outsider-absent version was used. In two conditions, the introduction prime came from the same story as the target; in one of these conditions, the pronoun sentence was used in the conclusion, and in the other, the allusion sentence was used. In the third condition of the experiment, the introduction prime was from a different story than the target; in this case, the sentence used (pronoun or allusion) was chosen randomly. The three conditions were combined in a Latin square with three groups of items (10 per group) and three groups of participants (10 per group).

Results

Experiment 7. We hypothesized that the reunion plus allusion sentences would draw together the introduction and conclusion parts of the stories for the outsider-absent versions. The data in Table 5 confirm this hypothesis: The amount of facilitation given by the introduction word prime to the target from the end of the story was not less for the outsider-absent version than for the outsider-present version. (In fact, it was more.)

As in Experiment 2, the middle part of the outsider-absent version should be less well connected to the end of the story than the middle part of the outsider-present version was, and this was also confirmed. There was less priming from a middle word to the target for the outsider-absent version than for the outsider-present version.

The interaction that supports these conclusions was significant, $F_1(1, 39) = 4.7$ and $F_2(1, 24) = 4.7$. The main effect of middle versus introduction prime approached significance, $F_1(1, 39) = 3.9$ and $F_2(1, 24) = 5.1$, but the main effect of story version was not significant ($F_s < 1$). The standard error of the response-time means was 19 ms. There were no significant effects on error rates ($F_s < 2.6$) with the standard error of the means being .03.

Planned tests on the response times showed that middle primes facilitated response times less for the outsider-absent versions than for the outsider-present versions, $F_1(1, 39) = 4.3$ and $F_2(1, 24) = 5.6$. The difference between introduction primes for the two versions was not significant ($F_s < 1.0$).

Experiment 8. We questioned whether the allusion sentences of a story could serve to draw together the introduction and conclusion as well as the pronoun sentences could. The data shown in Table 5 indicate that they did. The amount of facilitation given to the target word by a word from the

<table>
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<tr>
<th>Condition</th>
<th>Experiment prime</th>
<th>Middle prime</th>
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<tbody>
<tr>
<td></td>
<td>RT in ms % errors</td>
<td>RT in ms % errors</td>
</tr>
<tr>
<td>Outsider present</td>
<td>891 17</td>
<td>901 15</td>
</tr>
<tr>
<td>Outsider absent</td>
<td>874 19</td>
<td>959 15</td>
</tr>
</tbody>
</table>

Note. RT = reaction time.
introduction was not significantly larger with the pronoun than with the allusion sentences.

The main effect of prime condition was significant; \(F_1(2, 58) = 13.7\) and \(F_2(2, 54) = 6.7\). (The standard error of the mean response times was 14 ms.) Planned tests showed that the difference in facilitation between the pronoun and allusion conditions was not significant \((Fs < 1.0)\). There were also significant differences among the conditions in error rates, \(F_1(2, 58) = 4.1\) and \(F_2(2, 54) = 6.7\). (The standard error was .03.)

General Discussion

To summarize our results we return to the question of why unheralded pronouns are possible at all. According to many accounts of pronoun resolution, they should not be: Traditionally, pronouns have been assumed to have antecedents (at worst, implicitly) in the immediate linguistic environment. Unheralded pronouns do not have such antecedents. We have argued that unheralded pronouns are possible because memory processes, which are not special to language understanding, may make the referents of these pronouns available even before the pronouns are used.

In support of this view, we have offered two converging pieces of evidence. First, we explored the types of cues that are necessary to make the concept that functions as the referent of an unheralded pronoun readily accessible to discourse processes. In Experiments 4, 5, and 6, which used an on-line word-recognition paradigm, we demonstrated that the pronoun itself is not essential to return an outsider to prominence in a representation. Each story began with two characters establishing the existence of an outsider like the cousin. In the outsider-present version of the story, the cousin was continually present in the story and, thus, remained continually accessible in readers' representations. In the outsider-absent version, the cousin became less accessible when the story turned to other matters. We demonstrated, however, that the cousin became accessible again when the other two characters were reunited. Confirming the conclusions of Greene et al. (1994), the return to accessibility did not rely on the use of the pronoun. Experiment 1 showed, in addition, that other information besides the cousin also returned to prominence when the characters were reunited. It is on these grounds that we conclude that pronouns confirm accessibility rather than create accessibility.

This conclusion is consistent with the results of other experiments that have investigated the comprehension of pronouns. We have shown elsewhere that comprehenders do not always identify unique referents even for run-of-the-mill pronouns (Greene, McKoon, & Ratcliff, 1992). In circumstances in which fast, global retrieval processes would fail to provide a unique discourse entity to match the semantic features of an unambiguous pronoun, readers did not identify a unique referent for the pronoun. However, contrast that situation with one in which a single potential referent has been made more salient than others by the discourse context prior to the occurrence of the pronoun. In this context, a fast, global memory process can match the salient entity, and readers do, in fact, appear to quickly identify a unique referent for the pronoun (McKoon, Greene, & Ratcliff, 1993). The important observation for current purposes is that in the case of run-of-the-mill pronouns just as in the case of unheralded pronouns, the discourse has made a referent salient prior to the occurrence of the pronoun (Greene & McKoon, 1995).

The second type of evidence offered in this article in favor of the memory-based processing view comes from our examination of the long-term memory representations that result when participants read the stories. We predicted that concepts in the introductions and conclusions of the stories would be linked to each other irrespective of the intervening material. Experiment 2 provided evidence for both the outsider-present and outsider-absent versions of the texts that participants formed coherent representations of the portions of the text that initially introduced the outsider and then reintroduced the outsider with an unheralded pronoun. By contrast, the central portion of the text was closely associated with later portions of the text only in the outsider-present versions when the action had stayed with the outsider throughout the story. Experiments 7 and 8 extended this result to circumstances that omitted the unheralded pronoun. Thus, we concluded that the critical requirement is the configuration of textual cues that allows memory processes to draw together appropriate portions of the stories—the pronoun itself is not essential.

We believe that these data help inform recent discussions of the minimalist hypothesis (McKoon & Ratcliff, 1992) and of other theories of inference in text processing, such as the constructionist theories proposed by Graesser et al. (1994; Singer et al., 1994). An aspect of the minimalist hypothesis that has caused difficulty is that it is a hypothesis about processing, not about specific kinds of inferences. One class of minimalist inferences is made up of inferences that rely on information that is quickly and easily available from memory. This description does not give any clues as to what might be the content of inferences that fall in the class. Critics have been quick to point to this omission. The current experiments, however, are intended to support the idea that even given the inherent lack of specificity in the minimalist claim, what is easily available from memory accounts for significant aspects of discourse processing. That is, against the background of a particular theory of memory, we were able to make correct predictions on the basis of our conception of what information is made available from memory. In this light, we illustrate the goal of simultaneous development of a theory of memory and a theory of language processing.

Note, also, that our data suggest that the minimalist in minimalist hypothesis does not constrain the sophistication of the inferences that are accomplished (see also Gerrig, 1993). Thus, if we took unheralded pronouns to be special—a type of pronoun that requires special processes not required by ordinary pronouns—we might predict that their resolution would fall well outside the bounds of minimalist processing. Instead, we have suggested that normal memory mechanisms can make the resolution of unheralded pronouns extremely efficient.

We can find other circumstances in which minimalist processing appears to support relatively sophisticated understanding. Consider the way in which anaphors reinstate their referents. A number of studies have shown that the relationship between
an anaphor and its referent is quickly available (cf. Dell, McKoon, & Ratcliff, 1983; O'Brien, Duffy, & Myers, 1986). Gibbs (1990) extended this to nonliteral language. In his studies, the original concept was referenced through either a metaphorical or a metonymic reference. For example, a story might state, “There was one boxer who Stu hated.” At the end of the story, a character might remark, “The cream puff didn’t even show up.” Gibbs’s participants were quicker to indicate that boxer had appeared in the story with either the metaphorical or metonymic referring phrases as compared with an appropriate baseline (e.g., “The referee didn’t even show up”). Gibbs’s experiments reinforce the claim that minimal inferencing is not necessarily unsophisticated inferencing.

Finally, it is important to stress that our experiments ultimately apply to phenomena considerably more general than unheralded pronouns. Current models of how the entities in a discourse rise and fall in salience in memory as a story progresses from one topic to another attempt to capture the interplay between entities in memory and the surface characteristics of the words of the story (cf. Garrod, Freudenthal, & Boyle, 1994; Gernsbacher, 1989; Grosz, 1981; Grosz, Joshi, & Weinstein, 1983; Grosz & Sidner, 1986; Sanford & Garrod, 1981; van den Broek, Risden, Fletcher, & Thurlow, in press; Webber, 1983). Our data support the idea that memory-retrieval processes are instrumental in this interplay. Concepts currently in short-term memory evoke all those entities in memory with which they are highly associated, increasing their levels of accessibility and providing opportunities for associations to be formed. In the course of these interactions, language users are afforded special preparation for a range of related concepts that may be the topic of subsequent discourse.

References


Research Awards in Experimental Psychology

The Division of Experimental Psychology of the American Psychological Association (Division 3) announces a continuing series of up to five annual research awards. These awards are to be based on review of the research submitted to or published in the APA's Journals of Experimental Psychology each year by relatively new investigators. The intention is to provide early recognition to new scholars whose research contributions are especially promising. These awards are

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Animal Behavior Processes;

Division of Experimental Psychology (Annual)
New Investigator Award in Experimental Psychology:
Human Perception and Performance;

Division of Experimental Psychology (Annual)
New Investigator Award in Experimental Psychology:
Learning, Memory, and Cognition;

Division of Experimental Psychology (Annual)
New Investigator Award in Experimental Psychology:
General;

and

Division of Experimental Psychology (Annual)
New Investigator Award in Experimental Psychology:
Applied.

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