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Brief Exposure to Misinformation Can Lead to Long-Term False Memories

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Abstract: Do false memories last? And do they last as long as true ones? This study investigated whether experimentally created false memories would persist for an extended period (one and a half years). A large number of subjects (N = 342) participated in a standard three-stage misinformation procedure (saw the event slides, read the narrations with misinformation, and then took the memory tests). The initial tests showed that misinformation led to a significant amount of false memory. One and a half years later, the participants were tested again. About half of the misinformation false memory persisted, which was the same rate as for true memory. These results strongly suggest that brief exposure to misinformation can lead to long-term false memory and that the strength of memory trace was similar for true and false memories. Copyright © 2011 John Wiley & Sons, Ltd.

INTRODUCTION

Human memory is not perfect. True memory fades, whereas false memory appears (Brainerd & Reyna, 2005; Loftus, 2003). Much is known about the longevity of true (or veridical) memory (e.g. Ebbinghaus' (1885/1964) classic 'forgetting curve'). Much less is known, however, about the longevity or persistence of false memories. How long do false memories last? What types of false memories persist and why? Intuitively, false memories that are recounted once in a while (e.g. repeatedly giving eyewitness accounts of an event with some false information) will last at least as long as they are being recounted. What about false memory that is induced briefly in an experimental setting and is unlikely to be recounted? Answers to this question should be of great significance to our understanding of the enduring power of false memories.

Researchers have used several paradigms to study false memory [e.g. the Deese–Roediger–McDermott paradigm (DRM), the misinformation paradigm]. For example, the misinformation paradigm includes three standard stages—experiencing an event, receiving misinformation about the event, and being tested for memory of the event (Loftus, 2003)—with some variations in the specific design of each stage (e.g. Bekerian & Bowers, 1983; McCloskey & Zaragoza, 1985). Studies have shown that the subjects' memory of the original event was affected by the misinformation they received, and false memories were hence created (see Loftus, 2003 for a review). The nature of such false memories, however, has been under much debate. Researchers have proposed various theories such as the source-monitoring framework, the activation-monitoring account, the fuzzy trace theory, and the distinctiveness heuristic (see Brainerd & Reyna, 2005 for a description of these theories). The source-monitoring framework, for example, proposed that the false memories occur because of misattribution or confusion of the sources of information. Based on the source-monitoring framework, we predicted that once the subjects misattributed the source of

the false memories at the initial testing session, the rates of long-term decay of such false memories would be the same as those for true (veridical) memories.

Thus far, only a few studies have examined the long-term (>1 year) persistence of false memories created in experimental settings with the misinformation paradigm. More than a half century ago, Davis and Sinha (1950) conducted an experimental study of long-term false memory arising from misinformation. They asked the subjects to read a story and three days later showed the subjects a picture that purportedly depicted the story. One group of the subjects was shown a picture that included some information that was inconsistent with the original story. Of relevance to the current study, a total of 16 subjects (nine in the misinformation group) were asked to recall the story after 1 year. Results showed that details from the misinformation picture 'intruded' into later recall of the story. Although limited in scale and rigor (a very small sample size after much attrition, only one story with limited measures, no control items, no statistical tests), this study presented initial empirical evidence that false memory induced by experimentally presented misinformation can last for at least a year.

Since then, three other studies have examined long-term (≥1 year) maintenance of false memories created by misinformation in children. Huffman, Crossman, and Ceci (1997) explored whether source misattributions that had been reported in an earlier study (by Ceci, Huffman, Smith & Loftus, 1994) persisted over time. In the earlier study (Ceci et al., 1994), children had been asked to imagine a false event (e.g. riding a hot-air balloon). For the following 10 weeks, these children were interviewed weekly, during which they were asked to 'think real hard' about whether the events had occurred (no matter whether true or false) and try to 'recollect' them. At the end of these interviews (i.e. misinformation sessions), children assented to 22% of the false events. Two years later, Huffman et al. (1997) followed up 22 children (6–7 years old) from the original Ceci et al. (1994) study. Half of the children still assented to at least one of the false events, and on average, the children assented to 13% of all false events.

More recently, London, Bruck and Melnyk (2009) did a follow-up interview with 45 children (4–6 years old) who

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had participated in an earlier study (by Bruck, Melnyk & Ceci, 2000). In the earlier study, Bruck et al. (2000) introduced false memories by giving children both true and false reminders about a magic show they had previously watched. These reminders were presented twice (16 and 28 days after the magic show). The children were tested twice (12 days after the second reminder and 15 months after that, the latter of which was summarized in London et al. (2009)). The rates of false memory (inaccurate assents for false items) were 78% at the first test and 63% at the second test. These rates of false memory were much higher than those for the control items (i.e. false details about the show that were not mentioned during the reminding sessions), which were 17% and 37% for the first and second test, respectively. Results of these two studies suggested that misinformation could result in sustained false memory in children.

A third study, however, did not find long-term maintenance of false memories. Peterson, Parson and Dean (2004) studied children (3–13 years old) who were injured in accidents and being treated in the hospital. A year later, children in the experimental group were given both false and true information about their accidents, whereas the control group did not receive such information. An example of the misinformation is 'You hurt yourself on glass, what did the doctor do to make you feel better?' 'Glass' was the misinformation because the child did not hurt himself on glass. Misinformation used in the questions was different for each child so as to match his/her accident. One year after the misinformation session (2 years after the accident), experimental group children ($N = 36$) were asked to recall the accident. Results showed that virtually, none of the misleading information was incorporated into long-term recall.

There are various plausible explanations of the discrepancies between this study and the other studies because they differed in many aspects of the study design (e.g. nature of the original events, misinformation procedure, testing procedure, length of delay). One of the most likely explanations is that both Huffman et al. (1997) and London et al. (2009) studies relied on multiple sessions of misinformation, whereas Peterson et al. (2004) relied on one misinformation (misleading questions) session.

In addition to the previously mentioned long-term longitudinal studies of false memories induced by misinformation, researchers have also examined the persistence of errors in flashbulb memory. For example, based on the results of the 44 college students in the 2.5 years follow-up memory study, Neisser and Harsch (1992) found that *false* flashbulb memories persisted about 2.5 years even when participants were confronted with their own original writings that they had done on the day after the original event.

This review of studies that examined the long-term maintenance of false memories should be distinguished from another line of research that focused on increased susceptibility to misinformation when a long as opposed to short time interval has occurred between an event and the exposure to misinformation. Adult subjects were more susceptible to misinformation presented a week after an event than to misinformation presented shortly afterward (Loftus, Miller & Burns, 1978). Similar results have been found with children (e.g. Burgwyn-Bailes, Baker-Ward, Gordon, &

Ornstein, 2001; Goodman, Batterman-Faunce, Schaaf, & Kenney, 2002). These studies used misleading questions at the time of follow-up testing or used misleading information shortly before the follow-up testing to investigate whether children became more susceptible to suggestions after some time had passed since a key event occurred (up to 4 years, Goodman et al., 2002). In general, results of such studies confirmed their hypothesis that children were more susceptible to the misinformation effect when the original event was more distant in the past. These studies, however, did not address whether false memories from the original session of misinformation/misleading questions persisted. Instead, they showed that false memories were easier to create when true memories of the original event were degraded.

Another related but distinct line of research on 'long-term' false memory is that using the DRM paradigm (Seamon et al., 2002). In contrast to the long-term maintenance of the specific implanted false memory via the misinformation paradigm, the longitudinal studies (up to a few months) of the false memory in the DRM paradigm dealt with consistencies in spontaneous false memories that were recreated at every testing session. In other words, these consistencies are likely to reflect the strength of associations between the stimuli presented and the critical 'lure', rather than any trace of the 'lure' from the original testing session.

The current study is the first large-sample ($N = 342$ adults) study of long-term (1.5 years) maintenance of false memory from brief exposure to misinformation in an experimental setting. To reiterate, based on the source-monitoring hypothesis of misinformation false memory, we expected that false and true memories would decay at the same rate over the 1.5 year period. We reasoned that once a person has a memory, then this memory lasts regardless of the source of the memory.

METHOD

Participants

This is a one-and-a-half year follow-up of a previous study on misinformation false memory (Zhu et al., 2010). Of the original 437 participants (mean age = 20 ± 1 years; 189 males and 248 females), 342 (78.3%) took part in this long-term follow-up (mean age = 20 ± 1 years; 152 males and 190 females). To assess potential attrition biases, we compared the followed-up sample with those who were not followed-up in terms of their demographic characteristics (i.e. gender, age) and their scores on major study variables such as scores on the misinformation false memory tests. Results showed no significant differences between these 342 subjects and the 95 subjects who did not participate in the follow-up; t' s ranged from 1.60 to 1.86, p' s > .05.

Procedure

At Time 1, the classic misinformation test was given. It involved three standard stages (events, narrations, and then the recognition and source-monitoring tests). See Figure 1 for details.
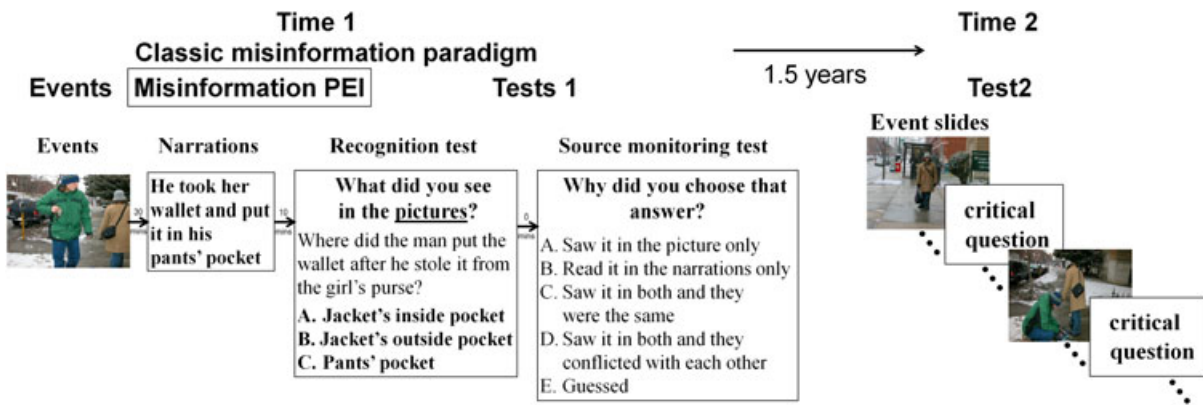
Figure 1. Diagram depicting the procedure of the experimental manipulation and tests

Events

Two separate events were shown to the subjects, each consisting of 50 digital color slides (taken from the research of Okado and Stark, 2005). All the subjects saw both of the events in order to generate reliable results. The order of the two events was counterbalanced across the participants. Each picture was shown for 3500 ms with an interslide interval of 500 ms. One of the events depicts a man breaking into a car and stealing things from it, and the other depicts a girl's wallet being stolen by a seemingly nice man. Of the 50 slides that comprised each story, 12 were critical slides that would be inaccurately described in the subsequent narrations (which are described). To attain a balanced design, two different images of each critical slide (one for the first stage and the other for the second/misinformation stage) were generated. They were counterbalanced across the participants. As presented in Figure 1, one subject may see a man put the wallet in his *jacket's outside pocket* and would be misinformed at the second stage that he put the wallet in his *pants' pocket*, whereas another subject may see the man put the wallet in his *pants' pocket* and would be misinformed at the second stage that he put the wallet in his *jacket's outside pocket*.

Narrations

After 30 minutes of filler tasks, the story narrations were presented. The narratives consisted of one sentence for each slide image describing the scene depicted in the image. All the subjects read two story narrations, one pertaining to each of the two events they had previously seen. For each event, 50 sentences were presented (including 12 inaccurate descriptions (misinformation) and 38 accurate descriptions (i.e. consistent with the original picture slides), and each sentence was shown for 3500 ms with an interval of 500 ms between sentences. The subjects were told that they were to read narrations made by an eyewitness to those events. The subjects were not warned about potential discrepancies between the picture slides and the narrations.

Tests at time 1

After 10 minutes of a filler task, the subjects took the recognition test and then the source-monitoring test (adapted from Okado & Stark, 2005). For the recognition test, 12 critical questions (pertaining to the critical slides) were asked for

each event (i.e. 'you saw the picture slides and read the narrations, please try your best to answer the following questions based on what you saw in the picture slides'). There was no explicit 'warning' that narrations included misinformation. For the recognition test of each event at Time 1, the questions were presented in random order (i.e. not following the chronology of events depicted in the slides). Each question had three possible choices as answers. Choices were either a detail presented in the picture ('original item') or a detail presented in the narrations with misinformation ('misinformation item') or a new foil detail ('foil item'). For example, the subjects might see in the pictures of a man hiding behind a door after stealing a girl's wallet and would then read the narration that he was hiding behind a tree. For the critical question 'Where was the man hiding after stealing the girl's wallet?', the choices were 'behind the tree' (misinformation item), 'behind the door' (original item), and 'behind the car' (foil). The endorsement rates of the original, misinformation, and foil items represented the 'overall true memory', 'overall false memory' and 'overall foil', respectively.

Immediately after the recognition test, the subjects took the source-monitoring test. The participants were asked from what presentation source they remembered the answers they had given on the recognition test. Five options were provided as follows: 'saw it in the picture only', 'read it in the narrations only', 'saw it in both and they were the same', 'saw it in both and they conflicted with each other', and 'guessed'. Critical details in the pictures that were accurately recognized and further endorsed on the source memory test as 'saw it in the picture only' or 'saw it in both and they conflicted with each other' were considered to be 'robust true memories'(RTM). Misinformation items that were further endorsed on the source memory test as 'saw it in the picture only' or 'saw it in both and they were the same' were considered 'robust false memories'(RFM). Foil items that were further endorsed on the source memory test as 'saw it in the picture only', 'read it in the narrations only', and 'saw it in both and they were the same' were considered 'robust foil'. In other words, the source-monitoring test gave the subjects a chance to rethink about the source of their memory. Based on the source-monitoring test, we could affirm whether the subjects really believed that they had seen the misinformation in the original event.

Test at time 2

The follow-up test occurred 1.5 years after the initial study. At Time 2, the subjects saw the same two 50-slide events again (with the same event presentation procedure as at Time 1), except that the presentation of these slides stopped right before each critical slide. The critical slides were not presented. Instead, the participants were asked what had happened in this missing critical slide based on what they had seen 'in the picture slides' one and a half years earlier. For each event, the content and format (i.e. a recognition test with three alternative choices) of these 12 critical questions were exactly the same as the original recognition test used at Time 1. The only procedural difference was that at Time 2, the questions were presented as part of the story, thus following the chronology of events depicted in the slides, whereas at Time 1, the order of presentations of the recognition test was random. The order of events was not counterbalanced at Time 2, because we did not find the order effect at Time 1. The noncritical items were not assessed at Time 2. We used this embedded procedure because the 1.5 years long-term memory of events might be better retrieved under the context of events presentation, possibly eliminating floor effects. All of these tests were self-paced and administered on computers.

The participants were debriefed at the end of the follow-up test. It should be noted that at the end of the original test, the participants were not told that they would be tested again 1.5 years later. Instead, as part of a larger project, these subjects were asked to complete several questionnaires and tested with many instruments during the first phase and were told only that they would be contacted again in the future for more data collection.

RESULTS

The endorsement rates for the true and false items are shown in Table 1. At Time 1, the subjects endorsed 61% of the original items [overall true (veridical) memory], 31% of the misinformation items (overall false memory), but only 8% of the foil items (overall foil). Results showed that the subjects had good memory of the original items (original versus foil), $t_{(341)} = 56.40$, $p < .001$, Cohen's $d = 4.35$, but also a strong misinformation effect (misinformation versus foil) $t_{(341)} = 22.70$, $p < .001$, $d = 1.85$. It should be noted that these results are only for those individuals who completed the tests at both Times 1 and 2. At Time 2 (1.5 years later), the average endorsement rate of the original items was 45%, that for misinformation items was 39%, and that for foil items was 17%. Memory decay was evident as shown by the decreased endorsement rate of the original items, $t_{(341)} = -17.38$, $p < .001$, $d = -1.22$, as well as by the increased endorsement of the foils, $t_{(341)} = 18.76$, $p < .001$, $d = 1.41$. The endorsement of misinformation items also significantly increased, $t_{(341)} = 7.76$, $p < .001$, $d = .55$. More importantly, the misinformation effect was just as strong at Time 2 as at Time 1, (misinformation versus foil), $t_{(341)} = 29.13$, $p < .001$, $d = 2.64$. There was a significant interaction between time (two time points) and item types (original, misinformation, and foil), $F_{(2, 340)} = 283.18$, $p < .001$, partial eta squared = .63, reflecting the opposite trends by item type (decreases in endorsement rates of the original items and increases in endorsement rates of misinformation and foil items across two time points).

The average endorsement rates reported showed persistence of false as well as true memories, but it was not clear how much of the false memory at Time 2 was exactly the same as that of Time 1. After all, endorsement of misinformation items at Time 2 could be due to three sources [persistence of false memory from Time 1, 'new' false memory due to original misinformation or exposure of misinformation item in the test (i.e. sleeper effect or test effect), and random guesses]. Random guesses were controlled for by the use of foil items.[1] To separate persistence of false memory from the sleeper effect of misinformation, we compared the items endorsed at both time points. As shown in Table 1 and Figure 2, we calculated the conditional probabilities of the consistent choices for items on the misinformation test {e.g. conditional probability of the misinformation items = [the number of misinformation items endorsed at both Times 1 and 2 consistently] divided by [the number of misinformation items endorsed at Time 1], Brainerd, Reyna, & Brandse (1995)}. Of the endorsed misinformation items at Time 1 (i.e. overall false memory), 53% were endorsed at Time 2. Similarly, of the endorsed original items at Time 1 (i.e. overall true memory), 53% were endorsed at Time 2. In contrast, only 28% of the foil items endorsed at Time 1 were re-endorsed at Time 2. In other words, there was a strong evidence of persistence of false as well as true memory, significantly higher than the 33% baseline, $t_{(340)} = 17.23$, $p < .001$, $d = .93$, for false memory, and $t_{(340)} = 26.55$, $p < .001$, $d = 1.44$, for true memory; but the persistence of foil was slightly lower than the 33% baseline, $t_{(340)} = -2.60$, $p = .01$, $d = -.14$.

These results were confirmed when we limited our analyses to robust memories [e.g. conditional probability of the RFM = (the number of item endorsed as RFM at Time 1 and then also endorsed as misinformation item at Time 2 consistently) divided by (the number of item endorsed as RFM at Time 1)]. Of the RFM at Time 1, 47% were endorsed at Time 2. Similarly, of the RTM at Time 1, 52% were endorsed at Time 2. In contrast, only 18% of the robust foil items endorsed at Time 1 were re-endorsed at Time 2.

To further understand the decay of long-term true and false memories, we examined the true and false memories that did *not* persist from Time 1 to Time 2, which accounted for about half (47%) of the true and misinformation false memories at Time 1. These changed memories showed similar probabilities of going from endorsing the original items (true memory) at Time 1 to endorsing misinformation items (new false memory) at Time 2 (32%) as from endorsing misinformation items (false memory) at Time 1 to endorsing the original items ('true' memory) at Time 2 (31%). These

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[1] The foil items were selected by Okado and Stark (2005) to be comparable to the true and misinformation items. To further ensure that foil items served as a good baseline in our study, a separate sample ($N = 27$) was recruited and given the recognition test and to guess the responses for each critical slide with no prior exposure to the events. Results showed that the foil items were endorsed 29% of the time, which was not significantly different from random guess (33% of the three alternatives). In other words, endorsement rates of the foil items served as a good baseline. Finally, this conclusion was further confirmed by the random pattern of endorsement among the three options at Time 2 for those who endorsed foils at Time 1 (see text).

Table 1. Average endorsement rate (% and *SD*) at Time 1, consistent choice rate (% and *SD*), and conditional probabilities (% and *SD*) on the misinformation tests

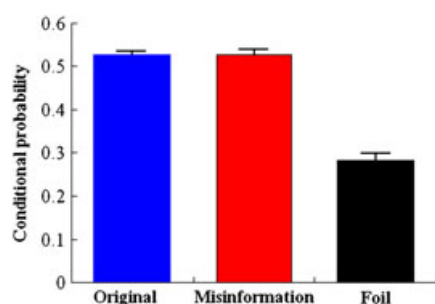|	Time 1		Time 2 after 1.5 years		Consistent choices rate after 1.5 years		Conditional probability of consistent choices	
Overall false memory	31	(17)	39	(9)	16	(10)	53	(21)
Overall true memory	61	(17)	45	(9)	32	(11)	53	(14)
Overall foil	8	(5)	17	(7)	2	(3)	28	(35)
Robust false memories	**13**	(9)	—	—	**7**	(6)	47	(35)
Robust true memories	50	(17)	—	—	26	(11)	52	(18)
Robust foil	4	(4)	—	—	1	(2)	18	(35)

Figure 2. Average conditional probabilities (and standard errors) of the consistent choices for items on the misinformation test

changes were more than twice as likely to occur as those from either true memory to endorsing foils (15%) or from false memory to foils (15%). These results suggested that the traces of true and false memories were similarly strong and both were stronger than that of the foils. Also illuminating were the changes for the foil items. The conditional probabilities were similar (about one-third) for the three choices (i.e. 28% from foils at Time 1 to foils at Time 2, 29% from foils at Time 1 to the original items at Time 2, and 33% from foils at Time 1 to the misinformation items at Time 2). These results suggest that the foil items had a random pattern of changes as would have been expected from well-chosen foils (also see footnote 1).

Another approach for detecting persistence of false memory is to use the individual differences approach. Correlational analysis showed modest but significant correlations for false memory between Times 1 and 2: $r = .15$, $p < .01$

for the correlation between long-term false memory and overall false memory at Time 1; $r = .16$, $p < .01$ for the correlation between long-term false memory and RFM at Time 1. To put these correlations in context, comparable correlations for true memories were .18 between long-term true memory and overall true memory at Time 1 and .16 between long-term true memory and RTM at Time 1 (see Table 2), indicating similar stability in individual differences in true and false memories.

Finally, although tangential to our study, we found modest gender differences for the true and false memories at Time 1. Specifically, males had higher scores than females in false memories (i.e. overall false memory: $F(1, 341) = 4.99$, $p < .05$, $d = 0.24$; RFM: $F(1, 341) = 7.87$, $p < .01$, $d = 0.31$). In contrast, males had lower scores than females for true memories (i.e. overall true memory: $F(1, 341) = 5.98$, $p < .05$, $d = 0.27$; RTM: $F(1, 341) = 7.88$, $p < .01$, $d = 0.31$). No gender difference was found in endorsement rates of the foil items at Time 1 (i.e. overall foil: $F(1, 341) = .21$, $p > .05$; robust foil: $F(1, 341) = .53$, $p > .05$). At Time 2, there were no significant gender differences in long-term memories. (i.e. overall false memory: $F(1, 341) = 2.25$, $p > .05$; overall true memory: $F(1, 341) = 2.38$, $p > .05$; overall foil: $F(1, 341) = .00$, $p > .05$).

DISCUSSION

The current study showed that with a brief exposure to misinformation, false memories were produced and persisted for an extended period. First, the participants endorsed false memory

Table 2. Bivariate correlations among indices of false memories

	LTFM	LTTM	LT foil	OFM	RFM	OTM	RTM	O foil
Time 2								
LTFM								
LTTM	−.68***							
LT foil	−.37***	−.36***						
Time 1								
OFM	.15**	−.14**	−.02					
RFM	.16**	−.12*	−.05	.56***				
OTM	−.16**	.18**	.00	−.94***	−.52***			
RTM	−.12*	.16**	−.03	−.83***	−.42***	.87***		
O foil	.01	−.06	.06	−.26***	−.18***	−.05	−.02	
R foil	.04	−.05	−.02	.09	.10	−.26***	−.22***	.53***

LTFM, long-term false memory; LTTM, long-term true memory; OFM, overall false memory; OTM, overall true memory; RFM, robust false memory; RTM, robust true memory; LT,Long-term; O,Overall; R,Robust; FM,false memory; TM,true memory.
*$p < .05$
**$p < .01$
***$p < .001$

items more than foils 1.5 years after the original exposure. Second, about half of the false memory from Time 1 was maintained at Time 2, at the same rate as true memory. Third, we found significant correlations between false memories at the time of the initial misinformation session (Time 1) and those 1.5 years later. In other words, those participants who had more false memory at Time 2 were the ones who also had more false memories earlier. These correlations, though modest, were similar to those for true memories.

Before we discuss the implications of these results for our understanding of false memories, it is worth pointing out that our design may have underestimated the degree to which false memories persist. First, the foils used at Time 2 were the same as those used at Time 1. Previous research showed that mere memory testing can create false memory because of exposure to alternative choices in the prior memory test (Brainerd & Reyna, 1996). It is conceivable that this phenomenon may be partially responsible for the increase of endorsement rate of foils, which had been seen by the subjects once when they were tested at Time 1.

Second, the recognition test at Time 2 was embedded in the picture slides show (a modification to the original recognition test). Based on the source-monitoring theory, this context should facilitate the memory toward the original picture slides rather than the memory of misinformation from the narrations (Johnson, Hashtroudi, & Lindsay, 1993; Smith & Vela, 2010). It is thus conceivable that if the context for the recognition test had been the narrations, the endorsement rate for misinformation items (which were presented in narrations) would have been higher. Also consistent with this conjecture, previous studies have found that chronologically ordered questions led to fewer misinformation errors than did questions presented in random order (Bekerian & Bowers, 1983). Future research might profitably use both contexts as well as other formats (e.g. context-free recall or recognition) to enhance our understanding of the conditions under which false memories persist. Of course, the use of multiple formats and/or multiple contexts has its own drawbacks (e.g. interference for the within-subject design, needing a large sample for between-subject design).

Future studies should also include one or more (if feasible) control groups which would not receive the post-event misinformation, or would receive accurate post-event information, or would simply participate in testing at Time 2 without taking the memory tests at Time 1, because testing per se might enhance later retention (Roediger & Karpicke, 2006). Other variables that can be examined include the format of studied materials (e.g. sentences for the original event but pictures for the misinformation session as in Davis and Sinha (1950) versus the reverse in our study or the same format for both sessions) and different lengths of delay in follow-up.

Taken together, our study presented evidence that the false memory briefly introduced in an experimental setting seemed to have similar strength of memory trace as true memory. These results are consistent with the source-monitoring framework. In other words, once the initial misinformation was misattributed, its resultant false memory may be similar in strength to true memory strength. Further studies might benefit from including a source-monitoring test at Time 2.

In that case, theoretically, we could better answer the question about whether both true and false memory last regardless of the source of memory. From the fuzzy trace theoretical perspective, the verbatim traces fade more quickly than the gist trace. But we found that the conditional probabilities of consistent choices for memory towards original items and post-event misinformation items are the same. Therefore, we believe the memory for original items and post-event misinformation items are behaving like verbatim traces. So the fuzzy trace theory might be a better explanation for the spontaneous DRM false memory, rather than for the false memory induced by post-event misinformation.

Our results also have implications for the forensic world. Although we used the embedded memory test at Time 2 for several reasons, primarily to reduce floor effects in memory, it may actually resemble the kind of testing that does go on in some real-world settings. In modern real life, the media [e.g. television news reports or video caught by the closed-circuit television (CCTV)] might give the eyewitness some visual information about the original events but not all of the details, which is similar to the 're-experiencing' events presentation we provided to the subjects at Time 2. The police might ask the eyewitness to watch the video caught by CCTV, and the police might pause the video presentation at the critical points and ask questions about the event details which were not caught by CCTV. Based on our findings, we believed, in testimony of victims or witness, it is not appropriate to make assumptions about differences between true and false memory in terms of how long they last, because they seem to have the same strength of memory trace. Our long-term false memory study further illustrates the importance of minimizing post-event misinformation or at least considering the power of such misinformation in creating long-lasting false memories.

ACKNOWLEDGEMENTS

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