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<https://escholarship.org/uc/item/53c7773f>

Journal

Psychology Crime and Law, ahead-of-print(ahead-of-print)

ISSN

1068-316X

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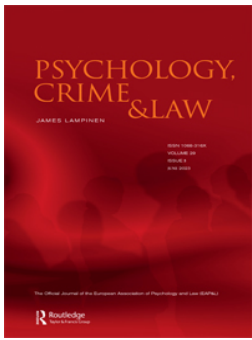
Publication Date

2023

DOI

10.1080/1068316x.2023.2219813

Peer reviewed



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To cite this article: Elizabeth F. Loftus & J. Zoe Klemfuss (2023): Misinformation – past, present, and future, *Psychology, Crime & Law*, DOI: [10.1080/1068316X.2023.2219813](https://doi.org/10.1080/1068316X.2023.2219813)

To link to this article: <https://doi.org/10.1080/1068316X.2023.2219813>



Published online: 01 Jun 2023.



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Misinformation – past, present, and future

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ABSTRACT

Decades of research have provided clear support for the misinformation effect. Exposure to misinformation after an event takes place puts memory accuracy at risk. Experts have long warned of the dangers of this phenomenon in legal contexts (e.g. for eyewitness memory) and new concerns about misinformation and its pervasiveness have arisen in recent years in the context of ‘fake news’. We need new approaches to combat misinformation and prevent its potential far-reaching consequences in real-world contexts with major implications for societal issues such as legal justice, community health, and politics. Here we briefly review the misinformation effect and call for an expansion of the small body of literature on means to prevent and correct misinformation. We end by discussing the new challenges technology and social media pose to memory and knowledge accuracy and propose new research directions to combat this changing landscape of misinformation delivery.

ARTICLE HISTORY

Received 2 November 2022
Accepted 20 May 2023

KEYWORDS

Memory; misinformation;
false memory

When people are exposed to information after an event is over, new information can become incorporated into their memory and can cause an alteration or even a supplementation to the memory. If the information is incorrect or biased, it can lead to memory errors, a phenomenon often referred to as the ‘misinformation effect’. Over the past several decades, we have learned a great deal about the power of post-event information to contaminate memory. We know that memories can be contaminated by exposing people to other people’s memories, by encouraging them to answer biased or leading questions, and by exposure to media coverage, just to name a few ways that post-event information can happen in the lab and in the real-world. We have learned that if a long period of time has passed since a key event occurred, the memories of the event are especially susceptible to post-event contamination (see reviews by Frenda et al., 2011; Loftus, 2005). Sometimes the post-event contamination is self-generated, as when people try to imagine what might have happened in the past. Imagination can supply some new pieces, that then, especially with repetition, turn into facts.

One indication that this memory phenomenon has been thoroughly established in the scientific community comes from a survey of experts who were asked about their beliefs about a variety of memory topics (Seale-Carlisle et al., 2022). One item on the survey asked experts whether they found this statement reliable: ‘An eyewitness’s testimony about an

event often reflects not only what they actually saw but also any information they have learned since the event occurred'. Another item asked about the wording of questions: 'When an eyewitness is questioned, how the question is worded can influence the eyewitness's answer'. This survey showed that these were two of the top three items that experts virtually unanimously agreed about (with agreement levels at 99% and 100% respectively.) As it happens, these two items had also been included in a survey of experts done two decades earlier, and even then, showed massive agreement with the two phenomena (Kassin et al., 2001). Thus, the notion that memory for an event can be influenced by what happens after the event appears to be pretty well established, to reflect the consensus of opinion within the scientific community, and has been for quite some time. More than a quarter of a century ago, memory researchers had noted that 'At this point, there is very little doubt that false memory reports occur under a variety of circumstances' (Lampinen et al., 1997, p. 181). They pointed to numerous studies on eyewitness memory when making this statement. The statement remains very true today.

Knowing how experts think about scientific findings is important. It can help inform policies about procedures that ought to be used when gathering memory information in legal, therapeutic, and other settings. Moreover, in cases where experts might be called to testify in court, these survey data can inform potential experts about which phenomena are sufficiently reliable for presentation to a jury or judge, and which are unsettled.

Indeed, for some time now, experts have been consulting or testifying about post-event information in legal cases. To give an example, consider the famous case of Pan Am flight 103 which blew up in 1988 over the town of Lockerbie, Scotland, killing 270 people (See Loftus, 2013). Based in large part on the testimony of a shopkeeper, a Libyan named Al Megrahi was convicted of the crime. He was allegedly the person who had purchased clothing packed in the suitcase that contained the bomb that blew up the plane. One of us analyzed the eyewitness evidence in the case, and wrote about the problems of potential post-event contamination. Briefly, the shopkeeper who had identified Al Megrahi had made only a tentative identification of him in February 1991, but made a more certain identification at a lineup in April 1999. What happened in between to change the nature of this reported memory? A few months prior to the April 1999 lineup, the shopkeeper had seen a photo of Al Megrahi. There were other changes in the memory, as well. For example, the shopkeeper initially said the customer was 6' tall and about age 50. But by the time of trial, the shopkeeper's memory shifted to be more in line with the accused, who was only 5'8" tall and would have been 36 years old at the time of the purchase. Was post-event information that the shopkeeper was exposed to responsible for these changes in the shopkeeper's memory? This analysis was presented to the Scottish Criminal Cases Review Commission which concluded that the conviction might have been a miscarriage of justice.

Fixing the misinformation problem

After decades of learning about the power of post-event information to contaminate memory, researchers have increasingly been turning their attention to whether there are ways to minimize the problem and help people remember more accurately. People

can be surprisingly poor at spontaneously detecting and resisting misinformation. For example, in one study, people who were exposed to massively incorrect post-event information (80% of sentences in a post-event narrative contained an inaccuracy) accepted an even higher percentage of those incorrect details relative to those who were exposed to minimally incorrect post-event information (20% of sentences contained an inaccuracy; Pena et al., 2017). However, they can also show resistance, especially when armed with certain strategies. In fact, several strategies have been shown to improve resistance, and even potentially to correct false memories.

Early studies of misinformation resistance began by examining the effects of warning people about potential misinformation and the warnings did seem to help, especially if they were provided before the misinformation was encountered (see Blank & Launay, 2014 for a meta-analysis). More recent work has demonstrated the potential effectiveness of offering people the opportunity to indicate discrepancies between their recollection and post-event information in real time ('change detection'; Bailey et al., 2021; Butler & Loftus, 2018; Putnam et al., 2017). In fact, one of these studies tested the effectiveness of both pre-warnings and change detection and found change detection to be most effective (Bailey et al., 2021). These approaches have the potential to serve as tools within contexts such as formal witness interviews. Imagine, for example, a simple warning stating that the interviewer may inadvertently introduce inaccurate details in the course of the interview and that the witness should carefully compare all information with their memory of the original event, or an instruction that the witness should indicate any time the interviewer says something that is discrepant with the details of the event. Versions of these instructions are already included in the gold standard National Institute for Child Health and Development child witness interviewing guidelines (e.g. '... if I say things that are wrong, you should tell me. Okay?'; Lamb et al., 2007; Orbach et al., 2000). In everyday life, however, people are unlikely to walk around with a 'warning' ringing in their minds to help them fend off misinformation, nor are they likely to be offered opportunities to indicate discrepancies between post-event information and their original memory while they are being exposed to the post-event information.

So, when prevention fails, can compromised memory be corrected after-the-fact? Perhaps. There is limited research on this front, and much of it entails privileged knowledge on the part of the interviewer (e.g. knowing which details are actually false). Thus, many of these strategies are impractical in everyday settings. However, in an important recent exception Oeberst et al. (2021) showed that even completely false autobiographical memories can be corrected using methods that are feasible for use in the field. Interviewers questioned participants about plausible false childhood autobiographical memories (as well as true ones; all verified by a parent) in three interviews across three weeks. More than a quarter of the participants developed false memories of these events when they were exposed to minimal false suggestions that the event occurred and more than half did so in a highly suggestive condition. Participants were then told that they should consider the possibility that *external sources* and *false memories* could negatively impact their autobiographical memory and were interviewed again by a new interviewer. False memories were immediately reduced after the *external sources* instruction and again after the *false memories* instruction resulting in false memory rate reductions to the level of the initial interview (and there was evidence that they were further reduced after debriefing and a one-year delay). Ratings of memory quality for

true memories was also reduced after each instruction, but not as much as false memory quality. Thus, these instructions may specifically target false memories. Future work is needed to further hone our defense and recovery strategies, especially in light of the changing landscape of misinformation.

The future of post-event information, and misinformation

Technology is almost certainly going to exacerbate the problem of misinformation in the coming years. Already we have seen that readily available technology can be used to create doctored photographs that may distort memory. One of the earliest demonstrations of the potential damaging effects of false photographs was published two decades ago (Wade et al., 2002). They showed subjects real childhood photos, and also a fake one showing the subject taking a hot-air balloon ride as a child. After their subjects viewed the photos three times over a two-week period, about half of them reported that they remembered something about taking the ride. Later studies showed the power of doctored photographs to affect memory for public events, such as scenes from the 2011 wedding of Prince William and Kate Middleton (Nash, 2018). Even when the digital forgeries were sloppy and poor quality, they could influence people's recollections and thoughts about the target event. Others have discussed at length why these doctored images distort memory, and mechanisms by which this might be occurring (e.g. Nash et al., 2009).

What is potentially even more powerful in terms of its ability to affect memory is deep fake videos. We now have the ability to create compelling and believable videos of people saying things or doing things that they have never said or done (Paris & Donovan, 2019). These deepfakes often appear on the internet, and are presented to their audience as truth. There you can find deepfakes that 'place' celebrities into movies that they never appeared in, or famous CEO's like Mark Zuckerberg convincingly telling an audience he would be deleting Facebook any day (See Kietzmann et al., 2020). As this technology gets in the hands of more and more people, it will become ever more important to explore the extent to which deepfakes can plant false memories, and how to protect against, or repair, the ensuing damage. Of course, these deepfake memories are actually their own special kind of false memory; Viewers have seen them, and thus have actually had the experience, even if the content happens to be untrue. It is worth thinking about how these experiences differ from the typical misinformation false memory where the viewer has fallen sway to a detail (like stop sign not a yield sign) or rich false memory (like getting lost in a shopping mall) that they never actually experienced.

As Nash notes, the findings that digital fakes can influence people, and are likely to be transmitted through popular media, is one more way in which citizens will be exposed to 'fake news'. They are one more way in which misinformation can be spread, and one more way in which we must explore ways of helping people detect, reject, and recover from the damaging influence.

In recent years, society has been deeply concerned about the spread of misinformation via social media, especially considering the growing ubiquity of social media use. Typically the concern has focused on the spread of misinformation about the pandemic, or epidemics, or climate change – all crucial social and political issues that require large-scale community support and that can be amplified or derailed by misinformation. A recent

article in the *Annals of the American Academy of Political and Social Science* cited a 2018 report from the World Economic Forum that named online misinformation as one of the top global risks to environmental, economic, and other systems on which the future of our society depends (Traberg et al., 2022). Can we apply some of the findings of psychological research on misinformation to this real-world social problem? Researchers have recently been invited to attempt this application (e.g. Greenspan & Loftus, 2021). Amongst other suggestions is one that calls for social media algorithms to be modified to provide messages to people who try to share misleading content. In other words, in addition to preventing adoption of misinformation and reversing the effects of false suggestions, can we minimize the likelihood that the public will be exposed to misinformation in the first place? The basic mechanism to do so is already in place within existing social media platforms. For example, when Facebook users try to share outdated articles they are first issued a warning message. One of us recently tried to share an article on Facebook and thought better of it when a message popped up with a warning that the article was eight years old. Facebook, and similar social media sites, now also tag potentially misleading viral articles and photos as such. Could these warnings be modified and used to stop social media users from sharing likely misinformation? What criteria might be used? Could message credibility be rated by users? User credibility? What would be the net effect of doing so?

Pennycook and Rand (2022) have also highlighted the problem of people sharing false or misleading information. They pose the interesting question of why it is that people do this. Of course sometimes they do it deliberately and maliciously (a point made later), but sometimes they do so innocently. One reason, these authors argue, is lack of attention to accuracy, and they explore a number of ways to increase attention and reduce the likelihood that bad information will be shared. For example, if people first rate the accuracy of a single politically neutral news headline, their later sharing of false news concerning politics or covid-19 is reduced. They urge future researchers to study the time course of these manipulations. How quickly does the intervention lose its power to influence? The overall goal here is to slow down the (mis)information superhighway, turning it into something more akin to a dirt road with warning signs along the way. Future research could profitably tackle the best ways to accomplish this with consideration for the evolving landscape of misinformation (and disinformation) and the spreading impact on society. As Reyna (2023) notes, there are practical problems to conquer in devising methods to help people avoid falling prey to misrepresentations, but it's an important thing for us to be doing.

A further complication to reducing the spread of misinformation through technology lies in individual motives. In the literature on misinformation in social media, a distinction has been made between misinformation and disinformation, where the former is the spread of misleading information that is shared by mistake or by people who don't realize it is false. Here, message and user credibility ratings by well-meaning users might effectively help curtail the spread of misinformation by other well-meaning users. By contrast, disinformation is the intentional spread of false or misleading information that is done to cause some sort of damage (National Academies, 2022). Both of these kinds of false information can lead people to accept falsehoods as fact, and can be harmful to people individually and to society as a whole. In the scientific examination of the negative effects of misinformation on memory for past experiences, this distinction

has not been a focus. A few examples exist showing that people are sensitive to the source of misinformation, and are less likely to fall sway to its influence if it comes from a biased source (Dodd & Bradshaw, 1980). In that study, investigators showed that when misinformation came from someone who wished to mislead people (e.g. a driver who caused an accident), the acceptance of the misinformation was lower than when it came from an unbiased source. Perhaps in the future, the potential differences between misinformation and disinformation should be further explored. In fact one fruitful research project might combine the misinformation literatures to simultaneously consider misinformation and disinformation about a personal past experience (the accident you saw last week) and misinformation about some fact about the world (whether vaccines help or hurt). The two worlds might learn a lot from one another.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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