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He did it! She did it! No, she did not! Multiple causal explanations and the continued influence of misinformation

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ABSTRACT

Two types of misinformation effects are discussed in the literature—the *post-event misinformation effect* and the *continued influence effect*. The former refers to the distorting memorial effects of misleading information that is presented after valid event encoding; the latter refers to information that is initially presented as true but subsequently turns out to be false and continues to affect memory and reasoning despite the correction. In two experiments, using a paradigm that merges elements from both traditions, we investigated the role of presentation order and recency when two competing causal explanations for an event are presented and one is subsequently retracted. Theoretical accounts of misinformation effects make diverging predictions regarding the roles of presentation order and recency. A recency account—derived from time-based models of memory and reading comprehension research suggesting efficient situation model updating—predicts that the more recently presented cause should have a stronger influence on memory and reasoning. By contrast, a primacy account—derived from primacy effects in impression formation and story recall as well as findings of inadequate memory updating—predicts that the initially presented cause should be dominant irrespective of temporal factors. Results indicated that (1) a cause's recency, rather than its position (i.e., whether it was presented first or last) determined the emphasis that people place on it in their later reasoning, with more recent explanations being preferred; and (2) a retraction was equally effective whether it invalidated the first or the second cause, as long as the cause's recency was held constant. This provides evidence against the primacy account and supports time-based models of memory such as temporal distinctiveness theory.

Introduction

Misinformation is known to influence one's memory and inferential understanding of unfolding events and causalities. One frequently studied type of misinformation relates to suggestive misinformation presented to witnesses of an event after they have experienced it. Such *post-event misinformation* is known to qualitatively distort event memories (Ayers & Reder, 1998; Chrobak & Zaragoza, 2013; Frenda, Nichols, & Loftus, 2011; Loftus & Hoffman, 1989; Loftus, Miller, & Burns, 1978; Paz-Alonso & Goodman, 2008). For example, if a witness is questioned about a car accident and a "Stop" sign is wrongfully mentioned, the witness may remember such a sign even if there was none present during the actual event (Loftus et al., 1978). Thus, a post-event misinformation effect on memory is said to occur when people at retrieval rely on misinformation that was encoded *after* the accurate information.

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A second type of misinformation, which has attracted increasing research interest over the last few years, relates to information that is initially presented as factual but subsequently corrected. In this case, misinformation can affect people's memory and reasoning after it has been retracted, and even when people acknowledge and demonstrably remember the retraction (e.g., Ecker, Lewandowsky, Swire, & Chang, 2011; Ecker, Lewandowsky, & Tang, 2010; Guillory & Geraci, 2013; Johnson & Seifert, 1994; Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012; Nyhan & Reifler, 2010; Seifert, 2002; Wilkes & Leatherbarrow, 1988). This effect of misinformation is commonly referred to as the *continued influence effect* (CIE; Johnson & Seifert, 1994). For example, people may continue to refer to a terrorist attack as the cause of a plane crash even when this initial suspicion is found to be baseless (Ecker, Lewandowsky, & Apai, 2011). A real world example of the CIE is some people's persistent belief in the debunked claim that autism can result from childhood vaccinations (Hargreaves, Lewis, & Speers, 2003), or that weapons of mass destruction were found in Iraq after the invasion of 2003 (Lewandowsky, Stritzke, Freund, Oberauer, & Krueger, 2013; Lewandowsky, Stritzke, Oberauer, & Morales, 2005). Thus, a CIE is said to occur when people at retrieval rely on misinformation that was encoded *before* the accurate information.

As misinformation can have potentially serious consequences when it influences our memory, inferential reasoning, and decision making (for a review of the implications of the CIE, see Lewandowsky et al., 2012), it is important to investigate why and how such effects occur. A number of theories have been proposed to explain post-event misinformation effects and the continued influence effect. Not surprisingly, the time of presentation of the misinformation, relative to the encoding of the correct information, has been an influential notion in this theorizing.

In the post-event misinformation literature, memory impairment accounts have suggested that post-event misinformation interferes with the original event memory representation, by either partially overwriting the original memory trace (Belli, Lindsay, Gales, & McCarthy, 1994; Loftus & Palmer, 1974; Loftus et al., 1978; but see McCloskey & Zaragoza, 1985), or by blocking the original memory trace at retrieval (Bowers & Bekerian, 1984; Loftus et al., 1978). This notion predicts that the information that is presented most recently will dominate at retrieval because it can overwrite or block the older memory trace. Likewise, time-based theories of memory argue that more recently encoded information is more strongly activated in memory, and may thus block access to the earlier-encoded original memory trace (cf. Ayers & Reder, 1998; Loftus, 2005).

Recency effects occur in many memory tasks (e.g., see Baddeley & Hitch, 1993, for a review), and there are various reasons why more recently acquired representations should be stronger or more easily accessible in memory. One notion invokes time-based decay of memory traces (e.g., Barrouillet, Bernardin, Portrat, Vergauwe, & Camos, 2007), although there is now growing evidence against a role of trace decay in forgetting (especially in the case of verbal memoranda in short-term working memory, but also on longer time-scales; see Berman, Jonides, & Lewis, 2009; Brown & Lewandowsky, 2010; Brown, Neath, & Chater, 2007; Ecker & Lewandowsky, 2012; Oberauer & Lewandowsky, 2013). Even if memory traces do not literally decay, access to details may decline over time, making reliance on more recently encoded information more likely (for an application of this notion to post-event misinformation effects, see Pansky, Tenenboim, & Bar, 2011; Reyna & Brainerd, 1995).

Another time-based account that predicts more recently encoded information to be more accessible is temporal distinctiveness theory (cf. Bjork & Whitten, 1974; Brown et al., 2007; Crowder, 1976; Ecker, Brown, & Lewandowsky, 2015; Ecker, Tay, & Brown, 2015; Neath & Crowder, 1990). Temporal distinctiveness theory assumes that items in memory are organized by their time of encoding and that this temporal context can serve as a retrieval cue for memory access. The theory assumes that psychological time is compressed such that older memory traces become more difficult to discriminate as time passes, resulting in facilitated retrieval of more recent information. Anderson and Schooler (1991) showed that a memory system following the core principles of temporal distinctiveness theory—in particular facilitated access to recent information—would result naturally from adaptation to the environment humans have evolved in.

A final line of research that predicts a strong impact of recent (e.g., post-event) misinformation on reasoning is research on reading comprehension, suggesting that by-and-large, people are highly efficient at keeping their mental models of unfolding situations up-to-date. In general terms, this approach argues that when people encode information about causal interrelations or an unfolding event, they build a situation model based on the initial information they receive (Bower & Morrow, 1990; van Dijk & Kintsch, 1983). When presented with new information that indicates change, this situation model is continuously updated in order to accurately reflect the current state-of-affairs (e.g., Albrecht & O'Brien, 1993; Glenberg, Meyer, & Lindem, 1987; Hamm & Hasher, 1992; Morrow, Bower, & Greenspan, 1989; Radvansky, Lynchard, & von Hippel, 2008; Rapp & van den Broek, 2005; Therriault & Rinck, 2007). Updating can be incremental or global in nature (Kurby & Zacks, 2012): When there are minor changes that occur within a broader event or situation, the additional information is integrated in the current situation model in an incremental fashion—for example, when following the protagonist of a novel, an incremental update may reflect the protagonist interacting with a new person or object in the same situation. When faced with an entirely new situation, however, a new situation model is created from scratch—such a global update may reflect the protagonist moving into a different situation such as another place or time. The new situation model is then "foregrounded" in memory, while the out-dated situation model is "moved to the background," that is, its activation decreases to a background level (Glenberg et al., 1987; Radvansky, Krawietz, & Tamplin, 2011).

This recency view can naturally explain post-event misinformation effects; however, it cannot explain the CIE.