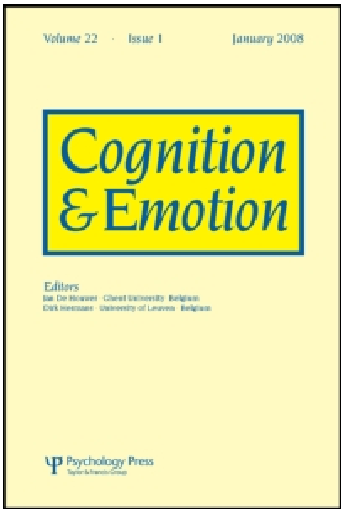

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Memory errors on emotional lures: Is it possible to mistake a positive stimulus for a negative one?

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This study examined whether it is possible for people to mistakenly recognise a stimulus of one emotional valence through exposure to stimuli with another emotional valence that share orthographical relatedness. Across three experiments, the recognition error rates for emotionally distinctive lures were lower than for nondistinctive ones. The reduction in memory errors generalises to different types of emotional distinctiveness: emotional lures from neutral words, neutral lures from emotional words, and lures that have opposite valence from the studied ones. However, emotionally distinctive lures were still prone to memory errors. Repeated exposure to orthographically related items resulted in higher recognition error rates than lures without such exposure. Implications for everyday memory are discussed.

> ''Recreating emotional experiences is an essential means of making sense of who we were in the past, who we are now, and who we might become in the future.''
> (Ross & Conway, 1986)

Emotion influences memory (for a review, see Ochsner & Schacter, 2000) and memory affects emotion (for a review, see Philippot & Schaefer, 2001). For three main reasons, the interaction between emotion and memory is one of the most popular issues concerning the interplay between emotion and cognition. First, many psychological disorders involve the abnormal processing of emotional memory. Depressed individuals have a bias in accessing their autobiographical memory and this handicaps them from finding concrete instrumental coping strategies when facing emotional problems (Williams, 1996). For posttraumatic stress disorder (PTSD) patients, an abnormal memory consolidation process has been found to be related to irregular stress hormone

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secretion (Yehuda, Marshall, & Giller, 1998; Yehuda & McFarlane, 1997). Second, memory of emotional experience is crucial to formation of the self (Ochsner & Schacter, 2000). Third, the accuracy of emotional memories can have a significant impact on society and individuals. Memory failures for details of an emotional event, such as a robbery, can bias testimony; memory errors of childhood abuse can ruin the lives of those accused.

Ochsner and Schacter (2000) concluded that emotion affects memory during the encoding stage, the postevent elaboration and consolidation stage, and even during the retrieval stage. Emotional stimuli may influence memory during any of these stages or during the entire memory process. For example, dramatic events, such as the explosion of the Challenger or the attack on the twin towers, capture attention. This attention influences what is perceived as relevant information about the event and in what context people receive the news, as shown in the literature on flashbulb memory (Brown & Kulik, 1977). Flashbulb memory is like a frozen picture made by a camera's flashbulb when people learn of a shocking emotional event. Such events also trigger an elaborative process afterward, as people repeat their episodic memory when describing to others how the event influenced their lives.

Distinctiveness may underlie the vivid memory of dramatic events. As early as 1935, von Restorff discovered enhanced memory for distinctive stimuli. Emotional episodes are rare as compared to the mundane events of daily life, and so may be more distinctive and lead to better encoding, which in turn enhances memory (Ochsner & Schacter, 2000). The results of Christianson, Loftus, Hoffman, and Loftus's (1991) study supported the role of distinctiveness in enhancing memory of emotional stimuli, but distinctiveness alone cannot fully explain why people have better memory for emotional episodes. Christianson et al. (1991) presented at a fast rate (150 ms) a series of pictures in which one picture was manipulated (neutral, emotional, and unusual) across three groups of participants. They predicted that distinctiveness alone would explain why emotion enhances memory if memory for unusual and emotional pictures was the same. However, participants remembered pictures with emotional elements (e.g., a woman lying on the ground with a bicycle next to her) at higher rates than unusual pictures (e.g., a woman carrying a bicycle) and there was no difference in recall or recognition of unusual and neutral pictures. In addition to distinctiveness, recent results have suggested that the arousal caused by emotional stimuli also plays a role in modulating memory (Kensinger & Corkin, 2004; Sharot & Phelps, 2004).

Although distinctive and vivid, memory of emotional episodes can nevertheless be inaccurate. Many have doubted the existence of flashbulb memory (Christianson, 1989). On the basis of the results of research on eyewitness testimony, Loftus (2003) questioned the verity of witness' testimony, especially for murder cases. Also, the accuracy of contested memories of childhood abuse is under suspicion (Loftus & Yapko, 1995). Hyman and Kleinknecht (1999) studied the verity of childhood memories and concluded that people are likely to create memories of events that never happened (even emotional ones) under certain therapy conditions. Porter, Spencer, and Birt's (2003) research yielded similar results. They asked half their participants misleading questions after viewing pictures of different emotional valences. The memory error rate on pictures with negative emotion was higher than on pictures with neutral or positive emotion. Participants who were not asked misleading questions did not have memory errors.

False recall and inaccurate recognition of new stimuli that have never been experienced reflect the vulnerability of human memory. Identification of such memory imperfections dates back to Ebbinghaus' study in 1885, and Bartlett was the first to demonstrate in 1932 that memory can be distorted by one's knowledge representation (cf. Baddeley, 1998). Yet, it was four decades before researchers explored the mechanisms that underlie memory failures, the mechanisms of misattribution (Loftus & Palmer, 1974), and source monitoring failure (Johnson, Raye, & Durso, 1980; Johnson & Sherman, 1990).

In the late 1980s, many middle-aged people began to recall being sexually abused during their childhood, shocking American society. Memory accuracy and inaccuracy suddenly became a highly valued topic (Loftus, 1979; Loftus & Davies, 1984). Experimental psychologists were eager to demonstrate how vivid recall could be false. Roediger and McDermott (1995) introduced a paradigm to study false memory: The Deese-Roediger-McDermott (DRM) paradigm.[1] In the DRM paradigm, participants learn a series of words relating to an unseen lure (e.g. ''kid'', ''adult'', and ''adolescent'' are words that relate to the unseen lure ''CHILD''). In the test phase, participants are asked to either recall or recognise items learned in the study phase. Although participants never saw the word ''CHILD'' in the study phase, participants inaccurately recalled or recognised this critical lure as a studied stimulus.

Although the application and generalisability of false memory observed in the laboratory to accounts of contested memories of childhood abuse have been questioned (Freyd & Gleaves, 1996), and the use of the term *false memory* for memory failure has been challenged (DePrince, Allard, Oh, & Freyd, 2004), the possibility that memory of emotional experiences may fail is still intriguing.

If emotional stimuli are distinctive and encoded into strong memory representations, memory failures should rarely occur. Gallo, McDermott, Percer, and Roediger (2001) manipulated stimulus modality and found that participants falsely recalled unpresented lures at a lower frequency when stimuli were presented visually. Gallo et al. (2001) argued that visual stimuli are more distinctive than auditory ones, leading to better memory and lower rates of memory

[1] Roediger and McDermott used the term *false memory* to describe memory errors observed with the DRM paradigm.

intrusions of the critical lures. With different methods of distinctiveness manipulation (e.g., words paired with pictures are more distinctive than words shown alone, a category with a smaller set size is more distinctive than a category with a larger set size), the results consistently showed that memory errors on distinctive items occur at a lower rate than on nondistinctive ones (Dewhurst, 2001; Dodson & Schacter, 2001; Gallo et al., 2001; Israel, Schacter, Verfaellie, & Anes, 1997).

Using a modified version of the DRM paradigm, Pesta, Murphy, and Sanders (2001) directly tested whether the distinctiveness shared by emotionally charged lures would reduce the recognition error rate. Pesta et al. (2001) presented words that were orthographically related to the lures. Six taboo words were chosen as emotional lures, and six neutral words that matched the taboo words in frequency, word length, and number of orthographic neighbours were chosen as neutral lures. Twelve study lists were presented to the participants, each containing ten neutral words that were orthographically related to the lures. Participants studied six of the lists (three for neutral lures and three for emotional lures) and were later given a recognition test. The results showed that the recognition error rate for emotionally charged lures was indeed lower. Yet, the recognition error rate was still higher when the emotional lures shared letters with studied items than when the lures did not.

Because Pesta et al. (2001) used taboo words as emotional lures, it is unclear whether these results are constrained to lures of extreme emotions. It is plausible that when participants saw the taboo words in the test phase, they used a strategy such as ‘‘if I had seen these taboo words during the study phase, I would have noticed them because they are quite unusual’’ to judge that the taboo words had not been presented in the study phase. Furthermore, the participants were told in advance that they might see some offensive, irritating stimuli during the test. Thus, expectancy during both the study and test phases may have caused the recognition errors on emotional lures that shared letters with the studied items.

The purpose of this study is to test the generalisability of the findings of Pesta et al. (2001) to less extreme emotional lures with the same paradigm. We also investigate whether the distinctiveness of the emotional valence (positive, negative, neutral) reduces recognition error rates, just as Schmidt (2002) showed that the recognition error rate on a picture of a dressed person was lower after viewing a series of nude pictures. We extend this finding to verbal materials. Finally, we investigate whether it is possible for participants to incorrectly recognise emotional lures that are orthographically related to studied items and yet are of an opposite valence. Freyd and Gleaves (1996) argued that induction of memory intrusions for abuse events from happy events is unlikely. We emulated a context in which lures share perceptual components with the experienced stimuli and yet are of an opposite valence. The results should further the understanding of memory failure for emotional lures.

GENERAL METHOD

The methodology used by Pesta et al. (2001) was adopted. The participants studied 12 lists of 10 two-character Chinese words. For each list, half the items shared the same first character and the other half shared the second character. The exact combination of studied lists differed across the three experiments to investigate the impact of valence distinctiveness on memory errors (see Table 1). The participants were tested on the recognition of studied and unstudied new items. Among the unstudied new stimuli, a lure was generated for each studied list by combining the common first character and the common second character to form a word of neutral, positive, or negative emotional valence. The frequency counts were matched between neutral and emotional lures. Because the lures never occurred in the study phase, a positive recognition represented memory failure.

To examine memory failure, another set of 12 lists was used as the baseline control for lures that never occurred in the study phase. The two groups of materials alternated between participants as the study and control lists. Because the controls were also the study lists for half of the participants, recognition errors on lures from these unstudied lists represent memory errors without any prior related experience (i.e., guessing). Memory failure on emotional and

TABLE 1
Valence of list words and lures used in each experiment

	Lure	*List words*
Exp. 1A	Neutral	Neutral
	Emotional	Neutral
Exp. 1B	Neutral	Neutral
	Emotional	Emotional
Exp. 2A	Neutral (Positive-matched)[a]	Neutral
	Neutral (Negative-matched)	Neutral
	Positive valence	Positive valence
	Negative valence	Neutral
Exp. 2B	Neutral (Positive-matched)	Neutral
	Neutral (Negative-matched)	Neutral
	Positive valence	Neutral
	Negative valence	Negative valence
Exp. 2C	Neutral	Emotional
	Emotional	Emotional
Exp. 3	Neutral (Positive-matched)	Neutral
	Neutral (Negative-matched)	Neutral
	Positive valence	Positive valence
	Negative valence	Positive valence

[a] the frequency counts of neutral lures were matched to the emotional lures.

neutral lures was revealed by examining the recognition of lures in a 2 (list type: studied vs. unstudied) $\times$ 2 (valence: neutral vs. emotional) repeated measures analysis of variance (ANOVA).

Two statistical effects were of interest: whether recognition of emotional lures generated from the studied lists was significantly higher than guessing from the unstudied ones, and whether recognition of emotional lures for studied items was lower than for neutral lures. The first effect addresses whether the memory error rate for studied emotional lures is statistically higher than what would be expected by guessing. The second effect relates to the reduction of memory errors by emotional distinctiveness.

Participants

A total of 40 undergraduates aged 18 to 28 participated in each experiment to receive bonus credit in an introductory psychology course. Participants were tested individually and each served in only one experiment.

Materials

A total of 24 lists of 11 two-character Chinese words were generated. Each list contained 1 lure and 10 words, with 5 words sharing the first character with the lure, and the other 5 sharing the second character. The 24 lists were divided into two sets: A and B. Within each set, 3 lists had an emotional lure of negative valence, 3 had an emotional lure of positive valence, and 6 had a neutral lure.

Several criteria were adopted to generate the lures and the corresponding lists. First, each lure had at least 10 orthographically related neutral neighbours, with five sharing the first character and another five sharing the second character. For example, for the lure ''*shun-li*'' (smooth going), the study words were: *shun-yin, shun-xu, shun-yian, shun-dao, shun-shi, quan-li, zhuan-li, ying-li, zhi-li, bi-li*. The other character of each studied word occurred only once during the study phase. Second, all words within a list were semantically unrelated or weakly related. More important, all items within a list were semantically unrelated to the lure. When choosing emotional lures in Experiments 2 and 3, an additional criterion was adopted such that studied items were of one emotional valence and the lure of another valence. There had to be an additional 10 orthographically related words that shared the same valence with the lure. Because of the difficulty in finding appropriate emotional lures, these stimuli were selected first. Neutral lures were then generated that had a similar structure and matched the frequency count of the emotional lures. Stimuli were presented in white against a black background in the centre of the screen.

To confirm the appropriateness of the materials, another group of 23 participants rated all the words used in this study. Participants were asked to judge the emotionality of each word on a 5-point scale from 0 (lowest) to 5 (highest).

Emotional words had a significantly higher rating than neutral words, $F(1, 28) = 284.836$, $p < .001$, $\eta^2 = .828$.

Procedure

The experiments were run with DMDX software (Forster & Forster, 2003). All experiments consisted of two phases with an intervening distraction task. In the study phase, participants were asked to memorise the words shown on the screen. Half of the participants were assigned to study group A, and the other half were assigned to study group B. To reduce the primacy and recency effects in memory, the study phase began with another two lists and ended with two other words. Data from these four lists were not analysed. The presentation order of the 12 lists was random, but the presentation order within each list was constant. Each stimulus was presented for 1500 ms, with 1500 ms as the interstimulus interval. There was a break of 10 s after every 40 words.

The participants went through three practice trials prior to the study phase to become familiar with the procedure. After the study phase, a distraction task was performed for 5 minutes, during which the participants judged perceptual similarity among geometric shapes. This distraction task was selected because it highly engaged the participants at a fast presentation rate with nonword stimuli that shared no resemblance to the studied materials. After the distraction task, the test phase began with three practice trials. All the participants were shown the same recognition lists and asked to judge whether the words were studied words or new ones. The recognition list consisted of 120 words, with 48 studied words and 72 new words. For the studied words, two words sharing the first character and two sharing the second character with the lure were selected from each studied list. Of the new words, 48 were words from the unstudied list and 24 were lures. Twelve lures were associated with the studied lists, and the other 12 were associated to the unstudied lists.

Participants were asked to press the key ‘‘z’’ for a *yes* response to old words and ‘‘/’’ for a *no* response to new words before the word disappeared from the screen. The presentation rate was the same as in the study phase. Participants were encouraged to make a correct response as quickly as possible. After the test phase, they were given a questionnaire about their awareness of any unusual aspects in the test phase. At the end of the session, they were debriefed and thanked for their participation.

EXPERIMENTS 1A AND 1B

The purpose of this experiment is to examine memory failure on emotional lures. Experiment 1A replicated the study conducted by Pesta el al. (2001) with lists of neutral studied words that were orthographically related to unstudied lures. Each participant studied 12 lists of ten neutral words. Three lists had an emotional lure of negative valence, three had an emotional lure of positive valence, and six had a neutral lure. To confirm that the distinctiveness of the emotional lures was the basis for the lower memory error rate for emotional lures, lists of emotional words orthographically related to the emotional lures were studied in Experiment 1B. Thus, the study lists consisted of six lists of neutral words, three of positive emotional words, and three of negative emotional words. If distinctiveness reduces memory errors on emotional lures, we expect to find a high rate of memory errors in Experiment 1B when distinctiveness is eliminated.

Results and Discussion

The dependent measure used throughout the study is the proportion of stimuli that participants identified as old items with a yes response. For items from the studied lists, this measure represented the proportion participants correctly recognised (i.e., hits). For items from the unstudied lists, and lures from both studied and unstudied lists, this measure represented the proportion of recognition errors (i.e., false alarms).

Experiment 1A. Recognition error rates for lures were analysed with a 2 (list type) × 2 (valence of lures) repeated measures ANOVA. The results revealed a statistically significant main effect of list type, $F(1, 39) = 163.032$, $p < .001$, $\eta^2 = .620$, of lure valence, $F(1, 39) = 86.853$, $p < .001$, $\eta^2 = .116$, and of the interaction, $F(1, 39) = 16.873$, $p < .001$, $\eta^2 = .042$. As shown in Table 2 and Figure 1, the recognition error rate for emotional lures was significantly lower than for neutral lures, replicating the results of Pesta et al. (2001). Recognition errors on emotional lures occurred when the lures had corresponding studied characters than when lures shared characters with the unstudied ones. The contrast in the unstudied controls also showed a lower rate of recognition when they were emotional words, perhaps reflecting the general distinctiveness of emotional words.

Recognition rates for list items were also analyzed with a 2 (list type) × 2 (valence of lures) repeated measures ANOVA. As shown in Table 2, the results revealed a statistically significant main effect of list type, $F(1, 39) = 637.150$, $p < .001$, $\eta^2 = .910$, and of lure valence, $F(1, 39) = 12.001$, $p < .01$, $\eta^2 = .006$. The interaction between the two variables was not statistically significant. The recognition of neutral list items was better than of emotional list items. The false alarm rate for unstudied items showed the same pattern. We have no explanation for this difference, except that the selected individual list items may not have matched in word frequency.

Experiment 1B. Recognition error rates for lures were analysed with a 2 (list type) × 2 (valence of lures) repeated measures ANOVA. The results showed only a statistical significant main effect of list type, $F(1, 39) = 453.381$,

TABLE 2
Mean proportion and (standard deviation) of yes responses in Experiment 1 by list type, valence type, and item type

	Studied	*Unstudied*
Experiment 1A		
Lure		
Neutral	.741 (0.21)	.163 (0.19)
Emotional	.423 (0.28)	.085 (0.13)
Studied item		
Neutral	.794 (0.18)	.123 (0.15)
Emotional	.728 (0.19)	.067 (0.07)
Experiment 1B		
Lure		
Neutral	.786 (0.15)	.151 (0.22)
Emotional	.803 (0.17)	.215 (0.16)
Studied item		
Neutral	.750 (0.14)	.077 (0.09)
Emotional	.740 (0.14)	.110 (0.13)

$p < .001$, $\eta^2 = .883$. No other effects reached statistical significance. As shown in Table 2 and Figure 1, recognition error rates for studied lures were significantly higher than for unstudied lures, while there was no difference between emotional and neutral lures. When lures were not emotionally distinctive and shared the same emotional valence as their corresponding study items, the recognition error rate was as high as for neutral lures.

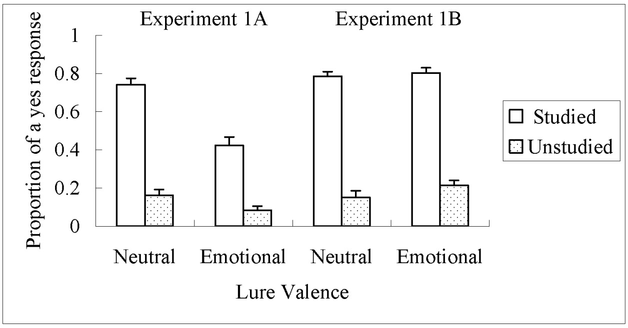

Figure 1. Memory errors on lures observed in Experiments 1A and 1B as a function of the emotional valence of the lures and the list type from which the lures were generated.

Recognition rates for list items (see Table 2) were also analysed by a 2 (list type) $\times$ 2 (valence of lures) repeated measures ANOVA. The results revealed a statistically significant main effect of list type, $F(1, 39) = 874.050$, $p < .001$, $\eta^2 = .929$. The other effects were not statistically significant. There was no difference between correct recognition rates for list items corresponding to neutral and emotional lures.

This experiment showed that memory errors on emotional lures were less frequent than on neutral lures only when emotional lures were emotionally distinctive (Experiment 1A), replicating the results of Pesta et al. (2001). Experiment 1B empirically tested a hypothesised experiment proposed by Kensinger and Corkin (2004), in which the same number of neutral and emotional words were shown to participants during the study phase to diminish the distinctiveness of emotional stimuli. Results from Experiment 1B demonstrated that when emotional lures were not distinctive, memory errors were as frequent as with neutral lures. Note that the emotional and neutral lures used in Experiment 1A and 1B were the same; only the emotional distinctiveness of the emotional lures changed. In summary, these results extend Pesta et al.'s (2001) finding beyond the use of taboo words. A lure with emotional valence, whether positive or negative, reduces the recognition error rate when it is emotionally distinctive.

Our results also differed from those of Pesta et al. (2001). First, the overall recognition error rates in the current experiment appear higher than errors observed in that study. One possible reason is that each lure in this study shared one character with half of the studied words, and another character with the other half. In contrast, the orthographically related stimuli used in English could only share a prefix, suffix, or syllable. Under such circumstances, it is more difficult for participants to come up with a rule to memorise orthographically related words. The perceptual gist in orthographic characters is more salient in Chinese, and participants may have been more likely to depend on this gist during retrieval, making recognition error more likely to occur (Koutstaal, Schacter, Verfaellie, Brenner, & Jackson, 1999).

The second difference in results is that Pesta et al. (2001) found fewer memory errors on emotional lures even when emotional distinctiveness was reduced by adding three emotional words to each study list. In contrast, no difference in recognition error rates between neutral and emotional lures were found in Experiment 1B when emotional distinctiveness was eliminated. The degree of distinctiveness may be the reason. In Experiment 1B, half of the study materials were emotional words, and half of the test words were emotional words. In contrast, only one-eighth of the test materials were emotional words in Pesta et al.'s (2001) study. The degree of emotional distinctiveness may have been higher in Pesta et al.'s (2001) study, with the result that the recognition error rates were significantly lower for emotional lures.

EXPERIMENTS 2A, 2B, AND 2C

The results of Experiment 1 generalised the findings of Pesta et al.'s (2001) study to two-character Chinese words. The purpose of the second experiment is to investigate recognition errors on lures with positive, negative, and neutral valence. Experiments 2A and 2B are designed to emulate contexts in which one experiences both neutral and emotional episodes of one valence. The point of interest is recognition errors on emotional lures that share elements with the neutral episode, and that are of the opposite valence to studied items. Experiment 2A addressed whether recognition errors on negative lures can occur from neutral studied words after studying neutral and positive words. Experiment 2B investigated recognition errors on positive lures after studying neutral and negative words. Experiment 2C investigated whether stimuli of neutral valence could reduce memory errors after the study of emotional words. As Schmidt (2002) showed, the recognition error rate on an image of a dressed person was low after viewing a series of nude pictures because of the image's emotional distinctiveness.

The study phase of Experiment 2A consisted of nine lists of neutral words and three lists of positive emotional words (e.g., happy, victory). Lures of negative emotional valence were generated from three lists of neutral words, whereas positive lures were generated from the lists of positive words. Thus, the lures of negative emotional valence were distinctive whereas the lures of positive emotional valence were not. Three of the six neutral lures matched the frequency counts of the positive lures and three matched the frequency counts of the negative lures. Experiment 2B followed the same design using lures of neutral and positive valence after studying neutral and negative words. The study phase of Experiment 2C consisted of three lists of negative words and three lists of positive words. Lures of congruent valence were generated from these lists. Lures of positive and negative valence were not distinctive. Because of the difficulty in gathering materials, the neutral lures were generated from the six lists that contained both positive and negative words.

Results and discussion

Experiment 2A. The recognition error rates for the lures were analysed with a 2 (list type) × 2 (lure valence) × 2 (distinctiveness) repeated measures ANOVA. Distinctiveness of neutral lures was not meaningful, except for matching word frequency with emotional lures that were distinctive. The results revealed a statistically significant main effect of list type, $F(1, 39) = 328.123$, $p < .001$, $\eta^2 = .611$, lure valence, $F(1, 39) = 23.613$, $p < .001$ $\eta^2 = .057$, and of distinctiveness, $F(1, 39) = 78.013$, $p < .001$, $\eta^2 = .122$. All the interaction effects, including the three-way interaction were significant.

Because memory errors on emotionally distinctive lures were of interest, a 2 (list type) × 2 (distinctiveness) ANOVA was conducted to analyse recognition errors on emotional lures only. The results revealed a statistically significant main effect of list type, $F(1, 39) = 71.848$, $p < .001$, $\eta^2 = .435$, and of distinctiveness $F(1, 39) = 73.319$, $p < .001$, $\eta^2 = .207$. The interaction was also significant $F(1, 39) = 28.411$, $p < .001$, $\eta^2 = .090$. As shown in Table 3 and Figure 2, recognition errors for negative lures were still significant, albeit at a rate lower than for positive lures. That is, memory failure for emotionally negative lures was still possible when lures shared components with neutral stimuli in a context that did not contain any negative stimuli. Using the Tukey's HSD test, we found that the significant interaction was due to the effect of distinctiveness, which was statistically significant only under the studied list

TABLE 3
Mean Proportion and standard deviation of yes responses in Experiment 2 by list type, valence type, and item type

	Studied	*Unstudied*
Experiment 2A		
Lure-Neutral		
Positive-matched	.867 (0.21)	.191 (0.21)
Negative-matched	.618 (0.32)	.091 (0.18)
Lure-Emotional		
Positive	.709 (0.33)	.141 (0.22)
Negative	.262 (0.30)	.050 (0.12)
Studied item		
Neutral	.767 (0.14)	.071 (0.08)
Emotional	.700 (0.14)	.042 (0.06)
Experiment 2B		
Lure-Neutral		
Positive-matched	.908 (0.20)	.149 (0.22)
Negative-matched	.601 (0.36)	.042 (0.13)
Lure-Emotional		
Positive	.442 (0.34)	.070 (0.14)
Negative	.897 (0.18)	.090 (0.17)
Studied item		
Neutral	.723 (0.16)	.062 (0.06)
Emotional	.711 (0.17)	.054 (0.06)
Experiment 2C		
Lure		
Neutral	.510 (0.31)	.262 (0.23)
Emotional	.721 (0.28)	.229 (0.24)
Studied item		
Neutral	.697 (0.19)	.096 (0.11)
Emotional	.611 (0.19)	.089 (0.09)

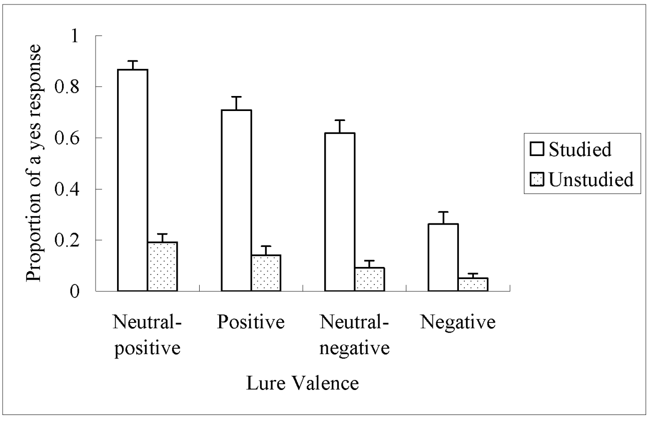

Figure 2. Memory errors on lures observed in Experiment 2A as a function of the emotional valence of the lures and the list type from which the lures were generated.

condition. Participants made fewer errors on emotionally distinctive lures from the studied list as compared to lures that were not emotionally distinctive from the studied list.

Recognition rates for list items were also analysed with a 2 (list type) × 2 (valence of lures) repeated measures ANOVA. The results revealed a statistically significant main effect of list type, $F(1, 39) = 955.005$, $p < .001$, $\eta^2 = .960$, and of lure valence, $F(1, 39) = 11.435$, $p < .002$, $\eta^2 = .004$. The interaction between these two variables was not statistically significant. As shown in Table 3, recognition was more accurate for the studied items than for the unstudied items. Participants were also more accurate in recognising neutral items from the studied list than in recognising emotional items from the studied list.

Experiment 2B. Recognition error rates for lures were analysed by a 2 (list type) × 2 (lure valence) × 2 (distinctiveness) repeated measures ANOVA. The results from a 2 × 2 × 2 ANOVA showed a significant main effect of list type $F(1, 39) = 419.878$, $p < .001$, $\eta^2 = .744$, and lure valence, $F(1, 39) = 4.389$, $p < .001$, $\eta^2 = .004$. All the interaction effects, including the three-way interaction, $F(1, 39) = 39.923$, $p < .001$, $\eta^2 = .097$, were significant. We further conducted three two-way ANOVAs and found that no two-way interaction effect was significant. Therefore, the three-way interaction arose because the effect of distinctiveness was opposite for different types of lure valence.

Because memory errors for emotionally distinctive lures were of interest, a 2 (list type) × 2 (distinctiveness) ANOVA was conducted to analyse recognition of emotional lures only. The results revealed a significant main effect of list type, $F(1, 39) = 276.211$, $p < .001$, $\eta^2 = .674$, and of distinctiveness, $F(1, 39) = 48.893$, $p < .001$, $\eta^2 = .115$. The interaction effect was also significant, $F(1, 39)$

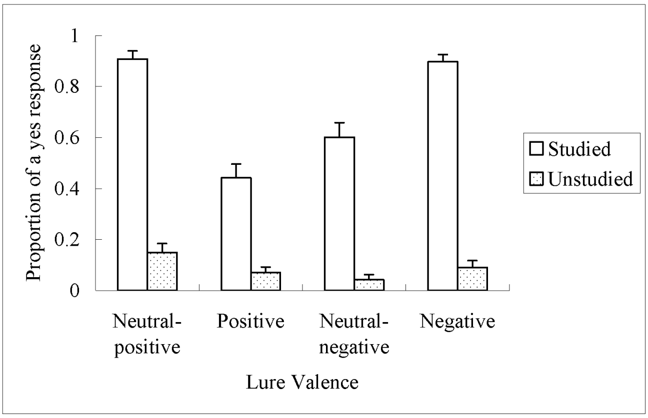

Figure 3. Memory errors on lures observed in Experiment 2B as a function of the emotional valence of the lures and the list type from which the lures were generated.

= 43.539, $p < .001$, $\eta^2 = .089$. Using the Tukey's HSD test, we found that the effect of distinctiveness was significant only among the studied lists. Participants made fewer errors on emotionally distinctive lures from the studied list as compared to lures that were not emotionally distinctive. As shown in Figure 3, recognition errors on positive lures were still statistically significant, albeit at a lower rate than for negative lures. That is, memory errors on emotionally positive lures were still possible when the lures shared components with neutral stimuli in a context that did not contain any positive stimuli.

Recognition rates for list items (see Table 3) were also analysed with a 2 (list type) $\times$ 2 (valence of lures) repeated measures ANOVA. The results revealed a statistically significant main effect of list type, $F(1, 39) = 1070.404$, $p < .001$, $\eta^2 = .948$. No other effects reached significance. Recognition was more accurate for the studied items than the unstudied ones. Yet, no statistically significant difference in accuracy was found between neutral and emotional items in either the studied or unstudied lists.

Experiment 2C. Recognition error rates for lures were analyzed with a 2 (list type) $\times$ 2 (lure valence) $\times$ 2 (distinctiveness) repeated measures ANOVA. The results from a 2 $\times$ 2 $\times$ 2 ANOVA showed a statistically significant main effect of list type $F(1, 39) = 109.932$, $p < .001$, $\eta^2 = .489$, and of lure valence, $F(1, 39) = 9.640$, $p < .001$, $\eta^2 = .053$. The interaction between these two variables was also significant, $F(1, 39) = 4.855$, $p < .05$, $\eta^2 = .028$. As shown in Figure 4, recognition errors on neutral lures were statistically significantly lower than for emotional lures. Yet, the number of recognition errors on neutral lures from the studied list was still statistically significantly higher than the number of recognition errors on unstudied ones.

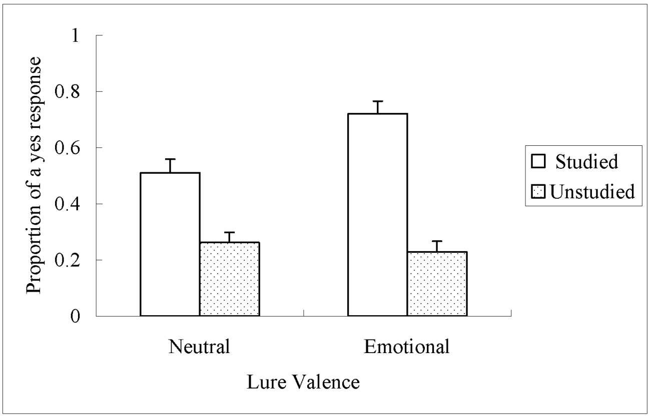

Figure 4. Memory errors on lures observed in Experiment 2C as a function of the emotional valence of the lures and the list type from which the lures were generated.

Recognition rates for list items (see Table 3) were also analysed by a 2 (list type) × 2 (valence of lures) repeated measures ANOVA. The results revealed a statistically significant main effect of list type, $F(1, 39) = 427.152$, $p < .001$, $\eta^2 = .877$, and of lure valence, $F(1, 39) = 5.946$, $p < .05$, $\eta^2 = .006$. The interaction between the two variables was also statistically significant, $F(1, 39) = 5.769$, $p < .05$, $\eta^2 = .004$. Using the Tukey's post hoc analysis, we found that the effect of emotional valence was statistically significant only for the studied items. Participants were more accurate in recognizing learned items from the emotional lists.

The results suggest that the participants used distinctiveness to reject lures of one emotional valence. Moreover, the distinctiveness applied to all three types: positive, negative, and neutral. The convergence is critical, because words of negative stimuli usually have lower frequency counts than positive or neutral ones, and distinctiveness in familiarity also reduced recognition errors on negative words. For example, in Experiment 2A, recognition errors on neutral lures were statistically lower when lures were matched in frequency count with negative valence words than when neutral lures were matched to positive valence words. The difference can be explained by the distinctiveness of familiarity. However, this alternative account can not explain the reduction of recognition errors by distinctiveness in Experiment 2B because participants made fewer errors on emotionally distinctive lures although these lures were not distinctive in terms of familiarity. Thus, it is the converging pattern that is important in supporting the role of distinctiveness in reducing memory errors.

EXPERIMENT 3

The results converge to show that the number of recognition errors on emotionally distinctive lures was lower than on nondistinctive ones. Yet, the number of recognition errors on distinctive lures was still significantly higher than the number of errors on unstudied ones. The emotionally distinctive lures were combinations of the components of the neutral stimuli used in Experiments 2A and 2B. What would happen if the distinctive lures were a combination of stimuli of opposite valence? Is it really possible to mistake a positive word for a negative word and vice versa? Freyd and Gleaves (1996) argued that memory errors are highly unlikely when the lures are very dissimilar to the actual experiences. This experiment is designed to emulate such a context with lures and list items of opposite emotional valence but shared orthographical similarities.

The participants in this experiment studied six lists of neutral words and six lists of positive words.[2] Three lists of positive words were used to generate the positive lures; three lists of positive words were used to generate the negative lures. Congruent lures were of positive valence and incongruent ones were of negative valence. For example, the incongruent lure ''*zi-da*'' (pompous) shared its first character with positive words like ''*zi-xin*'' (confidence) and its second character with positive words like ''*wei-da*'' (greatness). Neutral lures were also categorised as congruent or incongruent and matched with the type of lure and frequency count. Because of the difficulty in generating lures of a valence opposite to the list and generating neutral lures that matched in frequency count, only 12 lists were used in the study phase of this experiment for all 40 participants. Unstudied words used in the test phase were chosen carefully to match the characteristics of the words in the study phase. Lures from the unstudied lists also shared the same features as those in the studied lists.

Results and discussion

Table 4 shows the results. The recognition error rates for the lures were analysed with a 2 (list type) $\times$ 2 (lure valence) $\times$ 2 (congruency) repeated measures ANOVA. Results showed the main effects for list type and congruency were statistically significant: list type, $F(1, 39) = 758.765$, $p < .001$, $\eta^2 = .845$, and congruency, $F(1, 39) = 27.304$, $p < .001$, $\eta^2 = .037$. The List type $\times$ Congruency, $F(1, 39) = 18.073$, $p < .001$, $\eta^2 = .028$, and Lure valence $\times$ Congruency, $F(1, 39) = 5.098$, $p < .05$, $\eta^2 = .003$, were both statistically significant. No other effects reached statistical significance. The first interaction

[2] We also used six lists of neutral words and six lists of negative words in another experiment. The result patterns were the same as in this experiment. Because the raw data were lost after the first submission, we would not be able to provide raw data in the future and hence deleted it.

TABLE 4
Mean proportion and (standard deviation) of yes responses in Experiment 3 by list type, valence type, and item type

	Studied	*Unstudied*
Lure-Neutral[a]		
Congruent-matched	.917 (0.16)	.158 (0.17)
Incongruent-matched	.596 (0.30)	.125 (0.19)
Lure-Emotional		
Congruent	.838 (0.23)	.075 (0.16)
Incongruent	.650 (0.31)	.075 (0.14)
Studied item		
Neutral	.677 (0.17)	.111 (0.10)
Emotional	.671 (0.14)	.105 (0.11)

[a] The frequency counts of neutral lures were matched to congruent or incongruent lures.

arose because the effect of congruency was not observed for unstudied lists as congruency had no meaning in this context. The number of recognition errors on incongruent lures was lower than for congruent ones only on the studied lists. The latter interaction arose because the valence effect was observed only for the congruent lists. It is unclear why the recognition error rate on emotionally incongruent lures was not statistically different from the error rate on neutral words of matched frequency, because emotionally incongruent lures (positive) should be distinctive. According to the distinctiveness hypothesis, we expected emotionally distinctive lures to have fewer memory errors. However, the expectation was not met.

Because memory errors on emotionally distinctive lures were of interest, a 2 (list type) $\times$ 2 (congruency) ANOVA was conducted to analyse recognition errors on emotional lures. The results revealed a significant main effect of list type, $F(1, 39) = 438.760$, $p < .001$, $\eta^2 = .839$, and of congruency, $F(1, 39) = 9.210$, $p < .005$, $\eta^2 = .017$. The interaction effect shown in Figure 5 was also significant, $F(1, 39) = 6.894$, $p < .05$, $\eta^2 = .017$. The statistically significant interaction effect arose because the congruency effect was significant only for the studied lists. There was no difference between the recognition error rates for lures from incongruent and congruent unstudied lists.

Recognition rates for list items were also analysed with a 2 (list type) $\times$ 2 (valence of lures) repeated measures ANOVA. As shown in Table 4, the results revealed a statistically significant main effect of list type, $F(1, 39) = 571.392$, $p < .001$, $\eta^2 = .907$. No other effects were significant. Participants recognised more words from studied lists than from the unstudied lists.

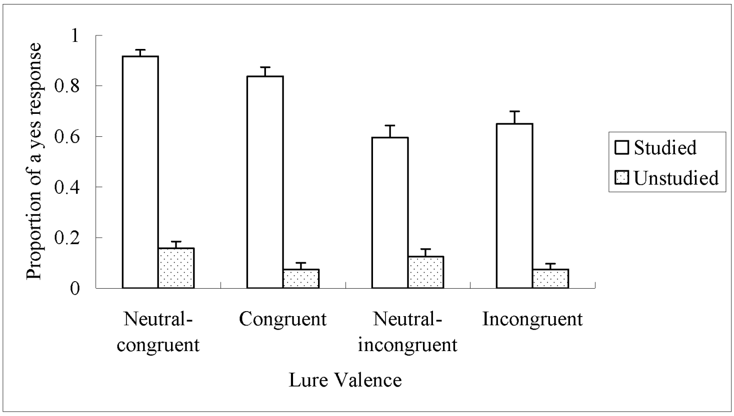

Figure 5. Memory errors on lures observed in Experiment 3 as a function of valence congruency of the lures and the list type from which the lures were generated.

Because of the difficulty in selecting stimulus materials for this experiment and because the frequency count may not reflect subjective familiarity, some result patterns appear to be stimulus-specific (e.g., more recognition errors for unstudied emotional lures). The most important result is the reduction of recognition errors when the lures were emotionally incongruent with the studied words. Moreover, the recognition error rate for emotionally incongruent lures was still statistically significantly higher than for unstudied ones. That is, recognition errors can occur even when lures are of an emotional valence opposite to the items studied, provided that the lures share perceptual components with the studied stimuli.

GENERAL DISCUSSION

This study used the DRM paradigm to investigate the effect of emotional distinctiveness on memory errors. The specific question of interest examined was whether it is possible for people to mistake a stimulus of one emotional valence that never occurred from exposure to stimuli of a different emotional valence. With orthographically related stimuli, the results revealed two main findings. First, lures, even the emotional ones that shared orthographic components with the studied words, were prone to memory failures. The number of recognition errors on emotional lures was statistically significantly higher than would be expected from guessing on emotional lures that shared components with the unstudied stimuli. Second, emotional distinctiveness reduced recognition error rates. These findings generalise across study lists of neutral words, and words of differing emotional valance with lures of positive, negative, and neutral valence.

The convergence of the result pattern rules out a frequency account that could explain the finding in some specific experimental contexts.

Rise of memory failures for emotional lures

The first main finding showed that after studying stimuli that share orthographic components, the recognition error rate on emotional lures was statistically significantly higher than guessing on lures related to the unstudied words, although it was lower than the rate for neutral lures. That is, emotional distinctiveness cannot eliminate memory failures if test items share orthographical similarity with the studied stimuli. Pesta et al. (2001) suggested that participants' expectations may account for recognition errors on emotional lures. In Pesta et al.'s (2001) study, participants were told that they might see some offensive, irritating stimuli during the test. Participants may have recognised the taboo words to meet the expectancy. In our study, participants were simply instructed to memorise the words in the study phase. As a result, expectancy cannot account for the finding of memory failure on emotional lures.

Recognition errors may arise from many possibilities, as suggested by models of false memory in the literature. The first possibility is that a perceptual gist developed after studying 120 words. According to the fuzzy trace theory (Brainerd, Reyna, Howe, & Kevershan, 1991; Reyna & Brainerd, 1995), recognition is based on retrieval of gist and verbatim. Gist information is long-lasting but provides little information to distinguish different items within a single semantic category. According to fuzzy trace theory, recognition errors arise because of over-dependence on gist information or retrieval of wrong verbatim information. The former can explain why participants recognised lures related to the studied stimuli in this study. Because the lures contained studied characters, participants were biased toward a *yes* response. Postexperimental interviews confirmed that nearly half of participants were aware of this perceptual gist and some adopted this strategy in memorising the words during the study phase. However, it is unclear whether participants depended on the perceptual gist during recognition.

Even if the participants did not use such a strategy, repetitive presentation of each character five times in the study phase could have increased the activation level for lures that contained studied characters. Although care was taken to select lures that were semantically unrelated or weakly related to the studied words, the activation could be both orthographic and semantic because some Chinese characters contain semantic radicals. With the activation above a threshold and failure in monitoring, recognition errors on lures could arise in memory retrieval (Gallo et al., 2001).

Alternatively, activation of the studied characters may lead to internally generated associations during encoding such that participants might actually think of unstudied lures in the study phase after seeing several orthographically related neighbours. In the test phase, participants may have mistaken these internally generated items as studied ones because of a failure in source monitoring (Johnson, Hashtroudi, & Lindsay, 1993). If participants were fully aware of the source, they would not mistakenly recognise the lures. Using the DRM paradigm with semantically related words, Libby and Neisser (2001) demonstrated this effect by telling their participants that all the studied words in a list were related to an unpresented word. Participants did not mistakenly recognise the critical lure when they successfully guessed the unpresented word, but memory error was high when they failed to guess it.

Reduction of recognition errors on emotional lures

According to the fuzzy trace theory (Brainerd et al., 1991; Reyna & Brainerd, 1995), verbatim information can reduce memory errors. To account for the reduction of recognition errors on emotional lures as compared to recognition of neutral lures, one must incorporate emotional connotations in verbatim information. That is, the perceptual gist (both characters had been studied) led to the increase in recognition errors and yet the distinctiveness in emotional valence could not retrieve an exact studied verbatim character that contained the same valence. The latter failure counteracted the effect of perceptual gist in recognition and hence reduced recognition errors on emotional lures. The activation account (Roediger, Watson, McDermott, & Gallo, 2001) can also explain the results by arguing that emotional distinctiveness instigates monitoring mechanisms, or that participants were less likely to internally generate emotional lures from neural words or from words of an opposite valence during the study phase. Thus, recognition errors were reduced when the lures were of a distinctive valence.

Validity of the current study

One might criticise the validity of the current study because of the usage of a recognition task. Memory failures might arise simply because of a response bias for orthographically similar items. Although we cannot completely rule out this possibility, some evidence suggests that the participants might actually have remembered the lures. Asked to rate their confidence in their response, participants in another experiment that used the same stimuli as in Experiment 1A (Huang, 2001) were quite confident even for the mistakenly recognised emotional lures ($M = 2.30$ on a 3-point scale, and 2.54 for the neutral lures). The confidence ratings for lures from the studied lists seemed to be higher than those from the unstudied lists (2.42 vs. 1.55). Because few participants mistakenly recognised lures from the unstudied list, it is not possible to conduct a parametric analysis on confidence ratings. The patterns suggest that participants were not just guessing during the recognition phase. On the contrary, participants seem to believe that the lures actually appeared in the study phase.

Implications for everyday memory

The results of this study deliver an important message: Memory failure does not come from nothing. Lures must share perceptual elements with the studied stimuli to generate recognition errors beyond guessing. When lures do not share any element with the studied stimuli, there are few recognition errors. Therefore, it is unlikely people will generate a memory error about episodes that are very different from existing mental representations.

No matter what is found with laboratory stimuli generated by researchers, recovery of emotionally charged events, such as childhood abuse, would remain controversial. After all, no one knows exactly what happened except for those directly involved. Freyd and Gleaves (1996) argued that there are two units of analysis: the object and the event. The DRM paradigm focuses on the object unit with emphasis on memory errors on items from studied lists. Any memory errors related to the object unit may not be generalisable to the event unit, because people are likely to remember details mistakenly but not a whole event. DePrince et al. (2004) further argued that the use of ''false memory'' to describe errors in details seriously confuses the constructs of human memory research.

Indeed, errors in details cannot be equated with errors in a whole event. As shown in this study, the number of memory errors is high only when the lures are orthographically related to the studied items and emotional distinctiveness can reduce recognition errors. Thus, a memory error of a negative emotional event cannot arise from unrelated neutral or positive experience as Freyd and Gleaves (1996) suggested.

Nevertheless, it is plausible that existing mental representations arise from many sources, such as reading fiction or newspapers, seeing movies, watching TV, or imagination from another person's depiction. Wade, Garry, Read, and Lindsay (2002) showed that participants could mistakenly recall the content of an event after being asked to image an episode. When induced to retrieve an episode of a certain emotional theme, memory failures might occur through the recombination of episodic elements from different sources if monitoring mechanisms fail. Thus, it is possible to mistake a positive episode for a negative episode if the two events share many elements or if the participants mistakenly combine elements from different sources. Jones and Jacoby (2001) have shown that memory failures may arise from conjunction errors.

Generation of internal thoughts combined with a failure in source monitoring provide a plausible explanation for the creation of emotional memory failures. Source monitoring failure was found to account for false childhood abuse memories (Loftus & Yapko, 1995). In addition, a person's attention may be biased toward personal subjective feelings in events with strong emotion so that the person has fewer cognitive resources to process information from the external environment. As a result, the person may be unable to attribute the source of a piece of information correctly. When participants were asked to focus on either the content of a passage or their subjective feelings about the passage, they made more errors about the source of the information in the latter condition (Hashtroudi, Johnson, Vnek, & Ferguson, 1994; Johnson, Nolde, & De Leonardis, 1996). Johnson et al. (1996) further showed that the failure of source monitoring occurred only when participants focused on their own emotional feelings, and not when they focused on what feelings others might have.

It is also plausible that creation of emotional memory failures is due to overreliance on general-autobiographical memory (g-ABM; Anderson & Conway, 1993; Conway & Rubin, 1993). When experiencing emotionally arousing events, a person might overactivate the g-ABM and retain little information about the specificity of those remembered events. Therefore, when retrieving those experiences, people may encounter difficulty in retrieving specific information about the event and so rely on the gist of g-ABM. This phenomenon is observed among depressed individuals. Clinically depressed patients are known to have a bias toward negative memories and preferentially depend on g-ABMs during memory retrieval (Williams, 1996). As a consequence, one would predict that depressed individuals have more memory failures on negative events. Roberts's (2002) study examined the false memory phenomenon with participants of different levels of depression and found that memory depends on the stress level and also the interaction between stress level and level of depression. Further research is needed to determine whether depressed individuals are more likely to mistakenly remember negative events from unrelated neutral ones and the consequences of such memory failures. More important, the challenge remains for researchers to identify a methodology that can emulate everyday life situations with ecological validity.

CONCLUSION

The aim of this study was to understand whether it is possible to mistake a positive stimulus for a negative one. Through a series of experiments, we conclude that memory failures for an opposite emotional valence can occur when lures share perceptual components with studied words, albeit at a low rate. Unless a positive episode shares many components with a negative episode, it is unlikely that a positive stimulus will be mistaken for a negative one. Future research might include the use of video clips of life events that are of one emotional valence and manipulate the degree to which lures of an opposite valence share components with the study events. The results from such a study may shed light on the mechanisms that produce memory failure on emotional lures in everyday life.

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REFERENCES

Anderson, S. J., & Conway, M. A. (1993). Investigating the structure of autobiographical memories. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *19*, 1178–1196.

Baddeley, A. D. (1998). *Human memory: Theory and practice* (rev. ed.). Needham Heights, MA: Allyn & Bacon.

Brainerd, C. J., Reyna, V. F., Howe, M. L., & Kevershan, J. (1991). Fuzzy-trace theory and cognitive triage in memory development. *Developmental Psychology*, *27*, 351–369.

Brown, R., & Kulik, J. (1977). Flashbulb memories. *Cognition*, *5*, 73–99.

Christianson, S. A. (1989). Flashbulb memories: Special, but not so special. *Memory and Cognition*, *17*, 435–443.

Christianson, S. A., Loftus, E. F., Hoffman, H., & Loftus, G. R. (1991). Eye fixations and memory for emotional events. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *17*, 693–701.

Conway, M. A., & Rubin, D. C. (1993). The structure of autobiographical memory. In A. F. Collins, M. A. Conway, & P. E. Morris (Eds.), *Theories of memory* (pp. 103–137). Hove, UK: Psychology Press.

DePrince, A. P., Allard, C. B., Oh, H., & Freyd, J. J. (2004). What's in a name for memory errors? Implications and ethical issues arising from the use of the term ''false memory'' for errors in memory for details. *Ethics and Behavior*, *14*, 201–233.

Dewhurst, S. A. (2001). Category repetition and false recognition: Effects of instance frequency and category size. *Journal of Memory and Language*, *44*, 153–167.

Dodson, C. S., & Schacter, D. L. (2001). ''If I had said it I would have remembered it'': Reducing false memories with a distinctiveness heuristic. *Psychonomic Bulletin and Review*, *8*, 155–161.

Forster, K. I., & Forster, J. C. (2003). DMDX: A Windows display program with millisecond accuracy. *Behavior Research Methods, Instruments, and Computers*, *35*, 116–124.

Freyd, J. J., & Gleaves, D. H. (1996). ''Remembering'' words not presented in lists: Relevance to the current recovered/false memory controversy. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *22*, 811–813.

Gallo, D. A., McDermott, K. B., Percer, J. M., & Roediger, H. L. (2001). Modality effects in false recall and false recognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*, 339–353.

Hashtroudi, S., Johnson, M. K., Vnek, N., & Ferguson, S. A. (1994). Aging and the effects of affective and factual focus on source monitoring and recall. *Psychology and Aging*, *9*, 160–170.

Huang, Y. (2001). *The effects of emotional distinctiveness on false memory*. Unpublished thesis: National Taiwan University.

Hyman, I. E. J., & Kleinknecht, E. E. (1999). False childhood memories: Research, theory, and applications. In L. M. Williams (Ed.), *Trauma and memory* (pp. 175–188). Thousand Oaks, CA: Sage.

Israel, L., Schacter, D. L., Verfaellie, M., & Anes, M. D. (1997). Pictorial encoding reduces false recognition of semantic associates. Illusory memories in amnesic patients: Conceptual and perceptual false recognition. *Psychonomic Bulletin and Review*, *4*, 577–581.

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, *114*, 3–28.

Johnson, M. K., Nolde, S. F., & De Leonardis, D. M. (1996). Emotional focus and source monitoring. *Journal of Memory and Language*, *35*, 135–156.

Johnson, M. K., Raye, C. L., & Durso, F. T. (1980). Reality monitoring: Second perceptions and thoughts. *Bulletin of the Psychonomic Society*, *15*, 402–404.

Johnson, M. K., & Sherman, S. J. (1990). Constructing and reconstructing the past and the future in the present. In E. T. E. Higgins & R. M. Sorrentino (Eds.), *Handbook of motivation and cognition: Foundations of social behavior* (Vol. 2, pp. 482–526). NewYork: Guilford Press.

Jones, T. C., & Jacoby, L. L. (2001). Feature and conjunction errors in recognition memory: Evidence for dual-process theory. *Journal of Memory and Language*, *45*, 82–102.

Kensinger, E. A., & Corkin, S. (2004). The effects of emotional content and aging on false memories. *Cognitive, Affective, and Behavioral Neuroscience*, *4*, 1–9.

Koutstaal, W., Schacter, D. L., Verfaellie, M., Brenner, C., & Jackson, E. M. (1999). Perceptually based false recognition of novel objects in amnesia: Effects of category size and similarity to category prototypes. *Cognitive Neuropsychology*, *16*, 317–341.

Libby, L. K., & Neisser, U. (2001). Structure and strategy in the associative false memory paradigm. *Memory*, *9*, 145–163.

Loftus, E. F. (1979). The malleability of human memory. *American Scientist*, *67*, 312–320.

Loftus, E. F. (2003). Memory in Canadian Courts of Law. *Canadian Psychology*, *44*, 207–212.

Loftus, E. F., & Davies, G. M. (1984). Distortions in the memory of children. *Journal of Social Issues*, *40*, 51–67.

Loftus, E. F., & Palmer, J. C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior*, *13*, 585–589.

Loftus, E. F., & Yapko, M. D. (1995). Psychotherapy and the recovery of repressed memories. In T. Ney (Ed.), *True and false allegations of child sexual abuse: Assessment and case management* (pp. 176–191). New York: Brunner/Mazel.

Ochsner, K. N., & Schacter, D. L. (2000). A social cognitive neuroscience approach to emotion and memory. In J. C. Borod (Ed.), *The neuropsychology of emotion. Series in affective science* (pp. 163–193). New York: Oxford University Press.

Pesta, B. J., Murphy, M. D., & Sanders, R. E. (2001). Are emotionally charged lures immune to false memory? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*, 328–338.

Philippot, P., & Schaefer, A. (2001). Emotion and memory. In T. J. Mayne & G. A. Bonanno (Eds.), *Emotions: Currrent issues and future directions. Emotions and social behavior* (pp. 82–122). New York: Guilford Press.

Porter, S., Spencer, L., & Birt, A. R. (2003). Blinded by emotion? Effect of the emotionality of a scene on susceptibility to false memories. *Canadian Journal of Behavioural Science*, *35*, 165–175.

Reyna, V. F., & Brainerd, C. J. (1995). Fuzzy-trace theory: Some foundational issues. *Learning and Individual Differences*, *7*, 145–162.

Roberts, P. (2002). Vulnerability to false memory: The effects of stress, imagery, trait anxiety, and depression. *Current Psychology: Developmental, Learning, Personality, Social*, *21*, 240–252.

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *21*, 803–814.

Roediger, H. L., Watson, J. M., McDermott, K. B., & Gallo, D. A. (2001). Factors that determine false recall: A multiple regression analysis. *Psychonomic Bulletin and Review*, *8*, 385–407.

Ross, M., & Conway, M. A. (1986). Remembering one's own past: The construction of personal histories. In R. M. Sorrentino & E. T. Higgins (Eds.), *Handbook of motivation and cognition: Foundations of social behavior* (pp. 122–144). New York: Guilford Press.

Schmidt, S. R. (2002). Outstanding memories: The positive and negative effects of nudes on memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *28*, 353–361.

Sharot, T., & Phelps, E. A. (2004). How arousal modulates memory: Disentangling the effects of attention and retention. *Cognitive, Affective, and Behavioral Neuroscience*, *4*, 294–306.

Wade, K. A., Garry, M. Read, J. D., & Lindsay D. S. (2002). A picture is worth a thousand lies: Using false photographs to create false childhood memories. *Psychonomic Bulletin and Review*, *9*, 597–603.

Williams, J. M. G. (1996). Depression and the specificity of autobiographical memory. In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical memory* (pp. 244–267). New York: Cambridge University Press.

Yehuda, R., Marshall, R., & Giller, E. L. J. (1998). Psychopharmacological treatment of post-traumatic stress disorder. In P. E. Nathan (Ed.), *A guide to treatments that work* (pp. 377–397). London: Oxford University Press.

Yehuda, R., & McFarlane, A. C. (1997). *Psychobiology of posttraumatic stress disorder*. New York: New York Academy of Sciences.