Encoding effects of reminders

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Understanding requires prior knowledge. Most theories and empirical work on understanding have focused on the use of general prior knowledge. In the experiments presented here, we examined the role of specific prior episodes in understanding. Subjects read ambiguous stories that had some superficial cue to make them think back to an earlier story. Experiment 1 shows that a superficial cue to an earlier story affects how the new story is interpreted. Experiment 2, in which a reading-time measure was used, provides evidence that this effect of the earlier story occurs during the initial understanding of the new story. We discuss the implications of these results for theories of understanding and the use of reminders in analogy.

Understanding is a complex cognitive activity that requires the use of prior knowledge. Prior knowledge is essential, because the input provided in any situation is incomplete or underspecifies the situation. Yet only a small part of what we know is relevant to any given situation, so understanding processes must involve selective retrieval of relevant knowledge that may be helpful in the current situation. The retrieved knowledge can then be used to fill in gaps in the current input.

In this paper, we consider two general views on understanding that focus on the access and use of different types of relevant prior knowledge. The first view is derived primarily from the text-comprehension literature, showing how general background knowledge is accessed and used "on line" in understanding. The second view, prominent in research on reminders and analogical transfer, focuses on the use of specific episodic knowledge to embellish new material following an initial encoding. The purpose of the present paper is to consider whether these two views may be complementary components of a larger system rather than competing alternatives. We derive several implications from considering both of these approaches and provide an experimental test of these implications that extends both views. In particular, we will show that the understanding of current material can be affected by episodic knowledge that is accessed on line via its superficial similarity to the material.

Text Understanding

Researchers of text comprehension have long considered the access and use of prior knowledge during comprehension. In the 1970s, investigators such as Bransford (e.g., Bransford & Johnson, 1972) stressed that understanding requires accessing general background knowledge to help construct an integrated representation from the input. Later work presented a more detailed analysis of how the relevant knowledge is accessed and applied. For example, in the construction-integration model of Kintsch (1988), each new text proposition stimulates retrieval of related general knowledge from long-term memory. Useful inferences are identified and integrated into the developing representation of the text.

Although there are many different models of text understanding, almost all of them have some general common characteristics that are important for the present work. First, understanding is considered to be a joint function of the input and activated knowledge. Second, the knowledge accessed is either general knowledge or knowledge about the current text (for coherence and local disambiguation). Third, general knowledge is accessed by means that ensure a high likelihood of its relevancy—through preexperimental connections from concepts and propositions in the current text (e.g., Kintsch, 1988), cuing of themes by devices such as titles (e.g., Bransford & Johnson, 1972), or explicit instruction to adopt some particular perspective (e.g., Pichert & Anderson, 1977).

Reminders in Understanding

A rather different approach to understanding has stressed the use of more specific knowledge. For example, Schank (1982) has argued that during the processing (understanding) of an event, an earlier event that had been processed in a similar way may come to mind. This earlier event may aid the person in understanding the current event and in making predictions from it. The emphasis in this approach has been on the abstract analysis of the event leading to the retrieval of a similar ab-

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stract analysis of an earlier event, allowing people to be reminded of earlier events that may be superficially dissimilar, but that have a common underlying structure. If the early abstract analysis has been used in processing many earlier events, one may access a more *generalized episode* (e.g., the common parts of a large number of earlier episodes) rather than a specific earlier event. Thus, this approach allows both general and specific knowledge to be accessed by the same abstract analysis of the current event.

These ideas on reminders have been especially influential in the psychological work on analogical problem solving, which are investigations of how relevant earlier problems might be retrieved and used in solving a current problem (e.g., Gentner, 1989; Gick & Holyoak, 1980, 1983; Holyoak, 1985; Ross, 1984). Although it is clear that the analysis of the current problem affects which earlier problem is retrieved, it is also clear that *superficial similarities* between problems can have large effects on the access of earlier problems (e.g., Gentner & Landers, 1985; Holyoak & Koh, 1987; Ross, 1984, 1987, 1989a). That is, similarities between the problems, which are not involved in the abstract analysis (e.g., names), may still influence the retrieval of earlier problems.

Despite the importance of reminders in analogical problem solving, their influence on the understanding of the problem has not often been directly studied. Although it is clear that reminders affect problem solving and inferences, there is little or no evidence to suggest that this effect occurs during the representation (encoding) of the current text or problem. In fact, most models of analogical problem solving assume that the current problem (called the *target*) is encoded *before* a reminding occurs. The effect of the reminding is assumed to occur during the mapping, adaptation, and transfer of the reminded solution to the target problem.

The empirical research that has addressed the role of reminders in representation has generally had goals other than examining how reminders might affect the understanding of current material. Some of the work has focused on whether the memories of earlier episodes are activated during understanding. For example, Seifert, McKoon, Abelson, and Ratcliff (1986) investigated whether general themes (such as morals) of stories automatically activate earlier stories with the same themes. They found no evidence for such automatic activation, except when the earlier stories had been explicitly compared or extensively studied. McKoon, Ratcliff, and Seifert (1989) showed that routine action sequences (similar to the scripts of Schank & Abelson, 1977) may be related back to earlier, similar action sequences; however, the connection seems to be through the general-knowledge structure, and not directly between the episodes. Thus, this work shows that with only abstract similarities between the current and earlier texts, specific episodic knowledge may not usually be activated (but see Wharton & Lange, 1993).

Other empirical work has addressed the use of analogies to earlier knowledge for learning and acting upon

new information. Schustack and Anderson (1979) examined the effect of analogies on memory. They found that when subjects were learning facts about fictitious people, analogies to famous people led to more elaborate encodings. Although this study was not designed to examine reminders (the names of the relevant famous people were explicitly provided), it does suggest that an earlier analog may affect the encoding of the current material. In addition, recent work by Johnson and Seifert (1992) provides evidence for the idea that reminders may occur from a partial representation of the current story. They showed that a part of the story—in particular, a part that is useful for predicting possible planning failures—is often sufficient to remind people of an earlier related story. Thus, these studies suggest that thinking back to earlier analogical knowledge may affect the information that is retrieved during encoding of new information, but they do not show that the earlier knowledge affected the understanding of the new information. Schustack and Anderson's study focused on later memory for the material, and the effects they found may have been due to additional elaborations following the initial understanding. Johnson and Seifert's studies show how retrieval from a partial representation may allow for the anticipation of plan failure, but there is no evidence that similar material is understood differently as a function of these reminders.

In summary, theoretical work suggests that reminders may influence exactly how a current situation is understood. Specifically, two important extensions to the general-understanding view are prompted by these theoretical considerations. First, specific knowledge of a particular earlier episode, rather than (or in addition to) general knowledge, may be activated. This type of knowledge, although certainly not inconsistent with current views (e.g., Kintsch, 1988), has simply not been addressed by most of them. Second, the reminding may be due to some superficial similarity, rather than to an explicit general connection. However, the empirical work has not generally addressed these influences. We will describe experiments that are investigations of the encoding effects of reminders. In particular, we examine whether the understanding of the current information is affected by the reminders to earlier episodic knowledge.

Superficial-Based Reminding Effects on Interpretation

The purpose of this paper is to examine a situation that we believe extends the work in understanding and also has implications for current views of reminding and analogy. The logic of the experiments builds upon the combined ideas from these two areas of research. First, superficial similarities can lead to reminders. Second, because these superficial similarities can occur early in the target text, an earlier episode may be activated early during the processing of the target text. Third, activated knowledge (whether general or specific) may influence the understanding of the input (target).

Thus, the main point of this paper is that *reminders based on superficial similarities may affect how the target is understood*. Although we will examine the implications of this idea in more detail following the experiments, we wish to briefly point out the implications here. As we mentioned, these results would extend the current views on understanding by allowing activation of specific episodes, as well as general background knowledge, and by allowing such access to occur from superficial similarities.

From the reminders perspective, we believe that the work also has two important implications. First, it provides empirical support for the idea that earlier episodes can affect understanding, even when these reminders are superficially based. Second, with respect to the analogical problem-solving models, it points to a more dynamic (interactive) processing, in that reminders can affect the initial representation. We will discuss each of these points in more detail in the General Discussion.

The present experiments were conducted to investigate whether early, superficially based reminding might influence the representation (interpretation) of the current text. To examine this issue, we chose texts that could have at least two thematic interpretations, such as the story shown in Table 1. This story, adapted from Anderson, Reynolds, Schallert, and Goetz (1977), can be interpreted in two ways—a wrestler is in a difficult match, or a prisoner is getting ready to break out of jail. The story had a “reminding cue” that bears a superficial similarity to one earlier source story. In Table 1, this reminding cue is indicated by <reading material>. Two earlier source stories had included a particular reading material (see Table 2). In one story, a reporter for the Delaware Daily newspaper was retiring and the speakers were discussing his career highpoints, such as the time he covered a jailbreak. In another story, an odd character had two passions in life, reading Shakespeare and watching wrestling on TV. There were two versions of each target story, differing only in the reading material. When the target story about Johnny included the Delaware Daily newspaper as the reading material, it was meant to remind the subjects of the earlier story about the reporter covering the jailbreak. If the subjects use the

Table 1
Experiment 1: Jailbreak/Wrestling Target

Although it was a big day for Johnny, he had tried to keep to his usual routine. As always, he had read <reading material> and done his morning stretches. He knew that preparation was crucial, so he had prepared well. Now he would find out if he had prepared enough.

Johnny slowly pushed up, planning his move. Things were not going well. The lock that held him was strong, but he thought that he could break it. He knew, however, that his timing would have to be perfect. Johnny was aware that it was because of his early roughness that he had been penalized so severely. The reward system here seemed to work against people like him, but there was not much he could do about it. The situation was becoming frustrating and he was ready to make his move. He knew that his success or failure would depend on what he did in the next few seconds.

Table 2
Experiment 1: Jailbreak/Wrestling Manipulation

Sources

1. The retirement dinner for a reporter from the *Delaware Daily newspaper*. He was thinking back on his career, including how he covered a **jailbreak**.

2. A description of a strange character who had many eccentricities, including his passions for reading *Shakespeare* and watching **wrestling** on TV.

Target

Johnny story (see Table 1) where he is reading either <*Delaware Daily newspaper*> or <*Shakespeare*>.

Note—Superficial reminding cues are italicized, and the possible interpretation of the target that could be derived from each source is in boldface type.

superficial similarities to retrieve earlier episodes and use those episodes in understanding, then this cue should lead them to be more likely to interpret the target story as being about a jailbreak. If the target story included reading some Shakespeare, then it was meant to remind the subjects of the Shakespeare and wrestling character in the earlier story; this would lead them to interpret the story as being about a wrestling match.

Note that these reminding cues do not involve either of the themes or any prior associations to either of the themes, which differentiates them from the cues used in earlier work on understanding. In addition, unlike earlier ideas about reminders in understanding, these cues are not relevant to an abstract analysis of the target story, so they would not be expected to lead to an abstract analysis similar to that in the corresponding source story. Thus, by many accounts of both understanding and reminders, such a superficial similarity should not influence the interpretation of the whole theme of the story.

In two experiments, we measured the reminding-appropriate interpretations in different ways. In Experiment 1, subjects provided a final interpretation of each target story. If the reminding cue is sufficient to bias the understanding of the target story, the subjects will be more likely to interpret the story by using the theme from the reminded source story (i.e., wrestling or jailbreak).¹ In Experiment 2, a reading-time measure was used to test whether this effect takes place during the understanding of the target story, or afterward, in response to the interpretation question.

EXPERIMENT 1

In Experiment 1, we investigated whether a superficial cue to an earlier story would affect the interpretation of the target story. As explained previously, each target story had two possible interpretations. Every subject saw both source stories for each target. Each of the two source stories included one of the possible target interpretations (e.g., jailbreak, wrestling match) as part of the story. The only manipulation was the superficial cue

in the target story. Half of the subjects had a superficial cue that was meant to remind them of one source story, and the other half of the subjects had a superficial cue that was meant to remind them of the other source story (see Table 2). The question of interest was whether this manipulation would affect their interpretation of the target story.

Method

Subjects. The subjects were 37 University of Illinois students, who participated for pay or as part of a course requirement. They were tested in small groups of 1–5. The study lasted 35–50 min.

Materials. The materials consisted of three target stories, six source stories, and one filler story. The three target stories were each written to be ambiguous, allowing two very different interpretations. Table 1 shows one of the stories, which could be interpreted as a story about either a jailbreak or a wrestling match. A second target story was ambiguous about whether a woman was either ill or pregnant (adapted from Owens, Bower, & Black, 1979), and a third was ambiguous about whether a man had just returned from a house he hoped to either buy or rob (adapted from Pichert & Anderson, 1977). Each story was 2–5 paragraphs long and 12–21 sentences long. (The story in Table 1 is the shortest.) Early in each story is a proper name (of the character, location, or reading material), which provides a superficial reminding cue to *one* of the earlier source stories. For example, in Table 1, Johnny had read either some Shakespeare or the Delaware Daily newspaper.

Each of the two target-story interpretations would be suggested by a different source story. For example, the two source stories connected to the “Johnny” target story were (1) a retirement party for a reporter of the Delaware Daily newspaper, who had become famous after covering a jailbreak, and (2) an unusual character whose passions in life were reading Shakespeare and watching wrestling on TV. All target and source stories are included in Appendix A. Each subject received all six source stories and one version of each of the target stories.

A filler story was written as a primacy buffer. Its content was unrelated to the other stories. The filler story and six source stories were put together in one booklet. This first booklet consisted of a cover sheet, the filler story, and then the six source stories. The order of the source stories was determined for each subject by choosing one source from each target, randomizing those three source stories, and then randomizing the other three source stories. Each of the seven stories was followed by a rating sheet. The three target stories were put together in a separate booklet in a random order following a cover sheet. After each story there was a page of written instructions, which read: “Please explain, in your own words, what the story you just read is about—how you interpreted the story. There is no right or wrong answer to the question. We are interested in your interpretation of the story.”

Design. The experiment consisted of three parts. First, the subjects read the filler and source stories, rating each of them on three scales (interestingness, comprehensibility, and pleasantness). Second, a distractor task, which required the similarity ratings of polygons, was given to allow a short delay and to separate the source and target stories. Third, the three target stories were given. For each target story, half of the subjects received the superficial cue to one of the source stories (e.g., Shakespeare), and the other half received the superficial cue to the other source story (e.g., Delaware Daily newspaper). The subjects read each story and provided a brief description of what they thought the story was about. The superficial-cue manipulation was meant to remind the subjects of different source stories, in order to examine whether this reminding would affect the interpretation of the target story. For

example, if the target story had Johnny reading some Shakespeare, we predicted that the subjects might think back to the source story involving a character with passions for Shakespeare and TV wrestling, and that this reminding would increase the probability that they would interpret the target story as being about wrestling rather than about a jailbreak (see Table 2).

Procedure. The subjects were told that they would be participating in three experiments. First, they received a booklet consisting of the filler and source stories with a rating sheet after each story. They read through the seven stories and rated them at their own pace (13–20 min). Second, they received a distractor task consisting of a booklet of polygon pairs and a rating sheet. They went through the booklet, rating each pair on similarity (6–11 min). Third, they received a booklet of the three target stories. After each story, they turned the page and wrote a brief description of what they thought the story was about (9–16 min). Following this phase, they were asked some questions about their interpretations and were debriefed about the purpose of the experiment.

Results and Discussion

Scoring. The 111 (37 subjects $\times$ 3 target stories) interpretations of the target stories were entered into a computer, all references to the superficial cues were deleted, and the 37 interpretations for each target story were randomized. Thus, all scoring was done blindly with respect to the superficial-cue manipulation. Three independent scorers then read each description and scored it, using both strict and lenient criteria. For the strict criterion, each description was scored as one of the two interpretations given by the source stories, or “other.”² The three scorers agreed on 97.3% of the judgments, and the remaining scores were decided by the majority. For the lenient criterion, some of the “other” interpretations, which seemed to suggest a particular interpretation but were somewhat ambiguous, were given half credit. The three scorers agreed on 88.2% of these judgments, and the remaining scores were decided by the majority. (The disagreements were equally distributed across the three targets, with disagreements of 5, 5, and 4 out of the 37 interpretations.) For each criterion, each interpretation was coded as being consistent with the superficial cue (i.e., the target was interpreted as predicted by the source with the same superficial cue), inconsistent, or other. For example, if Johnny had read some Shakespeare (target story), then a consistent interpretation would be wrestling, because the source story involving Shakespeare had concerned a person who watched TV wrestling. An inconsistent interpretation would be jailbreak, because a jailbreak had been mentioned in the other source story.

Interpretations. The main question of interest was whether the superficial-cue manipulation affected the interpretation. In particular, were the subjects more likely to interpret the ambiguous target in a way that was consistent with the source story containing the same superficial cue? The answer is yes. We first give the results from the strict scoring. When we compared the number of consistent versus inconsistent interpretations, the wrestling/jailbreak target had 15 consistent interpretations versus 6 inconsistent, the pregnant/ill target had 19 ver-

sus 6, and the burglar/buyer target had 15 versus 8. For each subject, we computed the number of consistent minus inconsistent interpretations (with a 0 given if "other"), so the measure ranged from -3 to 3. Of the subjects showing a nonzero difference, 21 had more consistent interpretations, and 5 had more inconsistent ($p < .05$). The mean difference was .78, which was significantly different from zero [$t(36) = 3.37, p < .05$]. (The full breakdown of these interpretations with the results of a norming study is given in Appendix B.)

For the lenient scoring, the effects were slightly larger. The wrestling/jailbreak target had 17.5 consistent interpretations versus 7 inconsistent, the pregnant/ill target had 19.5 versus 6, and the burglar/buyer target had 16 versus 8. Over the three targets, 25 of the subjects had more consistent interpretations, and 7 had more inconsistent interpretations ($p < .05$). The mean difference was .86 [$t(36) = 3.95, p < .05$].

The results of this experiment suggest that the interpretation of the target story was affected by the superficial reminding cue to the earlier source story. Although this cue was just a single word or short phrase, it led to very different interpretations. Before addressing the implications of this effect, it is important for our hypothesis to test whether this effect occurred during encoding. That is, the interpretation question was posed after the subject had read the target. Thus, it is possible that the manipulation did not have an effect during encoding, but did when the interpretation question was given. This possibility was examined in Experiment 2.

EXPERIMENT 2

In Experiment 2, we did not rely on a postencoding measure to assess the effects of the superficial reminding cue. Instead, we provided the stories one sentence at a time and measured the reading time for each sentence. In each target story, we constructed two critical sentences that we thought were consistent with one interpretation and inconsistent with the other interpretation, plus two sentences with the opposite consistency (i.e., consistent with the second interpretation and inconsistent with the first interpretation). Many studies of reading time have shown that people read sentences that "fit in" with what they are reading faster than sentences that seem inconsistent with their current understanding. Thus, if subjects use the superficial reminding cue to help interpret the story as they read it, they should show longer reading times for inconsistent sentences than for consistent sentences.

Method

Subjects. Thirty-seven subjects participated for course credit in small groups of 1-4. The complete experiment took about 25 min. The data from 1 subject were not included because she had participated in some pilot work with the same materials.

Materials. The materials were a modification of two of the target stories and their source stories from Experiment 1. The wrest-

ling/jailbreak story and the pregnant/ill story were rewritten to have two sentences consistent with each interpretation that were inconsistent with the other interpretation (see Table 3). For example, the wrestling/jailbreak target has two sentences that are reasonable given a wrestling interpretation ("He skipped breakfast to be sure he made the cut" and "He had to get more points than the other guy"), but they seem rather strange if the story is being interpreted as a jailbreak. The four critical sentences were separated by three to eight sentences and appeared in different paragraphs. In addition, we made two minor changes in the stories. First, to avoid possible prior associations that had been mentioned by a few subjects in the debriefings of Experiment 1, we changed "Shakespeare" to "Stephen King novel" (in both the target and relevant source stories).³ Second, to ensure that the target person was clearly identified as a new person (i.e., one not read about in any source story), we changed the character's name in the other target from Laura to a more unusual name, Cassandra. Both target stories are given in Appendix C.

The nine stories had 19 to 32 sentences (or "new paragraph" markings). In addition to the two target stories, there were two source stories for each target, and three filler stories. The order of the nontarget stories was the same for all the subjects. The first story was a filler, the next four were the source stories (alternating so that a target's two source stories were not consecutive), the sixth story was a filler, the seventh was one target story, the eighth was a filler, and the ninth was the other target story. The particular target story appeared half the time in the seventh position and half in the ninth position. For each target story, each superficial cue was presented to half of the subjects so that they were likely to be reminded of only one of the source stories while reading the target.

The stimulus presentation and response collection were conducted on a computer using the MEL program (Schneider, 1988) on AT clones equipped with color VGA monitors.

Design. Again, the main manipulation was the relation between the superficial reminding cue in the target story and the source stories. The question of interest was how reading time would vary between the consistent and inconsistent sentences in the target story as a function of the superficial-cue manipulation.

Procedure. The subjects were told that they would be participating in an experiment on understanding. The stories were shown one sentence at a time in the middle of a computer screen. As soon as the subjects understood the sentence, they pressed the + (plus) key for the next sentence. They were told that there would be questions at the end, so they should try to understand the story well enough to answer them. In addition, after each story, they were asked to rate its comprehensibility on a scale of 1-7 on a piece of paper next to the computer, where 1 = *easy to comprehend*, and 7 = *not comprehensible*.

Results

The important data are the reading times on the four critical sentences from each of the two target stories. The question of interest was how reading time for these sentences varied as a function of the superficial cue. In particular, were the sentences read faster when they were consistent with the source story that had the same superficial cue than when they were inconsistent? The answer is yes; reading times were 2,395 msec for the consistent sentences and 2,711 msec for the inconsistent sentences. Remember that these differences are not due to differences in sentences, because each critical sentence was both consistent and inconsistent, depending on the superficial cue. For example, "He skipped breakfast to be sure he made the cut" was consistent when the superficial cue

Table 3
Experiment 2: Reading Time

Jailbreak/Wrestling Target

It was a big day for Johnny, but he tried to keep to his usual routine.
 He read part of a Stephen King novel and completed his morning stretches.
 The routine helped calm him down.
 {NEW PARAGRAPH}
 Time seemed to crawl by.
 Johnny repeatedly checked his watch.
He skipped breakfast to be sure he made the cut. [wrestling consistent]
 He would soon find out if he had prepared enough.
 {NEW PARAGRAPH}
 The critical moment was at hand.
 Johnny slowly pushed up, planning his move.
 Things were not going well.
 The lock that held him was strong, but he thought he could break it.
 He knew that his timing would have to be perfect.
 He concentrated carefully on what had to be done.
He looked to make sure no one was around. [jailbreak consistent]
 {NEW PARAGRAPH}
 Johnny knew his early roughness had led to his being penalized.
 The reward system here seemed to work against people like him.
 However, there was not much he could do about it.
He had to get more points than the other guy. [wrestling consistent]
 The situation was becoming frustrating.
 He was ready to make his move.
 {NEW PARAGRAPH}
 Johnny tested the lock again.
 His success or failure would be decided in the next few seconds.
He knew how badly failure would be punished. [jailbreak consistent]
 He breathed deeply and began his move.

Note—Critical sentences are shown here in italics with their consistent interpretations in square brackets. All sentences were shown individually in the same type face. "Wrestling consistent" and "jailbreak consistent" were not presented.

that appeared in an earlier sentence (Stephen King novel) was to the earlier wrestling story, but it was inconsistent when the superficial cue (Delaware Daily newspaper) was to the earlier jailbreak story.

To analyze the data, we first subtracted out the subject and overall sentence effects (i.e., equating the overall time for each subject and the overall time for each sentence). For each story, we computed a consistency effect for each subject (inconsistent minus consistent). If consistent sentences are read faster, this difference should be positive. The wrestling/jailbreak story showed a 212-msec effect, and the pregnant/ill story showed a 419-msec effect. When we combined the two measures for each subject, there was a significant difference of 316 msec [$t(35) = 2.38, p < .05$], with 24 of the 36 subjects responding faster to the consistent sentences. Of the eight critical sentences, six were read faster when they were consistent with the superficial-cue source story interpretation, and two were read faster when they were inconsistent (though one of these latter sentences showed only a 10-msec difference). This pattern was marginally reliable by a two-tailed test [$t(7) = 2.28, p < .10$]. Appendix C includes the effect for each of the critical sentences.⁴

Thus, in this experiment, sentences were read more quickly when they were consistent with the superficial reminding cue than when they were inconsistent. Although the manipulation consisted of simply changing

one superficial part of an early sentence, it appears to have influenced the encoding of the target story.

GENERAL DISCUSSION

These two experiments have demonstrated that superficially based reminders to earlier stories can affect the interpretation of a target story. In the following discussion, we examine the implications of these results for the role of specific knowledge in understanding, the distinction between reminding and priming of episodes, the use of superficial similarities, and the need for more dynamic models of analogy.

Specific and General Knowledge Used in Understanding

As we mentioned in the introduction, the current views of text comprehension focus on the use of general background knowledge. The use of episodic knowledge is certainly not inconsistent with these views, but it has not received much attention. Our claim here is not that people are always consciously reminded of earlier episodes during comprehension, but rather that earlier episodes represent one type of knowledge that may be brought to bear in helping to understand some current event or text. The likelihood of accessing such knowledge depends upon what other knowledge one has, and

how related the new material is to the earlier episode. If one has much general, well-understood knowledge about the target material, then a particular episode may be less likely to be accessed. However, if one does not have such material, or if the target material has some strong similarity to a distinctive part of an earlier episode, then the earlier episode may be accessed. Once accessed, an earlier episode is not necessarily used for understanding. Again, it depends on what other knowledge is available and also on the judged usefulness of the earlier episode. In our experiments, although the details of the earlier stories were not of any special value in understanding the target, thinking back to the story may have at least provided a possible interpretation of what otherwise would have been a difficult story to understand.

Despite all these qualifications, the potential use of such specific knowledge in understanding has important implications for theories of text comprehension. The processes that bring relevant knowledge to bear cannot be such that they exclude the use of specific episodic knowledge. Rather, these results suggest that the theories need to allow for the access of such knowledge routinely during comprehension. (We say "routinely" because the understander cannot know ahead of time whether such specific knowledge might be relevant.) Thus, a central question becomes how to coordinate the access and use of specific and general knowledge.

It is interesting to consider that this tension between general versus specific knowledge has been addressed recently in other areas of research as well. We briefly mention three areas here to illustrate the tension and possible resolutions for how these types of knowledge are accessed and used. First, in categorization work, there is a contrast between the prototype views arguing for categorization on the basis of some summary representation and the exemplar views suggesting that similarity to instances may be more descriptive of much human categorization (see Medin, 1989, for a brief review). As in text comprehension, the general knowledge provides the advantages of larger statistical samples, but the specific knowledge provides the advantage of more finely related predictions. A trend over the last several years has been to investigate how one might integrate these two views (see Medin & Florian, 1992; Ross, Perkins, & Tenpenny, 1990; Spalding & Ross, *in press*). Second, in memory research, a large controversy took place over the separation of episodic and semantic knowledge (e.g., McKoon, Ratcliff, & Dell, 1986; Tulving, 1983). Everyone acknowledged the definitional differences between these types of knowledge, but the question was whether such differences require positing separate memory systems or simply definitional differences within the same memory system. Although no consensus has been reached, it is clear that, for many goals, both types of knowledge are potentially accessible and applicable. Finally, a major theme in recent work on problem solving is the importance of specific earlier examples in solving current problems and learning how

to solve future problems (e.g., Holyoak, 1985; Novick & Holyoak, 1991; Ross, 1989b). Even though the problem solver may be searching for task-relevant knowledge to accomplish some goal, the accessed and used knowledge often is an earlier episode from which the problem solver must figure out the procedure.

Our interpretation of the work in these other domains is that the most fruitful approach for dealing with specific knowledge is to consider theories that provide a seamless integration of specific knowledge with the use of other types of knowledge. Within the area of comprehension, this would require that the processes responsible for accessing the background knowledge also allow for the access of specific knowledge. In some current views, this change may require no major theoretical change. For instance, Kintsch (1988) proposed a construction-integration theory of text comprehension, in which each new proposition activates some potentially relevant knowledge through a spreading-activation process. Thus, if the spreading activation occurred over all stored knowledge (i.e., including specific episodes), it would provide a means of integrating the access and use of specific episodes with that of more general background knowledge. Lange and Wharton (1992) suggest a model of this type, in which the reminders during understanding are used to help make inferences about the material.

We believe that this use of more specific knowledge is important not only because it is one more type of knowledge used in understanding, but also because its inclusion may help in integrating understanding with other related phenomena, such as schema acquisition. People often develop general knowledge from specific instances. If specific knowledge were available for understanding, then it would provide a means by which more general knowledge could be acquired during understanding.

Reminding Versus Priming

In this presentation, we assumed that the subjects were reminded of the earlier stories. However, as mentioned in note 1, none of the results showed that the subjects were aware of the earlier stories when interpreting the target stories. A number of the subjects mentioned that they had consciously thought back to the earlier story, but it is also possible that some did not. Earlier episodes may affect understanding not only through conscious reminders, but also through priming (see Seifert, *in press*, and Wharton et al., 1994, for discussions). Note, however, that if priming were responsible for the effects, it could not be a general priming of having read an earlier story about jailbreaks, because all of the subjects read the same earlier stories. Rather, any "priming" at test would have to be sensitive to the inclusion of the superficial information (e.g., Delaware Daily newspaper) that was manipulated. Such sensitivity to a superficial-information manipulation seems more consistent with the possibility that the subjects thought back at test (whether consciously or not) to the earlier source story with the similar superficial information.

The main point of this paper is to show that specific earlier episodes are used in understanding new information. With clear evidence that they are, we hope future research will determine the exact nature of this use.

The Role of Superficial Similarity

An important part of the experiments reported here is that the reminders were not based on some abstract analysis of the text, but on a superficial aspect. What is the importance of superficially based reminding? Again, it may be useful to state clearly what we are *not* claiming—that superficial reminders are *more* important or common than other types of reminders and that they influence most cases of understanding. However, we are claiming that they are important as a tool for examining understanding as well as for facilitating many understanding activities.

First, superficially based reminders provide clues about how knowledge is accessed and used. In our experiments, the only connection between superficial information and relevant knowledge (e.g., Delaware Daily to jailbreak) is arbitrary, yet this connection influenced understanding and did so during the encoding (Experiment 2). This result suggests that the activation of potentially relevant knowledge is not some “smart” probing process that uses only structural aspects of the material in order to activate the most relevant knowledge. Rather, it seems more consistent with the reasonable idea that the activation follows the usual memory principles, such as semantic similarity and distinctiveness. This idea does not seem problematic for views in which knowledge is accessed by a spreading-activation-like process (e.g., Kintsch, 1988; Lange & Wharton, 1992), but it may be more problematic for views that require abstract analyses (e.g., Schank, 1982, though see arguments by Kolodner, 1988). Hammond, Seifert, and Gray (1991) and Wharton et al. (1994) also argue for the importance of a system that allows both structural and superficial reminders.

Second, many understanding activities may be influenced by superficial similarities. The reminders in the present experiments were successful because the superficial information was highly distinctive—it was very memorable and occurred with only one earlier source story. Work in reminding and analogical problem solving suggests that such characteristics influence the likelihood of retrieving a particular earlier source story (e.g., Johnson & Seifert, 1992; Ross, 1984, 1987; Wharton et al., 1994). However, we do not think that this means that such superficially based reminders are not “ecologically valid.” We need to consider both the probability of such reminders and their usefulness. Their probability depends upon many factors, such as the distinctiveness of their superficial aspects. Their usefulness depends upon the extent to which superficial features of events, problems, and so on are correlated with important structural similarities. If relevant structural knowledge and particular superficial contents tend to co-

occur, then superficially based reminders may be common and useful.

It is difficult to provide a general answer to the question of whether superficial aspects and more relevant ones are correlated. However, there are several reasons to believe that sometimes they are, and that people are sensitive to such correlations. Previous work with problem-solving experts may provide useful illustrations of how superficial contents may be predictive of more relevant aspects. For example, Hinsley, Hayes, and Simon (1977) found that good algebra-word-problem solvers made use of the superficial information of algebra word problems to help them decide on the type of problem and access relevant problem-solving knowledge. The beginnings of problems, such as “A river steamer...” are sometimes sufficient to allow the solver to make an educated guess about what information will be given and what solution methods might be useful. They argued that such superficial information allows the knowledgeable solver to access an appropriate problem-solving schema. Mayer (1981) analyzed algebra word problems in 12 widely used texts and obtained a strong correlation between superficial content and solution procedure. Finally, Bassok (1990) suggests that the superficial content in these word problems may affect how subjects interpret the problems, indicating that formal superficiality may not be psychological superficiality.

In addition to this work, theorists in other areas have suggested that people may notice and make use of correlations between superficial properties and structural properties. For example, Medin and Ortony (1989) have argued that although concepts may be structured around naive theories, people may identify instances of the concepts by using less theory-based features. For example, most of us have a theory that the difference between males and females is genetic, but we also realize that hair length is a useful, though not perfect, predictor in American culture.

Our general point is that although the world could be constructed so that there is independence between superficial properties and more structural properties, it may not be. One advantage of superficially based reminders in all these areas of human cognition is that if one does not understand the deeper structure, the use of superficial information at least allows *some* inference to be made (see similar arguments by Brown, 1989). Of course, such heuristics may lead one astray in situations in which the empirical correlation does not hold.

Analogical Processes: A More Dynamic View

Much of the previous research on analogical transfer has addressed the influence of specific examples. The emphasis in this previous work has been on what affects the retrieval of a source problem, how the source is mapped to the target problem, how the solution is adapted, and what is learned from this use. Thus, unlike the ideas on reminders in understanding, the focus has not been on how the current problem is understood, but rather on

how the understood target problem leads to a reminding of an earlier source and the use of that source.

Our work reveals a parallel between understanding and analogical transfer: Specific examples cued by superficial similarity can affect the process. This raises the question of how the use of specific examples in understanding and analogical transfer are related.

In problem solving, we, as researchers, generally assume that the problem is first "understood," and that the analogical access and use then come in as people try to figure out the solution to this understood problem. The implicit belief is that understanding and transfer are independent, or occur separately. Most models of analogical transfer reflect this belief in their ordering of processes: Transfer begins with target encoding, followed by source retrieval, mapping, adaptation, and generalization. Although the processes are not claimed to be strictly serial, they are usually treated as if they are.

We believe that the present results suggest that a more dynamic view of these processes is necessary—one in which at least some of the processes interact. Our current results imply that the encoding of the target and the retrieval of the source (i.e., reminding) do not always occur in this order. Rather, some initial encoding of the target (e.g., a superficial object) may access an earlier source problem, which may then influence the further encoding of the target.

We end this paper with some speculations about the potential for an even richer interaction among understanding and transfer processes. It is possible that understanding and transfer are concurrent activities; reminding, mapping, and transfer may occur during encoding. Such concurrence could work to the benefit of both understanding and transfer.

Understanding may be facilitated by having additional information available for constructing a representation. A problem (or any text or situation) never contains all the information needed to build a coherent integrated representation. The research during the 1970s emphasized how active a process understanding is. By retrieving relevant specific examples, the understanding of new problems may be facilitated on the basis of their similarity to previous problems.

Analogical transfer may be aided by such concurrence to the extent that the understanding of the problem allows other processes to be accomplished more easily. As one illustration closely related to the current paper, we can consider the difficult accessing of relevant source material and the mapping of elements from the target to the source. The access of relevant source material can require a detailed analysis of the current problem and then a complex match to earlier problems. The mapping is often considered to be the heart and main difficulty of analogical transfer, because of the many possible ways that the entities in the two problems may be aligned. However, the difficulty of these processes may change if there is more interaction among the processes. As one example, superficial similarities may lead to "shortcut" forms of reminding and mapping—people could retrieve

specific past experiences through superficial cues and then use the superficial similarity to suggest object correspondences. In addition, these shortcuts would enable analogical inferences to be made that could facilitate later encoding.

The dynamic account of encoding and transfer forces a rethinking of current processes such as target encoding, mapping, and transfer. Encoding is seen not so much as a two-step process that shifts the initial problem encoding to a rich version after analogical transfer, but as an evolving representation embellished by general knowledge and analogical transfer. Mapping may sometimes be the simple procedure of putting similar objects into correspondence. Transfer may serve the goal of understanding, as well as the goal of problem solving. Our results do not show this dynamic form of encoding and transfer, but they suggest that it is possible. In general, it may now be important to consider not just how each of the processes works in isolation, but also how they work together.

Conclusions

These two experiments show that superficially based reminders can affect the interpretation of the current story. This finding suggests that theories of text comprehension need to allow specific episodes, as well as general knowledge, to influence understanding. In addition, theories of reminders and analogical transfer need to allow for superficial reminders to influence understanding and for an interaction between understanding and reminding. Finally, we hope that this work provides one additional bridge in helping to pull together work on understanding and the use of understanding in other goal-directed cognitive activities.

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NOTES

1. We refer to the particular type of retrieval of earlier episodes throughout this paper as *reminders*. Our intuitions and reports from subjects suggest that the memory for the earlier story often does come to mind and is thought about. However, we do realize that the results do not directly address the issue of whether the effect of earlier episodes here is through some conscious "reminding-like" process or through some more priming-like use of the episodes (e.g., as suggested in Jacoby & Brooks, 1984). We examine this idea more fully in the General Discussion.

2. "Other" does not mean that some other interpretation (e.g., besides wrestling or jailbreak) was given, but includes mainly cases for which the interpretation was not clear. We purposely did not try to force the subjects to make an interpretation. A number of the answers simply repeated back what the subjects felt were the important parts of the story, so no clear interpretation could be discerned. The "other" grouping also included the few cases in which both interpretations were mentioned as possibilities.

3. A few of the subjects mentioned that they thought it was very strange to have someone interested in wrestling and Shakespeare. We changed the reading material, because we did not want to make this story more memorable than the others.

4. As one can see in Appendix C, the effects were not equal for each interpretation. The wrestling interpretation had an advantage over the jailbreak interpretation, and the illness interpretation appeared to lead to much stronger effects than the pregnancy interpretation (which showed almost no effect of consistency). For completeness, we collected norming interpretation data from 32 subjects who read these stories (when presented normally, not line by line) without source stories. The change in the stories led to greater initial bias than that in Experiment 1. For the jailbreak/wrestling story, 11 subjects gave a wrestling interpretation, only 1 gave a jailbreak interpretation, and 20 were scored as "other." For the pregnancy/illness story, there was an initial bias as well, but in this case it favored the interpretation (pregnancy) that showed a smaller consistency effect in Experiment 2. Of the 32 subjects, 18 gave a pregnancy interpretation, 7 gave an illness interpretation, and 7 were scored as "other." Although we can certainly come up with a post hoc explanation, the important point is that there were reliable effects of consistency despite any inequalities in the interpretation preferences (which would add variance and thus make the effects more difficult to find).

APPENDIX A

Materials Used in Experiment 1

Illness Source

Beth wondered how long she would be staying in Cloris City Hospital. Although she tried to think of all the good things that might happen, she was not optimistic. Hospitals are not the best places to be happy, even first-rate hospitals like the Cloris City one.

Beth got out the new novel by her favorite writer and began to read. For quite a while, she was no longer in a hospital, but exploring the Amazon jungle along with the book's characters. A nurse came in to give her some medicine—back to Cloris City, Beth thought.

Cloris City Hospital had many advantages for Beth and she was glad that she had decided to come here rather than to the other hospital. Most importantly, it was close to where she grew up. Beth's friends and family would visit often. She enjoyed the visits, but she could see the deep concern in their faces. She was not sure what she could do about it other than try to act like her usual self. It was hard, but she found that she could usually do it.

Finally, the doctor was to come in with the CAT scan findings. Beth realized now how scared she was and waited to see if the doctor would look at her. The doctor came in smiling and said, "We can't keep you on this vacation forever. Why don't you get out of here so we can let some sick person use the bed?"

Beth laughed. She knew that her crisis was over. Cloris City Hospital was a good one, but she would not be sorry to be leaving.

Pregnancy Source

Nancy made coffee and went out onto the deck behind the house. She sat down on a chair, sipped from her coffee, and looked out over Lake With-a-Wind. Although the summer was coming to a close, the last few days had been beautiful and it looked like it was going to be another beautiful day. It was still quite early and the sun was just coming up over the lake. The air was crisp and there was little noise. This was the time of day that she liked the most. It felt like she had the whole lake to herself. For many years, she had used this time of day to do her most serious thinking. Today, she needed it—the early pregnancy test results had confirmed what she already suspected.

Nancy sat for quite a while, thinking how fortunate she was. She enjoyed her work, but the summers when she could get up to the lake were her favorite. She loved the house, the setting, and, especially, Lake With-a-Wind. She thought about how she and Robert had been out hiking one day over 25 years ago, when they had come to a clearing and seen the lake. As soon as they could afford it, they had bought some land right on Lake With-a-Wind and built a house. They had done much of the work themselves. After it was completed, they had lived on this lake all year round and raised their three children here. She smiled as she remembered the children playing in the yard, running through the house, sailing on the lake. She pictured them as little kids learning to swim, children holding swimming races, then teenagers swimming across the lake.

Nancy thought about how wonderful it had been raising the children and how much she and Robert missed them now that they were grown and lived away from home. Then she remembered the pregnancy test results. She smiled as she thought about the changes that the new baby would bring. Lake With-a-Wind would soon have a new playmate.

Jailbreak Source

The room was filled with famous people. Paul Terrance looked around the room with satisfaction. He thought back on his long career of reporting for the Delaware Daily, and how this was a perfect ending. Rather, he thought, the ending of his "first" career and the beginning of his "second" career. He had not yet decided what to do, but had offers to be a commentator on a news show and to appear weekly on a Sunday morning discussion panel on TV. First, he had a month lying on a beach to look forward to.

While the various speakers came up and spoke about Terrance's distinguished career, he found his mind wandering. Although he knew people thought he was successful because of a combination of talent and luck, he knew how much luck had been important. He thought back to the two most important times of his career.

The first was when he was still a young, run-of-the-mill reporter on the Delaware Daily. He had gone to see the editor with an old idea—what if reporters followed up on stories over long periods of time, instead of just changing what they were writing about all the time? Paul argued that the readers were getting so much information thrown at them that they needed a reporter who knew the story and its history to put it all in perspective. Thinking back, he realized that most editors of that time would have thrown him out of the office, but his editor had not. The next day, the Delaware Daily began the practice of letting reporters stay on a story over a much longer period. It was the beginning of the rise of the Delaware Daily from a small-town paper to a nationally read paper. It was also the beginning of fame for Paul Terrance, who understood how to write this type of story better than any other reporter did.

The second break in his career was really due to a coincidence. Soon after his meeting with the editor, he was in the Delaware State Prison for Women to interview an inmate about a bribery charge. While he was waiting for the prisoner, all the sirens went off—there was an escape in progress. He watched as two bank robbers rushed through the gates and escaped. It was the first escape at the prison ever. Paul was able to interview the guards, warden, and other inmates long before any other paper even knew about the breakout. The Delaware Daily had a big scoop.

Paul returned from his daydreams to find the speaker telling about how Paul had started a new way of reporting and how Paul had covered the prison break. A pretty good reporter, thought Paul.

Wrestling Source

Doug Smith was an unusual man. He had made lots of money, but lived in a small house and drove an old car. He was a fanatic about exercising, but paid no attention at all to what he ate. He was known in town as a bit of an ill-tempered hermit. He gave much to charities, but always anonymously.

Every day, he would get up, make a cup of coffee, and go into a small locked room in the basement. In that room, he had the latest in computer equipment and a fax machine. He would connect into various financial computer networks, checking his investments, and sending orders to change them if need be. After two hours, he would emerge, done working for the day.

Next, he would usually go on a long jog or bike ride through the woods and hills nearby. This exercise would often be followed by a huge lunch at a local junk food restaurant.

The rest of his day would be spent on his two favorite hobbies: reading Shakespeare and watching wrestling on TV. He

had a special channel with much wrestling on it, plus a VCR to tape when it was not convenient for him to watch. So, he could choose each day what to do as he sat in his easy chair: read Shakespeare, watch a wrestling match, or, sometimes, on special days, both.

Shakespeare and wrestling, wrestling and Shakespeare. Doug Smith was a happy, if somewhat unusual, man.

Burglar Source

Secord drew a small leather pouch from his inside jacket pocket. He handed two small tools to his new assistant Jeff. "Work quickly," he said. "This is the most dangerous point for us." Jeff took the tools and in the dim moonlight picked the lock like a pro. The pair quickly entered the dark house, and drew out small flashlights.

"Mr. Sikes, are you sure the family is on vacation?" Jeff whispered.

"I know my business. The mail hasn't been delivered here for three days. Same with the newspaper. Let's do our job and get out of here. Mind your light."

Secord went to the master bedroom and tugged at each painting. The watercolor didn't swing freely. He found the hidden catch that released the painting away from the wall. Behind it was hidden a small safe. It looked like something Secord could open. He began the painstaking job of safe cracking.

Jeff began looking around the house for valuables. He started in the study. In one of the desk drawers he found a portable personal computer. The other drawers held only papers. He moved on, opening closets and cabinets in turn. In a hallway closet, he found a nice camera—another useful find. On another shelf lay a handgun. Jeff picked the gun up, and went to speak with Secord.

"What do we do about this?" he asked as he showed Secord the pistol.

"Take it." Secord said. "Stolen guns are always valuable because they can't be traced. What else have you found?" Jeff showed his other plunder. "Good work. Check each room." Secord went back to the safe as Jeff searched the rest of the house.

Jeff found nothing valuable in the remaining rooms. He returned to the master bedroom, where Secord was still working on the safe. Jeff checked his watch. They had begun almost a half hour ago.

Suddenly the safe made a hushed snicking sound. Secord smiled. "That is the sound of success!" He opened the safe, groped inside, and drew out some papers. They were an odd, heavy texture. He used his flashlight to study the items in his hand. His smile got even bigger. "Bearer bonds!" he exclaimed. "Kid, this has been a great heist. Let's get out of here."

Homebuyer Source

Reginald never liked the first visit with a client. Everyone expected to get twice what their house was worth, and part of Reginald's job was to move them towards a realistic appraisal of the value of their property. It never made anyone happy. He straightened his tie, and rang the doorbell of the prospective customer.

The woman who answered the door was plainly dressed, with no makeup. A good sign, Reginald thought. Someone who had a little sense about her. His smile was warm and friendly.

"Hello, Mrs. Lewis. I'm Reginald Redgate from Redgate Realty, here for the appraisal."

"Do come in, Mr. Redgate." Her voice was pleasant and smooth.

Reginald entered the house. To the left was a large living room almost filled with furniture. Reginald noticed several different kinds of scales: a pan balance, a hanging scale, even an antique grocery scale. An odd motif. A bell hung in the corner, the rope dangling down to the couch where it could be reached easily by someone lying down. Reginald threaded his way through the overcrowded room.

Reginald thought for a moment how to phrase his comment, then politely said, "The room would show better if you didn't have so much furniture."

"Really?" the woman asked in an astonished tone. "We both just love this room." Inwardly, Reginald sighed. This was not going to be an easy client to work with.

Other rooms in the house were equally crowded, and everywhere he found bells and scales. The TV room had a nautical theme, with mirrored portholes on one wall and ships' bells on the ceiling. The master bedroom once again had a bell attached to the ceiling with a pull rope down to one side. Reginald wondered if the woman's husband was an invalid.

"What does your husband do for a living?" he asked.

"He is a tennis instructor at the country club," she replied.

Reginald decided he must be a very lazy man at home. This house was going to be hard to unload. Inwardly Reginald groaned at the work involved. At least the market was good.

Illness/Pregnancy Target

(<location> was either Lake With-a-Wind or Cloris City)

Laura lay in bed with her eyes closed. The outside sounds must have awakened her, but she did not feel ready to get up yet. She lay in bed and thought about different things. She fell back asleep and woke an hour later. She lay in bed a little longer, listening to the sounds and thinking and thinking.

She got up and walked over to the window. She looked out over <location>. Her muscles felt stiff and she felt that she was moving awkwardly. The flowers in the vase next to the window smelled sweet. The room felt a bit cold and she was very glad for the new bathrobe that her husband had given her. She saw the knitting in the chair, but did not feel like working on it now.

Laura was rarely very hungry in the morning. The breakfast cereal looked unappetizing, so she settled for some toast. Laura knew she should be eating better than this and promised herself she would eat a better lunch. She thought briefly about having a cigarette, then laughed; she had given them up months ago.

Laura took a shower and found herself examining her body closely. She hadn't been prepared for the change in energy. It can't last forever, she joked to herself.

After the shower, she settled into a soft chair. On the side table were some papers that needed her attention. She took a look around and thought that the room seemed awfully drab.

Jailbreak/Wrestling Target

(<reading material> was either the Delaware Daily newspaper or some Shakespeare)

Although it was a big day for Johnny, he had tried to keep to his usual routine. As always, he had read <reading material> and done his morning stretches. He knew that preparation was crucial, so he had prepared well. Now he would find out if he had prepared enough.

Johnny slowly pushed up, planning his move. Things were not going well. The lock that held him was strong, but he

thought that he could break it. He knew, however, that his timing would have to be perfect. Johnny was aware that it was because of his early roughness that he had been penalized so severely. The reward system here seemed to work against people like him, but there was not much he could do about it. The situation was becoming frustrating and he was ready to make his move. He knew that his success or failure would depend on what he did in the next few seconds.

Burglar/Homebuyer Target

(<name> was either Secord or Reginald)

His heart was still beating quickly as he returned to his crowded apartment. He sat down on his favorite leather couch, lit a cigarette, and slowly drew a lung full of smoke in an effort to relax.

"Calm yourself, Peter <name>. Calm yourself," he thought. The place he just returned from had an atmosphere of taste and wealth. Peter remembered the marble staircase, the original, priceless paintings, and the beautiful display cases filled with rare coins. Peter had known it was perfect almost the moment he had stepped through the doorway. It was exactly the kind of place he had been hoping to find. The only question was, did they pick up on his interest? He had tried his best to seem blasé, even bored, as he moved around the house. But perhaps they had detected some eagerness on his part. Maybe he should have cut things short. That would have been best. He could have left early. Now he would have to wait, to do nothing for several days. He wanted to return that very evening, but waiting would be best.

The smoke rose in a steady stream from the tip of his smoldering cigarette, the ash at least an inch long. Outwardly Peter looked calm, but he still felt turmoil and excitement inside. Had they picked up on his interest?

APPENDIX B

Norming Data and Breakdown of Consistency Effects for Experiment 1

In this appendix, we present the details of the item analysis for Experiment 1 to examine how the overall consistency effect came about from the three stories. We show both the results of a separate norming study and a detailed breakdown of the strict scoring of Experiment 1.

Norming Study

Thirty-two additional subjects, from the same subject pool, were given the same tests the subjects in Experiment 1 had been given, but they did not see any of the target stories. Their interpretations provide information about the tendency of the target stories to be biased toward one or the other interpretation. The interpretations were scored as in Experiment 1. For these 96 interpretations, the three scorers agreed perfectly on 93.8%, and the remaining items were assigned the majority decision. Following the norming data for each story are the data from Experiment 1 for each of the possible interpretations (i.e., the rows represent the interpretation intended by the superficial-cue manipulation). An asterisk (*) indicates the interpretation

that would be consistent with the superficial-cue manipulation.

Jailbreak/Wrestling Story

	Interpretation		
	Jailbreak	Wrestling	Other
Norming data	8	9	15
Experiment 1 data			
Jailbreak	8*	1	9
Wrestling	5	7*	7

Pregnancy/Illness Story

	Interpretation		
	Pregnancy	Illness	Other
Norming data	12	6	14
Experiment 1 data			
Pregnancy	11*	3	5
Illness	3	8*	7

Burglar/Homebuyer Story

	Interpretation		
	Burglar	Homebuyer	Other
Norming data	8	13	11
Experiment 1 data			
Burglar	3*	8	7
Homebuyer	0	12*	7

As can be seen from the norming data, the latter two stories have an initial bias that favors one of the two possible interpretations. This bias only explains part of the interpretation effect (as would be expected, because the experimental effect depends also on the effectiveness of the superficial cues and the source stories). Suppose a story was heavily biased to one interpretation. One superficial cue would be consistent with that interpretation and could have been ignored by half the subjects with no change in interpretation. The subjects who receive a cue for the nonpreferred interpretation might become confused in their interpretation, shifting from the preferred interpretation to a nonspecific "other" interpretation. Even this sort of pattern would be evidence that at least one of the cues had some influence on interpretation, but the type of influence could differ from our account. To some extent, this pattern was observed for the burglar/homebuyer story, although the initial bias was not overwhelming. The strong effects were probably also due to the effectiveness of the homebuyer superficial cue and source story (and the apparent ineffectiveness of the burglar superficial cue and/or source story).

However, the interpretations in the first two stories do not follow this pattern. Out of the four possible interpretations in these stories, the most common specific interpretation matched that encouraged by the superficial cue. The materials seem to have encouraged the subjects to form one of the specific interpretations, regardless of a substantial initial bias in the case of the pregnancy/illness story. Despite any initial bias of the stories, the interpretation effect in Experiment 1 shows clear evidence that the superficial-cue manipulation led to an expected change in the pattern of interpretations.

APPENDIX C

Target Materials for Experiment 2

Boldface type indicates the consistency of the critical sentences, and the bold-face numbers indicate the reading-time (msec) difference for inconsistent minus consistent conditions. Square brackets indicate the two possible superficial cues that occurred in place of the angled brackets.

Pregnancy/Illness Target

Cassandra lay in bed with her eyes closed.
 She fell back asleep and woke an hour later.
 She got up and walked over to the window.
 She looked out over <location>. [Either Lake With-a-Wind or Cloris City]
 {NEW PARAGRAPH}
 Her muscles felt stiff and she felt that she was moving awkwardly.
 The flowers in the vase next to the window smelled sweet.
 The room felt a bit cold.
 She was very glad for the new bathrobe from her husband.
 She needed a whole new wardrobe these days. **Pregnancy 51 msec**
 {NEW PARAGRAPH}
 Cassandra was not very hungry in the morning, so she had toast.
 She knew she should be eating better than this.
 She promised herself she would eat a better lunch.
 She had hated the tubes, so would do her best. **Illness 981 msec**
 She thought briefly about having a cigarette, then laughed.
 She had given them up months ago.
 {NEW PARAGRAPH}
 Cassandra climbed into the shower.
 She was surprised at how big her stomach had become. **Pregnancy –10 msec**
 She also hadn't been prepared for her change in energy.
 {NEW PARAGRAPH}
 After the shower, she sat in a chair.
 She had an hour before her next dreaded session. **Illness 655 msec**
 She picked up a magazine to read.
 She took a look around and thought about the future.

Jailbreak/Wrestling Target

It was a big day for Johnny, but he tried to keep to his usual routine.
 He read <reading material> and completed his morning stretches.
 [Either part of a Stephen King novel or the Delaware Daily newspaper]
 The routine helped calm him down.
 {NEW PARAGRAPH}
 Time seemed to crawl by.
 Johnny repeatedly checked his watch.
 He skipped breakfast to be sure he made the cut. **Wrestling 550 msec**
 He would soon find out if he had prepared enough.
 {NEW PARAGRAPH}
 The critical moment was at hand.
 Johnny slowly pushed up, planning his move.
 Things were not going well.
 The lock that held him was strong, but he thought he could break it.
 He knew that his timing would have to be perfect.
 He concentrated carefully on what had to be done.
 He looked to make sure no one was around. **Jailbreak 299 msec**
 {NEW PARAGRAPH}
 Johnny knew his early roughness had led to his being penalized.
 The reward system here seemed to work against people like him.
 However, there was not much he could do about it.
 He had to get more points than the other guy. **Wrestling 213 msec**
 The situation was becoming frustrating.

He was ready to make his move.

{NEW PARAGRAPH}

Johnny tested the lock again.

His success or failure would be decided in the next few seconds.

He knew how badly failure would be punished. **Jailbreak –212 msec**

He breathed deeply and began his move.

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