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Misleading Postevent Information and Recall of the Original Event: Further Evidence Against the Memory Impairment Hypothesis

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This study evaluates the hypothesis that misleading postevent information impairs memory for the original event. Subjects viewed a sequence of slides depicting an event, read a postevent narrative that presented neutral or misleading information about critical details, and then were tested on their ability to recall the critical details. In two experiments no difference in recall performance between misled and control conditions was found. These results, in conjunction with the McCloskey and Zaragoza (1985a) finding that misleading information did not affect subjects' ability to recognize original information, argue strongly against the memory impairment hypothesis.

The claim that misleading postevent information may impair memory for an event has gained considerable currency among memory researchers. The empirical basis for this claim is a substantial body of results obtained with a procedure we will call the *original recognition test* procedure. In a typical experiment subjects first view a sequence of slides depicting an event such as a traffic accident or robbery. Postevent information, such as a written narrative description of the event, is then presented. For subjects in the *misled* condition the narrative provides misleading information about a detail from the original event. For example, a can of Coke appearing in the slide sequence might be described in the narrative as a can of 7-Up. For subjects in the *control* condition the postevent narrative provides no specific information about the critical detail. After presentation of postevent information, memory for the original event is assessed with a two-alternative forced-choice recognition test. For the test question about the critical detail, the alternatives are the item from the original slide sequence (e.g., Coke), and the item presented to misled subjects as misleading postevent information (e.g., 7-Up).

The consistent finding is that misled subjects perform more poorly than control subjects on the question about the critical detail (e.g., Loftus, Miller, & Burns, 1978). This result has been interpreted as evidence that misleading postevent information impairs memory for the original event.

The memory impairment interpretation has been widely accepted, and attention has focused primarily on the nature of the presumed impairment. Some researchers (e.g., Loftus 1979a, 1979b; Loftus & Loftus, 1980; Loftus et al., 1978) have suggested that misleading postevent information causes original information to be lost from memory, whereas others (e.g., Bekerian & Bowers, 1983; Bowers & Bekerian, 1984; Christiaansen & Ochalek, 1983) have argued that the original information merely is rendered inaccessible.

Recently, however, McCloskey and Zaragoza (1985a, 1985b) called the memory impairment hypothesis into question, arguing that results obtained with the original recognition test procedure do not imply that misleading postevent information in any way affects memory for the original event. The original recognition test, they suggested, is not appropriate for assessing effects of misleading postevent information on memory; because of response biases inherent in the procedure, poorer misled than control performance is expected even if misleading information has no effect on memory for the original event. Thus, although studies using the original test procedure clearly demonstrate that misleading postevent information may influence subjects' responses to test questions, the studies fail to demonstrate that the misleading information affects subjects' ability to remember the original event. (See McCloskey & Zaragoza, 1985a, pp. 2-4, for a more detailed discussion of this point.)

McCloskey and Zaragoza (1985a) used a *modified recognition test* procedure to obtain results bearing more directly on the memory impairment hypothesis. The modified procedure was the same as the original procedure except that the test question for the critical detail offered subjects a choice between the originally seen item (e.g., Coke) and a new item (e.g., Sunkist orange soda). With the modified procedure, poorer misled than control performance is expected if misleading information impairs memory for the original event. If, however, misleading information does not affect subjects' ability to remember the original event, no misled/control difference is expected. The results obtained with the modified procedure argued against the hypothesis that misleading postevent information impairs memory for the original event; in six experiments McCloskey and Zaragoza found no effect of misleading information.

In this article we report another test of the memory impairment hypothesis. The McCloskey and Zaragoza (1985a) experi-

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ments, like virtually all previous postevent information research, used a recognition procedure. The present experiments assessed effects of misleading postevent information on recall of original information.

There are several reasons to suppose that misleading postevent information might impair recall even if it has no effect on recognition. Recognition tests may minimize difficulties in retrieving stored information needed to answer a question. On a recognition test, the to-be-remembered item is provided as one of the response alternatives and so is available as a retrieval cue. Hence, recognition procedures may be less sensitive than recall procedures to effects of misleading postevent information on ability to retrieve stored information about the original event.

The possibility that misleading postevent information may impair recall but not recognition of original information is especially salient in light of the finding in studies of retroactive interference (RI) that recall tests typically yield robust RI effects, whereas recognition tests usually show little or no interference (see, e.g., Crowder, 1976; Postman & Underwood, 1973, for reviews). It is by no means a foregone conclusion that the results of traditional RI studies, which typically involve paired-associate lists learned to a criterion, will generalize to other sorts of stimuli and procedures. However, the RI data suggest that recall methods may be better suited than recognition procedures for detecting effects of misleading postevent information on ability to retrieve stored information about an original event.

The Loftus, Schooler, and Wagenaar (1985) critique of the McCloskey and Zaragoza (1985a) study provides another reason for adopting a recall procedure. Loftus et al. argue that because subjects who do not remember the original information have a substantial (i.e., 50%) probability of responding correctly by guessing on the modified recognition test, the test may be insufficiently sensitive to detect small effects of misleading postevent information on memory for original information. If, for example, misleading information causes forgetting of original information in 10% of misled subjects, only a 5% misled/control difference is expected on the modified recognition test, because half of the subjects who forgot the original information will respond correctly by guessing. In contrast, with a recall procedure one can readily obtain lower probabilities of guessing correctly, and hence, larger expected differences between misled and control conditions.

A Recall Procedure

In evaluating the memory impairment hypothesis the question of interest is whether, as a consequence of exposure to misleading postevent information, fewer misled than control subjects can remember the original information. Unfortunately, it is not a simple matter to design a recall procedure that can be used to answer this question. A procedure for testing the memory impairment claim must not only ensure that poorer misled than control performance will obtain if misleading postevent information impairs memory for original information; the procedure must also ensure that misled and control conditions will not differ if misleading information has no effect on memory for original information. The first requirement is easily met; the second, however, is more difficult to satisfy.

Consider once again a situation involving the original information *Coke* and the misleading information *7-Up*. We might attempt to assess effects of misleading information on recall of original information simply by giving misled and control subjects a recall test including the question, "What brand of soft drink was the can on the desk?" with the instruction that all questions must be answered.

However, this procedure is not adequate for testing the memory impairment claim; there are two reasons to expect poorer misled than control performance even if misleading postevent information has no effect on subjects' ability to remember the original event. First, the misleading information will bias the responses of subjects who, for reasons unrelated to the presentation of this information, do not remember what they originally saw. In the control condition, subjects who cannot remember the original information will have to guess on the test, and some proportion of these subjects will presumably guess the correct answer "Coke." In the misled condition, however, subjects who do not remember the original information *Coke* but do remember the misleading postevent information *7-Up* presumably will answer "7-Up" on the test. These subjects, instead of having some chance of responding correctly by guessing, will be uniformly incorrect. Thus, as long as the probability of a correct guess is greater than zero, performance for subjects who do not remember the original information will be worse in the misled condition than in the control condition. Consequently, even if the percentage of subjects who remember the original information is the same in both conditions, overall performance on the test will be lower in the misled condition.

A second reason that poorer misled than control performance may obtain, even if misleading information has no effect on memory for the original event, is that some misled subjects who remember both the original information (*Coke*) and the misleading postevent information (*7-Up*) may report the misleading information on the test. For example, a subject who thought she saw a Coke can in the slides but remembered that the narrative described the can as a 7-Up can might reason that the experimenter who prepared the narrative must have known what was in the slides, and hence that the can must have been a 7-Up can.

To test the memory impairment hypothesis, a procedure that eliminates these response biases is needed. Specifically, the procedure must ensure that (a) the probability of a correct response for subjects who remember the original information is the same in the misled condition as in the control condition and (b) the probability of a correct response for subjects who do not remember the original information is the same in the misled condition as in the control condition. If these requirements are met, poorer misled than control performance will obtain only if fewer misled than control subjects remember the original information.

In this study we satisfied the requirements by constructing stimulus materials and test questions in such a way that the items used as misleading information were not appropriate responses to the critical test questions. Consider once again the situation involving the original information *Coke*, and the test question, "What brand of soft drink was the can on the desk?"

However, assume now that the misleading postevent information is not *can of 7-Up,* but rather *can of Planter's peanuts.*

With this procedure, misled subjects who remember the original information should, like the corresponding control subjects, respond correctly on the test. "Planter's peanuts" is not a possible response to the question, "What brand of soft drink was the can on the desk?" Hence, misled subjects who remember the original information *Coke* will presumably report "Coke" on the test, whether or not they also remember the misleading information *Planter's peanuts.* Thus, the misleading postevent information should not bias the responses of misled subjects who remember the original information.

Similarly, misled subjects who do not remember the original information should, like the corresponding control subjects, guess on the test. Because the misleading information *Planter's peanuts* is not an appropriate response to the critical test question, misled subjects who do not remember the original information *Coke* must guess, whether or not they remember the misleading information.

One potential problem is that the misleading postevent information, although it cannot be given as an answer to the critical test question, may influence subjects' guesses. Hence, control and misled subjects conceivably could differ in the likelihood of answering a test question correctly by guessing. Imagine, for example, a situation involving the original information *spoon,* the misleading information *chisel* and the test question, "What kitchen utensil was the man holding?" A misled subject who did not remember the original information *spoon* but did remember the misleading information *chisel* might guess "knife" on grounds that a knife is the kitchen utensil that looks most like a chisel. In contrast, a control subject might be less likely to guess "knife" and hence more likely to guess the correct response "spoon." Although in this example the effect of the misleading information is to decrease the likelihood of a correct guess, the opposite could also occur. If *knife* were the original information, the misleading information *chisel* might lead to a higher probability of guessing correctly in the misled condition than in the control condition.

These potential effects of misleading information on the likelihood of guessing correctly present a problem because we require that subjects who do not remember the original information have the same probability of responding correctly in the misled condition as in the control condition. We dealt with this problem by pretesting stimulus materials to determine whether the misleading information affected the probability of guessing correctly in subjects who did not remember the original information. As is discussed later, the pretest results indicated that for our stimuli the misleading postevent information had no effect on the likelihood of a correct guess on the recall test.

Given these pretest results, the recall procedure we have outlined can be used to evaluate the memory impairment hypothesis: If misleading postevent information impairs subjects' ability to remember the original information, poorer misled than control performance is expected. If, however, misleading information has no effect on memory for the original event, then misled and control performance should not differ.

Experiment 1

Subjects viewed a sequence of slides, read a postevent narrative, and took a written test on the event shown in the slides. The slide sequence contained two critical items that were used to make a within-subjects misled–control manipulation: Each subject received misleading postevent information about one of the items and neutral information about the other.

Two groups of subjects were tested. Subjects in the *original recognition test* condition were tested with the original recognition test procedure to ensure that we could replicate the misleading information effect obtained in previous studies. Subjects in the *recall test* condition were tested with the recall procedure described earlier.

Method

Subjects. Subjects were 174 undergraduate students at Kent State University. Of them, 126 were assigned to the recall test condition, and 48 were assigned to the original recognition test condition. (We did not test a large number of subjects in the original recognition test condition because this condition was included only to show that we could obtain the usual misleading information effect with the original test. Large numbers of subjects are not typically required to obtain the effect.)

Stimuli. The slide sequence and postevent narrative were the same as those used in the McCloskey and Zaragoza (1985a) study. The series of 79 slides depicted an incident in which a maintenance man enters an office, repairs a chair, finds and steals $20 and a calculator, and leaves. The slide sequence included two critical slides, each showing one of the two critical items. For each critical slide three different versions were used. The critical items and the three versions of each were as follows: a magazine on a table (*Glamour, Vogue, Mademoiselle*), and a soft drink can on a desk (*Coke, 7-Up, Sunkist orange soda*). For each critical item each version was presented to one third of the subjects. For example, one third of the subjects saw a *Glamour* magazine, one third saw a *Vogue* magazine, and one third saw a *Mademoiselle* magazine.

The postevent narrative was a detailed description (approximately 750 words in length) of the incident shown in the slides. For each subject the narrative presented misleading information about one of the critical items (the misled item) and neutral information about the other critical item (the control item). The misleading information was *Wall Street Journal* for the magazine critical item and *can of Planter's peanuts* for the soft drink can critical item. The neutral information was *publication* for the magazine critical item and *can* for the soft drink item. Except for variations in references to the critical items, the narrative was the same for all subjects.

The assignment of critical items to misled and control conditions was counterbalanced across subjects. Each version of each critical item served as a control item for half of the subjects to whom it was presented and as a misled item for the other half.

A pretest was conducted to determine whether the misleading information influenced subjects' likelihood of responding correctly by guessing on the recall test. A total of 184 subjects viewed the slide sequence, read the postevent narrative, and took a recall test. Procedures were the same as those described below for the recall test condition, except that for the slide sequence used in the pretest, the two critical slides were replaced with slides that did not include the critical items but were otherwise identical. For example, the critical slide for the soft drink can, which showed a man reaching for a set of keys near a soft drink can on a desk, was replaced with a slide that was identical except that no can was on the desk. Omitting the critical items from the slide sequence ensured that none of the pretest subjects could remember the critical items and hence that all subjects would have to guess on the test. In this way the probability of a correct guess could be assessed for misled and control conditions. For example, the pretest allows us to assess the probability of guessing "Coke" in response to the test question about the soft drink can when the postevent narrative contains the misleading

information *can of Planter's peanuts* (misled condition), and when the narrative contains the neutral information *can* (control condition).

The probability of guessing a particular version of a critical item (e.g., "Coke") was computed simply as the proportion of subjects who produced that version on the pretest. For example, the proportion of pretest subjects who produced "Coke" in response to the test question about the soft drink critical item was .32 when the narrative included the neutral information *can* and .33 when the narrative included the misleading information *can of Planter's peanuts.* Thus, when *Coke* is presented as the soft drink critical item in the main experiment, the probability of answering the soft drink test question correctly by guessing should be about .32 in the control condition and about .33 in the misled condition.

Averaged across the individual versions of critical items, the estimated probability of a correct guess was .17 for misled items and .15 for control items, $t(183) = 1.23$, $SE = .05$, $p > .2$, in an analysis with subjects as the random effect, and $t < 1$, $SE = .02$, for an analysis with items as the random effect. Thus, the pretest revealed no effect of misleading postevent information on the probability of guessing correctly. Note that the probability of a correct guess on the recall test—approximately .16—is considerably lower than the .5 probability of a correct guess on the recognition test used in the McCloskey and Zaragoza (1985a) study. Hence, as discussed above, the recall test should be more sensitive than the recognition test to small memory impairments that might be caused by misleading postevent information.

The pretest results also verified that the items used as misleading postevent information were not appropriate responses to critical test questions: None of the pretest subjects gave the misleading information as an answer to a critical test question.

Procedure. Subjects were tested in groups of 6 to 20. As a rationale for presentation of the slides and narrative, subjects were told that the experiment concerned intuitions about memory. The subjects were informed that they would see a slide sequence depicting an event and that they would then read a written description of the event. The task, they were instructed, was to judge whether memory for the event generally would be better for the visual or the verbal mode of presentation. Subjects were told to pay close attention to both the slides and the narrative.

The subjects then (a) viewed the slide sequence at a rate of 5 s per slide, (b) performed a 10-min unrelated filler task, (c) read the postevent narrative once at their own pace, (d) answered two questions concerning their intuitions about memory and mode of presentation, and (e) completed a test on the material in the slides. Subjects in the original recognition test condition received a 12-item forced-choice recognition test, and subjects in the recall test condition received a 12-item recall test. The subjects were told to answer the questions solely on the basis of what they saw in the slides, and that for each question there was a correct answer.

The recall test consisted of 12 questions: 10 filler questions and 1 critical question for each of the critical items. The questions were the same for all subjects. In each question, words delimiting the range of acceptable responses were capitalized and underlined to ensure that subjects did not report the misleading information on the critical questions. For example, the critical question for the soft drink critical item was, "The keys to the desk drawer were next to a soft drink can. What BRAND of SOFT DRINK was it?" Subjects were told to answer every question, even if they had to guess.

The original recognition test consisted of the same 12 questions, presented with two response alternatives, and reworded to eliminate the material needed in the recall test to specify the range of acceptable responses. For example, for the soft drink can critical item, the question was, "The key to the desk drawer was next to a _____ can." The 12 questions (10 filler questions and 2 critical questions) were the same for all subjects, except for variation in the response alternatives. The alternatives were the version of the critical item appearing in the slide sequence (e.g., *Coke, 7-Up,* or *Sunkist*) and the item used as misleading postevent information (*Planter's peanuts*). Across the experiment the same alternatives were used for both misled and control critical test questions. Thus, the control and misled conditions differed only in whether the subject received misleading or neutral information in the postevent narrative. For each critical test question the response alternatives were presented in one order (e.g., *Coke, Planter's peanuts*) to half of the subjects, and in the other order (e.g., *Planter's peanuts, Coke*) to the other half.

Results and Discussion

For each condition t tests were performed with subjects as the random effect, and with items as the random effect. (In the items analysis the number of correct misled and control responses was tabulated for each of the six individual versions of critical items: *Coke, 7-Up, Sunkist, Vogue, Glamour, Mademoiselle.*)

As expected, the results for the original recognition test condition revealed the misleading information effect obtained in numerous previous studies. Recognition performance was 48% correct for misled items, and 75% correct for control items, $t(47) = 2.66$, $SE = .10$, $p < .05$, for the subjects analysis, and $t(5) = 7.06$, $SE = .31$, $p < .01$, for the items analysis.

In the recall test condition, however, the pattern of results was quite different. Recall performance was 33% correct for misled items, and 33% correct for control items, $t < 1$, $SE = .06$, in the subjects analysis, and $t < 1$, $SE = 1.22$, in the items analysis. Thus, the data show no effect of misleading postevent information on subjects' ability to recall what they originally saw, and hence argue against the memory impairment hypothesis.

The Appendix presents results from the pretest, original recognition test, and recall test separately for the magazine and soda critical items. It is evident from the Appendix that the overall means are representative of the results for the individual items.

One point worthy of discussion is the low level of performance in the recall condition. Although performance was well above the guessing rate of approximately 16% established by the pretest results, the percentage of subjects who were able to remember the original information under the conditions of the recall test was obviously rather low. Whether this represents a strength or a weakness of the experiment is not entirely clear. On the one hand, original information might be especially vulnerable to memory-impairing effects of misleading information when, as in the present experiment, the original information is difficult to remember even in the absence of misinformation. On the other hand, if few subjects are able to remember the original information even before misleading information is presented, there are few subjects whose memories can potentially be impaired by the misinformation.

One way of dealing with this issue is to assess effects of misleading postevent information under conditions producing good recall as well as under conditions yielding poor recall. Hence, in Experiment 2 we attempted to enhance subjects' memory for the original information by presenting the slide sequence twice in succession.

Experiment 2

Method

Subjects. Subjects were 228 undergraduate students at Kent State University. Of them, 174 subjects were assigned to the recall test condition and 54 were assigned to the original recognition test condition.

Stimuli. The slide sequence was the same as in Experiment 1, except that two additional details were used as critical items, bringing the number of critical items to four. The two new critical items and the three versions of each were as follows: a coffee jar on a file cabinet (*Folger's, Maxwell House, Nescafe*), and a tool lifted from a tool box (*hammer, wrench, screwdriver*). For each critical item, each of the three versions was presented to one third of the subjects.

The postevent narrative was also the same as in Experiment 1 except for changes resulting from the addition of two new critical items. For each subject, the narrative presented misleading information about two critical items (misled items) and neutral information about the other two (control items). The assignment of critical items to misled and control conditions was counterbalanced across subjects; each version of each critical item served equally often as a control item and as a misled item. The misleading information was *jar of sugar* for the coffee jar critical item, and *sandwich* for the tool critical item. The misleading information for the magazine and soft drink items was the same as in Experiment 1.

A pretest for the two new critical items indicated that misleading postevent information did not affect the likelihood of guessing correctly: The probability of a correct guess was .24 for misled items and .22 for control items, $t < 1$, $SE = .04$ for the subjects analysis, and $t < 1$, $SE = .04$ for the items analysis. As in Experiment 1, the pretest results verified that the items used as misleading postevent information were not appropriate responses to critical test questions: None of the pretest subjects gave the misleading information as an answer to a critical question.

Procedure. The procedure was the same as in Experiment 1, except that the slide sequence was presented twice in succession, at a rate of 5 s per slide, prior to presentation of the postevent narrative.

Results and Discussion

The additional presentation of the slide sequence improved performance considerably, but the pattern of results remained the same. The results for the original recognition test condition revealed the usual misleading information effect: Performance was 82% correct for control items and 61% correct for misled items. The misled/control difference was reliable in both the subjects analysis, $t(53) = 3.64$, $SE = .12$, $p < .01$, and the items analysis, $t(11) = 3.62$, $SE = .53$, $p < .01$.

In the recall test condition misled and control items did not differ: Performance was 58% correct for control items and 60% correct for misled items. The misled/control difference was not reliable in either the subjects analysis, $t < 1$, $SE = .07$, or the items analysis, $t < 1$, $SE = 1.04$. Thus, the results of Experiment 2, like those of Experiment 1, show no effect of misleading postevent information on subjects' ability to recall original information, and hence argue against the memory impairment hypothesis.

The Appendix presents results from the pretest, original recognition test, and recall test separately for the magazine, soda, coffee, and tool critical items. As in Experiment 1, the overall means are representative of the results for the individual items.

Two potential problems require discussion. First, it might be suggested that in the present experiments the misleading postevent information (e.g., *can of Planter's peanuts*) was not sufficiently similar to the original information (e.g., *can of Coke*) to impair subjects' memory for what they originally saw. There is, however, no apparent reason to assume that misleading information would impair memory for original information only when original and misleading information are very similar. The retroactive interference literature certainly does not show that RI effects occur only when the interfering and interfered-with responses are highly similar; if anything, RI tends to decrease as response similarity increases (see, e.g., Gladis & Braun, 1958; Osgood, 1946; Young, 1955). It is also worth noting that subjects clearly did not reject the misleading information as implausible: We obtained substantial misleading information effects with the original recognition test.

The second potential problem concerns whether the misleading postevent information actually contradicted the original information presented in the slide sequence. For example, in the case of the soft drink can critical item, did the misleading postevent information *can of Planter's peanuts* clearly refer to the critical can, as we intended, or could the misinformation have been interpreted in some other way (e.g., as a reference to another object on the desk where the soft drink can was located)?

For two of the four critical items used in the present study—the coffee jar and the tool—the misleading postevent information clearly referred to the critical item (and thus contradicted the original information). For example, the critical slide for the tool showed the man lifting a tool from his toolbox with one hand and slipping the stolen calculator into the box with his other hand. The misleading postevent information, however, indicated that the object lifted from the toolbox was a sandwich: "He stopped at his toolbox, opened it, lifted a sandwich, and slid the calculator beneath it."

For the other two critical items—the soft drink and the magazine—the misleading information is most plausibly interpreted as referring to the critical item, but could conceivably have been interpreted in another way. For example, the critical slide for the soft drink can showed a desk with several objects on it, including a framed photograph, a box of tissues, and a stapler. The misleading information *can of Planter's peanuts* was clearly false, and could not have referred to any object in the scene other than the critical soft drink can. However, some subjects conceivably could have interpreted the misinformation as referring not to the critical item (i.e., the soft drink can), but rather to another can that they failed to notice while viewing the slide sequence.

Because of this potential problem with the soft drink can and magazine critical items, we recalculated the misled and control recall performance in Experiment 2 using only the coffee jar and tool critical items. (The coffee and tool items were not used in Experiment 1.) The crucial features of the experimental design (e.g., within-subjects misled/control manipulation, counterbalancing) are retained when the analysis is restricted to these two items; the number of misled and control observations per subject is merely reduced from two to one. A total of 174 subjects were tested in the recall condition of Experiment 2. Thus, the analysis considering only the coffee and tool critical items involved 174 misled and 174 control condition observations.

Restricting the analysis to the coffee and tool items did not alter the pattern of results: Performance was 64% correct in the misled condition and 67% correct in the control condition, $t < 1$, $SE = .06$ in the subjects analysis, and $t < 1$, $SE = 1.14$ in the items analysis. Thus, even when the misleading postevent information clearly contradicted the original information, mis-

information did not affect subjects' ability to recall what they originally saw.

General Discussion

In two experiments assessing effects of misleading postevent information on subjects' ability to recall details of the original event, we found no difference between misled and control conditions. In conjunction with McCloskey and Zaragoza's (1985a) finding that misleading postevent information had no effect on subjects' ability to recognize original information, this result argues strongly against the hypothesis that misleading postevent information impairs memory for the original event. We suggest, therefore, that misleading postevent information neither erases original information, as Loftus and her colleagues have proposed, nor renders original information inaccessible, as Bekerian and Bowers (1983; Bowers & Bekerian, 1984) and Christiaansen and Ochalek (1983) have argued.

We further suggest that the consistent finding of poorer misled than control performance in studies using the original recognition test procedure reflects the response biases inherent in this procedure (see McCloskey & Zaragoza, 1985a), and not an effect of misleading postevent information on subjects' ability to remember what they originally saw.

Of course, we cannot rule out the possibility that under some circumstances misleading postevent information would impair memory for original information. It is conceivable, for example, that a memory test less structured than those we have used would reveal effects of misleading information on subjects' ability to retrieve original information. Both in our earlier experiments with the modified recognition test (McCloskey & Zaragoza, 1985a) and in the present experiments with the recall test, response biases were avoided in part through the use of test questions that excluded the misleading postevent information as a possible response. In the modified recognition procedure the misleading information was not included as a response alternative, and in the recall procedure questions were worded in such a way that the misleading information could not be given as a response. Under conditions in which the misleading information was not excluded by the test questions, misled subjects conceivably might show impairments in retrieving original information. A determination on this issue must await the development of procedures that avoid response biases without excluding the misleading information as a possible test response. At present, however, the available data provide no evidence that misleading postevent information produces any sort of memory impairment.

Conceptual Frameworks for Postevent Information Research

Most postevent information research has been conducted within a conceptual framework defined by three hypotheses proposed as potential explanations for the misleading information effect obtained with the original recognition test (e.g., Loftus, 1979a; Loftus & Loftus, 1980; Loftus et al., 1978). The *alteration* hypothesis states that misleading postevent information erases or "overwrites" the representation of the original information, so that the original information is irrevocably lost from memory and the misleading information is remembered instead. The *coexistence* hypothesis holds that the original information remains in memory but is rendered inaccessible (i.e., nonretrievable) by the misleading postevent information, which is remembered instead. Finally, the *demand characteristics* hypothesis assumes that both original and misleading information are accessible in memory, but that subjects respond on the basis of the latter in order to comply with demands inherent in the experimental situation.

The alteration, coexistence, and demand hypotheses have been taken as a systematic and exhaustive listing of possible explanations for the misleading information effect obtained with the original recognition procedure. Thus, much of the recent postevent information research has been aimed at discriminating among these hypotheses, with attention focusing primarily on the alteration/coexistence contrast.

In our view, the alteration/coexistence/demand framework has been a source of some confusion in postevent information research. Hence, we have approached the study of postevent information effects from a somewhat different perspective. In this section we discuss several problems with the traditional framework, and suggest that the approach we have taken is more fruitful.

Failure to consider response biases. Implicit in the alteration/coexistence/demand framework is the assumption that misleading postevent information affects only those subjects who initially encoded the original information and, in the absence of misinformation, would have remembered this information at the time of the test. All three hypotheses focus exclusively on subjects who would have remembered the original information had they not been misled, and propose some means by which misleading information could cause these subjects to respond incorrectly on a memory test (i.e., the original information is erased or is rendered inaccessible or is passed over in favor of the misleading information as a basis for responding on the test).

The alteration/coexistence/demand formulation thus ignores effects of misleading information on subjects who, for reasons unrelated to the presentation of this information, fail to remember the original information. However, with many test procedures, including the original recognition procedure, the responses of these subjects are likely to be profoundly biased by misleading information. The failure to take these response biases into consideration has led to widespread problems in the design of experiments and the interpretation of results.

When the response biases are considered, it becomes clear that the alteration, coexistence, and demand hypotheses are not the only possible explanations for the misleading information effect obtained with the original test procedure. In fact, we have argued that the effect is largely due to just those response biases that the alteration/coexistence/demand framework fails to consider (McCloskey & Zaragoza, 1985a, 1985b).

We have approached the response bias problem by attempting to develop procedures that eliminate potential response biases. Results obtained with such procedures provide a basis for conclusions about effects of misleading postevent information on memory for the original event, because poorer misled than control performance is expected only if misleading postevent information affects memory for the original event.

Failure to consider forgetting that is not due to misleading information. The exclusive focus on subjects who would have remembered the original information had they not been misled is also the source of a more subtle problem. The three hypotheses are typically stated in terms of the status of original information in the memories of misled subjects; is the original information gone from memory (alteration), in memory but inaccessible (coexistence), or in memory and accessible (demand)? This framing of the issue tends to obscure the fact that the critical question is not, What is the status of original information in the misled subjects?, but rather, Is the status of original information different in misled subjects than in subjects who have not been misled? Even in control conditions where no misleading information is presented, some subjects will fail to remember the original information at the time of the test. Thus, the failure of some misled subjects to remember the original information says nothing about whether misleading information affects memory for original information; one must determine whether failure to remember the original information is more prevalent among misled subjects than among subjects who have not been misled. In the alteration/coexistence/demand framework, it is easy to lose sight of this fundamental point.

Premature concern with types of memory impairments. The alteration/coexistence/demand framework focuses attention on questions concerning the type of memory impairment caused by misleading postevent information. Is original information lost from memory (alteration), or is it merely rendered inaccessible (coexistence)? However, these questions are premature, because no memory impairment of any kind has been demonstrated. Thus, our studies have been designed to determine whether misleading information causes any sort of memory impairment, and not to distinguish among different types of impairments.

Composite hypotheses. Another point that has not been clear in discussions of the alteration, coexistence, and demand hypotheses is that each hypothesis is a composite of two independent assumptions, rather than a unitary claim. All three hypotheses assume not only that the misleading information in some way affects the original information, but also that the misleading information remains in memory and accessible. For example, the coexistence hypothesis assumes that original information, although rendered inaccessible by the misleading information, remains in memory and therefore coexists with the (accessible) misleading information.

The assumption that misleading information is remembered is independent of the assumptions made in the alteration, coexistence, or demand hypotheses about effects of misleading information on original information. Original and misleading information might be mutually interfering, so that both become inaccessible; or the original information might be overwritten by misleading information that cannot be retrieved; and so forth. In fact, almost any assumption about effects of misleading information on original information could be combined with almost any assumption about memory for misleading information. Thus, the assumption that original information remains in memory but becomes inaccessible does not imply that the original information therefore *coexists* with the misleading information; the claim that the misleading information is in memory (and accessible) is an independent claim. Similarly, the assumption that original information is erased by misleading information does not imply that the misleading information is remembered instead.

Failure to distinguish claims about memory for misleading information from claims about effects of misleading information on memory for original information creates confusion about the implications of empirical results. For example, several recent findings (e.g., Bekerian & Bowers, 1983; Bowers & Bekerian, 1984; Christiaansen & Ochalek, 1983) have been interpreted as support for the coexistence hypothesis on the basis of the following logic: The results show that original information is rendered inaccessible by misleading information, but is not lost from memory; therefore, original and misleading information coexist in memory. Even if the initial assertion were valid (and in our view it is not), the conclusion would not follow: The claim that the original information remains in memory in no way implies that the misleading information is also in memory.

The questions of central interest in postevent information research are those concerning effects of misleading postevent information on memory for original information. These questions are distinct from questions about memory for misleading information. Hence, in designing experiments we have focused exclusively on the former.

Inconsistent use of the term "coexistence." A final source of confusion in discussions of the alteration, coexistence, and demand hypotheses is inconsistency in the use of the term *coexistence.* Coexistence is sometimes used, as in the preceding discussion, to refer to the specific hypothesis that original information, although not erased from memory by misleading postevent information, is rendered inaccessible (e.g., Bekerian & Bowers, 1983; Christiaansen & Ochalek, 1983; Loftus et al., 1985). However, the term is also used to refer to the less specific claim that original information is not erased by misleading postevent information but instead remains in memory (e.g., Loftus, 1979a). This latter usage carries no implications about the accessibility or inaccessibility of the original information. Not surprisingly, the inconsistent usage of coexistence leads to confusion. For example, we have seen several unpublished manuscripts in which the McCloskey and Zaragoza (1985a) study is cited with the Bekerian and Bowers (1983) and Christiaansen and Ochalek (1983) studies as support for the coexistence hypothesis. However, whereas Bekerian and Bowers (1983) and Christiaansen and Ochalek (1983) concluded that misleading postevent information renders original information inaccessible, McCloskey and Zaragoza (1985a) argued that misleading information neither erases original information nor renders it inaccessible.

The alteration/coexistence/demand framework has obscured the central theoretical issues and thus has impeded attempts to understand the effects of misleading postevent information on memory for the original event. In our view the alternative approach we have outlined is potentially more fruitful. Thus, we suggest (a) that research should focus on theoretical questions about effects of misleading postevent information on memory for original information, distinguishing these questions from questions about memory for the misleading information; (b) that efforts should center initially on determining whether misleading postevent information causes any sort of memory im-

pairment, and not on testing hypotheses about specific types of memory impairments; and (c) that in designing and interpreting experiments, careful account should be taken of ways that misleading information may influence subjects' responses over and above any effects on ability to remember original information.

Conclusion

From this perspective, the current state of affairs is as follows: The results of most previous postevent information studies do not permit conclusions about effects of misleading information on memory for original information. Among other problems, previous studies uniformly failed to take into account potential biasing effects of misleading information on the responses of subjects who, for reasons unrelated to the presentation of this information, did not remember the original information.

In contrast, the recall data presented in this article and the recognition results reported by McCloskey and Zaragoza (1985a) can be brought to bear on questions about effects of misleading information on memory for the original event. Both the recognition and recall results suggest that misleading postevent information has no effect on subjects' ability to remember original information.

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(Appendix follows on next page)

Appendix

Results for Individual Critical Items

Test	Critical item			
	Magazine	Soda	Coffee	Tool
Pretest[a]				
Misled condition	21	13	21	26
Control condition	17	13	21	23
Original recognition test[b]				
Experiment 1				
Misled condition	63	33	—	—
Control condition	87	63	—	—
Experiment 2				
Misled condition	63	41	63	77
Control condition	85	52	100	93
Recall test[b]				
Experiment 1				
Misled condition	39	27	—	—
Control condition	41	24	—	—
Experiment 2				
Misled condition	61	49	54	75
Control condition	54	44	60	75

[a] Guessing rate (%).
[b] Percent correct.

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