

The Fate of Memory: Comment on McCloskey and Zaragoza

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McCloskey and Zaragoza (1985) argue that misleading postevent suggestions do not affect the availability of originally encoded information. Their hypothesis stems from empirical work using a modified paradigm in which no effect of postevent information is observed. Although their "no impairment" hypothesis is plausible, careful consideration of the predictions of their experimental test suggests that it may be insufficiently sensitive to reveal the impact of postevent information. A small effect of postevent information can be observed when their paradigm is repeated with a more sensitive recognition test. McCloskey and Zaragoza's no impairment hypothesis is also difficult to reconcile with numerous reports of "blend" memories that reflect a compromise between the original and postevent information.

Information presented after an event can change a person's report of that event. When the new information is misleading it can produce errors in that report. Stop signs are recalled as yield signs, and hammers are recalled as screwdrivers. We refer to this as the *misinformation effect*. In numerous laboratories, this effect has been obtained, and there seems to be little doubt that erroneous reporting is easy to induce.

There is a question, however, about the fate of the memory underlying the report. Before discussing this question, it is important to emphasize that the terms *memory* or *memory representation* or *original memory* are used to refer to stored traces in the mind, whereas the terms *report* or *memory report* refer to observed performance. The dispute about the misinformation effect concerns its implications, if any, for memory representations.

When postevent information is encountered, does it alter the original memory that

was stored? Or, do separate memories corresponding to the original and the postevent information coexist? Prior to McCloskey and Zaragoza two general alternatives had been proffered to describe the underlying memory representation after postevent information is encountered: (a) destructive updating, the hypothesis that the previously stored memory is updated by the postevent information; and (b) coexistence, the hypothesis that the older memory survives but is rendered inaccessible through a mechanism of inhibition or suppression (see Bekerian & Bowers, 1983, Christiaansen & Oohalek, 1983, and Loftus & Loftus, 1980, for a more detailed discussion). Although these two interpretations differ with regard to the ultimate fate of the original memory, they share the assumption that the original memory is somehow affected by postevent information.

In their recent article, McCloskey and Zaragoza (1985) provide a different interpretation of the impact of postevent information. They argue that its influence is limited to those subjects who either do not recall the original information, or else, students who encode both sources of information but select the postevent information because they trust the experimenter's memory more than their own. McCloskey and Zaragoza's interpretation is a dramatic departure from previous considerations of the representation of postevent information because it rejects the assumption

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that postevent information affects the original trace at all. To test this hypothesis, McCloskey and Zaragoza developed a modification in procedure that differs in one fundamental way from previous examinations of the misinformation effect. The traditional paradigm involved showing subjects an event, providing them with misinformation about a detail, and then later giving them a recognition test containing both the original and suggested items. Subjects in studies using this paradigm frequently select the suggested item. McCloskey and Zaragoza's modified paradigm differs in one respect; their final test includes the original item and a never-seen, never-mentioned distractor. According to McCloskey and Zaragoza, if postevent information does not affect the original trace, then eliminating the suggested item from the recognition test should eliminate the misinformation effect. In fact, using this modified paradigm, they observe no effect of postevent information and consequently conclude that the original trace is unaltered by exposure to postevent suggestions.

At the heart of McCloskey and Zaragoza's work is the complaint that the usual testing procedure, where the suggested item is included on the test, is inappropriate for assessing the effects of misleading information on memory. In the first section of this comment, we argue that the usual testing procedure is quite appropriate for answering certain kinds of questions about the misinformation effect. We appreciate that the modified testing procedure could be better suited to answer other kinds of questions; however, it too has limitations, which we will discuss in subsequent sections. One problem with the modified test is that it is not sufficiently sensitive to detect small impairments in memory. Moreover, there is a problem with the test as applied to the specific critical items in the McCloskey and Zaragoza research; namely, their test does not allow for the possibility of *memory blends*, by which we mean memory representations that simultaneously contain features from both the original and postevent sources.

The Original and Modified Tests

Consider a case in which subjects first saw a series of slides including a man with a

hammer. Later subjects received either misleading information about a screwdriver or neutral information about a tool. How shall we now test these subjects to assess the impact of postevent information? If we wanted to know whether misled subjects would adopt the suggestion and choose it on a recognition test, it would be perfectly appropriate to give subjects a choice between the original and the suggested item. Using this procedure, we and others have discovered many interesting facts about the conditions under which subjects' reports are influenced by postevent information.

But suppose we were interested in whether the misleading information impaired memory. In this case, McCloskey and Zaragoza may be right that the presence of the suggested item on the test and the choice by subjects of that item cannot be easily interpreted. Subjects could be choosing the item not because their memory was impaired but because of demand characteristics. Or they could be choosing the item because they failed to encode the original information and the misleading information supplemented their memory. Or, finally, they could be choosing the item because their memory was altered by the misleading information. We have recognized these possibilities before (Loftus, Miller, & Burns, 1978). We have also used a variety of techniques to attempt to disentangle the various interpretations. In one study designed explicitly to identify those who were responding only to demand characteristics, we concluded that only 12% of misled subjects could be clearly characterized in this way (Loftus, Miller, & Burns, 1978, Experiment 2). In related work involving hypnosis (Sheehan, Grigg, & McCann, 1984; Sheehan & Tilden, 1984), where the demand pressures can be thought to work in favor of reporting the original information, many subjects do not do so.

We have also shown that people are affected by misinformation even when it can be presumed that they would have otherwise spontaneously recalled the original information. Thus it can be presumed that they did in fact encode the original information, but were affected by the misinformation anyway (Loftus, Miller, & Burns, 1978). These empirical observations, among others (e.g., Wagenaar & Boer, 1984), have contributed to our

conclusion that misinformation can impair memory.

If the presence of the suggested item as a response possibility leads to problems in interpreting performance, does the absence of the suggested item solve those problems? Certainly if subjects cannot choose the suggested item, then they cannot respond to that particular demand characteristic. This is one apparent benefit of the modified test. However, there are limitations to the modified test, at least as McCloskey and Zaragoza used it; a major limitation is that it is not sufficiently sensitive to detect small impairments in memory.

A More Sensitive Test

The test used by McCloskey and Zaragoza was a two-alternative forced-choice test. Because their test only offered two alternatives, a large proportion of subjects may have been correct simply by guessing. By reducing the influence of guessing we can create a more sensitive test of the impact of postevent information.

An example of a more sensitive test is a multiple choice "betting form" recognition test. In the betting form test, a subject distributes probability points among, say, four alternatives. For example, if a subject was reasonably confident of seeing a hammer, then on the betting form he or she might assign 70 probability points to hammer and 10 points each to wrench, screwdriver, and crowbar. On the other hand, if the subject were simply guessing, the response might be 25, 25, 25, 25.

In other domains, betting form tests have been shown to be more sensitive to a test taker's knowledge of an answer and his or her certainty in that knowledge (Michael, 1968). The betting form test has two advantages over the simple two-alternative forced-choice test used by McCloskey and Zaragoza. First, because it allows subjects to weight their response according to how confident they are, it discriminates between subjects who are guessing and those who truly believe they are correct. Second, by offering subjects more than two alternatives, it reduces the number of subjects who make a correct response simply by guessing. As a result, the betting form procedure is better able to iden-

tify subjects who truly recall the original information and, consequently, to evaluate whether subjects' memories have been impaired by postevent information.

Using a replication of McCloskey and Zaragoza's procedure with one change, namely the betting form test, Benzing (1985) showed that subjects are influenced by misinformation. In both the original and modified paradigms, subjects who received postevent information performed poorer than subjects who did not. Thus, misinformation appears to impair performance, in contrast to McCloskey and Zaragoza's failure to observe such impairment.

In one respect, however, Benzing's results support McCloskey and Zaragoza's interpretation. The betting form modified test, overall, produced a substantially smaller misinformation effect than that observed using the original testing procedure. This difference indicates that under original testing circumstances, a substantial proportion of the misinformation effect may be attributed to subjects who, not having encoded the original information, are simply biased toward the suggested item. However, not all of the misinformation effect is due to subjects who were simply biased.

Memory Blends

Another potential problem with McCloskey and Zaragoza's procedure is that their test forces subjects to choose between alternatives that may inadequately represent their actual memories. Consider a subject who saw a hammer and received misinformation about a screwdriver. Suppose that the misinformation produced a slight alteration in memory, resulting in a memory representation that contained features of hammer and screwdriver. The test between hammer and wrench does not permit the expression of subtle or minor changes that could have occurred in the memory traces. That is, the McCloskey and Zaragoza test may be forcing subjects to discriminate between two objects, neither of which matches what they have in memory. Given the opportunity, subjects may be quite willing to show that they had blended information from the two sources into a compromise memory. If a "hammerwrench" existed in the real world and were an option on the

test, perhaps subjects would choose it.¹ In order to determine whether subjects truly have intact the original pristine memory representation, it is necessary to provide subjects with the opportunity to indicate the existence of blend memories and observe that they reject the blend in favor of the original.

A study by Weinberg, Wadsworth, and Baron (1983) bears on this issue. These investigators used a testing procedure similar to McCloskey and Zaragoza's, but obtained a different result. Subjects in Weinberg et al.'s study viewed a sequence of slides, including a car at a yellow yield sign. Next some subjects received misleading information about a stop sign. Finally subjects were tested in one of two ways. The original testing procedure involved a choice between a yellow yield sign and a stop sign. The modified testing procedure involved a choice between a yellow yield sign and a red yield sign. Contrary to the findings of McCloskey and Zaragoza, subjects in the Weinberg et al. study performed poorer in the misled condition than the control condition, even when the modified test was used.

McCloskey and Zaragoza attribute this difference to an "unfortunate choice of items coupled with a failure to counterbalance" (p. 8). They argue that faced with a yellow and red yield sign, many subjects will choose the alternative most similar to a stop sign, namely the red yield sign. In short, the misleading stop sign information creates a bias toward the selection of the incorrect alternative on the test.

Did Weinberg et al. make an unfortunate choice of items? On the contrary, we think their selection was absolutely fortunate. The red yield sign, in one sense, contains features of both the original information (the shape of the yield sign) and the misleading postevent information (the color of the stop sign). Thus, it embodies a compromise between the two sources of information. Its inclusion as a test alternative permits some subjects to show that their memory reflects features of both the original and postevent information.

Further research is necessary to determine to what extent blends are an appropriate way of representing discrete memory changes. (i.e., when one type of object is transformed into another). However, substantial evidence in-

dicates that postevent suggestions pertaining to continuous features (e.g., color or size of an object) produce altered memories that represent a compromise between the original and postevent sources (Bornstein, 1976; Christiaansen, Sweeney, & Ochalek, 1983; Daniel, 1972; Loftus, 1977). Compromise memories are especially common when critical details concern the colors of objects. In several experiments, subjects have received misleading information about the color of certain key objects (Loftus, 1977). In these studies, subjects saw a series of color slides depicting an automobile and a pedestrian. In the series a green car drives past the accident but does not stop. Some time after viewing the slides of the accident, some of the subjects were exposed to the information that the car that had passed the accident was blue. Finally, the subjects were shown a color wheel containing 30 color strips and were given a list of objects that had appeared in the slides. Among other colors, the wheel contained some green strips, some blue ones, and some that were an intermediate bluish green. The task was to pick the color that best represented the subjects' recollection of each of the objects.

These studies showed that subjects given the blue information tended to pick a blue or bluish green as the color that represented their recollection of the car that passed the accident. Some of these subjects picked a solid blue, whereas others picked a bluish green, indicating greater or lesser influence of the misleading information. The choice of bluish green and simultaneous rejection of the true green indicates that subjects have some elements of the original information in memory but have been shifted toward a bluer color by the postevent suggestion.

In sum, studies have shown that subjects will choose a response that reflects a blend of original and postevent information. McCloskey and Zaragoza's subjects were not given the opportunity to do this. Do blend

¹ While writing this reply, we came across a reference to a screwrench—part screwdriver, part wrench—which a writer for the *New York Times* claimed to use to make adjustments in her chain saw (Hubbell, 1984). If she had been shown a screwdriver and misled with a wrench, what object would she claim to have seen?

responses necessarily demonstrate that the original trace has been altered? Not quite. It is possible that blend memories simply represent, as McCloskey and Zaragoza suggest, a calculated compromise on the part of subjects. During the test, subjects could specifically recall both sources of information and intentionally generate a blend to accommodate this conflicting information. Blends, they would argue, simply reflect the demand characteristics of the experiment.

It is the strong conviction with which subjects maintain blend memories that have convinced us that these are not the product of demand characteristics. Similarly, in less controversial work, Treisman and her colleagues (e.g., Treisman & Gelade, 1980; Treisman & Schmidt, 1982) have been impressed with the convictions people have when they combine features from different sources into the perception of single illusory conjunctions. For example, when a red *T* and a green *P* are shown, some subjects report with great conviction that they saw a green *T*. Although it is difficult for Treisman or anyone to demonstrate that these integrations reflect a single trace, the subjective experience is of a single percept.

Final Remarks

Ultimately, the current debate regarding the most appropriate way to conceptualize the fate of postevent information requires addressing some critical questions about the nature of memory representation. It is currently impossible to get inside subjects' heads and see how their memories are actually represented. Instead we must rely on indirect inferences based on subjects' reports of what they recall. Unfortunately, what subjects claim to experience may not actually represent the true nature of their memories. Demand characteristics, interference, and other phenomena may disassociate the subjects from their true memories. Fundamental problems in discerning the nature of memory representation are not limited to the issue of postevent information; the representation of imagery, semantic information, short-term versus long-term memory, and episodic memory have all caused heated debates about the most appropriate representation. In some cases progress

has been made; however, all too often the fundamental disagreements remain unresolved. Often, these differences, as important as they may seem, simply do not generate distinct empirical predictions (e.g., Anderson, 1978).

At some level the same is true for the representation of postevent information; even if we demonstrate that subjects truly believe that their altered memories represent what they originally saw, we can never know whether somewhere in the recesses of their mind lies an inaccessible unadulterated trace (Loftus & Loftus, 1980; Loftus, Miller, & Burns, 1978). Similarly, it may be impossible to determine whether all of the components of a blend memory are stored together or whether they are simply retrieved simultaneously and then combined into a single integrated response.

Rather than trying to make inferences about representational issues that may be unanswerable, researchers may more profitably focus their attention on myriad issues that better lend themselves to empirical inquiry. Numerous studies have demonstrated that subjects report integration of information from various sources (e.g., Bransford & Franks, 1971; Loftus, 1977; Loftus, Miller, & Burns, 1978). Because these integrations appear to be what subjects honestly claim to recall, in a real sense they are more relevant than some elusive trace that is neither consciously experienced by the subject nor accessible to the researcher. Instead of trying to discern whether these integrations represent the true nature of subjects' memories, it may be more valuable to ask, "Given these subjective experiences, when do they occur, what forms do they take, and how do they change over time?"

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