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The nature and consequences of false memories for visual stimuli

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ABSTRACT

Different theoretical views exist regarding whether false memories contain perceptual information or are merely conceptual in nature. To address this question, we conducted three experiments to examine whether false memories for pictures had a priming effect on a perceptual closure task. In Experiment 1, participants were presented with pictorial versions of Deese/Roediger-McDermott (DRM) lists and received a recognition task. Finally, in the perceptual closure task (PCT), participants were shown degraded pictures (studied pictures, critical pictures, unrelated pictures) that became clearer over time and had to identify the object depicted as quickly as possible. The results showed that false memories for pictures did not exhibit a priming effect in the PCT. Specifically, picture identifications based on false memories for visual stimuli were significantly slower than those based on true memories and the former did not differ from that of unrelated items. In Experiments 2 and 3, we manipulated the modality (verbal vs. pictorial) of the study phase and the PCT phase. In both experiments, false memories for pictures primed pictures significantly slower than true memories in the pictorial PCT, but false memories for pictures primed words faster than true memories in the verbal PCT. Our results suggest that false memories for pictures are unlikely to contain perceptual information but rather that they are conceptual in nature.

Introduction

It is not uncommon that you falsely remember when you had your meeting or where you dated your girlfriend a year ago. What matters is whether these memory distortions will result in any unwanted consequences. False memories are commonly associated with negative consequences such as false accusations of child sexual abuse (Otgaar, Sauerland, & Petrila, 2013). However, in recent years, studies have accumulated showing that false memories have adaptive value and can be beneficial under certain circumstances (Howe, 2011; Schacter, 2012). As many of these beneficial effects of false memories have been observed with verbal stimuli, the general aim of the current study is to investigate whether these same positive outcomes generalize to *visual* stimuli.

For example, a series of studies have demonstrated that false memories facilitate problem-solving behavior equivalent to or better than true memories (Howe, Garner, Dewhurst, & Ball, 2010; Howe, Garner, & Patel, 2013; Howe, Wilkinson, Garner, & Ball, 2016; Wang et al., 2017). In these studies, participants are usually presented with associated lists (e.g., *women*, *husband*, *uncle*, *lady*, *male*) using the well-known Deese/Roediger-McDermott paradigm (DRM; Deese, 1959; Roediger & McDermott, 1995). After the presentation of such DRM lists, participants commonly falsely recollect the non-presented 'critical lure' word (i.e., *man*) which is associatively related to each of the list words. Then, participants are asked to solve compound remote associate task problems. Each problem is a three-word puzzle (e.g., *old/hole/super*) and they have to come up with a theme word (in this case, *man*) that could link all the three words. Importantly, when the solutions are the non-presented critical lures, participants solve these problems in a more efficient way than when the solutions are the words presented on the lists. Not only when using compound remote associate problems do false memories exert positive consequences, but also with analogical reasoning problems in both children (Howe, Threadgold, Norbury, Garner, & Ball, 2013) and adults (Howe, Garner, Threadgold, & Ball, 2015).

Additional studies have concentrated on the positive priming effects of false memories on an adapted perceptual closure task (PCT) – a measure loosely linked to intelligence (Otgaar et al., 2015). In this PCT, participants are presented with degraded stimuli that become clearer over time and they have to indicate what the stimuli are (e.g., a certain word) as soon as they recognize the stimuli. The PCT requires people to fill in the missing parts of a degraded image, which is similar to

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subtasks in certain intelligence tasks (Luteijn & Barelds, 2004). In Otgaar et al.'s (2015) study, participants received DRM lists and a recognition test and they were then exposed to the PCT (Experiment 1). Here, they were presented with degraded versions of both presented words and the critical lures. The significant finding was that false memories for the critical lures primed the PCT faster than the presented words. The same finding emerged when no recognition task was included (Experiment 2). Again, this is evidence indicating the processing advantages associated with false over true memories.

The above lines of research clearly demonstrate the positive value of false memories. However, these findings may be somewhat limited inasmuch as the stimuli used in these studies were purely conceptual (i.e., words) and no studies have examined whether false memories for pictures have any positive consequence on cognitive tasks such as the PCT. This question is important for the following reasons. First, research dealing with visual false memories is limited (see Miller & Gazzaniga, 1998), but studies that have been conducted reveal that false memory rates for pictures differ from false memories for words. For example, Israel and Schacter (1997) found that false memories for pictures resulted in significantly lower acceptance rates than verbal false memories (see also Howe, 2006). When false memories are derived from visual scenes, recognition rates for critical lures were relative low as well (~30%; Otgaar, Howe, Peters, Smeets, & Moritz, 2014). One possible explanation for these differences in false memory rates is distinctiveness. That is, pictures contain more details which are distinct from each another and this tends to weaken the associatively-based generation of false memories (Koutstaal, Schacter, & Brenner, 2001; Seamon, Luo, Schlegel, Greene, & Goldenberg, 2000). So, the cognitive processes underlying visual and verbal false memories might be different, and hence, it is unknown whether false memories for visual stimuli also exert positive influences on subsequent priming tasks.

Second, spreading activation theories (Howe, Wimmer, Gagnon, & Plumpton, 2009; Roediger, Balota, & Watson, 2001) have been put forward to explain the positive consequences of associatively generated (e.g., verbal) false memories. In these activation theories, DRM list members (nodes) are embedded within an associative network. Activation of one conceptual node spreads to other related nodes. Activation of related but non-presented concepts not only leads to false recall/recognition of non-presented words but also triggers additional spreading activation that impacts performance on related (e.g., associative) tasks (Howe et al., 2010; Otgaar et al., 2015). When visual stimuli are presented and visual false memories are induced, it is unclear whether visual representations are integrated in this network and thus, it is unclear whether they will result in any positive priming consequences.

In theories about how information is represented in memory (e.g., Dual Coding Theory), it is thought that pictures are encoded in parallel into both imaginal and verbal representations (Paivio, 1991; Sadoski & Paivio, 2004). If false memories derived from visual stimuli also contain perceptual representations, false memories for pictures should facilitate priming on imagery/perceptual tasks. Studying the consequences of visual false memories on a priming task might help uncover the mechanism underlying false memories.

Perceptual vs. conceptual false memories

Indeed, there is no consensus regarding whether false memories encompass a perceptual mental representation in the same way that true memories do. One line of research favors the view that the memory representation for DRM critical lures contains perceptual details. For instance, McDermott (1997) had participants study DRM lists and then perform a word-stem completion task (e.g., bas__ for the target *basket*) or a fragment completion task (e.g., b_s__ for the target *basket*). These tasks were referred to as perceptual priming tasks by the author. The results showed that critical lures had a significant priming effect on the stem/fragment completion rates as compared to non-studied items, although the level of priming was not as strong as studied items. McKone and Murphy (2000) replicated McDermott's (1997) results and even found that the magnitude of critical lures' priming effect was equivalent to that of studied items. The priming effects of critical lures were also found in other studies involving similar tasks such as a lexical decision task (i.e., to classify stimuli as words or nonwords) (Tajika, Neumann, Hamajima, & Iwahara, 2005; Tse & Neely, 2005, 2007).

The opponent view is that false memories for critical lures do not contain perceptual information. For example, Hicks and Starns (2005) manipulated the study modality of DRM lists (visual vs. auditory presentation) to examine whether critical lure priming was modality specific. The logic was that, if critical lures are perceptually encoded, visual DRM lists should induce visually encoded critical lures and auditory lists should lead to auditory encodings of critical lures. Thus, critical lure priming of the *visual* stem completion task should only exist in the visual study modality but not in the auditory study modality. Hicks and Starns (2005) found that critical lures had a higher word-stem completion rate than non-studied items in both the visual and auditory study modalities, which suggested activations of critical lures are not perceptual but perhaps conceptual in nature. In addition to failures to find modality-specific priming effects for critical lures (but see McKone & Murphy, 2000, for a report of modality specificity), there are studies where critical lure priming was not found (or was restricted) in the lexical decision task (McKone, 2004; Meade, Watson, Balota, & Roediger, 2007) and in the stem completion task when participants did not attempt to retrieve words from the study phase (McBride, Coane, & Raulerson, 2006).

Importantly, different theoretical hypotheses about the mechanisms of false memory activation underlie these contrasting views. The Implicit Associative Response hypothesis (IAR; e.g., McDermott, 1997; Underwood, 1965) proposes that the presence of a word (e.g., table) may activate the encoding of a related/critical word (e.g., chair). The IAR does not predict perceptual priming of critical lures directly. McKone and Murphy (2000) extended it to the IAR/imagery hypothesis (see also Hicks & Starns, 2005) in that the critical item might be encoded in the specific modality during the study phase (e.g., visual lists create visual (perceptual) representations of critical lures). Thus, critical lures are related to perceptual characteristics from a specific modality, which can explain why critical lures were effective in perceptual priming tasks. Alternatively, theories of false memory activation predict conceptual critical lure priming effects. The activation-monitoring (Roediger et al., 2001) and the associative-activation (Howe et al., 2009) theories suggest that processing of one concept activates a corresponding conceptual node and this activation spreads to surrounding associative concept nodes. When the DRM list items are presented, their shared associative concept – the critical lure – is most likely to be activated during encoding. Thus, these activation theories predict conceptual priming for critical lures as critical lures in the DRM paradigm primarily result from conceptual activation. However, it is also possible that perceptual features are stored along with the "nodes" in the associative network or they are integrated in the network in some way (Howe et al., 2009). For instance, false memories can be induced by phonologically related lists (e.g., *fat*, *cab*, *sat*, for the critical lure *cat*; Sommers & Lewis, 1999) and recently Finley, Sungkhasettee, Roediger, and Balota (2017) found that hybrid lists of conceptual and phonological items produced higher false memory rates than purely conceptual lists.

The main evidence that either supports or refutes the perceptual priming hypothesis for critical lures comes from data in priming tasks including the stem completion task (Hicks & Starns, 2005; McDermott, 1997; McKone & Murphy, 2000), the fragment completion task (McDermott, 1997), the anagram task (Lövdén & Johansson, 2003), the lexical decision task (McKone, 2004; Tse & Neely, 2005, 2007) and perceptual identification of degraded words (Hicks & Starns, 2005; Otgaar et al., 2015), all of which concern completing/identifying a word (i.e., verbal in nature). We argue that there are two possible