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This prominent team of Dutch researchers was among the first to show that every second witness can easily be made to claim falsely to have witnessed a whole, complex and highly emotional event. We confidently claim to have seen what we have not – our memory crashes. The method was simple yet highly innovative and has inspired many other researchers to follow. The paper brings out clear and important applied implications, the findings are explained by the use of a cognitive theory, and it is provocative: Psychology at its best. The paper is ACP trademarked

Crashing Memories and the Problem of ‘Source Monitoring’

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SUMMARY

We demonstrate that it is relatively easy in a real life situation to make reasonably intelligent adults believe that they have witnessed something they actually have not seen themselves, but only heard reports about from others, and to make them report about particular details of the event. The event concerns the crashing of an El Al Boeing 747 on apartment buildings in Amsterdam. Over sixty per cent of the subjects said they had seen the crash on television, although no television film exists. Unexpectedly, women proved themselves significantly more vulnerable to this effect than men.

Reports by eyewitnesses are among the most important types of evidence in criminal as well as in civil law cases. Many cases are decided exclusively on the basis of eyewitness testimony. It is therefore disturbing that such testimony is often inaccurate or even entirely wrong. Errors may originate at the moment of perception and storage, during retention, and/or at the time of retrieval. At the moment of perception the witness may not see or hear everything there is to see or hear, or, alternatively, fail to store significant parts in long-term memory. The difference between these two theoretically distinguishable possibilities, however, is moot as we are not able to distinguish between them empirically.

A similar problem occurs when we try to distinguish empirically between three theoretically possible sources of errors during retention. During retention, (a) a witness may simply forget what was perceived, (b) information from another source—post-event information—may replace part of the already stored information, or (c) be added to it. The fact that forgetting does occur and that retention time is an important—but by no means the only—factor influencing forgetting, hardly needs documentation (Baddeley, 1990; Cohen, 1989). Memory distortion through post-event information is also a well-established fact since Elizabeth Loftus (1979) did her well-known experiments on the topic. Many other

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experiments have followed suit, documenting time and again that 'people have recalled nonexistent broken glass and tape recorders, a clean shaven man as having a mustache, straight hair as curly, and even something as large and conspicuous as a barn in a bucolic scene that contained no buildings at all' (Loftus, 1993).

In all these studies the experimenters know how (in)accurate their experimental subjects were, because they knew the experimentally created truth. In real life, however, the distinction between things not perceived or not stored, and things forgotten, changed or added is largely moot, because there is no way to distinguish between them empirically. Most of the time we cannot even distinguish between forgetting, memory distortion and lying, because we do not know the truth. We can often only surmise that something is wrong in an eyewitness report. However, even in real life we can sometimes catch a witness at a mistake or a lie, because we just happen to know the truth from an independent source. This was the case in the two studies reported here.

The fact that it is easy to distort the recollections of experimental subjects we know mostly from laboratory studies. To what extent is distortion possible? In her earlier writings on the subject Loftus (1979) says that peripheral aspects of an event are more vulnerable to post-event information than are central aspects, and that the memories for dramatic events are less vulnerable. More recently, however, some evidence was offered that the central features of highly dramatic events can also be changed by post-event information. Haugaard, Reppucci, Laird and Nauful (1991) reported that children aged four to seven could be led to believe that they had themselves witnessed a girl being hit by a man after they heard the girl lie about it. Pynoos and Nader (1989) reported that children could be brought to testify about a sniper attack that had actually taken place in the playground of their (elementary) school, but which they themselves had not witnessed. In both these studies the children were not without information about the event they reported. In the experiment by Haugaard *et al.* they had been told by the girl, who was an experimental confederate. In the Pynoos and Nader study the children had not only obtained information from their classmates who had actually witnessed the incident, but probably also from many others, e.g. their parents, who in turn had hearsay knowledge about the event from the media. Although children are more sensitive to suggestion than adults, there is no particular reason to believe that the influence of suggestion on adults works through different mechanisms.

In most cases in which post-event information distorts the original recollection of a witness, hearsay information is mixed with first-hand information. The hearsay information may be implanted intentionally or unwittingly and be either true or false. We add that the false information to be implanted probably must have some *prima facie* plausibility. For example, one can probably insert a non-existing dog into the memory of a witness of a bank robbery by asking the witness during interrogation, 'Do you think you were momentarily distracted by the dog that crossed the street the moment the two men entered the bank?' (This is how post-event information is usually implanted in real life as well as experiments, as part of a question asked.) However, by substituting 'camel' for 'dog' in this question one would probably not succeed in inserting a non-existing camel into a witness's memory, assuming the scene is set in Amsterdam. If this is true, it may be said that memory distortion during retention most of the time results from hearsay information of *prima facie* plausibility. In the present study the misinformation is

not about what happened, as in the Loftus-type studies, but about the source of the subjects' knowledge. We will suggest that they saw an air crash on television, while in reality no such film exists. It can be expected that this type of misinformation will have a stronger effect than the misinformation about the event itself, because source awareness can be fairly low, even when the event is well remembered (Johnson, Hashtroudi, and Lindsay, 1993).

There is another major source of post-event information—common sense inference (Wagenaar, Van Koppen, and Crombag, 1993). Common sense and common sense inference tell us what is probably true most of the time in more or less familiar situations. In this context Cohen (1977) spoke of 'common sense presumptions'. When we give an account of an episode we have witnessed, it is difficult for us to distinguish between what we have actually witnessed, and what common sense inference tells us that must also have been the case, or, as Johnson and Raye (1981) put it, to distinguish between memories produced by 'perception of external stimuli' and those produced by 'thought'. In their analysis of 'reality monitoring', Johnson and Raye distinguish between these two sources of memories, not mentioning that hearsay or instruction is yet another source of memories. In a recent article, however, Johnson *et al.* (1993) do mention this third possibility. In daily life, to act on knowledge obtained by common sense inference or from others is most often the sensible thing to do, but the law of evidence in so many words forbids the trier of fact to decide a legal case on the basis of anything but first-hand, perceptual information.

It finally should be noted that the two sources of post-event information—hearsay and common sense inference—may conspire in distorting an eyewitness's memory; a witness may concoct a mixture of real observations with hearsay information and what he unwittingly infers from the information from the other two sources.

The two studies reported here are real life demonstrations that adults of probably more than average intelligence can, by very simple or rather crude means, be brought to believe that they witnessed with their own eyes a very dramatic event about which they have only heard and read reports in the media, and to testify, with some confidence, as to some aspect of what they mistakenly thought they had observed. The data will, moreover, indicate that these witnesses in their testimony combine real observations with hearsay information and common sense inference based on these two sources of information.

TWO REAL LIFE STUDIES

On 4 October 1992 a cargo plane of El Al lost both starboard engines shortly after take-off from Amsterdam Schiphol Airport. The aircraft, a Boeing 747, is supposed to be able to fly on two engines, even if these are both on the same wing, but this is known to be very difficult. The crew decided that the best they could do under the circumstances was to return to the airport. They took a wide turn over the city of Amsterdam to come in line for one of the runways. The plane did not make it; over the southern suburb of Amsterdam known as the Bijlmermeer it had lost too much height and at 6.28 pm it crashed into an 11-storey apartment building. Part of the building collapsed and a tremendous fire broke out immediately. The 4 crew members aboard and 39 people in the building were killed. When these figures

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became eventually known, in a sense they came as a relief, because shortly after the crash it was feared that more than 200 might have been killed.

Of course, the media reported extensively on what was justly considered a national disaster. Within the hour all television networks had crews in place, filming the fire brigade fighting the blaze and rescuing people from the still further collapsing building. They also showed people milling about in search of their families, friends and neighbours. For days the disaster was the number one item in all the news media. The story of what had happened was told again and again, illustrated with what film there was available. Eventually probably everyone in the country knew, or thought they knew, in great detail what had happened. Because very few people had witnessed the actual crash and because, of course, there was no TV film of this moment either, the most important part of the story in virtually everybody's mind must have been based on a mixture of hearsay and inference.¹

Since the crash was an intensely shocking event, the remembrance of a filmed account may be comparable to the so-called flashbulb memories of Kennedy's assassination or the explosion of the *Challenger*. There is one major difference, however. In the typical flashbulb memory studies, subjects are asked how they first learned about the event, which forces them to critically consider the possibilities. Instead, we asked whether they had seen the TV film, which may have created a less critical attitude. Therefore it can be expected that the accuracy is less than that usually found in flashbulb memory studies, which is already not particularly high (see Wright, 1993).

STUDY 1

Method

Ten months after the event, in August 1993, we first questioned 193 people about the crash. The respondents were a mixed group of students and members of the teaching and administrative staffs of our faculties and institutes. They were chosen merely because they happened to be easily available to us at the time. Virtually all our respondents either held an MA or higher degree or were working for one of those. They therefore probably all belonged to the upper half of the intelligence distribution and may be taken to have easily understood the simple questions we put to them. There were 97 male and 96 female subjects. They were all given a one-page questionnaire in Dutch. It began with reminding them of 'last fall's' disaster, in which an Israeli cargo plane crashed into an apartment building in the Bijlmermeer. It continued: 'We want to test your memory for a particular detail of this disaster. The test question is preceded by three factual questions'.

The first two questions concerned the respondents' gender and age. These were mainly asked to get the respondents into an answering mood. They were followed by the key question of the study that, however, was presented as one of the 'factual questions':

¹To make up for the absence of TV film of the real event, some networks showed a schematic computer animation of the movements of the plane between take-off and the moment of impact. This computer animation, however, did not show how the plane crashed.

Did you see the television film of the moment the plane hit the apartment building?

To answer the respondents could choose between 'yes' and 'no'. The question of course, contains the false information that this film had been shown on TV. This method of planting false information has been used many times before, e.g. by Loftus (1975).

Only those who had answered the question affirmatively were then asked to proceed to what was called the 'test question', which ran as follows:

After the plane hit the building, there was a fire. How long did it take for the fire to start?

The respondents were given a choice out of three answers:

- a. The fire broke out (almost) immediately.
- b. It took a while, namely ____ seconds/____ minutes.
- c. I don't remember.

Results

As already indicated, the third question was the key question. How many of our respondents could be lured into saying they had actually witnessed the plane crashing? Such a film was never shown on television and it seems easy for people to realize that it would have been very improbable that some cameraman had happened to be in place to record it.

Nevertheless, 107 of our respondents, i.e. 55 per cent, confirmed that they had seen the event, and proceeded to answer the next question concerning the time it took for the fire to start, which virtually everybody had seen repeatedly on television, although not the beginning of it. Of those 107 respondents, 63 (59%) said the fire started immediately upon impact, 24 (23%) said it took a little while (range 2/30 seconds), and 20 (18%) said they could not remember. So more than half of our subjects erroneously reported having witnessed something they had only heard about, and of those 82% did not choose the prudent and readily available alternative 'I don't remember', but felt confident enough to report on a detail.

One more and surprising thing remains to be reported; women answered significantly more often than men that they had seen the plane crashing ($\chi^2 = 11.6$, $df = 1$, $p < 0.001$). Without further knowledge about the underlying processes, this result is difficult to interpret. It may be that women are more suggestible than men, but it is also possible that women watch more television, and therefore find it more easy to assume that they have seen a particular film.

STUDY 2

We were not really surprised that some of our respondents could be misled by false post-event information. What did surprise us was that we succeeded with the

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majority of our respondents. A little thinking would have made them realize that the planted information was highly improbable. Indeed, many—but not all—of those who were not fooled must have realized that the planted information could not possibly be true, and some actually said so.

Encouraged by the unexpected magnitude of our success we decided to become bolder with a new group of respondents. This time we asked not only about having seen the film of the crash, but also whether they remembered a number of visual details. This corresponds to asking the witness of a crime not only whether she has seen it, but also what she saw. Such a question may assist a witness in realizing that she actually has not seen the event; but, if answered, it provides evidence for a stronger illusion than the mere belief of having seen a film.

Method

The subjects were 93 law students from the University of Nijmegen; 35 (38%) were male, 58 (62%) female. Ninety per cent of them were younger than 25 years. The introduction now stressed that this task was an illustration of memory failure. Then they were given a questionnaire of nine questions. The first six were labelled 'biographical questions':

1. What is your age?
2. What is your gender?
3. Were you in the country when it happened?
4. Have you seen the TV film showing the plane crashing?²
5. Did you know any of the victims personally?
6. Do you know the local situation through an actual visit to the location?

The question planting the false information is formulated in somewhat bolder terms than in Study 1, but it is better hidden among the other questions.

The 'biographical questions' were followed by three more questions labelled 'memory questions', to be answered by choosing one of the given alternatives:

7. When the plane crashed
 - a. it was already burning
 - b. it wasn't burning, but it caught fire upon impact
 - c. it wasn't burning yet and it took several minutes before the fire started
 - d. I can't remember.
8. The plane
 - a. came down vertically, nose up and almost without forward speed
 - b. came down vertically, nose down and almost without forward speed
 - c. hit the building flying almost horizontally and at considerable speed
 - d. I can't remember.
9. After the plane hit the building
 - a. parts of the plane's body stuck out above the building
 - b. the plane's body fell to the ground

²The Dutch word for 'film' is also *film*.

- c. the plane's body disintegrated
- d. I can't remember.

At this point it must be noted that those who said they had not seen the TV film were not discouraged to answer the memory questions, as was done in Study 1. Of course, if all our respondents had taken the name 'memory questions' literally, they would not have answered them. Yet, some of those who said they had not seen the film thought they could answer these questions anyhow. We shall return to this.

Results

One of the subjects said she did not live in the Netherlands at the time of the disaster (question no. 3) and was discarded as a subject. None of our respondents said they had personally known any of the victims (question no. 5), and a single respondent indicated that he had at one time visited the location (question no. 6). For each subsequent question some respondents failed to answer, but for no questions were there fewer than 89 respondents.

The main result of Study 2 is that this time an even larger proportion of the respondents (66%) said they had seen the TV film of the crashing plane. Being students of law these respondents may be inexperienced with psychologists' trickery, but they are certainly not stupid or naive. The somewhat longer time lapse may account for the increase (cf. Neisser and Harsch, 1992; Wright, 1993), but of course not for the strength of the illusion.

Let us first see how precisely the subjects testified. Table 1 shows the answers to the 'memory questions'.

Since none of our respondents actually saw the plane crashing, one would expect that most of our respondents would be hesitant to answer pertinent questions and

Table 1. Answers to questions in percentages

	'Saw TV film' %	'Did not see TV film' %
Question no. 7: When the plane crashed	<i>n</i> = 61	<i>n</i> = 30
a. It was burning already	23	10
b. It caught fire upon impact	41	53
c. It took several minutes for the fire to start	3	0
d. I can't remember	33	37
Question no. 8: The plane hit the building	<i>n</i> = 61	<i>n</i> = 30
a. Vertically, nose up	2	3
b. Vertically, nose down	8	13
c. Horizontally	67	53
d. I can't remember	23	30
Question no. 9: After impact	<i>n</i> = 61	<i>n</i> = 31
a. The body stuck out above the building	3	6
b. The body fell to the ground	18	10
c. The body disintegrated	28	39
d. I can't remember	51	45

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prefer the prudent answer 'I can't remember'. But they did not. Not only did most of them tell us, as in Study 1, how long it took for the fire to start, but also how the plane hit the building and what happened next. But equally remarkable is it to realize that many of our respondents gave the wrong answers. As far as we know the fire started immediately, the plane crashed nose down and almost vertically and the body of the plane fell to the ground. Many of these facts were covered in the subsequent news coverage, but apparently these subjects had formed images of their own.

Most of the subjects who answered question no. 7 chose the correct and common sense option that the plane caught fire upon impact. But to question no. 8, most subjects chose the wrong option, i.e. that the plane hit the building while going more or less horizontally. At first sight this may appear to be the more plausible alternative, but the two actual eyewitnesses that we have questioned about it told us that, according to them, the plane seemed to fall more or less vertically from the sky, the answer that only 11% of our respondents gave. As far as we know the media were silent about the precise angle of impact. The erroneous belief may stem from a well-known movie, in which an aircraft hits a sky scraper building about halfway.

Only when they came to answer question no. 9, did half of our respondents finally opt for the safe answer: I can't remember. Much of the aircraft was recovered and did not disintegrate, although substantial parts were burned in the ensuing fire. Yet most of those who said they remembered believe that the body disintegrated upon impact, which may be what common sense suggests.

You do not have to have witnessed the plane crash to think that you are able to answer the questions. In fact, as the data in Table 1 show, knowing they have not been eyewitnesses does not make our respondents any less inclined to answer questions about details of what happened. The differences never did reach significance ($\chi^2=0.10$; $\chi^2=0.51$; $\chi^2=0.28$; $df=1$). Also, the distribution of responses in the two groups, as shown in Table 1, never reached significance ($\chi^2=3.60$; $\chi^2=1.85$; $\chi^2=2.30$; $df=3$).

Finally, it remains to be reported that also in Study 2 we found a significant gender effect ($\chi^2=4.8$, $df=1$, $p<0.05$), indicating that our female subjects were more often misled by the false information embedded in question no. 4 than our male subjects. So we have an independent replication of this unexpected outcome, although the source of this result remains to be further investigated.

GENERAL DISCUSSION

In daily life most often the important thing is to get it right. For this, 'source monitoring'—i.e. keeping track of where our knowledge originated from—is usually not necessary. Indeed, most of what we know, we came to know because someone else told us. Most of our knowledge is hearsay knowledge. Sometimes the reliability of some piece of hearsay knowledge is problematic. This happens when another source says differently or when the information lacks *prima facie* plausibility, i.e. does not appear 'logical' in the light of common sense inferences based on prior knowledge. The common sensical but often incorrect nature of many of our subjects' responses suggests the real source of their 'knowledge'. Obviously, they have not seen a film. They must also have paid little attention to the lengthy reports in the media. Instead they seem to have imagined the various scenes using their common

sense. These images have become very real to them, and since to many subjects the source of these images was not obvious, the suggestion that they had seen them on TV, for many, proved irresistible.

The practical question is not whether all these responses came from something that behaves in all respects as a real memory. What is important is the fact that more than one-half of the subjects say that they saw the film, so that their answers are easily accepted as memory reports.

Conflicting and implausible information typically occurs in court cases; one witness contradicts another, or a defendant comes up with some lame story. Then all of a sudden 'source monitoring' becomes of the essence, and that is why the law of evidence in many countries forbids, or at least limits, the use of hearsay information in court. People are often not very good at 'source monitoring', simply because in daily life it often does not matter. The fact that in Study 2 many of the respondents answered the 'memory questions' after having admitted that they had not seen the (nonexisting) TV film indicates that they thought that all that mattered was getting it right.

We suspect that most witnesses in legal trials only feel responsible for getting their answers right. Many will consider the hearsay exclusion as one of those fine legal points that lawyers are known to relish. Witnesses in legal trials must therefore be explicitly reminded that they can only testify as to what they know first-hand.

Our results confirm that people easily mistake post-event information, either from hearsay or from their own visualization, for first-hand knowledge. This is particularly easy when, as in our studies, the event is of a highly dramatic nature, which almost by necessity evokes strong and detailed visual imagery.

If this is a fair argument, then we should expect that, contrary to Loftus's earlier conjecture, dramatic events may be more vulnerable to post-event information, because they are usually highly publicized and by their very nature may more readily evoke visualization, thus interfering with the 'source monitoring' required of legal witnesses.

On the other hand it should not be forgotten that only very little critical sense would have made our subjects realize that the implanted information could not possibly be true. We are still at a loss as to why so few of them realized this. Even among those who said they had not seen the film some apologized for not being able to help, explaining that they usually watch very little television.

Our results constitute a challenge to the whole notion of 'flashbulb memories'. If flashbulb memories are of the reputed special kind that includes an accurate recording of the circumstances in which the memory was created, it simply should not happen that the majority of our subjects believe they have learned the news from a filmed recording. True, we used a suggestive question instead of the usual neutral 'flashbulb memory question'. But the ease with which our subjects were fooled conflicts with the supposedly indelible nature of flashbulb memories. One possible excuse is that only hearing about the disaster does not qualify as a source for flashbulb memories. But that forces us to assume that the highly shocking event of a crashing Boeing 747 is not bad enough, which undermines the concept in another manner.

Although we did not intend to study gender differences, we found a significant gender effect in both studies, which deserves some comment. In related studies gender differences have been found before (Loftus, 1979). Powers, Andricks, and

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Loftus (1979) reported results indicating that women pay more attention to, and may therefore be assumed to be less suggestible with respect to, typically female items, while men pay more attention to typically male items. This finding, however, does not explain the difference we found. We can think of quite a few things that may have caused it; women may watch more television and may therefore find it more difficult to remember what they actually have seen; women may watch more television and answer from this base rate; women may be less cautious when they answer questionnaires; women may have a stronger wish to help the researcher; women may have a stronger tendency to visualize dramatic events, and finally, women may be more susceptible to suggestion. With respect to the latter hypothesis, we note that Gudjonsson (1992), using his Suggestibility Scale, did not find a significant difference between men and women, which leaves us to choose between the other possibilities. As things stand, we know too little to make a choice.

REFERENCES

- Baddeley, A. (1990). *Human memory: theory and practice*. Hillsdale, New Jersey: Lawrence Erlbaum.
- Cohen, G. (1989). *Memory in the real world*, Hillsdale, New Jersey: Lawrence Erlbaum.
- Cohen, L. J. (1977). *The probable and the provable*. Oxford: Clarendon Press.
- Gudjonsson, G. H. (1992). *The psychology of interrogations, confessions and testimony*. Chichester: Wiley.
- Haugaard, J. J., Reppucci, N. D., Laird, J., and Nauful, T. (1991). Children's definitions of the truth and their competency as witnesses in legal proceedings. *Law and Human Behavior*, **15**, 253–271.
- Johnson, M. K. and Raye, C. L. (1981). Reality monitoring. *Psychological Review*, **88**, 67–85.
- Johnson, M. K., Hashtroudi, S., and Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, **114**, 3–28.
- Loftus, E. F. (1975). Leading questions and the eyewitness report. *Cognitive Psychology*, **7**, 560–572.
- Loftus, E. F. (1979). *Eyewitness testimony*. Cambridge, MA: Harvard University Press.
- Loftus, E. F. (1993). The reality of repressed memories. *American Psychologist*, **48**, 518–537.
- Neisser, U. and Harsch, N. (1992). In E. Winograd and U. Neisser (Eds.), *Affect and accuracy in recall: studies of "flashbulb" memories*. Cambridge: Cambridge University Press.
- Powers, P. A., Andriks, J. L., and Loftus, E. F. (1979). The eyewitness accounts of females and males. *Journal of Applied Psychology*, **64**, 339–347.
- Pynoos, R. S. and Nader, K. (1989). Children's memory and proximity to violence. *Journal of the American Academy of Child and Adolescent Psychiatry*, **28**, 236–241.
- Wagenaar, W. A., Van Koppen, P. J., and Crombag, H. F. M. (1993). *Anchored narratives: the psychology of criminal evidence*. Hemel Hempstead: Harvester Wheatsheaf.
- Wright, D. B. (1993). Recall of the Hillsborough disaster over time: Systematic biases of 'flashbulb' memories. *Applied Cognitive Psychology*, **7**, 129–138.