

Altering traumatic memory

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Can you experimentally contaminate memory for truly traumatic events? We investigated this question in a study in which 80 Russian participants reported on their memories for one of two terrorist bombings. Half the participants recalled the 1999 attacks on Moscow apartment buildings while the others recalled the 2001 attacks on the World Trade Center in New York. Participants recalled the events on two separate occasions over a six month period. Just prior to the second recall, we strongly suggested to all participants that they had seen a wounded animal in the attacks and had mentioned it in their original memory reports. While none of the WTC group were convinced by the suggestion, 12.5% of the Moscow group did so, and even elaborated with sensory detail (e.g., a bleeding cat lying in the dust). This group was more susceptible to contamination despite the greater emotion that they experienced about the Moscow terrorist attacks. These findings support the notion that even traumatic memories are experimentally malleable.

There has been substantial interest in the malleability of memory. Much work has shown that our memories can be altered, distorted, contaminated or even supplemented by new information that comes along at a later time. Naturally, as with most experimental studies of memory, the events in question are not particularly traumatic. This has prompted the question of whether highly emotional, even traumatic events in life, are similarly susceptible to such experimental alteration.

Brown and Kulik (1977) originally coined the term, “flashbulb memory” to refer to a specific type of memory that is a perfect and permanent mental

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representation of an emotionally arousing event. Some writers have argued that traumatic memories are not readily susceptible to contamination, even taking the stronger position that such memories are immune to contamination. The claim is that they leave some sort of indelible fixation in the mind (e.g., “traumatic events create lasting visual images ... burned-in visual impressions”, Terr, 1988, p. 103; “memory imprints are indelible, they do not erase—a therapy that tries to alter them will be uneconomical”, Kantor, 1980, p. 163). In other words, proponents of this view would predict that experimental attempts to distort genuinely traumatic memory would fail.

There is anecdotal evidence that traumatic memories, like ordinary ones, are sometimes distorted. One frequently cited anecdote involves a highly public baseball tragedy (Anderson, 1990). Baseball aficionados may recall that Jack Hamilton, then a pitcher with the California Angels, hit the outfielder, Tony Conigliaro, in the face with a first-pitch fastball. Although Hamilton thought he remembered this horrible event perfectly, he misremembered it as occurring during a day game, when it was actually at night, and misremembered it in other critical ways.

There is other anecdotal evidence that very traumatic memories can be created in people. One of the most compelling such case resulted in litigation brought by a patient against her former therapist (Grumman, 1998; Holden, 1998). Patricia Burgus sued her former psychiatrist, Dr Bennett Braun for malpractice. According to news accounts and court records, Dr Braun used “repressed memory therapy, including hypnosis” (Holden, p. 6), which resulted in Burgus coming to believe that she was the high priestess of a Satanic cult. Moreover, she would come to remember such atrocities as eating thousands of babies in a year’s time. Despite the absence of bones, missing person’s reports, and any evidence, Burgus clung to these beliefs. Eventually, her lawsuit, also brought on behalf of her children, then aged 4 and 5 years, who had spent years in a psychiatric ward, brought a settlement that exceeded 10 million dollars.

One obvious problem with anecdotal evidence is that there usually is no way to verify the accuracy of the story (Loftus & Goyer, 2002a, 2000b). In the case of pitcher Hamilton, stories are told of his misremembering, but few have access to any “original data”. In the case of Patricia Burgus, medical records and other evidence do suggest that she really adopted the false beliefs and memories, but there remains the possibility, however small, that she never truly held this bizarre set of beliefs. One other consideration in the typical anecdotal report is that the change in memory that is assumed to have occurred came about either spontaneously (as in the Hamilton example) or through therapeutic suggestion (as in the Burgus example). These did not involve a deliberate controlled experimental attempt to bring about that memory distortion.

There is also evidence of a less anecdotal, more experimental nature that supports the imperfections of personally experienced traumatic memories. The well-known study of people’s recollections of how they heard the news of the

1986 explosion of the space shuttle *Challenger* is an example (Neisser & Harsch, 1992). Participants answered questions shortly after the explosion and again nearly three years later. More than one third were inaccurate. One participant, for example, learned the news from her best friend and later recalled learning it from television. A more recent study by Morgan and colleagues (2002) examined the memories of active duty military personnel who had gone through highly traumatic survival school training. Later many of them made errors when they tried to remember the individual who was primarily responsible for their torment. In both the Neisser and the Morgan studies, errors of traumatic memory were evident, but in neither study was there a deliberate experimental attempt to contaminate the traumatic memory.

There are a few important studies that did successfully use a leading question to plant a false suggestion into memory for a traumatic event (Crombag, Wagenaar, & van Koppen, 1996; Granhag, Stromwall, & Billings, 2002; Ost, Vrij, Costall, & Bull, 2002). In the Crombag et al. study, the traumatic event was the crash of an El Al Boeing 747 into an apartment building in Amsterdam, which occurred in October 1992. The plane crashed into an 11-story apartment building, killing the four crew members aboard the plane and 39 people inside the building. While no television crews filmed the actual crash, they did film the resultant fire and the rescue of survivors from the building. For several days this was the top news story, and virtually everyone in the country knew about it.

Ten months after the crash, the Dutch subjects were questioned about their memories, including a leading question that presumed that the moment of the crash had been shown on TV: "Did you see the television film of the moment the plane hit the apartment building?" If they responded in the affirmative, they answered follow-up questions such as whether they could remember how long it took for the fire to start. Of 107 respondents, more than half (55%) claimed to have seen the fire start. Of these, 59% said the fire started immediately upon impact, 23% said it took a little while, and only 18% said they could not remember. In a second study, an even larger proportion (66%) of respondents said they had seen a TV film of the crashing plane. Many reported highly specific memories (e.g., the plane was already burning when it crashed, that it hit the building horizontally, that it disintegrated after impact) that they could not have seen. The true facts were discussed in later news coverage: The fire actually started immediately, the plane crashed nose down and almost vertically, and the body of the plane fell to the ground. Of course, these facts could not have been personally witnessed, and if the subjects had taken the time to contemplate, they would have realised how improbable it was that the crash moment would have been captured on television. Nonetheless, this study documents the malleability of traumatic memories. Crombag et al. (1996) speculated that dramatic events may be even more vulnerable than ordinary events to post event influences, because they are often highly publicised and by their very nature may more readily evoke visualisation, thus interfering with our "source

monitoring” capabilities. They did not manipulate the extent of trauma. Nor did they have an experimental manipulation that would have revealed whether it was the leading question that prompted the false recall, or whether it occurred through autosuggestion or some other process.

In more recent work, Ost et al. (2002) replicated the main findings of Crombag et al. (1996), this time using the Paris car crash that claimed Princess Diana’s life. Nearly half (45%) of the British sample reported that they had seen a nonexistent film of the car crash.

In another recent study, Granhag et al. (2002) asked participants to read descriptions of film coverage of two disastrous events (the 1993 airplane crash at an air show in Stockholm and the 1994 sinking of the *Estonia*). There was actual film coverage of the air crash, but not of the sinking. The description of the nonexistent film of the *Estonia* was as follows:

One night in September 1994, the ferry *Estonia* sank and over 850 people lost their lives. One of the marine helicopters came first to the scene of the accident. One of the rescue divers on the helicopter video-filmed the last pictures of the *Estonia*. On the short film, one can see how the ferry is standing almost vertically, prow up, and sinking slowly. Around the sinking ship, one can see a number of yellow rubber rescue boats drifting around in the rough sea.

After reading each of the film descriptions, participants answered questions about that event. Participants were told that each of the disasters was broadcast on television. They were later asked: “Did you see the film?” for each event. While 76% of participants claimed to have seen the actual film of the air crash, 38% claimed to have seen the nonexistent film of the *Estonia* sinking. In a second study, experimental and control participants were handed the same *Estonia* description and questionnaire as used in experiment 1. Experimental participants read the description and then overheard a confederate exclaim: “*Estonia*—of course, I remember that film!” (positive social influence) or “*Estonia*—I can’t remember such a film!” (negative social influence). Control participants received no social influence. As expected, in the positive social influence, more participants claimed to have seen the nonexistent *Estonia* film (76%), than in the negative influence (36%). Controls were right in the middle (52%). These findings demonstrate the power of social influence in the formation of false memories for traumatic events.

Taken together, the Crombag et al. (1996) study and those of Ost et al. (2002) and Granhag et al. (2002) indicate that it is possible to convince people that they had seen footage of traumatic events that they could not possibly have seen. In some cases, this was accomplished by describing the film, while in other cases, the distortion appeared to be caused by a leading question that suggested the existence of such footage, for example: “Have you seen the paparrazi’s video-recording of the car crash in which Diana, Princess of Wales, and Dodi Fayed lost their lives?” (Ost et al., 2002, p. 129). We say “appeared to be caused”

because the question format was not experimentally manipulated, so no strong causal arguments can be made. We only know that distortions in memory for a traumatic public event do occur, and we know a bit about some factors that affect the degree of such distortion.

To our knowledge, only one study, an unpublished doctoral dissertation (Abhold, 1995) has demonstrated the experimentally induced malleability of memory for a serious life-and-death situation. High-school students had attended a football game at which a player on the field went into cardiac arrest. Attempts to resuscitate the player appeared to fail, and many students thought he had died (although he was later revived). Reactions ranged from complete silence, to sobbing and screaming. Six years later, many of these students were interviewed, and some were exposed to misleading information (blood on the player's jersey) about this traumatic event. More than a quarter of the students accepted the misinformation. This single study does show that experimental contamination of traumatic memory is possible. The delicacy of conducting such work (e.g., deliberate contamination of memories of those who have suffered) has probably been responsible for the dearth of additional research along these lines.

To address these issues and provide data to fill the aforementioned gap in the literature of memory malleability, we attempted to plant false information into memory for a truly traumatic event. We used a unique opportunity to examine memory for two different traumatic events that were personally and historically significant. The first critical event involved two separate terrorist bombings that occurred in two Moscow apartment buildings, one on 9 September 1999 (at midnight), and another on 13 September 1999 (at 5:05 am). The second critical event involved the terrorist attacks on the World Trade Center (8:45 am and 9:03 am) in New York City on 11 September 2001. The Moscow attacks claimed 233 lives, while the World Trade Center (WTC) attacks claimed nearly 3000 lives. We hypothesised that the two critical events would differ for the Russian sample used in this study. The Moscow attacks should be highly personally relevant to the Russian sample, but these same attacks were likely not of great historical significance. Conversely, the WTC bombings should be less personally significant to the Russian sample, but were likely of great historical importance.

We attempted to plant a false memory for having witnessed a wounded animal as part of the critical event. Such a manipulation could have one of four possible outcomes. Those who believe that truly traumatic memories are immune to such suggestive manipulation might predict that neither the group remembering the Moscow bombings nor the group remembering the WTC bombings would accept the suggestion. Those who believe that all memory is highly susceptible to strong suggestion might predict that both groups would fall sway to the suggestion.

There is also reason to predict that the Moscow bombings group would be less susceptible to suggestive contamination. If the event is much more per-

sonally significant, it might be more rehearsed, and it might be stronger, rendering it more resistant to alteration (Loftus, 1979/1996, pp. 130–131).

On the other hand, there is also reason to predict that the Moscow bombings group would be more susceptible to memory distortion. The critical event in question occurred much earlier in time (three years before the suggestive manipulation vs. one year before). Older memories have been found to be more susceptible to contamination (Loftus, Miller, & Burns, 1978), perhaps because they have diminished strength. Thus, it is possible that the older memory for the Moscow bombings would be weaker than that for the WTC disaster. As such, the older memory would be more prone to alteration.

METHOD

Participants

The participants were undergraduate students from Moscow State University in Moscow, Russia. In the first session, 91 individuals completed a questionnaire. In the second session, 80 returned to complete a new set of questions. These included 62 females and 18 males, with a mean age of 22.6, $SD = 0.94$.

Materials and procedure

Session 1 was conducted in March 2002, approximately 6 months after the World Trade Center bombings, and approximately 2.5 years after the Moscow bombings. During this session, participants filled out a questionnaire designed to induce them to recall and write about these tragedies.

Session 2 was conducted in late September and October, 2002, thus approximately a half year after Session 1. During Session 2, 40 participants were randomly assigned to answer questions about the WTC bombings (WTC Memory group), and 40 to answer about the Moscow bombings (Moscow Memory group). For their assigned event, they rated their memories using a 5-point scale that ranged from 1 (very low) to 5 (very high). They rated the event in terms of its personal significance, for example: “How significant was the event to you personally?” [translated from Russian]. They also rated the event in terms of historical importance, how emotional they were at the time of the event, and how emotional they are now about the event. These key ratings were embedded amongst a set of 12 items. Participants also described their emotional reaction to the critical event, in their own words.

The attempt to contaminate memory occurred in Session 2, and was accomplished by asking this question: “A half year ago, when you were taking part in our study you mentioned a wounded animal. Do you remember it?” They were asked to provide as much information as they could remember.

RESULTS

Ratings of WTC vs. Moscow

One possible outcome was that the Moscow memory would be less malleable because of its great personal significance for this sample. To check that our Russian participants did find this event to be of greater personal significance, we conducted *t*-tests comparing the two groups. Indeed, we found that the Moscow Memory participants rated the event as more personally significant than did the WTC Memory participants during both sessions: 2.95 vs. 1.85 for Session 1 $t(78) = 5.23$ and 3.48 vs. 1.5 for Session 2 $t(78) = 9.07$, $p < .01$ for both. By contrast, the Moscow Memory participants rated the event as less historically important during both sessions: 2.33 vs. 4.13 for Session 1 $t(78) = 9.75$ and 2.65 vs. 3.75 for Session 2 $t(78) = 5.78$, $p < .01$ for both.

In terms of emotional ratings, the Moscow Memory participants rated their emotions in the past as being stronger than did the WTC Memory Participants during both sessions: 4.25 vs. 3.65 for Session 1 $t(78) = 3.33$, $p < .01$ and 4.2 vs. 3.80 for Session 2 $t(78) = 2.54$, $p < .05$. They also rated their emotions now as being stronger during both sessions: 3.08 vs. 2.50 for Session 1 $t(78) = 2.56$, $p < .05$ and 3.50 vs. 2.38 for Session 2 $t(78) = 5.41$, $p < .01$.

To determine the consistency in ratings between the two sessions, we computed correlations between Session 1 and Session 2 ratings for each of our four variables of interest (personal significance; historical importance; emotions in the past; emotions now) for both the WTC and Moscow Memory Groups. The average intercorrelations were .18 for the Moscow Memory Group (Range = $-.11$ to $.48$) and .11 for the WTC Memory Group (Range = $-.17$ to $.43$). Thus, ratings during the two sessions were not very consistent for either group.

Not only did the Moscow Memory participants express stronger emotion, but they also characterised their emotions differently. Moscow Memory participants commonly expressed emotions, such as fear and empathy. WTC Memory participants commonly described the event using more cognitive terms, such as disbelief and astonishment.

So we did indeed find that the Moscow Memory participants regarded the event to be of greater personal significance, and one in which they experienced stronger emotions, both past and present. Would this make the event less prone to contamination?

(False) memory for a wounded animal

None of the participants in either group mentioned a wounded animal during Session 1. However, after receiving the strong suggestion that they had mentioned this detail, five Moscow Memory participants (12.5%) accepted the suggestion that they had seen and previously recalled a wounded animal during

the Moscow bombings. In contrast, none of the WTC Memory participants accepted this suggestion ($\chi^2 = 5.0, p < .05$). While 12.5% is not large, it does show that it is possible with only a small suggestion to create aspects of memories for a traumatic event like the Moscow bombings. This small suggestion, however, failed to make anyone report a wounded animal at the WTC.

When describing the “wounded animals” three participants imbued the scene with elaborate sensory detail. One recalled an “absolutely crazy dog, barking and rushing around police officers”. Two others described “a lost parrot in a cage”, and “a bleeding cat, lying in the dust”. A fourth recalled “a broken glass, that could be a fragment of a home aquarium”. The final individual reported that he did indeed remember an animal, but his image was vague, and he gave no further details.

Who falsely remembers?

To gather further information about the five individuals who fell sway to the suggestion about a wounded animal, we separately calculated their ratings of personal significance and other aspects. We found that the “wounded animal believers” (i.e., false memory participants) rated the personal significance of the Moscow bombings as substantially lower than did those who resisted the suggestion (2.0 vs. 3.69) $t(38) = 3.64, p < .01$, despite the two groups being similar during Session 1 (3.2 vs. 2.9) $t(38) = 0.64, p > .1$. Moreover, they rated the historical importance as higher than did their non-misled counterparts (3.8 vs. 2.49) $t(38) = 3.50, p < .01$, despite the two groups being similar during Session 1 (2.8 vs. 2.26) $t(38) = 1.67, p > .10$. In terms of emotional ratings, the “wounded animal believers” and the “resistors” rated their past and present emotions similarly both during Session 1 and Session 2 (t -values all < 1.0).

Thus, the individuals who accepted the wounded animal misinformation and those who resisted the misinformation in the Moscow Memory group rated the personal and historical importance of the attack similarly during Session 1, but the two groups’ ratings diverged during Session 2. Despite these rating differences during Session 2, the two groups had similar emotional ratings both during Session 1 and Session 2 (and both groups expressed greater emotion than did the WTC Memory group). So the particular set of participants who succumbed to the wounded animal suggestion happened to be a group that found the Moscow event to be less personally relevant, but still they were emotional about it. This contradicts the hypothesis that greater emotionality would protect the event from contamination.

DISCUSSION

We began this project with a simple question: Can you deliberately plant false details into truly traumatic memories? We attempted to convince participants that they had seen a wounded animal as part of their memory for a tragic

bombing. We found a minority of participants fell sway to the suggestion and claimed to have seen a wounded animal, but only when we asked about the Moscow bombings, and not about the WTC bombings.

Our finding contradicts an often-asserted claim that traumatic memories are immune to such suggestive influences. Moreover, we showed that we could alter memory for an event about which participants reported strong emotion. The suggestion appears to have led to the planting of a false memory, and for some individuals one that is quite detailed.

One potential challenge to this claim is that perhaps this is not a false memory. Perhaps there were wounded animals around the Moscow collapsed building, and participants saw them even if they did not mention them in their time 1 reports. We regard this as unlikely. We checked Internet sites and television archives and found no evidence of wounded animals.

The greater malleability that occurred with the Moscow bombings fits with other research showing that older memories are more susceptible to contamination. The idea is that as a memory is weakened, there is less likelihood that people will notice a discrepancy between the suggestive information, and what they have readily available in memory. So the time factor could have contributed to the greater susceptibility we saw here in the Moscow Memory group (although see Kvavilashvili, Mirani, Schlagman, & Kornbrot, 2003).

There is at least one possible reason why only the Moscow Memory group accepted the suggestion and no participants in the WTC Memory group did. That is, we planted a suggestion about an animal. Animals are more likely to be seen in residential settings such as the setting for the Moscow bombings. Pets are far less likely to be seen in commercial settings. In that sense one could say it is rather implausible that animals would be seen, and some work on memory malleability indicates that it is easier to distort memory if the distorting information is plausible (Pezdek, Finger, & Hodge, 1997).

We acknowledge a drawback in our procedure. We chose the two critical events because they were both highly tragic terrorist attacks, and they happened to have both occurred in September, albeit separated by two years. For our Russian sample, the critical events differ in numerous ways. One is an older memory and more personally relevant. The other is more recent, and more historically important (see Smith, Bibi, & Sheard, 2003). One occurred in a residential setting where the planted false information was more plausible. The two events also differed in terms of the kind of post event media coverage that appeared. As is well known, there were television cameras at the WTC and images of the collapsing towers were widely disseminated. While 60% of Americans reported watching these events occur live on TV and over 99% watched some TV during the week following the attack (Silver, Holman, McIntosh, Poulin, & Gil-Rivas, 2002), it is unknown what the corresponding percentages are in Russia. We do know that some of the same "live" images of the WTC were repeatedly available. By contrast, there were no cameras at the

Moscow apartment bombings, so Russian citizens had only still images of the ruins to view in the aftermath. It would be ideal if in future research these various event differences could be minimised to help determine which factors are truly at the root of responsiveness to suggestive misinformation for a traumatic event.

Finally, it is worth noting that despite our ability to plant a false detail into a traumatic memory, we succeeded with only a minority of subjects. Thus, the vast majority resisted the suggestion, despite our attempt to convince them that they had even mentioned the detail earlier. While the WTC Memory group may have done so because of the low probability of the specific details that we suggested, this does not explain the wide resistance that occurred in the Moscow Memory group. This observation points to the need to develop theories of when people are vulnerable to such suggestions that contaminate autobiography and when they are resistant.

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