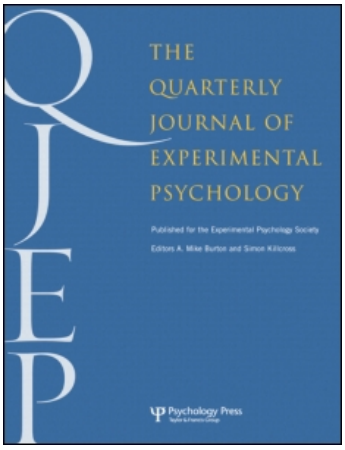

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Avoiding Misinformation: Reinstating Target Modality

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Explanations of the misinformation effect were considered in an experiment using a reversed eyewitness suggestibility design (Lindsay & Johnson, 1989b). Forty-eight subjects read a narrative describing a photograph that they subsequently viewed. For half the subjects, the narrative contained misinformation. Recognition tests for objects appearing in the photograph were administered in either a verbal or a pictorial modality. A misinformation effect was found in the verbal condition, as found by Lindsay and Johnson. With pictorial probes there was no misinformation effect, indicating that reinstatement of the appropriate modality cues can eliminate the influence of misleading post-event information upon memory and permit the retrieval of the target memory. The experiment was conceived of and discussed within the headed records framework.

A misinformation effect can occur when the witness to a crime, or the subject in an experiment who experiences an event, is later exposed to other information concerning the event, which contains factual inaccuracies. If the eyewitness's testimony or the subject's report subsequently includes some of this erroneous information, then a misinformation effect has occurred.

There are a number of ways of explaining the misinformation effect. One is that of "destructive updating", posited by Loftus (e.g. Loftus, Miller, & Burns, 1978), that the original information has been overwritten. In the Loftus et al. experiment, a target event, comprising a sequence of slides, was followed by a questionnaire, which contained an item of misinformation. At test, the subject was forced to choose between two slides, one which occurred in the original presentation and the other which included the misinformation. McCloskey and Zaragoza (1985) presented evidence in favour of the "supplementation" account of the misinformation effect, arguing that the effect shown by Loftus et al.

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resulted from two kinds of response bias inherent in the standard testing procedure. These biases "supplement" the misled subject's choice of a misleading item at the test, compared to controls. The first kind of bias is "misinformation acceptance", whereby subjects who did not notice the critical information in the original presentation but did notice the misinformation believe that the misinformation did indeed occur in the original event. The second bias in the standard testing procedure is that subjects may respond on the basis of "demand characteristics". A subject might remember the original information as well as the post-event information but still responds with the misleading option on the test, assuming, for example, that the misinformation must be correct because the experimenter provided it. In neither case, then, would the misinformation overwrite the original memory. Instead, the event in which the misinformation was embedded would be in a different memory from the original.

McCloskey and Zaragoza (1985) have a convincing case for the existence of the biases that they target. However, they also make the stronger claim that "misleading post-event information has no effect on memory for the original event" (p. 1)—that is, that retrieval of the original information is unaffected by the presence of misleading information. In this respect their position differs from the third group of explanations, known as the "coexistence" account. Proponents of this position interpret the misinformation effect primarily in terms of retrieval failure. It is argued that the original memory remains intact and is not altered or overwritten by the new (mis)information. By this view, apparent forgetting in misinformation paradigms results from difficulty in gaining access to the original information at the time of test compared with the relative ease of access of the more recent misinformation (Bekerian & Bowers, 1983; Morton, Hammersley, & Bekerian, 1985). In support of this theory, Bekerian and Bowers were able to eliminate the susceptibility of witnesses to being misled in the Loftus et al. (1978) design by recreating the circumstances under which the original stimuli were viewed. Specifically, in the Loftus et al. experiment, neither the questionnaire containing the misinformation nor the subsequent test procedure preserved the narrative structure of the original slide sequence. Bekerian and Bowers first replicated the Loftus et al. findings but demonstrated that the contaminating effects of the misleading information were eliminated when the test was modified appropriately, with the narrative sequence of the original event preserved. Since the test follows the supposed contamination, the original memory could not have been updated and must be intact. Such a factor would operate in addition to the response biases described in the supplementation account.

Lindsay and Johnson (1989b) reversed the standard rate of temporal events in their experiment, in what they call the "Reversed Eye-Witness Suggestibility Design". Misled subjects were given verbal suggestions about a visual scene *before* witnessing it. The scene contained some items that had been referred to in the narrative and some that had not. In addition, there were some items referred to in the narrative that did not appear in the visual scene. These constituted the misinformation items. As in the standard procedure, the subjects were subsequently tested on their memory for items present in the visual scene. This test included distracter items and consisted of a written checklist. A misinformation effect was obtained with this reversed procedure. The usual Loftus explanation cannot be given to these findings because, as the misinformation came first, it could not have overwritten the correct information. However, it would in principle be

possible for the correct information to have partially overwritten the original, incorrect (narrative) information. Lindsay and Johnson (1989b) suggest that "information from different sources can become integrated" (p. 112). We interpret this as meaning that at the time of testing there would be a single memory source with a variety of tags.[1]

The Lindsay and Johnson (1989b) experiment can be interpreted in a number of ways:

1. Misinformation can have an effect without it being able to overwrite the correct information. As such, the Lindsay and Johnson data contradict any generalized account of misinformation effects that requires such overwriting. These data would not, of course, preclude overwriting occurring in the normal experimental design where the misleading information follows the correct information.
2. Lindsay and Johnson tested their subjects by presenting individual items in a yes/no recognition test. This procedure is not subject to the "demand characteristics bias" described by McCloskey and Zaragoza (1985), because this bias requires a choice to be made between alternatives (Belli, 1989). The other bias discussed by McCloskey and Zaragoza, "misinformation bias", relies on the subject not having noticed the critical item in the original presentation of the test material and so, instead, accepting the misleading information that was noticed. This then is also irrelevant to the Lindsay and Johnson procedure, because the misleading and original items are judged independently in that experiment. Again, there is no evidence in the Lindsay and Johnson experiment that would argue against the McCloskey and Zaragoza biases operating in other experimental designs.
3. Lindsay and Johnson suggest that memories from different sources could be combined into a single memory. In this respect, they align themselves with Loftus and against McCloskey and Zaragoza who argue explicitly against such an integration position on the grounds that it is "so vague and ambiguous as to be virtually meaningless" (McCloskey & Zaragoza, 1985, p. 16).
4. Lindsay and Johnson analyse the misleading errors in terms of source monitoring. In brief, all items laid down in memory have tags, which, in principle, indicate their source. Following retrieval of any item, there is "an attribution which is the outcome of judgement processes that take into account certain phenomenal characteristics of memories, as well as plausibility judgements and other extended retrieval and reasoning strategies" (Johnson, in press). Source monitoring is thus a set of post-retrieval processes, which would operate under all the previously discussed theoretical positions, concerning the nature of memory storage of the correct and misleading information. Equally, it would operate in any experimental design. It can be seen that McCloskey and Zaragoza's demand characteristics bias is a bias that operates against source monitoring, whereas "misinformation acceptance" is independent of that principle.

[1] Within the source-monitoring framework, there are a number of other options. Normally, the framework is used in relation to information that is coded neutrally (such as a proposition about the world) but that has a tag to indicate its origin. In the present design, information is distinguished by coming from a verbal modality or a pictorial modality, which is completely correlated with the source (narrative vs. picture).

The "coexistence" interpretation of the Lindsay and Johnson (1989b) experiment, particularly that under the headed records model (Morton et al., 1985), is slightly more complex than that given by Lindsay and Johnson.

1. A record[2] would be laid down of the narrative. All positions would agree on that point.
2. The interpretation of the picture would give rise to a second record. This is the position that we have in common with McCloskey and Zaragoza (1985) and that is different from the position of both Loftus et al. (1978) and Lindsay and Johnson.
3. During the interpretation of the picture, the record of the narrative would automatically be retrieved and used. This is simply the application of the general principle that relevant information in memory is used in interpretation of the current input. In this way, misinformation could, in principle, get into the record of the visual scene.
4. The record of the narrative would be untouched. This position agrees with that of McCloskey and Zaragoza and is a key postulate of the headed records model (Morton & Bekerian, 1986). Evidence in favour of this position is given in Morton et al. (1985). This includes experiments showing release from misinformation (Bekerian & Bowers, 1983; Bowers & Bekerian, 1984; Christiaansen & Ochalek, 1983; also Newcombe & Seigal, 1997).

A further principle of the headed records position (Morton et al., 1985; Morton & Bekerian, 1986) concerns retrieval. Both Tulving's (1983) encoding specificity principle and the principle of state-dependent learning were essential foundation blocks for the model and were implemented in the model through the operation of headings, within which the modality of stimuli are preserved, and where contextual cues are encoded. Encoding specificity is actually not so much a theory as a hypothesis about behaviour, predicting that more will be recalled when the conditions of testing match the conditions of recall. The hypothesis is neutral as to why this happens or what mechanisms are employed. Tulving puts forward the concept of "synergistic ecphory" as an explanatory principle. Headed records uses headings in the same way. However, Tulving seems also to opt for the destructive updating view of misinformation. He says: "Changes in the memory trace of an event, or recording of the trace brought about by subsequent related events, for instance questioning the rememberer about the original experience (Loftus, 1975; Loftus et al., 1978), are assumed to be incorporated into trace information" (Tulving, 1983, p. 366). Such a view is not entailed by the principle of encoding specificity.

The present study was undertaken in order to show how the reversed eyewitness misinformation effect, demonstrated by Lindsay and Johnson (1989b), can be virtually eliminated if the test conditions encourage access to the critical memory records. Within this viewpoint, subjects in the Lindsay and Johnson experiment, probed with words, would be likely to access the record of the narrative. However, if they were to be probed with pictures, they would be more likely to access the record of the picture itself. Thus, the misinformation effects should be reduced or eliminated.

[2] "Record" is the term used in the headed records model to refer to the mental representation of an event. It is taken from Norman and Bobrow (1979).

The predictions from the source monitoring viewpoint are clear. First, of course, we expect to replicate the Lindsay and Johnson (1989b) result, showing the effects of misinformation when a written checklist of objects is used at test. However, the source-monitoring principles have nothing to say about retrieval itself. It is clear that we would expect a reduction in the misinformation effect if we instructed the subjects to pay more attention to the source of the information, as happened in an experiment of Lindsay and Johnson (1989a) using the normal order of target followed by misinformation. We would also expect a reduction in the misinformation effect through increases in the extent of source monitoring if we drew the subjects' attention to the possibility of confusion, for example by mixing written and pictorial probes. However, there is nothing in the monitoring part of the source-monitoring position that would predict any change in performance as a result of using pictorial probes. On the other hand, a strong interpretation of Lindsay and Johnson (1989b) would positively predict no change in performance with a change in probe, because the loss of source information that leads to the misinformation effect leads to a situation where "the rememberer may be unable to discriminate among aspects of those memories derived from different sources" (p. 112). This state of affairs would be unaffected by the nature of the probe.

In the present experiment, subjects first read a partly misleading narrative, then they viewed a photograph, as in Lindsay and Johnson (1989b). Finally, half of each group were tested verbally (written checklist of objects), the other half pictorially (individual photographs of objects) for objects they remembered seeing in the picture. In employing a checklist we followed Belli (1989) who pointed out that although the yes/no recognition procedure was sensitive to possible memory impairments its use considerably reduced or eliminated response bias from the test procedure, thus avoiding criticism from the supplementation camp. A yes/no recognition test is utilized for all categories of objects, and subjects are told at test that some objects were present in the picture and some were not.

Method

Subjects

Forty-eight subjects took part in this study. Most were undergradute students, recruited on campus at UCL university, and the remainder were working adults. The mean age was 23.3 years, with a range from 17 years to 58 years. Subjects were randomly assigned to the four conditions in the main study (12 subjects per condition).

Design

The experiment had a $2 \times 2 \times 4$ split-plot design. The independent variables were: (1) whether the subjects read a misinformed or control narrative (between subjects); (2) whether subjects were tested pictorially or verbally (between subjects); and (3) the four categories of objects presented in the test—those mentioned only in the misinformed narrative ("misinformed"), those appearing in both the narrative and the picture ("picture-and-narrative"), those objects only appearing in the picture ("picture-only"), and objects not appearing in either ("distracter") (within subjects). The dependent variable was the number of objects out of eight, for each of the four categories of test objects, to which the subjects responded "yes" in a recognition test for objects that they remembered seeing in the

picture. It was predicted that subjects in the misinformed verbal condition would respond "yes" to more misinformed objects than would subjects in the control verbal condition. No difference for misinformed objects was predicted in the pictorial modality between misinformed and control groups. In addition, we predicted that "yes" responses for picture-only objects would be greater in both pictorial conditions than in the verbal conditions because the modalities of stimulus and probe would match.

Materials

Three categories of object were needed for each subject: (1) objects that appeared in the picture alone; (2) those that appeared in both narrative and picture; and (3) those that appeared only in the narrative. From a pilot study using a single photograph of a scene with multiple objects and using both visual and pictorial recognition probes, we selected three sets of eight objects, A, B, and C, equated for memorability and object size. These three sets were rotated in a Latin square as the picture-only, picture-and-narrative, and narrative-only objects.

The pictorial stimuli were three 7.5 × 5 inch colour photographs of 24 objects arranged around a shelf and a desk in the corner of a bedroom. The objects were associated with a scene of this type (e.g. stereo on the shelf, A4 folder and stapler on the desk, etc.). In each picture there were 8 objects designated as picture-only objects and 8 designated as picture-and-narrative objects, together with 8 distracter objects. The distracter objects were the same for all subjects.

The pictorial condition test items were cut out from a copy of the stimulus photograph and mounted onto squares of cardboard (approximately 1 inch square). Eight further pictures were taken of objects not in the "bedroom corner". These distracter items were matched roughly for size with the target items and fitted in with the general theme of the scene. The verbal test response sheet was prepared by listing these 32 target and distracter objects (including their colour) in a random order with a yes/ no check-box next to each item, with the added constraint that a maximum of 2 distracter or target objects appeared in succession. The pilot study was also used to check the accuracy of the verbal labels.

Texts. Texts of about 220 words were written to describe each of the three possible scenes. The texts described the rough layout of the objects in relation to large "landmarks" in the picture, such as the curtain, the desk, and the shelf. Hence, in the three control narratives everything in the relevant picture was mentioned, including the set of 8 distracter items but excluding the picture-only items: giving a total of 16 objects. The three misinformed narratives also had 16 objects mentioned: the set of 8 misinformed objects (which did not appear in the equivalent picture), and the set of 8 picture-and-narrative items. The six texts were therefore equal in all ways other than object randomizations, including length (about 220 words) and the total number of objects mentioned. A sample misinformed text follows:

> To the far right of the scene there is a world globe standing on a white desk, directly behind a pair of plastic black sun-glasses, and directly in front of a grey curtain that skirts across approximately half the length of the desk. The other half of the desk has a wooden shelf mounted on the wall above it that extends to the end of the desk and follows the corner of the room onto the wall at the left side of the desk.
>
> Resting on the part of the shelf that is to the left of the desk, there is a stereo, some cassettes and an empty bottle of beer. Directly below the shelf, and leaning against the wall is a blue file. Also near the wall is a Duracell battery. At the back of the desk there is a black hole-punch. In the middle region of the desk stands a white mug and a red clock.

On the section of the shelf that appears in front of the desk, there sits a green cuddly dinosaur, some brown/ cream books, and a plug on a lead. Other objects on the desk are a white telephone, a lamp, and a black calculator.

The equivalent control text would have 8 filler items (unused in the rest of the experiment) instead of the set of 8 misinformed objects. The verbal response sheet was adjusted to ensure that none of the randomizations would incur 2 objects from a given set occurring in succession on the recognition checklist.

Procedure

Subjects were tested individually in a quiet room. They were assigned to subject groups in rotation. They were seated and told that the experiment investigated the way in which people notice objects in a scene. They were then informed by the experimenter that they would soon be shown a picture with many objects in it, and that after studying it for a while they would be tested on their memory for the objects in that scene. Subjects were told that this test would consist of choosing the objects that had been in the picture from a selection that included objects that were distracters. The subjects were then told that sometimes people are aided in tasks such as these by reading a verbal description of the scene before being shown the picture of the scene, and they were handed the appropriate text to read. They were informed that they had 30 sec to read it. After 30 sec, the experimenter removed the text, and subjects were asked to count aloud backwards in threes for another 30 sec, after which they were given the appropriate picture to study for 30 sec. Following this, the picture was removed from sight, and subjects were told that they would now be tested on their memory for objects in the picture. Subjects in the pictorial test condition had each mini-photograph placed in front of them, and they were instructed to respond "yes" if they recognized it from the picture and "no" if they had not. The experimenter presented them in the same order as the verbal test checklist (response sheet) and noted down the subject's response himself. The subjects in the verbal test condition were simply given the verbal test response sheet and told to put a tick in the "yes" box by an object if they recognized it from the picture and a tick in the "no" box if they had not. Subjects were told that they did not have a time restraint in this test phase. After completing the test, subjects were debriefed. Two subjects with abnormally high false acceptance rates (3 and 4 of 8 distracter items) were replaced.

Results

The number of "yes" responses, out of 8, for the four categories of object in the test (misinformed, picture-and-narrative, picture-only, and distracter) were determined for each subject. Table 1 shows the mean number of "yes" responses for the 12 subjects in each of the four different groups; control pictorial, control verbal, misinformed pictorial, and misinformed verbal, for the four categories of object.

A four-factor mixed model ANOVA was conducted on the data, with test object category as a within-subjects factor, and modality, narrative condition, and stimulus randomization as between-subjects factors. This revealed that the within-subjects main effect was significant, $F(3, 108) = 830.01$, $p < .001$. The within- versus between-subject interactions showed significance for modality and for narrative condition but not for randomization: modality, $F(3, 108) = 7.16$, $p < .001$; narrative condition, $F(3, 108) = 6.97$, $p < .001$; randomization, $F(3, 108) = 1.62$, $p > .05$. There was, however, a significant

TABLE 1
The Mean Number of "Yes" Responses to the Four Classes of Stimuli

		Stimulus Objects							
		Misinformed		*Picture and Narrative*		*Picture Only*		*Distracter*	
Test Condition	*Narrative Condition*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Pictorial	Misinformed	1.58	1.17	7.17	0.88	7.25	0.39	0.17	0.89
	Control	1.08	0.91	7.17	1.24	6.83	1.79	0.25	0.65
Verbal	Misinformed	2.83	1.61	6.91	1.17	6.08	1.17	0.33	0.67
	Control	1.00	1.65	7.33	0.24	5.92	0.90	0.42	0.78

Note: Maximum value 8. There were 12 subjects in each group. Note that the first three classes of objects were rotated round a Latin Square: the distracter objects were a different set.

three-way interaction between modality, narrative, and the within-subjects factor, $F(3, 108) = 2.79$, $p < .05$.

Given the significant three-way interaction, simple effects of modality and narrative condition were computed at various levels of the test object categories. The findings of primary interest were that the modality of testing influenced the modality of the items responded to. First, the misinformation, being in the verbal modality, only affected the subjects in the verbal group. This replicated the Lindsay and Johnson (1989b) result. The misinformed verbal group recognized more misinformed object names than did the control verbal group, $F(1, 36) = 23.93$, $p < .001$. However, the misinformed pictorial group was no different from the pictorial control group, $F(1, 36) = 1.94$, $p > .05$. Second, one might expect that a pictorial cue would be more effective than a verbal cue in accessing the objects that were in the picture-only set. Indeed, the data showed that the subjects in the pictorial conditions scored more highly with the picture-only objects than did subjects in the corresponding verbal conditions (means 7.04 vs. 6.00/ 8, respectively); $F(1, 36) = 10.23$, $p < .01$.

Further analysis of simple effects investigated whether an object was better remembered if it appeared in both the narrative and the picture, rather than just in the picture. These simple effects revealed a difference in performance in the misinformed verbal group between the picture-and-narrative and the picture-only objects, $F(1, 36) = 7.71$, $p < .01$. The control verbal group similarly recalled the picture-and-narrative objects better than the picture-only objects, $F(1, 36) = 22.27$, $p < .001$. However, the corresponding tests for the pictorial groups revealed no significant difference in recognition of the picture-and-narrative objects over the picture-only objects; control: $F(1, 36) = 2.23$; $p > .05$; pictorial: $F(1, 36) < 1$.

We needed to check whether there was a positive responding bias in the misinformed over the control groups. The simplest way of doing this is by a comparison of performance on the distracter items. Note that the distracter items were the same for all subjects and were a different set from those used in the other object categories. The comparison showed that the four groups were not significantly different from one another in their

acceptance of these items, $F(3, 44) = 0.64$, $p > .05$. An even more conservative test is to compare the difference between subjects' scores on the distracter items and those on the misinformed items. This effectively uses the small and non-significant differences between acceptance of the distracter items as a baseline for the misinformed items. A separate two-way between-subjects ANOVA (Narrative × Modality) was carried out. There was a main effect of narrative, $F(1, 44) = 14.1$, $p < .001$. After inspection of the significant interaction, $F(1, 44) = 4.01$, $p < .05$, simple effects showed evidence of a difference between misinformed and control subjects in the verbal conditions but not in the pictorial conditions; verbal, $F(1, 44) = 16.58$, $p < .001$; pictorial, $F(1, 44) = 1.54$, $p > .05$. From this we conclude that the increased response to the misinformed objects by the verbal misinformed group was not due to a general acceptance response bias in that group.

Discussion

The first thing to note is that we replicated Lindsay and Johnson's (1989b) reversed eyewitness suggestibility design in finding a misinformation effect when subjects were given a misleading narrative *prior* to viewing a stimulus picture and were tested with verbal probes. As Lindsay and Johnson (1989b) observe, finding a suggestibility effect with this reversed procedure means that the effect does not require destructive updating, because no memory of the visual scene existed when the misleading suggestions were given. The finding that when pictorial probes were used there was no misinformation effect parallels the Bekerian and Bowers (1983) result, which undid the Loftus et al. (1978) destructive updating claim. In both cases the misinformation effect vanishes when the test conditions match those of the target stimuli in some respect.

From the Bekerian and Bowers (1983) result, Morton et al. (1985) concluded that when there are two related events, the second does not modify the memory of the first. Rather, there are two event records laid down. At the time of the second event, the record of the first event is retrieved to help the subject process the second event. The second record would thus include information from the record of the first event. In the Loftus et al. (1978) experiment, the events were a slide sequence followed by a written questionnaire. At the time of the questionnaire, the record of the slide sequence would be retrieved and a composite record laid down, which could include some pictorial information from the slides as well as the misinformation. At the time of test, subjects retrieved information from the second record, while intending to retrieve from the record of the slide sequence. What Bekerian and Bowers (1983) succeeded in doing was to arrange things so that subjects went back to the original record at the final test, so avoiding the misinformation.

One might note here that McCloskey and Zaragoza (1985) claimed that they had failed to replicate the findings of Bekerian and Bowers (1983). However, there were vital differences in experimental design, which vitiated those claims. In particular, McCloskey and Zaragoza presented the misinformation in a narrative, which matched the temporal and causal structure of the stimulus event they used. In the Bekerian and Bowers experiment (as in the original study of Loftus et al., 1978) the misinformation was presented in a questionnaire where the order of the questions did not correspond to the order of the actions in the event but was randomized with respect to that order. In Bekerian and

Bowers' crucial condition, the test items were presented in an order that corresponded to the original sequence of events and did not correspond to the order of the questions in the misinforming event. Thus, narrative structure could be used as a means of differentially addressing the record of the original event rather than the record of the misinformation event. In McCloskey and Zaragoza's experiment, there was no such possibility and, accordingly, manipulation of the test items had no effect. The Bekerian and Bowers (1983) results were replicated by Bowers and Bekerian (1984), and similar misinformation and release from misinformation were shown by Newcombe and Seigal (1997) with children.

There is no reason to suppose that the principles of stimulus processing and memory storage would be any different in the present experiment than in other misinformation designs. Let us restate these to avoid misunderstanding. The initial information—target or misinformation depending on the design—will be processed, and relevant information will be stored. As it is relevant, this information will be retrieved automatically during the event that constitutes the second phase of the experiment. Following the second phase, material will again be stored. According to Loftus (e.g. Loftus & Loftus, 1980; Loftus et al., 1978) the second act of storage will affect the previous memory; according to Bekerian and Bowers (1983), Belli (1989), McCloskey and Zaragoza (1985), Morton et al. (1985), and others, the second event will be stored separately.

In the present experimental design, there would first be a record of the descriptive passage. When the subjects viewed the picture, the record of the narrative would be retrieved and used in processing the picture. This is just an application of the fundamental part of all theories of cognition—that perception is influenced by relevant material in memory. The result of this would be a composite record, which included information from the passage and possibly some of the misleading information. This record would, therefore, include both verbal and pictorial representations. However, whereas the storage processes are similar to those in the Bekerian and Bowers (1989) paradigm, retrieval is somewhat different. It could not be the case that the verbal probe groups accessed only the record of the narrative. If that had been the case, then they could not have recognized any of the picture-only set of items. Some of the time, therefore, the subjects with verbal probes, like those with pictorial probes, must have been accessing the record that was laid down when the picture was scanned. In fact, as this record is a composite, as already noted, it could be the case that both groups of subjects accessed only the second record. Retrieval, however, could not have been straightforward.

Remember that subjects who were probed verbally had better memory for the picture-and-narrative items than they did for the picture-only items. This was not the case for the subjects who had pictorial probes, who recognized these two sets of items equally well. This pattern of data suggests a complex memory representation where a picture probe accesses only pictorial representations, but a word probe could access either a pictorial or a verbal representation. This is the same conclusion as that arrived at by Snodgrass, Wasser, Finkelstein, and Goldberg (1974) following Paivio's (1971) dual coding hypothesis. To account for the data, the verbal probe would, however, be less efficient than the pictorial probe at accessing pictorial representations. Hence the verbal probe led to a lower hit rate with the picture-only items than did the pictorial probe. With the picture-and-narrative items, the two groups had equivalent performance, the pictorial probe's

advantage with the pictorial representations being offset by the verbal probe's additional ability to access the verbal representations of those items.

The release from misinformation shown in the present experiment complements that shown by Bekerian and Bowers (1983). We can summarize the difference between them in the following way. In the Bekerian and Bowers study, the change in the form of the test meant that the subjects accessed the original record rather than the record that included the misleading information. On the other hand, in the present experiment, the switch of modality of the probe changed the nature of the material accessed from the record that was laid down while the subject was scanning the picture.

Next, there is a problem for McCloskey and Zaragoza's (1985) position in that there was a misinformation effect that was generated successfully in the narrative modality, using a yes/ no recognition test for all categories of objects. The fact that this disappeared with a change of modality, with the same test, indicates that the demand characteristics of the experiment were not decisive in determining the subjects' responses in this experiment.

In addition, there is a problem for the source-monitoring position, which, in its strongest form, predicted no shift in the extent of misinformation in response to a shift in probe from written to pictorial.

We have tried to make it clear throughout this article that the conclusions we have come to are specific to the particular experimental design that we used. We are satisfied that the kinds of response bias described by McCloskey and Zaragoza (1985) occur in certain experimental designs, though we are not convinced that such biases account for all the classical misinformation effect. Equally, the case in favour of the influence of source tags in storage and the role of source monitoring following retrieval is overwhelming. Any complete model of memory must have the facility for such effects to operate. It seems to be the case, however, that neither of these two principles can account for the results of the present experiment, which shows, rather, the influence of encoding specificity on retrieval—a property of headed records (Morton et al., 1985), the framework within which the present experiment was conceived. Finally, the release from misinformation found in this experiment adds to the evidence in favour of the coexistence of original and misinforming information in memory.

REFERENCES

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

Belli, R.F. (1989). Influences of misleading postevent information: Misinformation interference and acceptance. *Journal of Experimental Psychology*, *118*, 72–85.

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

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

Johnson, M.K. (in press). Source monitoring and memory distortion. In L. Squire & D. Schacter (Eds.), *Biological and Psychological Perspectives on Memory and Memory Disorders*. New York: American Psychiatric Press.

Lindsay, D.S., & Johnson, M.K. (1989b). The eyewitness suggestibility effect and memory for source. *Memory and Cognition*, *17*, 349–358.

Lindsay, D.S. & Johnson, M.K. (1989b). The reversed eyewitness suggestibility effect. *Bulletin of the Psychonomic Society*, *27*, 111–113.

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

Loftus, E.F., & Loftus, G.R. (1980). On the permanence of stored information in the 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 & Memory*, *5*, 19–31.

McCloskey, M., & Zaragoza, M. (1985). Misleading post-event information and memory for events: Arguments and evidence against memory impairment hypotheses. *Journal of Experimental Psychology: General*, *114*, 1–16.

Morton, J., & Bekerian, D.A. (1986). Three ways of looking at memory. In N.E. Sharkey (Ed.), *Advances in cognitive science 1* (pp. 43–71). Chichester: Ellis Horwood.

Morton, J., Hammersley, R.H., & Bekerian, D.A. (1985). Headed records: A model for memory and its failures. *Cognition*, *20*, 1–23.

Newcombe, P.A., & Siegal, M. (1997). Where to look first for suggestibility in young children. *Cognition*, *59*, 337–356.

Norman, D.A., & Bobrow, D.G. (1979). Descriptions: An intermediate stage in memory retrieval. *Cognitive Psychology*, *11*, 107–123.

Paivio, A. (1971). *Imagery and verbal processes*. New York: Holt, Rhinehart & Winston.

Snodgrass, J.G., Wasser, B., Finkelstein, M., & Goldberg, L.B. (1974). On the fate of visual and verbal memory codes for pictures and words: Evidence for a dual coding mechanism in recognition memory. *Journal of Verbal Learning and Verbal Behavior*, *13*, 27–37.

Tulving, E. (1983). Ecphoric processes in episodic memory. *Philosophical Transactions of the Royal Society of London B*, *302*, 361–371.

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