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On the susceptibility of adaptive memory to false memory illusions

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ABSTRACT

Previous research has shown that survival-related processing of word lists enhances retention for that material. However, the claim that survival-related memories are more accurate has only been examined when true recall and recognition of neutral material has been measured. In the current experiments, we examined the adaptive memory superiority effect for different types of processing and material, measuring accuracy more directly by comparing true and false recollection rates. Survival-related information and processing was examined using word lists containing backward associates of neutral, negative, and survival-related critical lures and type of processing (pleasantness, moving, survival) was varied using an incidental memory paradigm. Across four experiments, results showed that survival-related words were more susceptible than negative and neutral words to the false memory illusion and that processing information in terms of its relevance to survival independently increased this susceptibility to the false memory illusion. Overall, although survival-related processing and survival-related information resulted in poorer, not more accurate, memory, such inaccuracies may have adaptive significance. These findings are discussed in the context of false memory research and recent theories concerning the importance of survival processing and the nature of adaptive memory.

1. Introduction

Recently, a number of researchers have shown that words specifically processed for their importance to survival are remembered better than words processed in other contexts (e.g., Kang, McDermott, & Cohen, 2008; Nairne, Pandeirada, & Thompson, 2008; Nairne, Thompson, & Pandeirada, 2007; Weinstein, Bugg, & Roediger, 2008). That is, memory for lists of words (e.g., items from categories such as fruit, vegetable, four-footed animals) is better when participants are asked to rate them for their importance to survival (e.g., usefulness on a desert island) than when they engage in other forms of semantic processing (e.g., pleasantness or self-reference ratings) and this effect is thought to be independent of depth-of-processing (Nairne et al., 2008). This memory benefit is said to arise because human memory systems are primed to remember survival-related information better than other types of information due to its greater adaptive value (Nairne et al., 2007, 2008).

Previous studies of this adaptive memory effect by Nairne and his colleagues (Nairne & Pandeirada, 2008; Nairne et al., 2007, 2008), as well as by others (e.g., Kang et al., 2008; Weinstein et al., 2008), have focused almost exclusively on the amount of information that is correctly remembered. It is well known that because memory is reconstructive, errors can also occur when people try to recollect things that were processed. That is, people can forget information that they have experienced (errors of omission) and "remember" information that they have not experienced (errors of commission). These latter errors, or false memories, have yet to be examined in the context of adaptive memory.

It turns out that this is an important issue because if it is true that human memory benefits from survival processing (i.e., adaptive memory is more accurate), this benefit must

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include both better true recollection of information actually present in the environment (i.e., fewer errors of omission), but also a reduced susceptibility to false memory illusions (i.e., reduced errors of commission). For example, if survival information is more distinctive and is processed at an item-specific contextual level, then false memory rates should be low. However, if survival-related processing of information primes networks of strongly interrelated concepts, then once activation spreads to these highly interconnected concepts, they should become active and serve as the basis of false memory illusions (e.g., Collins & Loftus, 1975; Karpicke, McCabe, & Roediger, 2008; Roediger, Balota, & Watson, 2001). Therefore, if survival processing of information promotes more relational than item-specific processing, then false memory rates should be higher for items processed for their survival value than those same items processed for non-survival purposes.

Because recall and recognition rates tend to be higher for information processed for their survival value than processed for, say, pleasantness, it would seem that there is clear evidence that such survival processing reduces errors of omission (Kang et al., 2008; Nairne et al., 2007, 2008; Weinstein et al., 2008). However, there are some findings that suggest that errors of commission may be higher in survival than other processing conditions. For example, Nairne et al. (2007, Experiment 1) found significantly higher rates of semantic intrusions when randomized lists of neutral words were processed for their survival relevance than when processed for their pleasantness. Indeed, when the same, categorically related materials were processed for survival instead of for pleasantness, higher intrusion rates were observed for survival than pleasantness processing (Nairne & Pandeirada, 2008, Experiment 1). Although the mnemonic advantage for survival processing remained even after participants who made intrusions were removed from the analyses, both of these preliminary results are consistent with the idea that survival processing promotes relational, not item-specific processing. This processing, in turn, primes networks of strongly interrelated concepts that are later falsely recollected.

Although categorized materials do give rise to errors of commission, there is considerable evidence that networks whose relations are associative give rise to higher intrusion rates (e.g., Howe, Wimmer, & Blease, 2009; Howe, Wimmer, Gagnon, & Plumpton, 2009; Park, Shobe, & Kihlstrom, 2005). This may be because members of categorical lists are linked in a superordinate (i.e., vertical) manner whereas members of lists of associates are linked within the same, basic level (i.e., horizontally) (see Howe, Wimmer, Gagnon et al., 2009; Park et al., 2005). Regardless, it is clear that items related to survival do not simply exhibit insular categorical relations (e.g., food, weapons) but relations that cross category boundaries, linking one to the other in thematically mediated associative networks (e.g., watering hole [a place to satisfy thirst or a place for cooling] → vegetation [a place to hide or a source of food] → - other animals [a source of food or something to be feared such as a predator] → a sharp rock [to use as a tool to create something else or to be used as a weapon). Such associative networks (see Fig. 1) are common in modeling human thought (e.g., Anderson, 1976, 1983; Reder, Park, & Kieffaber, 2009) and involve a variety of semantic relationships (e.g., temporal continguity, spatial proximity, feature overlap, shared perceptual properties, category membership, antonymity, synonymy) (e.g., Wu & Barsalou, 2009). Although it is often difficult to discriminate associative strength and semantic overlap (see Hutchison, 2003), the use of associatively related lists (e.g., as in the Deese/Roediger–McDermott [DRM] paradigm; Deese, 1959; Roediger & McDermott, 1995) has become the *sine qua non* for researchers interested in the study of memory accuracy (i.e., the relationship between rates of correct recollection and error rates). Indeed, the use of the DRM paradigm to study memory accuracy is appropriate because these lists contain many of the semantic relations found in human thought, not just taxonomic (categorical) relations (see Brainerd, Yang, Reyna, Howe, & Mills, 2008; Howe, Wimmer, & Blease, 2009; Howe, Wimmer, Gagnon, 2009; Park et al., 2005).

We hypothesize that it is not only the processing of information for survival purposes that results in differences in accuracy, but also the presentation of survival-related materials themselves. That is, survival-related concepts (e.g., *injury, death, struggled, virus, battle*) should be remembered differently than concepts that are not directly related to survival, regardless of whether they are explicitly processed for their survival value. Specifically, if adaptive memory prioritizes survival information, then whether this survival priority is invoked by the type of processing or type of material being processed may not matter.

To answer these questions about the type of processing at encoding as well as the type of material being processed, we present a series of four experiments in this article. In the first experiment, we examined both type of processing (pleasantness vs. survival) and type of material (neutral, negative, and survival-related concepts) in a fully crossed design. We did this in order to examine the independent, as well as the combined, effects of processing and material on recollection accuracy.

In the subsequent three experiments we focused on the effect of type of material on memory performance. To do this, we examined the hypothesis that increased true and false recognition on survival relevant lists was due to the number and ease with which participants could generate integrating themes. Because fewer themes should be related to higher levels of false recollection (i.e., as each list item is more likely to activate a single integrating theme),[1] in Experiments 2a and 2b we manipulated

[1] The astute reader will notice that we argued earlier that categorical information is usually linked to a single theme (i.e., the category label) whereas associative information can be linked to multiple themes (see Fig. 1). If lists with fewer themes are more likely to give rise to higher rates of false recollection, then why do category lists not produce more false memories than associative lists? The reason for this is simple and it has to do with the hierarchical structure of categorical lists. As Park et al. (2005) and others (e.g., Gallo, 2006) have demonstrated, items that are organized in a superordinate or vertical relation tend not to be as susceptible to false memory illusions as those whose members occupy the same horizontal strata (e.g., basic-level concepts). So when we refer to number of themes or theme availability, we restrict ourselves to items that occupy similar strata and do not traverse different ordinate levels.