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Misleading Postevent Information and the Memory Impairment Hypothesis: Comment on Belli and Reply to Tversky and Tuchin

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Belli and Tversky and Tuchin used a "Yes"/"No" recognition procedure to explore effects of misleading postevent information on memory for events. We examine the data and arguments presented in these studies, concluding that neither study demonstrates that misleading postevent information impairs memory for the original event.

Belli (1989) and Tversky and Tuchin (1989) present new evidence and arguments bearing on the hypothesis that memory for an event may be impaired by misleading postevent information. In both articles the authors report data from a "Yes"/"No" recognition procedure not previously used in postevent information research, and they also offer reevaluations of earlier findings. We weigh the implications of the studies for the memory impairment hypothesis, making three major points.

First, neither study demonstrated that misleading postevent information impairs memory for the original event. This point is freely acknowledged by Belli (1989). Tversky and Tuchin (1989), however, claim that their findings provide evidence of memory impairment. Second, neither article offers an entirely adequate account of the results that we have presented as evidence against the memory impairment hypothesis (McCloskey & Zaragoza, 1985a; Zaragoza, McCloskey, & Jamis, 1987). Third, although it may appear (especially from each article's discussion of the other) that the two studies are consistent with respect to rationale, results, and conclusions, there are in fact significant differences between the studies along each of these dimensions. We conclude with an assessment of the current status of the memory impairment hypothesis, arguing that memory-impairing effects of misleading postevent information have yet to be demonstrated.

Belli's (1989) Study

The "Yes"/"No" Recognition Procedure

In Belli's (1989) experiments, subjects first viewed a sequence of slides depicting an event that included several critical details (e.g., a Coke can on a desk). The subjects subsequently read a narrative that included either misleading information (misled condition) or neutral information (control condition) about the critical details. For example, in the misled condition the narrative described the can as a 7-Up can, whereas in the control condition the narrative referred only to a soft-drink can.[1]

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The subjects were then given a "Yes"/"No" recognition test in which they were asked to indicate whether particular items appeared in the slide sequence. For critical details, the test item was either the item from the original event (i.e., Coke) or a new item (e.g., Sunkist) that did not appear in the slides and was not presented to misled subjects as misleading postevent information. Belli refers to the originally seen and new items as the *event* and *novel* items, respectively.

Interpreting the Results

Belli (1989) recognized that one could not assess potential memory-impairing effects of misleading information simply by comparing misled and control condition performances for the event item (Coke). He argued that fewer "Yes" responses to the event item in the misled condition than in the control condition would not imply that the misleading postevent information impaired subjects' ability to remember what they originally saw, because several other factors could also lead to poorer misled than control performance.

Misinformation acceptance. In the first place, Belli (1989) pointed out, misleading information may bias the responses of subjects who, for reasons unrelated to the presentation of misinformation, fail to remember the event item. In the control condition the subjects who do not remember the Coke can will have to guess when asked whether a Coke can appeared in the slides and with some probability will guess the correct answer, "Yes."

The situation is somewhat different for misled subjects who fail to remember the event item. Some of these subjects may also fail to remember the misleading information (7-Up), and these subjects will guess "Yes" with the same probability as the control subjects who do not remember the event item.

[1] Throughout this article we use Coke as an example of a critical item that subjects saw in the slide sequence, 7-Up as an example of misleading postevent information, and Sunkist as an example of a novel item that was neither shown in the slides nor presented as misleading postevent information. In the experiments that we discuss, counterbalancing ensured that some subjects saw a Coke can in the slides, others saw a 7-Up can, and still others saw a Sunkist can. Assignment of the three soft drinks to the postevent and novel item roles was similarly counterbalanced.

However, misled subjects who do not remember the event item (Coke) but do remember the misleading information (7-Up) may be less likely to respond "Yes" to the event item. To the extent that a misled subject accepts the misinformation and therefore believes that the can on the desk was a 7-Up can, the subject will presumably be biased away from a "Yes" response to the event item, Coke. Belli (1989) refers to the biasing effects of misinformation on subjects who do not remember the originally seen detail as *misinformation acceptance.*

If misleading information does in fact decrease the likelihood of a "Yes" response to the event item among misled subjects who do not remember this item, then the misled condition will show poorer performance (i.e., fewer "Yes" responses) than the control condition on the event item test, even if the proportion of subjects who remember the event item is the same in both conditions—that is, even if misleading postevent information has no effect on subjects' ability to remember what they originally saw.

The biasing effects of the misleading information need not be all-or-none. Subjects' responses may be affected even if they are not entirely convinced by the misinformation that the event item did not appear in the slides. For example, consider a subject who does not remember the Coke can and is then asked whether a Coke can was shown in the slides. If the subject has not received misleading information, he or she might decide that it was reasonably likely that a Coke can was present and hence might respond "Yes" with a probability of, say, .4. On the other hand, if the subject has been misled and remembers the misleading information (7-Up), he or she might decide that whereas the presence of a Coke can in the slides is possible (on grounds that there could conceivably have been both a Coke can and a 7-Up can on the desk), it is not very likely. As a result, his or her probability of responding "Yes" to the event item might be reduced to, say, .2.

Also, one need not assume that every misled subject who fails to remember the event item will respond "No" on the event item test. As long as the misinformation creates some bias away from a "Yes" response to the event item in some misled subjects who do not remember this item, poorer misled than control performance is expected even if the misinformation has no memory-impairing effect.

Correcting for effects of misinformation acceptance. Belli (1989) devised a clever means of correcting for potential misinformation acceptance. He reasoned that if misled subjects who did not remember the event item (Coke) were biased against responding "Yes" to this item, they should be biased to the same extent against responding "Yes" to the novel item (Sunkist). After all, for a subject who does not remember the event item, there is no distinction between this item and the novel item: Both are items that the subject does not remember encountering.

Although the misleading information will bias subjects away from "Yes" responses for both the event item and the novel item, the effect is to decrease performance in the case of the event item (for which "Yes" is the correct response) but to improve performance in the case of the novel item (for which the correct response is "No"). Therefore, Belli (1989) reasoned, collapsing performance over event and novel items should correct for the effects of misinformation acceptance on the event item test because the increased performance on the novel item should exactly compensate for the decreased performance on the event item.

Thus if poorer misled than control performance is found when results are collapsed over event and novel item tests, the difference cannot be attributed to effects of misleading information on subjects who failed to remember the event item for reasons unrelated to presentation of misleading information. Rather, the difference would imply that misinformation led to incorrect responses in some subjects who initially encoded and remembered the event item and would therefore have responded correctly had they not been misled.

Belli's findings. In the second of his two experiments, Belli (1989) did in fact find poorer misled than control performance when results were collapsed over event and novel item tests: Performance was 66% correct in the control condition and 60% correct in the misled condition. (In the first experiment, low overall performance levels suggested that few subjects in either condition remembered the event items. Hence the experiment provided little opportunity to detect effects of misinformation on subjects who initially encoded and remembered event items).

Although the misled/control difference in Experiment 2 implies an effect of misleading information on subjects who initially remembered the event item, the effect need not be one of memory impairment. As Belli (1989) acknowledges, another potential effect of misleading information could instead be responsible for the effect.

Source misattribution. Specifically, misleading information may lead to confusion about the sources from which the event and postevent items were obtained, without affecting subjects' ability to remember the event item; that is, because of presentation of misinformation, some misled subjects who remember Coke may nevertheless be unsure whether Coke or 7-Up appeared in the slides. The confusion about source could cause these subjects to be less likely to respond "Yes" on the event item test than control subjects who remember Coke but are not confused about its source. The result would be poorer misled than control performance, even if the proportion of subjects who remembered the event item was the same in the misled and the control conditions.

Belli (1989) uses the term *memory interference* to refer jointly to memory impairment and source misattribution. He argues that the finding of poorer misled than control performance (for results collapsed over event and novel item tests) provides evidence of memory interference. In other words, he argues that the result reflects memory impairment, or source misattribution, or both. Belli acknowledges, however, that because his procedure cannot discriminate between memory impairment and source misattribution, the finding does not offer clear evidence of memory impairment.

Deliberation. One other potential effect of misleading information on subjects who remember the event item also merits discussion. Even if misleading information does not affect subjects' ability to remember event items and their source, the misinformation might nevertheless shake some subjects' confidence in the correctness of their recollections of the event item and might therefore decrease their likelihood

of responding "Yes" on the event item test. For example, a subject might reason as follows: "I thought I saw a Coke can on the desk, but the paragraph said it was a 7-Up can. The paragraph is probably right, so I guess maybe I was wrong and it was a 7-Up can." Once again, subjects need not be entirely convinced that their recollections of the event item are incorrect. Merely by decreasing a subject's confidence, the misleading information may decrease his or her likelihood of responding "Yes" to the event item.

Belli (1989) considers and rejects this interpretation, which he refers to as the *deliberation hypothesis.* In arguing against the hypothesis, Belli compares the "Yes"/"No" test to the two-alternative forced-choice test used by Loftus and her colleagues (e.g., Loftus, Miller, & Burns, 1978), in which the test alternatives are the event item (Coke) and the postevent item (7-Up). Belli notes that the Loftus forced-choice test may incline deliberating subjects toward a decision that the misleading item and not the event item appeared in the slides because the misleading item is one of the test alternatives. However, he notes, on the "Yes"/"No" test, the misleading item is not a response alternative; hence the "Yes"/"No" test does not promote the misleading item as a potential correct response.

We agree with Belli (1989) that the event item is probably less likely to be rejected through deliberation on the "Yes"/"No" test than on the Loftus forced-choice test. However, we fail to see the relevance of this point. To exclude deliberation as a potential source of misled/control differences on the "Yes"/"No" test, one must show that deliberation virtually never leads to rejection of the event item (i.e., to a "No" response). For deliberation to result in poorer misled than control performance, it is necessary only that some subjects reject the event item by deliberation. Obviously, the possibility that some deliberating subjects will reject the event item on the "Yes"/"No" test is not ruled out by the argument that subjects should be more likely to do so on a different test.

Belli (1989) goes on to argue that the presentation of the event item on the test gives the subject evidence that his or her recollection of the original detail is correct and therefore that "the likely deliberation would result in a decision that the postevent item was mistaken (either as a mistaken memory or as a mistake of the experimenter)" (p. 79). This argument also has little force, for the same reason. It is not sufficient to argue that the likely outcome of deliberation is acceptance of the event item (i.e., a "Yes" response); one must argue that this is the virtually inevitable outcome. If at least some subjects reject the event item by deliberation, the expected result is poorer misled performance than control performance.

It is not even clear that the points raised by Belli (1989) are sufficient to motivate his claim that acceptance of the event item is the likely outcome of deliberation. The presentation of the event item on the test does not provide definitive confirmation of the subject's recollection. Furthermore, as Belli discusses, a decision to accept the event item requires the subject to somehow discount his or her memory for the postevent item (e.g., by concluding that his or her recollection of the postevent item was incorrect, or that the experimenter erred in preparing the postevent narrative, or perhaps that both items appeared in the slides). Thus we see no firm basis for asserting that a decision to accept the event item is more likely than a decision to reject the item. At the least, it seems clear that Belli's arguments fail to rule out the possibility that some subjects will respond "No" to the event item as a result of deliberation.

To summarize, Belli's (1989) results do not warrant the conclusion that misleading postevent information impairs memory for the original event because the poorer misled than control performance could have resulted instead from source misattribution and/or deliberation. Even if we accept Belli's arguments against the deliberation hypothesis, his results still do not imply memory impairment because source misattribution remains a viable alternative interpretation.

Belli's Treatment of Our Results

In a recent article (McCloskey & Zaragoza, 1985a), we argued that the forced-choice recognition procedure used in most postevent information research (e.g., Loftus et al., 1978) is inappropriate for assessing effects of misleading information on memory for the original event and hence that the findings cited in support of the memory impairment hypothesis did not in fact demonstrate memory impairment. We also reported results from six experiments in which we used a modified recognition procedure that, we argued, was appropriate for assessing potential memory-impairing effects of misleading postevent information. In these experiments we found no effect of misleading information on memory for the original event.

In a subsequent study, Zaragoza et al. (1987) used a recall procedure to assess the effects of misleading postevent information on memory for the original event. In two experiments with this procedure, no effect of misleading information was found.

Notwithstanding the fact that his results provide no clear evidence of memory impairment, Belli (1989) arrived at a favorable assessment of the memory impairment hypothesis (e.g., "these results .... do enhance the status of memory impairment as a viable explanation that partly accounts for the misinformation effect"; p. 82). He reconciles this assessment with the findings that we have reported by suggesting that our procedures are insensitive to memory-impairing effects of misleading postevent information (e.g., Belli, 1989, pp. 73, 82). In offering this suggestion, Belli relies on a point that we raised in the article reporting our recall experiments:

> 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.... 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. (Zaragoza et al., 1987, p. 41)

This discussion leaves the door open, not for the memory impairment hypothesis in all of its various forms, but only for versions of the hypothesis that incorporate some specific assumptions. Our findings can be dismissed as irrelevant only if one is willing to assume that memory-impairing effects of misleading information are limited to circumstances in which the misinformation is a possible response. In other words, one must assume that in situations in which the misleading information cannot be given as a response, this information has no effect on ability to remember information from the original event. For example, it must be assumed that misleading information (e.g., 7-Up) has no effect on ability to retrieve the event item (e.g., Coke) in the context of a forced-choice test (McCloskey & Zaragoza, 1985a) in which the alternatives are the event item (Coke) and a novel item (Sunkist).

This position not only implies limits on the generality of potential memory impairments produced by misleading information but also restricts possible assumptions about how misleading postevent information disrupts memory for the original event. For example, the assumption that misleading information impairs memory in some but not all retrieval situations is incompatible with the hypothesis that misleading postevent information exerts its (supposed) effects by erasing event information from memory (e.g., Loftus & Loftus, 1980).

Last, it is worth pointing out that the form of memory impairment hypothesis considered by Zaragoza et al. (1987) is not one that was previously entertained by proponents of the memory impairment hypothesis, but rather it is a form that Zaragoza et al. generated when assessing the implications of their results. Furthermore, to the best of our knowledge, no theorist other than Belli (1989) has subsequently endorsed this form of the hypothesis.

Unfortunately, Belli (1989) fails to make clear that our findings may be dismissed only if one is willing to adopt a form of the memory impairment hypothesis that is not among those put forth by proponents of the hypothesis. Rather, he seems to suggest that our results have no bearing on any form of memory impairment hypothesis (e.g., "by eliminating any influence resulting from misinformation acceptance, [McCloskey & Zaragoza] also prevented the possible detection of misinformation interference"; p. 82).

Last, we feel obliged to comment on Belli's (1989) statements that our procedures cannot be used to detect source misattribution (p. 73). This is certainly true. However, far from being a shortcoming of our methods, the insensitivity to source misattribution (as well as misinformation acceptance and deliberation) is one of their major strengths. In accord with our goal of evaluating the memory impairment hypothesis, we have attempted to devise procedures that are sensitive only to memory impairment. Consequently, our procedures generate data bearing directly on the memory impairment hypothesis. In contrast, procedures that fail to discriminate memory impairment from source misattribution cannot clearly establish the occurrence of either effect.

Tversky and Tuchin's (1989) Study

The "Yes"/"No" Recognition Experiment

Tversky and Tuchin's procedure. Tversky and Tuchin (1989) explored effects of postevent information by using a "Yes"/"No" recognition procedure that differed from Belli's (1989) in only a few minor respects. For example, whereas Belli asked subjects to make "Yes"/"No" decisions only for event items (e.g., Coke) and novel items (e.g., Sunkist), Tversky and Tuchin tested not only the event and novel items but also the items presented as misleading postevent information (e.g., 7-Up).[2] Furthermore, whereas Belli presented each subject with only one test item for each critical detail (e.g., either Coke or Sunkist), each subject in Tversky and Tuchin's study received all three "Yes"/"No" test items (i.e., Coke, 7-Up, Sunkist) for each critical detail.

These minor procedural variations are inconsequential when it comes to assessing the implications of the results for the memory impairment hypothesis. Thus at least with respect to this hypothesis, Tversky and Tuchin's (1989) procedure may be considered equivalent to that of Belli (1989).

Interpretation of results. It is somewhat surprising, therefore, that the logic whereby data were brought to bear on theoretical claims was quite different in Tversky and Tuchin's (1989) study than in Belli's (1989). As we have seen, Belli took as given that misled/control differences on the "Yes"/"No" test for the event item (Coke) could not be interpreted as evidence of memory impairment because misinformation acceptance and source misattribution (and, we would add, deliberation) could lead to poorer misled than control performance even if misleading postevent information had no effect on subjects' ability to remember the original event. He argued that one could eliminate contributions of misinformation acceptance by collapsing data over event item (Coke) and novel item (Sunkist) tests, but he recognized that even when data are collapsed in this way, the "Yes"/"No" recognition procedure cannot enable researchers to discriminate memory impairment and source misattribution. Thus Belli did not argue that his data demonstrated memory impairment resulting from misleading postevent information.

In contrast, Tversky and Tuchin (1989) assume that a misled/control difference on the event item test provides clear and direct evidence of memory impairment. Thus when they found (as Belli, 1989, had) that fewer subjects responded "Yes" to the event item (Coke) in the misled condition (43%) than in the control condition (65%), they concluded that the misleading postevent information impaired subjects' ability to remember what they originally saw. Obviously, this conclusion is completely unwarranted because the difference could

[2] Tversky and Tuchin (1989) use terminology somewhat different from that of Belli (1989). However, to facilitate comparisons between studies, we continue to use Belli's terminology in discussing Tversky and Tuchin's study.

be due to misinformation acceptance, source misattribution, and/or deliberation, instead of memory impairment.

Tversky and Tuchin (1989) do not discuss potential source misattribution or deliberation effects. With respect to misinformation acceptance, they concede that "this may account for some of our effects" but state that "several lines of reasoning argue against this as accounting for all of it" (Tversky & Tuchin, 1989, p. 89). However, none of the lines of reasoning presented by Tversky and Tuchin are even of the type required to establish that a particular factor cannot be fully responsible for an effect; that is, no argument of the following form is offered: "A difference of 22% between misled and control conditions was obtained on the event item test. The maximum difference that could be due to misinformation acceptance, however, is only y (where y is less than 22%). Therefore, misinformation acceptance cannot fully account for the obtained effect."

One of Tversky and Tuchin's (1989) arguments (i.e., that the misinformation acceptance interpretation does not apply to the effect obtained by Belli, 1989, on the event item test because he presented only one test item for each critical detail) is simply incorrect. Another argument—that some subjects said "Yes" to more than one test item for a critical detail (e.g., Coke and 7-Up)—serves only to suggest that *some* misled subjects may not have been biased away from a "Yes" response to the event item by the misleading information. The argument in no way excludes the possibility that biasing did occur for many other subjects. The remaining arguments are similarly uncompelling.

Of course, even if we accepted Tversky and Tuchin's (1989) claim that their effect cannot be attributed entirely to misinformation acceptance, the effect could not be taken as a demonstration of memory impairment because source misattribution and/or deliberation might be responsible for the portion of the effect not attributable to misinformation acceptance. In fact, even if one could assume that misinformation acceptance in no way contributed to the misled/control difference, the effect would not provide clear evidence of memory impairment because one could not rule out the possibility that source misattribution and/or deliberation were entirely responsible for the effect.

Empirical Evidence of Misinformation Acceptance

Thus far, we have offered only logical arguments in support of the claim that misinformation acceptance, source misattribution, and deliberation, rather than memory impairment, may be responsible for misled/control differences obtained with the "Yes"/"No" recognition test. However, empirical evidence may also be adduced, at least with respect to misinformation acceptance. Belli (1989) found in both of his experiments that misled subjects were substantially less likely than control subjects to respond "Yes" to the novel item (Sunkist). For example, in Experiment 1, 44% of the control subjects, but only 16% of the misled subjects, responded "Yes" on the novel item test. This finding suggests that subjects who remember and accept the misleading information (7-Up) may be biased against responding "Yes" to other items of the same sort (Sunkist or Coke), at least if they do not remember seeing these items. In particular, the result suggests that misled subjects who do not remember the event item may be biased against responding "Yes" on the event item test, which would lead to poorer misled than control performance for the event item.

Somewhat surprisingly, Tversky and Tuchin (1989) failed to obtain the novel item effect reported by Belli (1989). In Tversky and Tuchin's experiment, 24% of the subjects responded "Yes" to the novel item in both the misled condition and the control condition. Although this result might be taken to suggest that misinformation acceptance was not a factor in Tversky and Tuchin's experiment, the fact that Belli twice obtained a different result with a very similar procedure suggests that Tversky and Tuchin's result should be interpreted with caution. Furthermore, as discussed later, we obtained novel item data consistent with Belli's when we replicated Tversky and Tuchin's experiment.

A study of misinformation acceptance. In the "Yes"/"No" recognition study that we conducted, the aim of replicating Tversky and Tuchin's (1989) experiment was ancillary to the primary goal of exploring potential biasing effects of misleading information on subjects who did not remember the event item. To ensure, that subjects would fail to remember an item, we simply omitted the item from the original slide sequence. We used Tversky and Tuchin's stimuli and procedures,[3] with the exception that for each subject, one of the two critical item slides (i.e., the slide showing the soft drink can or the slide showing the magazine) was replaced with a slide that did not contain the item but was otherwise identical. Thus each subject saw either the soft drink or the magazine critical item (but not both).

For presented and nonpresented critical items, half of the subjects received misleading postevent information, and half received neutral information. Thus of the subjects for whom the slide showing a Coke can was replaced by a slide that did not include a can, some received a postevent narrative referring to a 7-Up can, whereas others received a narrative referring only to a soft-drink can. Subjects were 288 undergraduate students at Kent State University.

The presented critical items (i.e., those that did appear in the slide sequence) provide a replication of Tversky and Tuchin's (1989) experiment. In accord with Tversky and Tuchin's findings, we obtained poorer performance for the event item (Coke) in the misled condition (36% correct) than in the control condition (48% correct; $z = 3.0$, $p < .01$).[4]

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[3] The slide sequence used by Tversky and Tuchin (1989) was the one that we developed in our earlier forced-choice recognition study (McCloskey & Zaragoza, 1985a). We thank Tversky and Tuchin for making available the instructions and test materials used in their study.

[4] The 48% correct in the control condition is not chance performance and does not suggest that none of the control subjects remembered the event item. On the "Yes"/"No" recognition test, chance performance is not necessarily 50% correct. Rather, performance on that test is at chance when the percentage of "Yes" responses is no higher for event items than for novel items. Control condition performance for the novel item test (reported in the next paragraph) shows that performance on the event item test was considerably above chance.

For the novel item (Sunkist), we found fewer "Yes" responses in the misled condition (16%) than in the control condition (25%; $z = 2.7$, $p < .01$). This finding, which suggests the occurrence of misinformation acceptance, replicates the novel item effect obtained in both of Belli's (1989) experiments and contrasts with Tversky and Tuchin's finding of no difference. Given that in three out of four experiments a misled/control difference on the novel item test was found, Tversky and Tuchin's null result is perhaps most plausibly interpreted as reflecting noise in their novel item data.

The results for the critical items that were not presented in the slide sequence provided further evidence that misleading postevent information may bias responses to the event item among subjects who do not remember this item. On tests of nonpresented event items, "Yes" responses were made by 26% of the control subjects but only 15% of the misled subjects ($z = 3.0$, $p < .01$); that is, subjects who had not seen (and therefore could not remember) the event item (Coke) were less likely to respond "Yes" to this item if they had received misleading postevent information (7-Up) than if they had not been misled.

The results that we have discussed clearly demonstrate that biasing effects of misleading information on the "Yes"/"No" responses of subjects who do not remember the event item are more than just an abstract theoretical possibility. These effects occur and are substantial in magnitude. Hence we suggest that one must take misinformation acceptance, as well as source misattribution and deliberation, into account when interpreting results from the "Yes"/"No" recognition procedure.

Tversky and Tuchin's confidence data. In discussing Tversky and Tuchin's (1989) study, we have focused on the percentage correct results from the "Yes"/"No" test. Tversky and Tuchin also report confidence data and suggest that these data provide further support for the memory impairment hypothesis. As we have argued elsewhere (McCloskey & Zaragoza, 1985b), however, confidence data cannot readily be brought to bear on the memory impairment hypothesis because misleading postevent information may lower subjects' confidence even if it has no effect on their ability to remember what they saw. (See McCloskey & Zaragoza, 1985b, p. 385, for further discussion of this point). Similar objections may be raised against studies involving reaction time data, such as the Donders, Schooler, and Loftus (1987) study, cited by Tversky and Tuchin as additional evidence in favor of the memory impairment hypothesis.

Tversky and Tuchin's Treatment of Our Results

In attempting to develop a case for the memory impairment hypothesis, Tversky and Tuchin (1989) discuss one of the two articles in which we reported data arguing against the hypothesis. Specifically, they discuss our forced-choice recognition study (McCloskey & Zaragoza, 1985a) but fail to consider the recall study (Zaragoza et al., 1987).

In our recognition experiments (McCloskey & Zaragoza, 1985a) subjects were given a forced choice between the event item (Coke) and a novel item (Sunkist). We found that subjects who had received misleading postevent information (7-Up) performed as well on this test as did subjects who had not been misled, and we interpreted this finding as evidence against the memory impairment hypothesis.

Tversky and Tuchin (1989) suggest that our forced-choice procedure may have failed to detect memory-impairing effects of misleading information. Their argument is as follows: Subjects could select the correct response on the forced-choice test either by remembering that they had seen the event item (Coke) or by knowing that they had *not* seen the novel item (Sunkist). Therefore, even if misleading information impaired subjects' memory for the event item, they could still succeed on the recognition test by rejecting the novel item as something they had not seen ("Although misled subjects may not have known what they saw, they did know what they did not see. In a forced-choice procedure, knowing what you did not see is just as good as knowing what you saw"; Tversky & Tuchin, 1989, p. 89).

Although this argument may appear reasonable at first blush, a careful examination reveals some problems. In a forced choice between the event and novel items, a feeling of unfamiliarity evoked by the novel item (i.e., a feeling that one did not see this item) points to the event item as the correct response only if the event item fails to evoke a similar feeling of unfamiliarity. If both the event item (Coke) and the novel item (Sunkist) seem equally unfamiliar, the unfamiliarity of the novel item is of no help whatsoever to a subject faced with a forced choice between the two items.

Obviously, event and novel items will both seem unfamiliar unless the subject has some memory for the event item. Therefore, a subject who has no memory for the event item will not be able to choose the correct response systematically on the forced-choice test; both items will seem unfamiliar, and the subject will have to guess.

If, then, misleading postevent information causes some subjects to be unable to remember the event item, these subjects will not be able to succeed on the forced-choice test by relying on the unfamiliarity of the novel item. Therefore, contrary to Tversky and Tuchin's assertions, memory-impairing effects of misleading information should result in poorer misled than control performance on the forced-choice test. Thus our finding of no misled/control difference (McCloskey & Zaragoza, 1985a) cannot be dismissed on grounds that our forced-choice procedure is insensitive to memory impairment.

One might attempt to save Tversky and Tuchin's (1989) argument by suggesting that misleading information may not necessarily cause complete loss of memory for the event item but may instead simply weaken the memory. One could then suggest that the weakened memories, though inadequate to support most types of memory performance, might nevertheless be sufficient to make the event item seem more familiar than the novel item. If this were the case, then misled subjects could succeed on the forced-choice test in spite of their weakened memories.

This argument does not go through. Assume that in the control condition of our experiments, subjects' memories for the event item were distributed along a continuum of strength, such that some subjects had strong memories and others had weaker memories, (see Figure 1A). Because control subjects

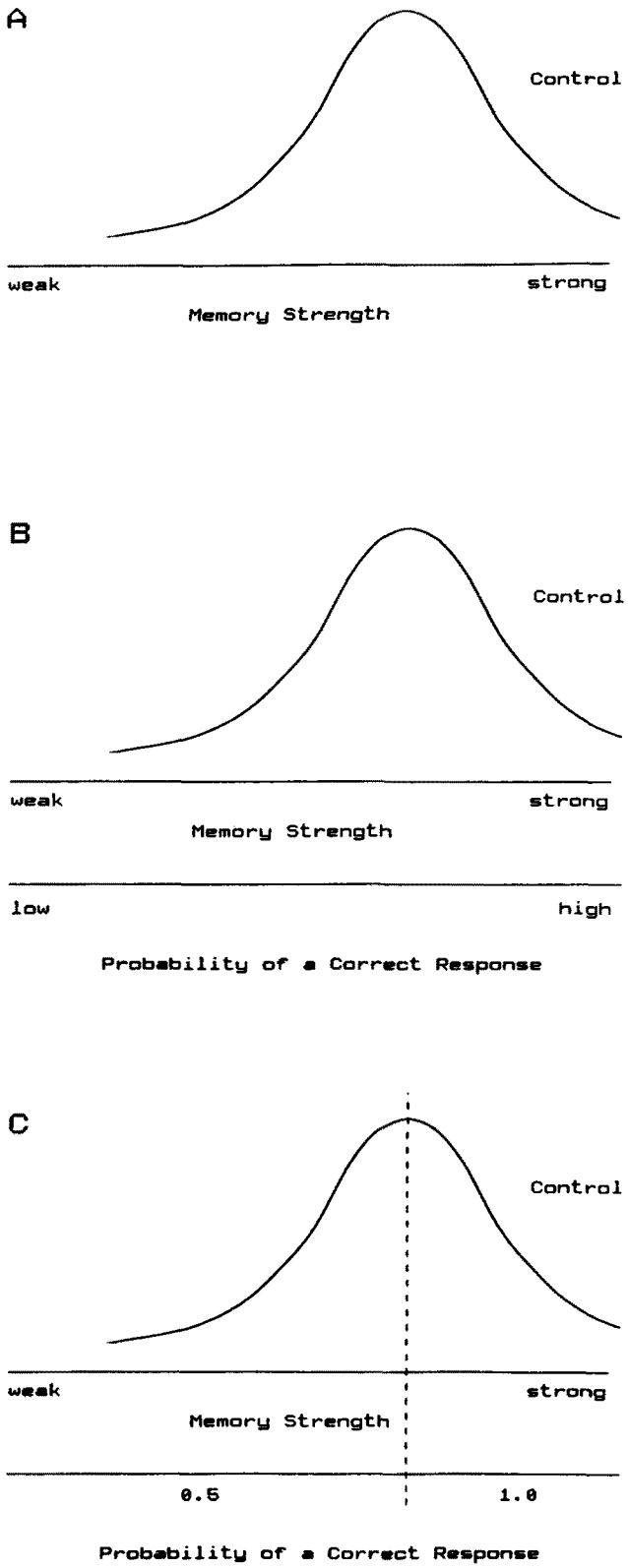

Figure 1. (A) Hypothetical strength distribution for event item memories in the control condition of a postevent information experiment. (B) Strength distribution showing hypothetical probabilities of a correct forced-choice response at various strength levels. (C) Strength distribution showing hypothetical strength threshold.

in our studies were correct only about 75% of the time on the forced-choice test, we must assume that some of the subjects' memories were too weak to support the systematic choice of the correct response on the test. Thus we might posit that the weaker the memory, the lower the probability of a correct response on the test (on grounds that as strength decreases, the likelihood that the event item will seem more familiar than the novel item will also decrease; see Figure 1B). Alternatively, we might postulate a threshold strength level above which test performance is perfect and below which performance is at chance (see Figure 1C).

Assume now that misleading postevent information weakens memory for the event item and therefore shifts the strength distribution to the left (see Figure 2A). On either interpretation of control condition performance, poorer performance is expected in the misled condition. If the probability of a correct response decreases continuously with the strength of the memory, then the misleading information, by decreasing the strength of misled subjects' memories, will also decrease their likelihood of responding correctly on the test (see Figure 2B). Similarly, on the threshold account, the misleading information will shift some misled subjects from above to below the threshold, thereby reducing their probability of responding correctly from 1.0 to 0.5 (see Figure 2C).

One cannot avoid predicting that memory-weakening effects of misinformation would lead to poorer misled than control performance by assuming that the memories in the misled condition, although weakened, would still permit the systematic selection of the correct response on the test. If we make this assumption, we have no way of explaining why performance is less than perfect in the control condition.

We conclude, therefore, that Tversky and Tuchin's (1989) dismissal of our results is unwarranted.

Discrepancies and Reconciliation

Our final point raised by Tversky and Tuchin's (1989) article requires comment. Tversky and Tuchin's discussion may create the impression that the results of our earlier studies (McCloskey & Zaragoza, 1985a; Zaragoza et al., 1987) conflict with the data reported by Loftus and her colleagues (e.g., Loftus et al., 1978). In other words, it may appear that the two sets of findings imply contradictory conclusions concerning the memory impairment hypothesis, with the results of Loftus and her colleagues supporting the hypothesis and our data arguing against it. For example, Tversky and Tuchin refer to the "discrepancy between Loftus et al. and McCloskey and Zaragoza's findings" (Tversky & Tuchin, 1989, p. 87), and their article is entitled, "A Reconciliation of the Evidence on Eyewitness Testimony."

In our view, however, there is no discrepancy between the findings of Loftus and her colleagues and those that we have reported. We have argued at length in our earlier articles (McCloskey & Zaragoza, 1985a, 1985b; Zaragoza et al., 1987) that both Loftus's results and ours are consistent with the position that misleading postevent information does not impair memory for the original event.

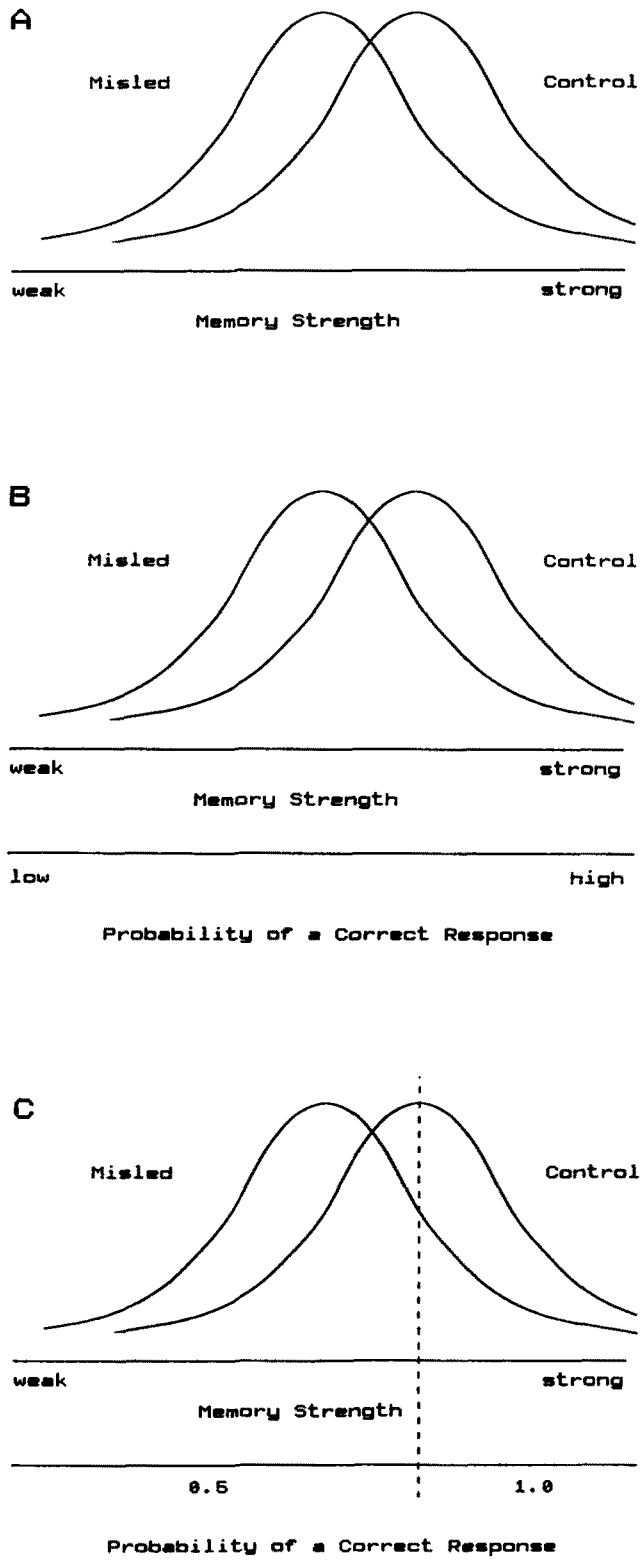

Figure 2. (A) Hypothetical memory strength distributions for misled and control conditions, illustrating the assumption that misleading information weakens memory for event items. (B) Misled and control condition strength distributions with hypothetical probabilities of a correct response at various strength levels. (C) Misled and control condition strength distributions with hypothetical strength threshold.

Concluding Remarks

Belli (1989) and Tversky and Tuchin's (1989) studies underscore the point that misleading postevent information may potentially affect subjects' responses on memory tests in a variety of different ways. Unfortunately, the studies also underscore the difficulty of discriminating among the various possible effects of misinformation, particularly the difficulty of devising methods for determining whether misleading information impairs subjects' ability to remember what they originally saw.

The "Yes"/"No" recognition procedure used by Belli (1989) and Tversky and Tuchin (1989) is interesting in many respects. The procedure cannot, however, provide clear evidence of memory impairment resulting from misinformation because reasonable alternative interpretations can be offered for findings of poorer misled than control performance.

Thus the results reported by Belli (1989) and Tversky and Tuchin (1989) do not alter the conclusions that we have drawn in our earlier studies. The available data still provide no clear support for the memory impairment hypothesis, and the results that we have reported (McCloskey & Zaragoza, 1985a; Zaragoza et al., 1987) still argue against most forms of the hypothesis. At best, therefore, memory-impairing effects of misleading postevent information remain to be demonstrated.

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