Similarity of Encoding Context Does Not Influence Resistance to Memory Impairment Following Misinformation
Author(s): Laura L. Bowman and Maria S. Zaragoza
Source: *The American Journal of Psychology*, Vol. 102, No. 2 (Summer, 1989), pp. 249-264
Published by: University of Illinois Press
Stable URL: http://www.jstor.org/stable/1422956
Accessed: 08/12/2008 13:39



# Similarity of encoding context does not influence resistance to memory impairment following misinformation

LAURA L. BOWMAN and MARIA S. ZARAGOZA
Kent State University

Several recent studies have shown that exposure to verbal misleading post-event information does not impair subjects' ability to retrieve originally seen details. Two experiments were conducted to test the hypothesis that subjects would be more susceptible to memory impairment if the original and misleading information were presented in similar contextual formats. The results showed that misleading information did not lead to memory impairment when both original and misleading information were presented in the context of slides (Experiment 1) or when both original and misleading information were presented in the context of narratives (Experiment 2). Furthermore, resistance to memory impairment was observed both at relatively low levels of memory for the original information (Experiment 1) and at relatively high levels of memory for the original information (Experiment 2). The implications of the present results for interference principles of forgetting are discussed.

One of the oldest and most widely held views about forgetting is the notion that people forget because subsequently learned information interferes with their ability to remember originally learned information. Interest in the phenomenon of forgetting caused by subsequent learning has recently been revived in the context of research on eyewitness memory. A number of studies have shown that misleading information presented after subjects view an event can lead to profound decrements in performance on later tests of memory for the event (Bekerian & Bowers, 1983; Bowers & Bekerian, 1984; Christiaansen & Ochalek, 1983; Lotfus, 1975, 1977, 1979a, 1979b; Loftus, Miller, & Burns, 1978; Loftus & Palmer, 1974; McCloskey & Zaragoza, 1985a). Initially, the dominant interpretation of these *misinformation phenomena* was that misleading information impairs subjects' ability to remember the original information. Misleading information was thought to impair memory either by altering the original memory representation (Loftus, 1979a, 1979b; Loftus & Loftus, 1980) or by rendering the original information difficult or impossible to retrieve (Bekerian & Bowers, 1983; Christiaansen & Ochalek, 1983).

AMERICAN JOURNAL OF PSYCHOLOGY
Summer 1989, Vol. 102, No. 2, pp. 249–264

More recently, this memory impairment interpretation has been called into question on the basis that the test procedures typically used in these studies are likely to produce poorer performance in misled than in control subjects, even if the memory of misled subjects is not impaired (McCloskey & Zaragoza, 1985a, 1985b). As we discuss in greater detail in the next section, this is because misled subjects can be expected to report the misinformation more often than control subjects, even if they can remember the original event as well as control subjects who were not misled. Because of this potential confound, it cannot be determined whether the results obtained with these test procedures are in fact due to memory impairment. The results of studies employing test procedures that assess memory impairment more directly have shown that misleading information does not impair subjects' ability to retrieve original details. Evidence that misleading information does not cause memory impairment has been obtained with tests of recognition (McCloskey & Zaragoza, 1985a) as well as tests of cued recall (Zaragoza, McCloskey, & Jamis, 1987).

The absence of memory impairment following exposure to misinformation seems somewhat surprising in light of the long-established view that interference is one of the primary causes of forgetting.[1] What is not clear, however, is whether the finding that misinformation does not lead to memory impairment indicates that there are limitations to interference as a general principle of forgetting, or whether the results of these memory impairment experiments are an exception to an otherwise widespread phenomenon. The present study seeks to begin answering this question by determining whether misleading postevent information might impair memory for originally learned details under circumstances that differ from those employed in the typical misinformation study.

In the typical misinformation experiment, subjects first view a slide sequence or film clip of a witnessed event, and are subsequently provided verbal misinformation (e.g., in the context of a narrative or questions) about selected details from the original event. In this way, the laboratory situation is roughly analogous to the experience of a witness who views an event and is later exposed to leading questions about the event. It is possible, however, that the difference between the visual context in which the original information is presented and the verbal context in which the misleading information is presented may serve to reduce or eliminate potential memory-impairing effects of the misinformation by enhancing the discriminability of the original and misleading information in memory. When subjects are later asked to report what they saw in the slides, the subjects may be able to discriminate between the original and misleading information in mem-

ory on the basis of their different contextual attributes. If original and misleading information were presented in similar contexts, the resulting memory representations would have fewer attributes on which to differentiate them, and subjects might thus be less able to retrieve the originally learned details.

The foregoing predictions receive some support from the literature on list-learning studies of retroactive interference (RI). For example, several studies have shown that retroactive interference is reduced if original and interpolated learning take place in different environmental contexts such as different rooms (Bilodeau & Schlosberg, 1951; Greenspoon & Ranyard, 1957). Other studies have shown that RI can be eliminated if subjects use different strategies when encoding the original and interpolated learning, for example, by focusing on different features of the stimulus (e.g., Goggin & Martin, 1970). In general, there is a good bit of evidence to show that factors that increase list differentiation will reduce interference effects (Abra, 1972). It is, of course, not certain that the results of RI studies that employ lists of paired associates learned to some criterion will generalize to other situations. Nonetheless, the RI results suggest that if misleading information can cause memory impairment, memory impairment should be more likely to occur when the original and misleading information are encoded in similar contexts.

In the present study, we sought to determine if misleading information would impair subjects' ability to retrieve original details when some of the contextual cues that typically differentiate the original and misleading information in memory are no longer available. To this end, we conducted two experiments in which the original and misleading information were presented in the same contextual format. Both the original and misleading information were presented visually (in slide sequences) in Experiment 1, and verbally (in narratives) in Experiment 2.

**Methodological considerations**

In testing the memory impairment hypothesis, the question of interest is whether, as a result of misleading postevent information, fewer misled than control subjects are able to remember the original details. A procedure for testing the memory impairment hypothesis must not only ensure that poorer misled than control performance will obtain if misleading information does impair memory; the procedure must also ensure that performance in misled and control conditions will not differ if misleading information does not impair memory for original details. The difficulty lies in satisfying the latter requirement.

In the test procedure that has traditionally been used in misinformation studies, hereafter referred to as the *Original Test* procedure (see, e.g., Loftus et al., 1978), all subjects first view an event containing several *critical details* that they will later be tested on. For example, one critical detail might be a hammer that a thief is holding. Following the event, subjects in the misled group are exposed to misleading information about the critical detail (e.g., being told that the thief had in fact been holding a screwdriver), whereas subjects in the control group are not exposed to any information about the critical detail. When later tested on their memory for the tool they saw, subjects in both groups are asked to choose between the originally seen detail (e.g., hammer) and the item that served as misinformation for subjects in the misled group (e.g., screwdriver). The problem with this test procedure is that there are several reasons to expect poorer misled than control performance even if misleading information does not impair subjects' ability to remember what they saw.

The main difficulty involves subjects in both groups who do not remember the original information at the time they are misled (e.g., because they failed to encode it or because they have forgotten it between the initial presentation and the test). Misleading information will lead these subjects to perform more poorly than the corresponding control subjects. Whereas control subjects who do not remember the original information (and were not misled) should guess on the test and thereby select the correct alternative at chance (or 50% of the time on a two-alternative forced choice), the corresponding subjects in the misled group should select the correct alternative at a probability much lower than choice. This is because some of the misled subjects who do not remember the original information may nevertheless remember the misleading information, and will therefore systematically select the misleading alternative on the test. These subjects have no reason to distrust the misleading information because they have no memory of the original information to contradict it.

A second potential problem is that misled subjects may feel pressured to conform to the misleading suggestion provided by the experimenter even if they can remember what they saw originally (cf. Weinberg, Wadsworth, & Baron, 1983). Alternatively, misled subjects who remember both the original and misleading information may reason that the experimenter must know what was in the slides, and that the misleading information presented most recently must therefore be the correct answer. In contrast, all the control subjects who remember the original information should select the correct alternative on the test because they were never exposed to the misinformation.

For these reasons, misled subjects should perform more poorly than control subjects on the Original Test whether or not their memory has been impaired (see McCloskey & Zaragoza, 1985a, 1985b, for a more complete analysis and discussion). Thus one is unable to determine to what extent, if at all, these decrements in misled subjects' performance are due to memory impairment.

To test the memory impairment hypothesis, McCloskey and Zaragoza (1985a) developed a *Modified Test* procedure that is free from influences other than memory impairment. The Modified Test procedure is identical to the traditional procedures except that the misleading information is not provided as an alternative on the test; test questions about the original detail provide subjects with a choice between the originally seen item (e.g., hammer) and a new item (e.g., wrench). On the Modified Test, the performance of misled and control subjects will differ only if the proportion of subjects who remember the original information in each group differs. For misled subjects who remember both the original and misleading information, this test eliminates the social pressure to agree with the experimenter's suggestion. Because the misinformation is not a choice on the test, misled subjects who remember the original information will, like the corresponding subjects in the control group, select the original information on the test. Similarly, the Modified Test procedure ensures that misled subjects who do not remember the original information will, like the corresponding subjects in the control group, indicate so by guessing on the test. Whether or not they remember the misleading information, all misled subjects who do not remember the original information will have to guess because the misleading information is not an option.

If misleading information causes memory impairment, misled subjects will perform more poorly than control subjects on the Modified Test. This is because misled subjects whose memory has been impaired should perform no better than chance on this test, whereas the control subjects whose ability to remember remains intact will select the correct response on the test. On the other hand, if misleading information does not cause memory impairment, misled and control performance will not differ.

For ease of exposition, in the above discussion we have described subjects as either "remembering" or "not remembering" the original information. We do not mean to imply, however, that memory impairment is an all-or-none phenomenon. It is possible that exposure to misinformation merely reduces the "strength" or "accessibility" of the original information. It is important to note, however, that even if misinformation merely reduces the strength of original in-

formation, this will result in impaired performance on the Modified Test. To see why this is the case, consider the following argument. It can be assumed that there is a strength threshold for recognition such that strengths above the threshold are sufficient to permit a correct response on a recognition test and strengths below the threshold are not. It can also be assumed that across the experiment the initial strength of the original information is distributed along a strength continuum, such that some items fall above the recognition threshold and some items fall below. If misleading information reduces the strength of the original information, it will shift the distribution downward relative to the strength threshold. This will cause some items (though not all) to shift from above threshold to below threshold, and will therefore impair performance on the recognition test. It follows, therefore, that the Modified Test should be sensitive to possible strength-reducing effects of the misinformation.

For the above reasons, in the present study we employed the Modified Test to investigate the potentially memory-impairing effects of misleading postevent information. In addition, in each experiment we tested a second group of subjects with the Original Test typically employed in misinformation experiments; these Original Test groups were included to ensure that we could replicate the misinformation effect reported in the literature when the original and misleading information were presented in the same format. The Original Test group also served as a check that subjects were attending to and encoding the misinformation.

## EXPERIMENT 1

### METHOD

#### Subjects

Subjects were 102 undergraduates from Kent State University, who participated in the experiment in partial fulfillment of a course requirement. Of them, 60 were assigned to the Modified Test group and 42 were assigned to the Original Test group. Subjects were tested in groups of up to 12 individuals.

#### Materials

The slide sequence was the same as that used by McCloskey and Zaragoza (1985a). The series of 76 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 four critical slides, each showing one of the four critical items. For each critical slide, three different versions were used. The critical items and the three versions of each were as follows:

a coffee jar on a file cabinet (Folgers, Nescafé, Maxwell House), a magazine on a table (*Glamour, Vogue, Mademoiselle*), a soft drink can on a desk (Coke, 7up, Sunkist orange soda), and a tool lifted from a tool box (hammer, screwdriver, wrench). For each critical item, each version was presented to one third of the subjects (e.g., one third saw a hammer, one third saw a screwdriver, and one third saw a wrench).

The second slide sequence was identical to the first except for variations in the critical slides. For each subject the second sequence presented misleading information about two of the critical slides (misled condition) and no information about the other two critical slides (control condition). The assignment of critical items to misled and control conditions was counterbalanced across subjects. For example, half the subjects who had seen a jar of Maxwell House coffee in the original slide sequence were shown either a Nescafé jar or a Folgers jar in the second sequence (misled condition), and the other half saw slides that were identical to those they had originally seen, with the exception that the critical item was missing (control condition). Across subjects each version of each critical item served equally often as original and misleading information.

## Procedure

As a rationale for the presentation of the two slide sequences, subjects were told that the experiment concerned intuitions about memory. Subjects were informed that they would see two presentations of a slide sequence. The task, they were told, was to try to assess how much their memory is improved by multiple presentations of the same stimulus. Subjects were instructed to pay close attention to both presentations of the slide sequence.

Subjects then (a) viewed the first slide sequence at a presentation rate of 5 s/slide, (b) performed a 10-min unrelated filler task, (c) viewed the second slide sequence at a rate of 5 s/slide, (d) answered one question concerning their intuitions about the effects of multiple presentations on memory, and (e) completed a 12-item forced-choice recognition test. Subjects were told to answer the questions solely on the basis of their memory for the initially presented slide sequence.

All test questions were sentences with a missing word and two alternatives. For example, for the tool critical item, the test question was "The man slid the calculator beneath a ____ in his tool box." Eight of the test questions were fillers, and these were the same for all subjects. The remaining four questions consisted of one question for each of the four critical items. The four critical questions were the same for all subjects except for variations in the response alternatives. The alternatives were dictated by the test condition (Original Test or Modified Test), the version of the item that appeared in the initial slide sequence, and the version presented as misleading information in the second slide sequence. For example, for a subject in the Modified Test condition who saw a hammer in the first slide sequence and was misled with a screwdriver in the second slide sequence, the test alternatives were hammer and wrench. Across the experiment, the same test alternatives were used for both control and misled critical item questions.

Thus, the control and misled conditions differed only in whether the subject received misleading information about an item.

## RESULTS AND DISCUSSION

As expected, the results of the Original Test group replicated the misinformation effect reported in previous studies. The mean recognition test performance was significantly lower in the misled condition (55% correct) than in the control condition (87% correct). A $t$ test was performed with subjects as the random effect, and a second $t$ test was performed with items as the random effect. For the items analysis, the number of correct responses in the misled and control conditions was tabulated for each of the 12 versions of the critical items (i.e., hammer, wrench, screwdriver, Folgers, and so forth). Both analyses confirmed that the misled-control performance difference was highly reliable, $t(41) = 4.52$, and $t(11) = 5.74$, for the subjects and items analyses, respectively, $ps < .01$.

In the Modified Test group, however, the results were quite different. Mean recognition test performance in the misled condition (75% correct) did not differ significantly from performance in the control condition (68% correct). The misled-control performance difference was not significant in either the subjects analysis, $t(59) = 1.35$, $p > .1$, or the items analysis, $t(11) = 1.24$, $p > .1$.

The results of the first experiment show that presenting the original and misleading information in the same format did not impair subjects' ability to retrieve originally seen details. The results of the Original Test group suggest that the failure to find a memory impairment effect cannot be attributed to the fact that subjects did not encode the misinformation in the second slide sequence. Because subjects in the Original Test group were significantly more likely to select the misleading alternative when they had been exposed to the misinformation (misled condition) compared to when they had not (control condition), it is clear that subjects did indeed encode the misinformation.

Although our attempt to reduce the discriminability of the original and misleading information by presenting both in the context of a slide sequence did not lead to memory impairment effects, it is difficult to come to any firm conclusions on the basis of this one result. Hence, in Experiment 2 we attempted a second test of the hypothesis that misleading information would impair subjects' ability to remember original details when the original and misleading information are encoded in similar contexts. Experiment 2 was identical to Experiment 1 with the exception that subjects were given the original and mis-

leading information in the form of narratives and were later tested on their memory for the details presented in the original narrative.

## EXPERIMENT 2

### METHOD

#### Subjects

Subjects were 132 undergraduates from Kent State University, who participated in this study in partial fulfillment of a course requirement. Of them, 72 were assigned to the Modified Test group and 60 were assigned to the Original Test group.

#### Stimuli

The narrative, the same as that employed in the McCloskey and Zaragoza (1985a) study, was a detailed description (approximately 750 words) of the incident depicted in the slides employed in Experiment 1. The narrative contained the same four critical items employed in Experiment 1, and for each critical item each of the three versions was presented to one third of the subjects.

The second narrative was identical to the first except for variations in the critical items. As in Experiment 1, for each subject the second narrative presented misleading information about two of the original critical details (misled condition), and no information about the other two critical details (control condition). The assignment of critical items to misled and control conditions was counterbalanced across subjects, and across subjects each version of each critical item served equally often as original and misleading information.

#### Procedure

The procedure was identical to that of Experiment 1 with the exception that written narratives were substituted for the slides. Subjects were instructed to read the narratives at their normal reading pace. The test was also identical to that of Experiment 1.

### RESULTS AND DISCUSSION

Overall, the results of Experiment 2 replicated those of Experiment 1. In the Original Test condition, mean recognition test performance was significantly lower in the misled condition (67% correct) than in the control condition (92% correct). The misled-control performance difference was highly significant in both the subjects analysis, $t(59) = 4.65$, $p < .01$, and the items analysis, $t(11) = 4.59$, $p < .01$. These results once again replicate the misinformation effect reported in the literature.

In the Modified Test condition, however, we again found that exposure to misinformation did not impair subjects' ability to remember original details. Mean recognition test performance was 90% and 91% correct in the misled and control conditions, respectively. The misled-control performance difference was not significant in either the subjects analysis, $t(71) = .21$, $p > .1$, or the items analysis, $t(11) = 1.0$, $p > .1$.

One noteworthy feature of the results is that the level of performance on the Modified Test (90% vs. 91% correct for the misled and control conditions, respectively) is much higher than that obtained in Experiment 1 (75% vs. 68%) and in all other studies that have employed the Modified Test (McCloskey & Zaragoza, 1985a). This difference in performance level can only be attributed to the fact that in the present study the original information was presented in the context of written narratives rather than slides. Presumably, subjects are more likely to notice and remember a critical detail when presented in the context of a narrative that they read almost word-for-word than when presented as a peripheral detail embedded in a complex scene.

The failure to observe memory impairment in this study is particularly important in light of Chandler's (in press) suggestion that previous investigators have failed to obtain memory impairment effects because the levels of control performance obtained in these studies were too low. The logic behind Chandler's proposal is that with low levels of control performance there are few subjects who can remember the original information and therefore few subjects whose memories can potentially be impaired. With high levels of control performance, there are more subjects who can remember the original information and therefore more subjects whose memories can potentially be impaired. Thus, high levels of control performance offer more opportunity for memory impairment effects to be observed. The finding in Experiment 2 that misleading information did not cause memory impairment even when the level of memory for the original information was quite high strengthens the conclusion that misleading information did not affect subjects' ability to remember original details.

Collectively, the results of Experiments 1 and 2 suggest that the failure to observe memory impairment effects in the typical misinformation experiment cannot be attributed to the fact that the original and misleading information are encoded in distinct contexts. When the original and misleading information were presented in identical formats, there was no evidence of memory impairment caused by the misinformation.

## GENERAL DISCUSSION

The present research extends the known conditions under which misleading postevent information does not impair subjects' ability to remember original details. More specifically, the results of the present study suggest that resistance to memory impairment is not limited to situations in which the original and misleading information can be easily differentiated on the basis of contextual cues. There was no evidence of memory impairment caused by the misinformation when both original and misleading information were presented in the context of slides (Exp. 1) and when both original and misleading information were presented in the context of narratives (Exp. 2). Furthermore, resistance to memory impairment was observed at relatively low levels of memory for the original information (Exp. 1) and at relatively high levels of memory for the original information (Exp. 2).

Although there was considerable contextual overlap between the original and misleading information in the present experiments, the present results cannot rule out the possibility that subjects were able to differentiate the original and misleading information on the basis of more subtle cues such as temporal cues. In both studies the presentation of the original and misleading information was separated by a 10-min filler task whose purpose was to minimize inattentiveness during the second presentation of the slides and narrative. However, the filler task may have enhanced the temporal distinctiveness of the original and misleading information in memory. Thus it is possible that misinformation did not interfere with subjects' ability to retrieve original details because subjects were able to differentiate between the original and postevent information on the basis of temporal cues. Nonetheless, the contextual overlap of the original and misleading information in the present study differs dramatically from that of previous studies where the original information is presented visually and the misleading information is presented verbally. Hence, if resistance to memory impairment were a function of the distinctiveness of the original and misleading information in memory, we should have observed at least a tendency toward impaired misled performance in the present experiments. In fact, there was no evidence of such a trend.

An alternative explanation of the present results might be that the Modified Test is not a sensitive enough measure of memory impairment. According to this argument, the failure to observe memory impairment effects is not due to the fact that memory has not been impaired, but rather to the insensitivity of the test to small memory-

impairing effects of the misinformation. In considering this possibility, it is important to note that at least one study has obtained evidence of memory impairment with the Modified Test. In two experiments, Ceci, Ross, and Toglia (1987) found a significant memory-impairment effect in children 3 to 4 years of age when the Modified Test was used. Thus, although it is possible that other, more sensitive tests of memory impairment might be constructed, it is not the case that the Modified Test is insensitive to memory impairment effects.

It might also be suggested that our failure to find evidence of memory impairment with the Modified Test is not surprising in light of the well-known finding in list-learning studies of RI that retroactive interference effects are difficult to observe on tests of recognition, especially when the interpolated-learning responses are not included as alternatives on the recognition test (Anderson & Watts, 1971; Myrow & Anderson, 1972; Postman & Stark, 1969). Nevertheless, it is not the case that RI effects cannot be obtained with recognition testing. When acquisition of the lists is by a recall procedure and retention is tested by recognition (i.e., associative matching), some RI is typically found (e.g., Dalprato, 1971; Garskof, 1968). Furthermore, substantial RI effects on recognition tests have been obtained with the A-B, A-Br procedure. This is a procedure where the A and B terms from the first list are re-paired in the second list (Postman & Stark, 1969).

In attempting to reconcile the results of the present study with the literature on list-learning studies of RI, it is important to recognize the distinction between *retroactive interference* and *memory impairment.* Retroactive interference is a general term which refers to decrements in performance on a memory test following interpolated learning. Memory impairment, on the other hand, refers to the specific case where decrements in performance arise because the original information is no longer accessible as a consequence of the interpolated learning (i.e., the misinformation). Hence, it is possible to have retroactive interference effects that are not attributable to memory impairment. As a case in point, the misinformation effects observed with the Original Test procedure have demonstrated that subjects are likely to report the misinformation whether or not their ability to remember the original information is impaired. One important remaining question is whether the RI effects observed in the traditional list-learning studies are due to memory impairment, or whether these decrements in performance can be attributed to other causes.

There are several studies in the RI literature that suggest that some RI effects are the result of memory impairment caused by interpolated learning. One example is the classic study by Melton and Irwin (1940).

The basic finding in that study (as in many other studies) was that RI, or the inability to recall first-list responses, increases as a function of the number of trials on the interpolated list. The Melton and Irwin study is critical in that they recorded how many of subjects' failures to recall the original-list responses were due to the fact that they were reporting second-list responses. This is important because the finding that subjects report second-list responses when incorrect is inconclusive with regard to the memory impairment issue. It is possible, for example, that some subjects who report second-list responses can also remember the original-list responses but have chosen to report the latter on the test. Although the finding that subjects report second-list responses does not prove that their ability to remember the original list is not impaired, the opposite finding—that subjects report something other than the second-list responses when in error—shows that their ability to remember the original list is in fact impaired. Melton and Irwin's results support the view that interpolated learning leads to memory impairment. They showed that although subjects' ability to recall first-list responses decreased with increasing number of trials on the interpolated list, the number of errors attributable to second-list responses actually decreased with number of trials on the interfering list.

Using the Modified-Modified Free Recall Test (MMFR), Barnes and Underwood (1959) also showed that interpolated learning reduces subjects' ability to recall first-list responses. In the MMFR, subjects are instructed to recall the responses from both the first and second lists. By providing subjects the opportunity to report everything they can remember, the MMFR ensures that subjects will report the first-list responses if they are still accessible. Barnes and Underwood found that subjects' ability to recall first-list responses decreased with increasing trials on the interpolated list, thus showing that the interpolated learning had impaired subjects' ability to remember the original list.

In summary, the present state of affairs appears to be as follows: Among list-learning studies of RI there is evidence that subsequently learned information can impair subjects' ability to retrieve original information, but among misinformation studies conducted with adults there is no evidence of memory impairment caused by subsequent presentation of the misleading information. Although the RI studies that show clear evidence of memory impairment employed recall tests and the present study employed recognition, it is important to keep in mind that at least one previous misinformation study has failed to find evidence of memory impairment on tests of recall (Zaragoza,

McCloskey, & Jamis, 1987). The differences between the procedures employed in the list-learning and misinformation studies are too numerous to be able to assess which factors mediate memory impairment caused by subsequent learning. Nevertheless, an answer to this question remains a critically important issue for future research. Given the well-established finding that RI increases with increases in interpolated learning (see Keppel, 1968; Postman & Underwood, 1973, for reviews), one promising hypothesis is the possibility that memory impairment occurs with repeated presentations of the subsequent (i.e., misleading) information only. Although McCloskey and Zaragoza (1985a) report that presenting the misleading information twice did not lead to memory impairment, no studies have employed multiple presentations of the misleading information.

The results of the present study raise the possibility that memory impairment caused by subsequent learning may not be as widespread as is commonly believed. Studies of the effects of misleading postevent information represent an important case where interpolated learning does not lead to impaired memory. Although the precise source of this resistance to memory impairment remains to be identified, it may well be that memory impairment caused by subsequent learning occurs under restricted circumstances only.

## Notes

This research is based on a master's thesis submitted by Laura L. Bowman to Kent State University. Preparation of this article was supported in part by NIMH Grant MH43581.

Correspondence concerning this article should be addressed to Maria S. Zaragoza, Department of Psychology, Kent State University, Kent, OH 44242. Received for publication October 27, 1987; revision received June 17, 1988.

1. When we say that a subject has forgotten, or cannot remember, some piece of information, we mean that under the conditions of the test the subject cannot access the information in memory. It is not important for our purposes whether the information that cannot be accessed is not available in the memory store, or is in memory but cannot be retrieved. Similarly, when we say that a subject remembers some piece of information, we mean that under the conditions of the test the subject can access the information in memory.

## References

Abra, J. C. (1972). List differentiation and forgetting. In C. P. Duncan, L. Sechrest, & A. W. Melton (Eds.), *Human memory: Festschrift in honor of Benton J. Underwood.* New York: Appleton-Century-Crofts.

Anderson, R. C., & Watts, G. H. (1971). Response competition in the for-

getting of paired-associates. *Journal of Verbal Learning and Verbal Behavior, 10,* 29–34.

Barnes, J. M., & Underwood, B. J. (1959). Fate of first-list associations in transfer theory. *Journal of Experimental Psychology, 58,* 97–105.

Bekerian, D. A., & Bowers, J. M. (1983). Eyewitness testimony: Were we misled? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 9,* 139–145.

Bilodeau, I. M., & Schlosberg, H. (1951). Similarity in stimulating conditions as a variable in retroactive inhibition. *Journal of Experimental Psychology, 41,* 199–204.

Bowers, J. M., & Bekerian, D. A. (1984). When will postevent information distort eyewitness testimony? *Journal of Applied Psychology, 69,* 466–472.

Ceci, S. J., Ross, D. F., & Toglia, M. P. (1987). Suggestibility of children's memory: Psycholegal implications. *Journal of Experimental Psychology: General, 116,* 38–49.

Chandler, C. (in press). Specific retroactive interference in modified recognition tests: Evidence for unknown cause of interference. *Journal of Experimental Psychology: Learning, Memory, and Cognition.*

Christiaansen, R. E., & Ochalek, K. (1983). Editing misleading information from memory: Evidence for the coexistence of original and postevent information. *Memory & Cognition, 11,* 467–475.

Delprato, D. J. (1971). Specific-pair interference on recall and associative matching retention tests. *American Journal of Psychology, 84,* 185–193.

Garskof, B. E. (1968). Unlearning as a function of degree of interpolated learning and method of testing in the A-B, A-C, and A-B, C-D paradigms. *Journal of Experimental Psychology, 76,* 579–583.

Goggin, J., & Martin, E. (1970). Forced stimulus encoding and retroactive interference. *Journal of Experimental Psychology, 84,* 131–136.

Greenspoon, J., & Ranyard, R. (1957). Stimulus conditions and retroactive inhibition. *Journal of Experimental Psychology, 53,* 55–59.

Keppel, G. (1968). Retroactive and proactive inhibition. In T. R. Dixon & D. L. Horton (Eds.), *Verbal behavior and general behavior theory* (pp. 172–213). Englewood Cliffs, NJ: Prentice-Hall.

Loftus, E. F. (1975). Leading questions and the eyewitness report. *Cognitive Psychology, 7,* 560–572.

Lotfus, E. F. (1977). Shifting human color memory. *Memory & Cognition, 5,* 696–699.

Loftus, E. F. (1979a). *Eyewitness testimony.* Cambridge, MA: Harvard University Press.

Loftus, E. F. (1979b). The malleability of memory. *American Scientist, 67,* 312–320.

Loftus, E. F., & Loftus, G. R. (1980). On the permanence of stored information in the human brain. *American Psychologist, 35,* 409–420.

Loftus, E. F., Miller, D. G., & Burns, H. J. (1978). Semantic integration of verbal information into a visual memory. *Journal of Experimental Psychology: Human Learning and Memory, 4,* 19–31.

Loftus, E. F., & Palmer, J. E. (1974). Reconstruction of automobile destruc-

tion: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior, 13*, 585–589.

McCloskey, M., & Zaragoza, M. (1985a). Misleading postevent information and memory for events: Arguments and evidence against memory impairment hypotheses. *Journal of Experimental Psychology: General, 114*, 3–18.

McCloskey, M., & Zaragoza, M. (1985b). Postevent information and memory: Reply to Loftus, Schooler, and Wagenaar. *Journal of Experimental Psychology: General, 114*, 381–387.

Melton, A. W., & Irwin, J. McQ. (1940). The influence of degree of interpolated learning on retroactive inhibition and the overt transfer of specific responses. *American Journal of Psychology, 53*, 173–203.

Myrow, D. L., & Anderson, R. C. (1972). Retroactive inhibition of prose as a function of the type of test. *Journal of Educational Psychology, 63*, 303–308.

Postman, L., & Stark, K. (1969). Role of response availability in transfer and interference. *Journal of Experimental Psychology, 79*, 168–177.

Postman, L., & Underwood, B. J. (1973). Critical issues in interference theory. *Memory & Cognition, 1*, 19–40.

Weinberg, H., Wadsworth, J., & Baron, R. S. (1983). Demand and the impact of the leading questions on eyewitness testimony. *Memory & Cognition, 11*, 101–104.

Zaragoza, M. S., McCloskey, M., & Jamis, M. (1987). Misleading postevent information and recall of the original event: Further evidence against the memory impairment hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13*, 36–44.