The influence of encoding style on the production of false memories in the DRM paradigm: new insights on individual differences in false memory susceptibility?

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ABSTRACT

Recent research has shown that there are individual differences in how preexisting (internal) schemata (versus cues from the outside world) affect encoding processes, which can be reliably assessed with the internal and external Encoding Style Questionnaire (ESQ, Lewicki, 2005). Since reliance on preexisting schemata at encoding has been found to increase the production of false memories in the DRM paradigm (Roediger & McDermott, 1995), while item-specific encoding has been shown to reduce it (see Gallo, 2006), it was examined whether individual differences in encoding style affects the production of such false memories. To this purpose, normal participants were asked to complete a French version of the ESQ questionnaire (Billieux *et al.*, 2009) and were presented with a modified DRM procedure (Brédart, 2000) assessing false recall. The results showed a positive correlation between ESQ scores and false recall showing that internal encoders were more susceptible to false memories than external encoders.

Keywords: internal and external encoding, encoding style, false memories, false recall, individual differences

INTRODUCTION

The possibility to induce people to report false memories have recently captured the attention of both psychologists and the public at large. Consequently, psychologists have devised paradigms that investigate false memories in the laboratory. One of the most frequently used is the DRM paradigm (Roediger & McDermott, 1995) in which participants are asked to remember lists of associated words (e.g., pin, thread, eye, sewing…) converging towards a critical theme word (the *lure*: needle) that is never presented. After studying such lists, participants typically recall or recognize the lure at high rates. In addition, these false recalls or recognitions are held with strong subjective confidence and are frequently accompanied by details related to the supposed presentation of the word (Lampinen, Neuschatz & Payne, 1998), a phenomenon called “illusory” or “phantom” recollection.

Several explanations have been advanced to account for false memories in the DRM paradigm (see for a review Gallo, 2006). Among them, the fuzzy-trace theory (e.g., Brainerd & Reyna, 2002) and the activation/monitoring theory (e.g., McDermott & Watson, 2001; Roediger, Watson, McDermott, & Gallo, 2001), have gained a large support over the last decade. Following these accounts, critical lures will be likely to seem familiar to individuals due either to activation (e.g., spreading of activation in a semantic network, elaboration, overt generation) or to reliance on gist traces encoded at study that represent the meaning or the common features of the stimuli but which lack perceptual details. Both explanations rely on the availability of item-specific information for the successful editing of memories. That is, verbatim traces of presented items that capture the surface details of physical stimuli can be used to reject false-but-consistent information or item specific information can be used to correctly attribute the familiarity of the critical lure to the participant’s own thoughts and not to the item’s occurrence in the list through a successful reality monitoring process (Johnson, Hashtroudi, Lindsay, 1993).

Hence, both the fuzzy-trace and activation-monitoring accounts hold that information processing during list encoding plays an important role in false memory production. Accordingly, studies have shown that encoding manipulations such as presentation duration, presentation modality and levels of processing influence levels of false memory (see for a thorough review Gallo, 2006). More specifically, it has been shown that instructions promoting deeper (semantic) processing of DRM lists increase false memory for critical lures (Chan, McDermott, Watson, & Gallo, 2005; Toglia, Neuschatz, & Goodwin, 1999) while instructions focusing on, or promoting, item-specific information reduce false memory production (e.g., Dehon, 2006; Schacter, Israel & Racine, 1999).

DRM task performance can also be mediated by individual differences such as, for instance, fantasy proneness (Geraerts, Smeets, Jelicic, van Heerden & Merckelbach, 2005), tendency toward delusional ideation and dissociative experiences (Dehon, Bastin & Larøi, 2008) that are associated with an increased susceptibility to false memories in the DRM paradigm. However, to our knowledge, whether individual differences in encoding style may affect DRM task performance has not been investigated. And yet, such a hypothesis merits examination based on William James' well-known General Law of Perception (James, 1890), which states that the result of every act of perception is a combination of the objective external data (what "comes through our senses" in James' words) and the internal (subjective), interpretive schemata (what "comes out of our mind," as he put it). Recent research has revealed that there are individual differences in how these preexisting, internal schemata (versus external cues from the outside world) affect encoding processes. These differences relate to how "hasty" (or "internal", i.e. based on internal encoding categories) versus "conservative" (or "external", i.e. based on data from external stimuli) the encoding processes are (Lewicki, 2005).

This hypothesized encoding style can be interpreted in terms of the validation threshold for instantiation of schemata, which is the relative amount of supportive evidence a perceiver needs to collect before imposing an interpretative category (schema) on a stimulus. When stimuli are ambiguous, encoding algorithms may nonconsciously impose on them preexisting interpretative categories even if the stimuli objectively do not match with the categories very well (e.g., Lewicki, Hill, & Sasaki, 1989). Research indicates that the more internal the style of encoding, the greater the probability that environmental cues will be interpreted in terms of preexisting (internal) encoding categories, thus providing support for those categories and contributing to their reinforcement through a process of “self-perpetuation” (e.g., Lewicki, 2005; Lewicki, Hill, & Czyzewska, 1992).

Recently, a new scale has been developed in order to identify the location of a person on a continuum of encoding style: the Encoding Style Questionnaire (ESQ, Lewicki, 2005). This questionnaire is based on the assumption that the threshold of instantiation of schemata will determine the probability, and therefore the frequency, of experiencing the commonly observed phenomenon of "split second illusions" by including questions about the frequency of having such “split-second illusions” experiences in everyday life (e.g., erroneously recognizing an animal moving off the road before finding out a moment later that it was a piece of paper moved by the wind). Indeed, because internal encoders are more likely to more "hastily" impose imperfect or even incorrect encoding schemata, they are likely to experience split-second illusions more frequently when identifying certain known objects or phenomena. Studies investigating the relationship between encoding style (as measured using the ESQ) and objective cognitive performance measures show, among others, that internal encoders are more accurate than external encoders when they are exposed to tachistoscopic presentations of images of everyday objects or incomplete displays of letters and are asked to recognize them, implying that they exhibit a lower threshold of instantiation of interpretive schemata in the process of encoding (see Lewicki, 2005). Moreover, internal encoders show more self-perpetuation of newly acquired encoding algorithms (e.g., after watching series of schematic drawings of faces generated by a computer and labeled either “race X” or “race Y”, they were more likely to classify faces of a new type as belonging to either the “X”- or “Y”-race) as predicted from the fact that their threshold of instantiation of schemata is lower, which should facilitate the rate of self-perpetuation (see Lewicki, 2005; Lewicki *et al.*, 1989, for examples of procedures used in research on self-perpetuation).

In addition, multiple case studies have been conducted to investigate the personality profiles (assessed by the NEO-PI-R, Costa & McCrae, 1992) of “extremely internal” versus “extremely external” subjects (Lewicki, 2005). Interestingly, results revealed that internal encoders had higher score on the Openness and Neuroticism domains. More specifically, internal encoders had higher scores on the “fantasy” and “feelings” facets of the Openness domain and higher scores on the “depression”, “anxiety”, and “impulsiveness” facets of the Neuroticism domain. Findings from these case studies suggest that internal and external encoders have relatively distinct cognitive approaches to “reality,” with each style having its strengths and weaknesses. For example, an internal encoding style may facilitate various forms of artistic creativity but at the expense of potentially losing “touch with reality” and perhaps even related to a proneness to develop dysfunctional encoding dispositions (and furthermore psychopathological states such as dissociative and psychosis-like experiences).

OVERVIEW OF THE CURRENT EXPERIMENT

Provided that focusing on schematic (internal) processing over external cues should increase the susceptibility to produce false memories in the DRM paradigm, the purpose of the present study was to examine the influence of encoding style on the production of such false memories. The participants were asked to complete a French version (Billieux, D’Argembeau, Lewicki & Van der Linden, 2009) of the ESQ scale and were also presented with DRM lists for a modified recall task (Brédart, 2000) allowing to obtain estimates of activation and monitoring of non-presented critical lures. More specifically, after the memory test, participants were asked to say whether, during the learning phase or during the recall phase, a word came to their mind, but that they did not write it down during the recall task because they thought the experimenter had not produced it. Hence, with this paradigm it is possible to examine the distribution of the critical lures throughout the experiment and to determine the best explanation for why false memories did not occur for some trials (i.e., whether it is related to a monitoring success versus an activation failure). Specifically, a failure to recall a critical lure either in the initial recall phase or during the added phase suggests that the list failed to evoke it (i.e., an activation failure). On the other hand, reporting a critical lure during the added phase for a list that did not initially produce a false memory is indicative of successful monitoring (see also Dehon, 2006; Dehon *et al.*, 2008).

A correlational approach was used to investigate the relationship between scores on the ESQ scale, false recall, activation rate and monitoring of the non-presented critical lure. We hypothesized that ESQ scores would be positively associated with false recall. Indeed, participants with high scores on the ESQ, reflecting internal encoding and reliance on existing schemata, should produce more false memories. In contrast, participants with low scores on the ESQ, reflecting a greater reliance on cues from the outside world, should be more resistant to this illusion. In addition, this influence should also be reflected on monitoring abilities, with ESQ scores being negatively associated with monitoring abilities. That is, external encoders (scoring low on the ESQ scale) should be more efficient in source monitoring through the use of external cues, while internal encoders relying on existing schemata (or self-perpetuating these schemata) would be less able to make accurate source attributions (e.g., Johnson et al., 1993).

METHOD

Participants. A total of 188 participants (91 females, mean age= 25.62, SD=3.53; ranged from 20 to 35; mean education = 15.24 years, SD= 2.38) were approached for their co-operation, which was voluntary and was not required for course credit. None of the volunteers had a previous history of mental illness, or alcohol or drug abuse.

Internal and External Encoding Style Questionnaire (ESQ). The French version of the ESQ, translated from Lewicki (2005) consists of 21 items translated into French using a translation and back-translation procedure (Billieux, et al. 2009). Only six items (number 5, 8, 11, 15, 18, and 21) are diagnostic items; the remaining 15 items are included to disguise the critical items. Representative diagnostic items include, “For a split second from a distance, I sometimes mistake strangers for people I know” or “Sometimes when I’m driving, I see a piece of paper or a leaf being moved by the wind, and for a split of second think that it might be an animal (e.g., a squirrel or a cat)”. Participants respond to each item using a six-point Likert-scale, ranging from 1 = “Strongly disagree” to 6 = “Strongly agree”. Hence, a high score on the ESQ reflects an internal encoding style, whereas a low score reflects an external encoding style.

False memory task. We used a modified DRM procedure (Brédart, 2000) in which the participants were presented with eight French DRM word lists of 15 items for which the critical lures were (English translation is provided in brackets): *arbre* (tree), *informatique* (computer science), *chaise* (chair), *temps* (time), *mouton* (sheep), *maison* (house), *musique* (music) and *odeur* (odour).

Procedure. Participants were tested individually. They were told that the experimenter would read 8 lists of words aloud and that they would be tested for each list after having counted backwards by 3's for 30 seconds. The lists were presented in random order for each participant. The words were read aloud by the experimenter at a rate of one word per 1.5 s. For each recall phase, the participants were instructed to write down on a sheet of paper as many words as possible from the list they had just heard, in any order, but without guessing. They were given 90 seconds to complete each recall phase. After having recalled all the lists, the participants were instructed to say if, during the learning phase or during the recall phase, a word came to their mind but that they did not write it down during the recall task because they thought the experimenter had not produced it (later referred to as the "added phase"). The participants were presented successively with the word lists they recalled in the first phase and they were asked to write down (with a different colored pen) any other words they had thought of for that list. The participants were instructed to only write down words they remembered having thought of during the presentation of the lists and not to infer or to guess the words from the current instructions. Finally, participants were asked to complete the ESQ and were fully debriefed.

RESULTS

Overall Memory performance and personality questionnaire. A two-way ANOVA 2 (gender) X 3 (Item Type: veridical vs. critical vs. non critical intrusion) with repeated measures on the last factor was carried out on the mean proportions of recall. This analysis revealed a significant main effect of item type [$F(2,372)= 583.35$; $p< .0001$] in which participants recalled higher proportions of veridical items (M= .63, SD= .10) than critical items (M= .41, SD= .28), and both kinds of responses were significantly more recalled than non critical intrusions (M= .03, SD= .03). The main effect of gender and the gender by item type interaction were non significant [$Fs< 1$]. Gender did not influence the estimates of unsuccessful monitoring [$t(186)=-0.46$, $p=.64$] or activation [$t(186)=0.01$, $p=.99$]. The mean score on the ESQ scale was 18.69 (SD=5.80, ranging from 6 to 35; Cronbach's α = .75), which is very similar to results from previous studies using the French version of the ESQ (mean= 18.13, SD= 5.86; Billieux *et al.*, 2009). Gender did not influence ESQ scores [$t(186)=0.22$, $p=.82$].

Correlational analyses. Because gender did not interact with any of the variables in this study, data were collapsed across gender. Table 1 shows the Pearson's correlations between false recall (i.e., proportion of critical lures recalled during the recall task; M= .41, SD= .28), correct recall (i.e., percentage of studied items recalled during the recall task; M=.63, SD=.10), unsuccessful monitoring of critical lures (i.e., number of falsely recalled critical lures divided by the number of falsely recalled critical lures plus critical lures recalled during the added phase; M = .25, SD = .31), activation rate (i.e., the sum of the proportions of critical lures recalled during the recall task and during the added phase; M= .66, SD= .25) and ESQ scores.

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Overall, in agreement with previous studies (Dehon, et al., 2008), the results showed: (1) a positive correlation between false recall and unsuccessful monitoring of critical lures (r = .79, $p < .0001$) and between false recall and activation rates (r = .29, $p < .0001$); (2) that correct recall was negatively correlated to the unsuccessful monitoring measure (r = -.21, p= .004) and to false recall (r = -.16, p= .027); and, finally, (3) that there was no significant correlation between correct recall and activation rate (r = .04, p= .58).

With respect to individual differences in encoding style, as expected, ESQ scores were found to be positively correlated with false recall (r = .21, p=.004) suggesting an influence of these individual differences on the production of false memories. However, such a correlation does not on its own determine whether this higher susceptibility to false memories is driven by a higher activation of the critical lure (e.g., over-reliance on associative processes) or by reduced monitoring abilities in participants scoring high on the scale. Hence, another aspect of the data which deserves closer inspection is, on the one hand, the pattern of correlations between ESQ scores and unsuccessful monitoring and, on the other hand, findings concerning the activation measure. The significant positive correlation between the ESQ scale and the unsuccessful monitoring measure (r = .16, p <=.031) and the absence of a correlation between encoding style and the activation rate (r = .04, p = .59) suggest that individual differences did not influence the activation of the critical lure but rather impaired the source monitoring abilities. It is also interesting to note that the effects of individual differences on source monitoring do not seem to be due to a general memory problem as there was no correlation between ESQ scores and correct recall (r = -.01, p = .92).

DISCUSSION

The purpose of this study was to examine the hypothesis that the production of DRM false memories can be mediated by individuals' encoding style as measured by the ESQ scale. We will first discuss the correlational results directly related to the general predictions following the activation/monitoring account of DRM false memories (e.g., McDermott & Watson, 2001; Roediger *et al*., 2001) and then turn more specifically to the effects of encoding style on these components.

Following the activation/monitoring model, processing the list items should activate the critical lure and false recall should be reflected in a failure to correctly monitor the source of this activation. Hence, false recall should be positively correlated with the activation rate and with the unsuccessful monitoring measure. Accordingly, the results showed a positive correlation between false recall and unsuccessful monitoring of critical lures, on the one hand, and between false recall and activation rates, on the other hand. Correct recall and activation rate are sometimes correlated depending on the encoding conditions (e.g., McDermott & Watson, 2001). In the current study, the encoding condition tends to favor the use of item-specific information to correctly recall studied items. Support for this interpretation is based on the following findings. First, as monitoring abilities also rely on item-specific information to correctly attribute an origin to a mental experience, there should be a negative correlation between correct recall and the unsuccessful monitoring measure, which was indeed observed.

Second, false recall and correct recall should be negatively correlated, which was also the case. Finally, there was no significant correlation between correct recall and activation rate. Overall, this supports the assumptions made by the activation/monitoring model and previous results obtained with the modified procedure (Dehon *et al.*, 2008).

The results also support the hypothesis that an internal encoding style is associated with an increased susceptibility to false memories while an external encoding style is related to less false memories. This finding is consistent with the activation-monitoring (e.g., Roediger *et al.*, 2001) and fuzzy trace (e.g., Brainerd & Reyna, 2002) accounts of false memory assuming that false memories arise from activation of semantically related critical items at encoding, which may occur consciously through elaborative processing or unconsciously through semantic networks. Increased reliance on schematic knowledge in internal encoders was associated with higher DRM false memories. These results are also in agreement with previous research showing that deeper levels of processing (i.e., processing thematic information at the expense of more item-specific information) during list encoding increase false memory in the DRM task (e.g., Chan *et al.*, 2005; ; Toglia *et al.*, 1999). However, while deeper processing at encoding in internal encoders should affect activation or gist processing, we did not find a "more is less effect" (i.e., an increase in both true and false memory with deeper levels of processing, ; Toglia *et al.*, 1999). This is probably due to the fact that, overall, veridical memory is not completely supported by activation/gist processing but rather by verbatim/item-specific remembering (i.e., see the absence of a correlation between correct recall and activation and the significant negative correlation between correct recall and unsuccessful monitoring in the present study). Moreover, if deeper processing at encoding in internal encoders affects activation or gist processing, we should also have found a positive correlation between activation and ESQ scores which was not the case. However, Lewicki (2005) suggested that internal encoders are more likely to come to the conclusion that they have perceived something in the environment based on what they are expecting rather than based on external information. In contrast, external encoders will instantiate a schema only if there is a relatively greater amount of confirming information from the external environment. In the DRM paradigm, one might consider that the presentation of numerous semantic associates in the list is enough confirming information supporting gist processing and the instantiation of the schema. Hence, it is not surprising not to get differences in activation between internal and external encoders in these conditions. This suggestion needs further inspection.

In contrast, our results suggest that encoding style rather influences source monitoring efficacy. Two explanations may account for the correlation between ESQ scores and unsuccessful monitoring found in the present study. First, compared to external encoders, internal encoders may have preferentially focused on thematic/semantic information at study which may have made their source decision less accurate (i.e., fewer item-specific/verbatim information available at retrieval to make correct source attributions). Another explanation, which is not mutually exclusive, is that internal encoders may have been less likely to engage in an effortful search of source-specifying information at retrieval. Indeed, internal encoding style has been related to low perseverance (Billieux et al., 2009), that is, a tendency to have difficulties in remaining concentrated on a task that may be boring and/or difficult. This relationship is not surprising as people who focus more on internal schemata and are less attentive to the external environment probably experience increased difficulties when facing complex, tedious tasks, and especially on tasks requiring a prolonged, consistent focus on external stimuli (e.g., one can speculate that they might be more prone to "mind wandering" in such situations). This explanation is also supported by the results of a recent study by Herndon (2008) showing that internal encoders experience a higher frequency of cognitive failures (e.g., distractibility) as assessed by the Cognitive Failure Questionnaire (CFQ, Broadbent, Cooper, Fitzgerald, & Parkes, 1982) and they also exhibit a lower level of mindfulness (i.e. the capacity to be attentively tuned to what is happening in the "here and now") as assessed by the Mindfulness Attention Awareness Scale (MAAS, Brown & Ryan, 2003).

Consequently, further work is needed to determine the relationships between cognitive failures, mindfulness, encoding style and their influence on false memories in the DRM paradigm and in other procedures designed to elicit false memories. In addition, internal encoding style is thought to facilitate various forms of artistic creativity but at the expense of potentially losing “touch with reality” and is perhaps even related to a proneness to develop dissociative-like experiences. As the tendency to creative experiences (also known as “fantasy proneness; Merckelbach, Horselenberg & Muris, 2001) and dissociation have been shown to be associated with an increase susceptibility to false memories in the DRM paradigm (e.g., Dehon *et al.*, 2008) and in other procedures (e.g., Merckelbach, 2004; Horselenberg *et al.*, 2006; Porter, Birt, Yuille & Lehman, 2000), the relationships between encoding style, fantasy proneness and dissociation and their contribution to individuals’ susceptibility to false memories deserve a closer inspection. Taken as a whole, these further studies warrant new insights on the relationships between individual differences and false memory susceptibility.

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