The Effect of Memory Trace Strength on Suggestibility

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This experiment tests the memory trace strength theory of suggestibility, that stronger memories are more resistant to suggestibility than weaker memories, with strength of memory manipulated by means of frequency of presentation of target items. Four- and 10-year-old children viewed a slide sequence in which four target slides were presented one or two times each. In a postevent narrative, participants were misled about two target items, and two target items served as controls. In a subsequent recognition memory test, the hypothesis was confirmed. The $d'$ difference between control and misled items was greater for frequency one than for frequency two; stronger memories (items viewed twice) were more resistant to suggestibility than weaker memories (items viewed once). This pattern was consistent for both 4- and 10-year-old children, indicating that similar cognitive processes underlie suggestibility at each age. These results suggest that if children's memory is tested for an event that occurred to them frequently, they would be expected to have more accurate memory for this event and be less vulnerable to suggestive influences such as biased interviewing procedures than they would for an event that occurred only a single time. © 1995 Academic Press, Inc.

The purpose of this study is to begin to identify the conditions under which children's memory will be resistant to versus vulnerable to suggestibility. While the bulk of the research on the suggestibility of children's memory has centered on the question, "Are children too vulnerable to suggestibility to serve as witnesses in court?" this study looks past this global question and seeks to identify the specific conditions under which children are likely to be reliable or unreliable witnesses.

A number of new classic studies have demonstrated that introducing postevent information impairs memory for an original event (Loftus, 1975, 1979; Loftus, Miller, & Burns, 1978; Pezdek, 1977). In a typical study, participants view a sequence of slides, a videotape, or a film of an event (e.g., a traffic accident or a robbery). After viewing this event they read a narr-
tive or are asked some questions that intentionally mislead them about the identity of a small set of target objects viewed in the original event (the misled condition), or they do not receive the misleading information (the control condition). The principal result is that participants are more accurate recognizing the original target objects in the control condition than in the misled condition; that is, they are misled by the postevent information presented in the narrative or questions. This finding is known as the eyewitness suggestibility effect.

Over the past 10 years, a number of researchers have investigated developmental differences in the eyewitness suggestibility effect. Using a diverse set of methodological approaches with children of various ages, these researchers have reached quite mixed results (see Ceci & Bruck, 1993, for a recent review of this research). However, most of these studies have addressed the question, “Are there developmental differences in children’s vulnerability to suggestibility?” As these studies principally have tested for main effects of age rather than interactions involving age, they have not advanced our understanding of developmental differences in the cognitive processes involved in suggestibility. This study looks past this global question and seeks to identify the conditions that affect children’s vulnerability to suggestibility and the extent to which these conditions vary developmentally.

More specifically, this study provides a test of the memory trace strength theory as it relates to suggestibility. According to the memory trace strength theory, stronger memories are more likely to resist suggestibility than weaker memories. To examine this prediction, it is necessary to consider the nature of the representation for strong versus weak memories. Using the conceptualization of Brainerd, Reyna, Howe, and Kingma (1990), a memory trace is considered to be a strong one if the original information is retained in an elaborated form in which many of the semantic and formal features are preserved in a richly associated network representation. A memory trace is considered to be a weak one if few of the semantic and formal features are retained and if the original information is only loosely associated with related information in memory. Brainerd et al. (1990) referred to the latter as “fuzzy traces.” There are two principal explanations for why weak memories might be more vulnerable to suggestibility than strong memories. First, the more loosely integrated weak memories permit more intrusions in the trace itself from external sources (Brainerd, Kingma, & Howe, 1985; Brainerd et al., 1990; Howe, 1991). Second, suggested information is more likely to coexist in memory with the original information if the original information has begun to “disintegrate” and is retained in a weak unelaborated form. Consequently, the suggested information is subsequently more likely to be retrieved than the relatively weaker original information (Ceci, Toglia, & Ross, 1988; McCloskey & Zaragoza, 1985).
Although the memory trace strength theory of suggestibility has received some indirect empirical support, in none of these studies has the strength of information in memory been directly varied for the purpose of measuring the effect on the vulnerability of the information to suggestibility. For example, the trace strength theory has been used to interpret why younger children appear to be more vulnerable to suggestibility than older children; it is argued that the strength of the original information in memory is weaker for younger children (Ceci, Ross, & Toglia, 1987; Goodman, 1984; Loftus & Davies, 1984). Lindberg (1991) demonstrated that children were less suggestible in domains in which they had greater knowledge (i.e., greater memory strength). Similarly, the findings of King and Yuille (1987) and Warren, Hulse-Trotter, and Tubbs (1991) suggest that children with weaker memories for original events were less resistant to suggestibility about those events. In a study by Farrar and Goodman (1992) children who visited an unfamiliar laboratory three times to play “animal games” were less likely to confuse this event with a subsequent “deviation visit” than children who visited the laboratory only one time.

On the other hand, some have argued that weak traces may be no more susceptible to misleading information than strong traces (Chandler, 1989; Howe, 1991; Howe & Brainerd, 1989; Zaragoza, 1987, 1991). The results reported by Howe (1991) specifically did not support the trace strength theory of suggestibility. In his study, children were presented a story either one time or until a recall criterion was reached. They were subsequently presented consistent or inconsistent postevent information followed by a test of information in the original story. Although storage failures as well as number of intrusions were higher in the one-trial condition than in the criterion condition, this variable did not interact with the misled versus control condition manipulation, thus offering no evidence that weak memories are more susceptible to suggestibility than strong memories.

Several studies by Zaragoza also dispute the relationship between memory trace strength and suggestibility. Zaragoza (1991) reported no effect on memory for originally presented information as a result of varying the number of filler slides or the exposure duration of the target slide (Experiment 2), nor for varying the time interval between presenting the original and the misleading information (Experiment 3). Similarly, Zaragoza (1987) reported no difference in vulnerability to suggestibility between conditions in which children were misled once versus twice. However, Zaragoza’s findings are not without criticism. In four experiments with adults, Belli, Windschitl, McCarthy, and Winfrey (1992) reported that memory was impaired by suggested information only with long (5 to 7 days) but not short (15 min) retention intervals and reviewed 13 published studies that fit this same pattern of results.

This experiment critically examines these two views and tests the memory trace strength theory of suggestibility. In this experiment a specific factor known to relate to the strength of memory was included—frequency of
presentation. Participants viewed a slide sequence in which the target slides were presented one or two times each. It has been amply demonstrated that the strength of memory increases with the frequency of presentation (Ebbinghaus, 1964, originally published 1885). If stronger memories are more likely to resist suggestibility than weaker memories, then the difference in recognition memory between misled and control test items would be predicted to be greater for items with weaker traces (i.e., the frequency one condition) than for items with stronger traces (i.e., the frequency two condition). This predicted pattern of results would be reflected in a significant interaction of misled/control test item type with frequency.

Two age groups were included—children 4 years of age and those 10 years of age. The 10-year-old children were selected based on the suggestion from prior studies that the suggestibility of children about 10 years of age may not differ significantly from that of adults (Cole & Loftus, 1987). The younger age group included 4-year-old children because it has been reported that around the age of 4 is another transition point in the suggestibility of memory (Goodman, Aman, & Hirschman, 1987). Also, pilot testing indicated that 4 years of age was the youngest age at which children could reliably perform this task above the chance level.

**METHOD**

*Participants and Design*

The participants were 60 4-year-olds (mean age = 4.5 years, SD = .43) and 60 10-year-olds (mean age = 10.0 years, SD = .59) from preschool and fourth- and fifth-grade classes in several public schools in the Los Angeles County metropolitan area. Children were recruited by letters sent home from school to parents. Approximately equal numbers of boys and girls participated in each age group. To assure a heterogeneous racial and ethnic mix in the sample, the schools were selected from lower and middle socioeconomic neighborhoods. Children who indicated that they did not speak English at home, however, were not included in the study. We were concerned that especially younger children who were not facile with English might not remember information in the narrative simply because of difficulty with the English language. The design was a 2 (age) × 2 (frequency) × 2 (misled vs control test items) mixed design, with age as the only between subjects variable.

*Materials*

The presentation slide sequence. Two slide sequences were developed for this study, each 38 slides in length. One sequence depicted a young woman returning home from grocery shopping and performing various activities in the kitchen—putting away groceries and preparing to make a cake. The second sequence included a man working on a construction site performing various activities associated with building a house—hammering, sawing, mov-
ing boards, etc. These two sequences were selected because the themes are both generally familiar and interesting to children of various ages. There were two target slides in each sequence. In the kitchen sequence the two target slides were (a) a picture of the woman reaching up into an open cabinet and taking out a plate and (b) a picture of the woman reaching into a kitchen drawer and pulling out a spoon. In the construction sequence the two target slides were (a) a picture of the workman next to a pile of boards picking up a hammer and (b) a picture of the workman bending down to pick up a brick. In pilot testing it was confirmed that 4-year-olds are commonly familiar with the items and name labels for all items used in this study. Each participant viewed both slide sequences with two of the four target slides presented once each (one control and one misled) and two presented twice each (one control and one misled). The assignment of each of the four target slides to the four conditions arrived at by combining the two levels of frequency with two test item types was counterbalanced across participants.

The postevent narrative. Two narratives containing the control and misleading information were read to each participant after viewing both slide sequences. Each narrative described the corresponding slide sequence, summarizing the activities that were observed in the same order viewed. The kitchen narrative was 90 words in length, and the construction site narrative was 85 words in length. A description of both target slides was included in each narrative. The misleading sentences suggested that the plate was a bowl, the spoon was a fork, the hammer was a screwdriver, and the brick was a rock. The control sentences were identical except that the generic phrase “something” was substituted for the name of each specific item (e.g., “The woman reached into a kitchen drawer and pulled out something.”). Thus, neither the original nor the suggested item was repeated in the control condition.

The recognition memory test. The test was designed following suggestions of Tversky and Tuchin (1989). The same 12 test sentences were presented to each participant. Each test sentence described one of the four target slides. There were three versions of each of the four target items, each worded the same except that the key word referred to either (a) the item in the slide, (b) the item mentioned in the misleading condition of the narrative, or (c) a foil item. The foil items were cup for plate, knife for spoon, paintbrush for hammer, and newspaper for brick. In the control conditions, subjects were presented the same test items as in the misled condition even though the narrative items were mentioned only in the misleading condition and not in the control condition. The slide, narrative, and foil item for each target were selected by the experimenters to be physically similar to the target item and approximately equally likely to appear in the target slide. The selection of which items would be assigned to the slide, narrative, and foil conditions for each target was made randomly. The use of foil test items in addition to the slide and narrative test items allows an as-
essment of whether participants who were misled simply forgot the original slide item (in which case they would be equally likely to false alarm to the narrative and the foil test item) or whether they were more specifically misled to remember the item viewed in the slide as being that suggested in the narrative (in which case they would false alarm to the narrative test item but correctly reject the foil test item).

The 12 recognition target sentences were presented to all participants in one randomly arranged order with the restriction that no two versions of the same target item were presented consecutively. Each participant was instructed that as each sentence was read, they were to respond either “yes” or “no” that the sentence described one of the pictures that they had viewed in the initial presentation phase. The “yes”/“no” procedure (rather than forced choice) allows separate measures of the memory for the original information (slide), the misleading information (narrative), and memory for plausible information from the same category that is entirely new (foil).

Procedure

Children participated individually in a presentation phase followed by a suggestion phase and then the test phase. The entire sequence took approximately 20 min per participant. In the presentation phase they viewed both the kitchen slide sequence and the construction site slide sequence. Prior to the presentation phase they were instructed to look at each picture carefully as they would be asked some questions afterward about what they had seen. Slides were presented for 3 s each. Each child then participated in a distractor task. The distractor phase was 5 min for 4-year-olds and 12 min for 10-year-olds. In pilot testing it was determined that the older children required a longer distractor phase to avoid ceiling effects on the recognition memory test. As the principal effects in this study involve interactions with age rather than the main effect of age per se, unequal distractor periods between ages was not deemed a problem. The distractor task was one of several puzzles or games selected by the child. They were then read the narrative with instructions to listen carefully because listening to this description would help them better remember the pictures they had just seen. After the narrative each child participated in the distractor task again for 1 min (4-year-olds) or 5 min (10-year-olds). Finally, the recognition memory test was administered. The experimenter read the 12 test sentences one at a time and the participant responded “yes” or “no” to each. Several practice test sentences were presented first to ensure that each child understood the task and was comparing each test item to the item previously seen in the slide.

RESULTS

Presented in Table 1 are the mean percentage correct data for the slide, narrative, and foil test items as a function of age, frequency, and mis-
TABLE 1
MEAN PROPORTION CORRECT AND \(d'\) DATA IN EACH CONDITION FOR 4-YEAR-OLD AND 10-YEAR-OLD CHILDREN

<table>
<thead>
<tr>
<th></th>
<th>Slide</th>
<th>Narrative</th>
<th>Foil</th>
<th>(d')</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4-Year-old children</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>.53</td>
<td>.58</td>
<td>.73</td>
<td>1.40</td>
</tr>
<tr>
<td>Misled</td>
<td>.48</td>
<td>.27</td>
<td>.72</td>
<td>-3.00</td>
</tr>
<tr>
<td>Frequency 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>.72</td>
<td>.53</td>
<td>.67</td>
<td>3.00</td>
</tr>
<tr>
<td>Misled</td>
<td>.82</td>
<td>.30</td>
<td>.73</td>
<td>1.40</td>
</tr>
<tr>
<td><strong>10-Year-old children</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>.65</td>
<td>.87</td>
<td>.95</td>
<td>6.20</td>
</tr>
<tr>
<td>Misled</td>
<td>.45</td>
<td>.33</td>
<td>.93</td>
<td>-2.60</td>
</tr>
<tr>
<td>Frequency 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>.73</td>
<td>.88</td>
<td>.97</td>
<td>7.40</td>
</tr>
<tr>
<td>Misled</td>
<td>.63</td>
<td>.52</td>
<td>.95</td>
<td>1.80</td>
</tr>
</tbody>
</table>

led/control test condition. Because the major predictions involved the ability of participants to discriminate between items they saw in the original slides and the corresponding items suggested in the narrative, the signal detection measure of \(d'\) was also computed. As this was the purpose of the signal detection analysis, in computing the \(d'\) data the hit rate to slide items and the false alarm rate to narrative items were used. The \(d'\) measure was also judged to be more appropriate as there was an obvious bias, especially among the 4-year-olds, to respond “yes” to test questions. The \(d'\) measure unconfounds response bias from memory sensitivity. The procedure outlined by Hochhaus (1972) was followed for calculating \(d'\) values. The mean \(d'\) data are presented in the fourth column of Table 1. For clarification, it should be noted that as each child contributed only one response per cell, the \(d'\) value per child per cell took on one of four possible values.

The \(d'\) data were analyzed with a 2 (age) \(\times\) 2 (frequency) \(\times\) 2 (misled/control condition) mixed factorial analyses of variance (ANOVA). The rejection region for all analyses was \(p < .05\). First, the main effect of frequency was significant, \(F(1,118) = 15.04, MS_e = 67.10\), with a higher \(d'\) rate under the frequency-two condition (\(d' = 3.40\)) than the frequency-one (\(d' = 0.50\)) condition. Therefore, the independent variable was generally successful in increasing memory strength. Also as expected, the main effect of age was significant, \(F(1,118) = 14.95, MS_e = 50.18\), with 10-year-olds more accurate (\(d' = 3.20\)) than 4-year-olds (\(d' = 0.70\)), and participants were more accurate in the control condition (\(d' = 4.50\)) than in the misled condition (\(d' = -0.60\)), \(F(1,118) = 47.67, MS_e = 65.47\).
The major prediction involved the interaction of frequency by the misled/control condition. This interaction was marginally significant, \(F(1,118) = 3.45, MS_e = 78.24, p < .07\), in the predicted direction. Planned comparisons yielded the difference between the control and the misled conditions significant in both the frequency-one condition, \(t(119) = 5.64, p < .01\), and the frequency-two condition, \(t(119) = 3.46, p < .01\); however, the size of the \(d'\) difference between control and misled items was larger with frequency one (\(d' = 3.80\) vs \(2.80\), respectively) than with frequency two (\(d' = 5.20\) vs \(1.60\), respectively).

Further, the age × frequency × misled/control condition interaction did not approach significance \((F < 1.0)\), indicating that the pattern of the frequency × misled/control interaction was statistically consistent across the two age groups. As an additional verification of the consistency of the frequency × misled/control interaction for both 4-year-olds and 10-year-olds, planned comparisons were used to test the significance of the \(d'\) difference between the misled and control conditions at each level of frequency for each age group separately. As can be seen in Table 1, for 4-year-olds, the \(d'\) difference between control (\(d' = 1.40\)) and misled (\(d' = -3.00\)) items was larger for frequency one, \(t(59) = 2.69, p < .01\), than for frequency two (\(d' = 3.00\) vs \(1.40\), respectively), \(t(59) = 1.11, p > .10\). Similarly, for the 10-year-olds, the \(d'\) difference between control (\(d' = 6.20\)) and misled (\(d' = -2.60\)) items was larger for frequency one, \(t(59) = 5.38, p < .01\), than for frequency two (\(d' = 7.40\) vs \(1.80\), respectively), \(t(59) = 3.82, p < .01\).

To assess the extent to which the pattern of \(d'\) data reflects both the pattern of hit rates for slide items (i.e., \(p\) ("old"/slide)) and the pattern of correct rejection rates for narrative items (i.e., \(p\) ("new"/narrative)), separate 2 (age) × 2 (frequency) × 2 (misled/control condition) mixed factorial ANOVAS were applied to the responses to slide and narrative items. As can be seen in the first and second columns of Table 1, although the critical frequency by misled/control condition interaction was in the predicted direction with both the hit rate and the correct rejection rate data, this interaction was not significant with either the hit rate data, \(F(1,118) = 2.28, MS_e = .21\), or the correction rejection rate data, \(F(1,118) = 1.96, MS_e = .24\). Together, these findings suggest that the major result of this study, principally the pattern of the frequency by misled/control condition interaction, was generally consistent with the hit rate data and the correct rejection rate data.

Other effects were also significant with the hit rate data for slides and correct rejection rate data for narratives. With the hit rate data, only the main effect of frequency, \(F(1,118) = 22.00, MS_e = .21\), was significant. With the correct rejection rate data, three effects were significant; the main effects of age, \(F(1,118) = 32.55, MS_e = .19\), the main effect of the misled/control condition, \(F(1,118) = 74.24, MS_e = .21\), and the interaction of age by misled/control condition, \(F(1,118) = 4.33, MS_e = .21\).
The final analysis addressed the pattern of responses to the foil test items. A 2 (age) × 2 (frequency) × 2 (misled/control condition) mixed factorial ANOVA was applied to the responses to foil items. The average accuracy rate for foil items was quite high (mean proportion correct = .83), and the only significant effect in the analysis of these data was age, \( F(1,118) = 42.46, M_{S} = .16 \), with 10-year-olds more accurate than 4-year-olds (mean proportion correct = .95 vs .71, respectively). The high correct rejection rate for foil test items confirms the findings of Tversky and Tuchin (1989) that the effect of the misleading information in the narrative is quite specific in that memory for the original item seen in the slide is not simply weakened in some general sense in the misled condition; rather, it is altered by the precise information in the item suggested in the narrative.

As can be seen in Table 1, recognition accuracy was higher for foils than for the narrative items in the control condition. It is not clear why this result occurred. In the control condition the foil and narrative items should have been equally unfamiliar as neither was presented prior to the test, but apparently the foil items were easier to reject than were the narrative items in the control condition. The selection of which items was assigned to the slide, narrative, and foil condition for each target was made randomly. However, it is suggested that in future research this assignment be counterbalanced across subjects.

**DISCUSSION**

This experiment tested the hypothesis that stronger memories are more likely to resist suggestibility than weaker memories, with strength of memory manipulated by means of frequency of presentation of target items. This hypothesis was confirmed by the finding that the \( d' \) difference between control and misled items was greater for frequency one than for frequency two. Further, the frequency by misled/control condition interaction approached significance. That is, participants were less likely to be misled if they had viewed the original item two times rather than only once. Further, this pattern was consistent for both the 4-year-olds and the 10-year-olds and generally reflects the pattern of results obtained with both the hit rate data and false alarm rate data.

What is it about weaker memory traces that makes them more vulnerable to suggestibility than stronger memory traces? One explanation is based on the nature of the memory trace itself. According to this view, weak memories are more likely to exist in an unelaborated form or to have disintegrated such that they are overwritten by the subsequent suggested information (cf. Brainerd et al., 1985, 1990). Alternatively, the trace competition explanation posits that weaker memories are more difficult to retrieve. According to this view, a weak original memory coexists with memory for the suggested information, but at the time of testing, the suggested information is more likely to be retrieved than the relatively weaker original in-
formation (cf. Ceci et al., 1988). The results of the present study do not specifically differentiate between these two views. However, Howe (1991) found that when misinformation effects occurred, they were related to destruction of the original trace rather than to trace competition. Although additional research is necessary to distinguish between these two explanations, the present study confirms that regardless of the locus of the effect, weaker memories are more vulnerable to suggestibility than stronger memories.

How can we reconcile the differences between the results of this study and the results of Howe (1991) and Zaragoza (1987, 1991), who reported that weaker memories were not more vulnerable to suggestibility than stronger memories? First, in the Howe (1991) study, the fact that the overall effect of the misled/control condition manipulation was small to nonexistent suggests one reason why the potential variance explained by the interaction of the number of training trials with the misled/control condition may have been so limited. Also, differences between the recall measure in the Howe (1991) study and the d' recognition measure in the present study make it difficult to draw direct parallels between these two sets of findings.

Inconsistencies between the results of the present study and those of Zaragoza (1987, 1991) also need to be addressed. In Zaragoza's studies it was reported that the degree of suggestibility was not related to either memory strength or age. It should be noted, however, that these findings of Zaragoza have been brought into question by the results of Belli et al. (1992), that memory impairment by suggested items occurs only with long but not short retention intervals. Further, Ceci, Ross, and Toglia (1987), using a procedure very similar to that of Zaragoza, found that the degree of suggestibility did relate to age. Toglia (1991) offered numerous suggestions for procedural differences between these two studies that might account for the apparent differences in results. Most notably, he suggested that differences in results may be related to differences in the level of recognition performance in the control conditions in the two studies.

We propose two major differences between the present study and those by Zaragoza that may relate to the differences in results. First, Zaragoza used the "modified test condition" in which participants had to discriminate between the original item and a completely new item, whereas in the present study, using a "yes/no" recognition procedure, participants had to discriminate between the original item, the misleading item suggested in the narrative, and a completely new foil item. As noted by Zaragoza (1987) herself, the differences between the control and the misled condition is reliably less using the "modified test condition" than the original test condition used in the present study. Second, suggestibility was assessed in terms of percentage correct data by Zaragoza, but in terms of d' data in the present study. The fact that the critical pattern of results in the present study was significant (albeit marginally) using d' data, but not using percentage correct data alone, suggests that d' is a more sensitive measure of suggestibility.
Several developmental results are worth noting from this study. First, the consistency of the frequency by misled/control condition interaction across age groups indicates that the processes that relate trace strength to suggestibility function similarly for older and younger children. Although it has been reported in a number of studies that 4-year-olds are generally more vulnerable to suggestibility than are 10-year-olds (cf. Ceci & Bruck, 1993), the results of this study indicate that, nonetheless, the specific conditions that affect children's vulnerability to versus resistance to suggestibility appear similar for 4- and 10-year olds. Further, these results suggest that similar cognitive processes underlie suggestibility effects for younger and older children. Thus, although it is problematic to draw conclusions regarding age differences in the suggestibility of memory using this paradigm because the degree of original learning is not controlled across age groups (cf. Howe & Brainerd, 1989), these results suggest that the pattern of interaction of factors within each age can be revealing of the processes underlying suggestibility at each age.

It is worth noting, however, that there was a significant main effect of age on the $d'$ data ($d' = 0.70$ vs $3.20$ for 4-year-olds vs 10-year-olds, respectively), the correct rejection rate for narrative items (.42 vs .65), and the correct rejection rate for foils (.71 vs .95). These main effects of age are difficult to interpret, given the issue of potential differences in initial encoding across ages mentioned above, as well as the fact that in this study, the procedure involved distractor tasks of a longer duration for 10-year-olds than for 4-year-olds. Only with the hit rate data for slides was the memory differences between 4- and 10-year-olds nonsignificant (.61 vs .64). However, the high hit rate for 4-year-olds can be attributed in part to the greater bias of the 4-year-olds to respond "yes" to test questions. This finding, along with the fact that in this study the principal results were observed with $d'$ data and not with either hit rate or false alarm rate data alone, suggests $d'$ as a more sensitive measure of the eyewitness suggestibility effect, and perhaps one reason for the "now-you-see-it, now-you-don't" nature of misinformation effects in children's memory (see Howe, 1991, for a discussion of this issue) in a literature in which $d'$ data are rarely examined.

From an applied point of view these results are important because they begin to suggest conditions under which children are likely to be reliable or unreliable eyewitnesses. Specifically, strong memories are more resistant to suggestibility than are weak memories. Thus, if a child is recalling an event that occurred several times to him or her, he or she would be expected to have more accurate memory for the event and be less vulnerable to suggestive influences such as biased interviewing procedures, compared to an event that occurred only a single time. Of course it would also be important to evaluate the relative strength of the suggested information in memory. If a suggestive interview had been repeated numerous times, then the strength of the suggested item may exceed that of the original item. Research in progress specifically focuses on the interplay between the mem-
ory strength of the original and the misleading information in affecting the suggestibility of memory.

These findings begin to articulate the conditions under which children’s memory would be expected to be vulnerable to versus resistant to suggestibility. The finding that items viewed more frequently are more resistant to suggestibility than items viewed only once provides support for the memory trace strength theory of suggestibility. A fruitful direction for future research would be to examine the suggestibility of memory for items and events under various other conditions that are known to relate to the strength of memory, for example, recent versus delayed events, novel versus familiar domains, or information consistent versus inconsistent with expectation.

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