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Word type effects in false recall: Concrete, abstract, and emotion word critical lures

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Previous research has demonstrated that definable qualities of verbal stimuli have implications for memory. For example, the distinction between concrete and abstract words has led to the finding that concrete words have an advantage in memory tasks (i.e., the concreteness effect). However, other word types, such as words that label specific human emotions, may also affect memory processes. This study examined the effects of word type on the production of false memories by using a list-learning false memory paradigm. Participants heard lists of words that were highly associated to nonpresented concrete, abstract, or emotion words (i.e., the critical lures) and then engaged in list recall. Emotion word critical lures were falsely recalled at a significantly higher rate (with the effect carried by the positively valenced critical lures) than concrete and abstract critical lures. These findings suggest that the word type variable has implications for our understanding of the mechanisms that underlie recall and false recall.

In the list-learning false memory paradigm, participants are presented with a list of words that are highly associated with a nonpresented word (i.e., the critical lure). For example, *door, glass, pane, shade, ledge, sill, house, open, curtain, frame, view, breeze, sash, screen,* and *shutter* are related to the critical item *window.* The typical finding is that critical lures are falsely recalled with high probability during attempts to retrieve the presented list items (Deese, 1959; Roediger & McDermott, 1995). This effect has been found for phonologically related word lists (Sommers & Lewis, 1999) and appears to be reliable after repeated study-test exposures to the same list items (McDermott, 1996) and under conditions of incidental learning (Dodd & MacLeod, 2004). Levels of false memory often increase over a 1-day delay, whereas veridical memory tends to decrease over time (McDermott, 1996; Payne, Elie, Blackwell, & Neuschatz, 1996). In addition, prior warning about the nature and production of false memories does not seem to produce a reliable decrease in subsequent reports of false memories (Gallo, Roberts, & Seamon, 1997; McDermott & Roediger, 1998), and the effect occurs with visual and auditory list presentations, although auditory presentation appears to increase false memories (Gallo, McDermott, Percer, & Roediger, 2001; Kellogg, 2001; Smith & Hunt, 1998).

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Although the false memory effect has been found across many different experimental situations, a perplexing aspect of this phenomenon is that some lists tend to produce more false memories than others (Roediger, McDermott, & Robinson, 1998). One factor that appears to influence critical lure production is the strength of association between the studied items and the critical lures (McEvoy, Nelson, & Komatsu, 1999). However, even when associative strength is controlled, variation across lists is still found, suggesting that other factors may contribute to the production of false memories. Such factors may include qualitative aspects of the critical lure. Thus, the present study was designed to investigate aspects of the critical lures that may influence the false memory effect. Specifically, three word types (i.e., concrete, abstract, and emotion words) were defined in terms of concreteness, imageability, pleasantness, and emotionality and incorporated into the false memory paradigm in order to determine whether the word type of the critical lures has an effect on the production of false memories. For example, if emotion words are more distinctive than the abstract and concrete word types, then it would be predicted that false memory productions for emotion critical lures would occur less often than false memory productions for abstract and concrete critical lures. However, if aspects of emotion words increase memory processes such as rehearsal, then it is likely that emotion critical lures would be falsely recalled more often than abstract and concrete critical lures. Overall, it is known that emotional stimuli lead to enhanced memory in a variety of paradigms; moreover, data are emerging that describe the neural mechanisms for the processing of emotional events as compared to neutral events (see Kensinger & Schacter, 2005; Sharot, Delgado, & Phelps, 2004).

Previous research has demonstrated that concrete and abstract words produce different effects on memory performance. For example, concrete words are often better remembered than abstract words, a finding that is generally known as the concreteness effect. In these studies, word concreteness is often assessed through word ratings and typically refers to the ease with which a word elicits a mental image of its referent or intimates that the referent object has sensory qualities. This finding has been demonstrated in a variety of tasks including lexical decision (Day, 1977; James, 1975), paired-associate learning, free recall, recognition (Paivio, 1971, 1986), and comprehension tests (Holmes & Langford, 1976). The results of these studies suggest that rated word concreteness may play a role in establishing the representational formats that underlie differences in memory performance. Toward this end, concreteness effects have been explained in terms of the dual-coding model (Paivio, 1971, 1986) and the context-availability hypothesis (Schwanenflugel, Akin, & Luh, 1992). However, other studies suggest that emotion words, words that refer to human emotional conditions (e.g., fear, sad, happy, love, anger, surprise) may also have implications for memory performance (Altarriba & Bauer, 2004; Altarriba, Bauer, & Benvenuto, 1999).

Altarriba et al. (1999) performed a norming study in an attempt to distinguish between concrete, abstract, and emotion words. In their study, words were categorized a priori as concrete, abstract, and emotion words, and participants were asked to rate these words according to concreteness, imageability, or context availability scales. On all three dimensions, the three word types were rated differently. Concrete words were rated highest on all three dimensions. For imagery and context availability, emotion words were rated higher than abstract words. Interestingly, for concreteness ratings, abstract words were rated higher than emotion words. A similar result, high imageability and low concreteness for emotion-laden words, was also suggested by Paivio, Yuille, and Madigan (1968), based on the results of an extensive norming study. Experimental evidence for the distinction between the three word types has also been provided. Altarriba and Bauer (2004) demonstrated that the three word types have implications for free recall, such that emotion words were recalled at a higher rate than both concrete and abstract words and that concrete words were recalled better than abstract words (i.e., the concreteness effect). Additionally, their study also demonstrated word type effects for rating and lexical decision tasks. Taken together, these results suggest that concrete, abstract, and emotion words are differentially definable in terms of ratings on various dimensions and that this result has implications for the influence of the word type variable on memory performance.

The current study was designed to explore the possibility that the word type variable may influence the production of false memories. Pesta, Murphy, and Sanders (2001) found that emotion-laden items with a high shock value produced a false memory effect, although it was significantly less than the effect for neutral items. They attempted to determine whether emotion-laden stimuli could be erroneously produced in the context of unrelated and nonemotional items by creating matched lists of orthographic associates (e.g., cape, tape, ripe; part, perk, dark) that were related to an emotion-laden (e.g., rape) or non-emotion-laden critical lure (e.g., park). They found that critical lures for the related lists were higher than for the unrelated lists, but this effect was greater for the nonemotional condition. In other words, it appeared that the emotionality of the critical lure reduced false alarms to these items (Experiment 1; see Kensinger & Corkin, 2004, for similar methods and results, but see Dougal & Rotello, 2007, for an alternative explanation). This finding was taken to support the general hypothesis that emotionality reduces false memories because of the salient distinctiveness of such items. In other words, the emotion items stand out in memory. They concluded that distinctiveness could be one quality that contributes to reducing the false memory effect and that emotionality may contribute to an item's distinctiveness. One question that remains is the extent to which these effects are moderated by valence. That is, do they generalize across both positive and negative stimuli, or are they more likely to occur with one or the other? This question is explored in the current article.

Although they resembled those of the current study, Pesta et al.'s (2001) stimuli and design differed in a number of ways. First, they used emotionally charged words as their critical lures, which are different from emotion words (which name specific emotions), under the assumption that these words would produce a strong sense of memorability in the form of distinctiveness. Emotion words may or may not offer this same sense of memorability or distinctiveness. Second, the presented items they used were orthographically related to the critical lures, whereas the list items in the present study were associatively related to the critical lures. Third, their studied items were presented visually, whereas the studied items in the current study were presented auditorily, as is more common in false memory studies. Finally, they used a recognition test, whereas the current study used free recall.

Although the aforementioned literature suggests that emotional qualities of critical items may facilitate the reduction of false memories, other research suggests that emotionality could have the opposite effect. For example, Christianson and Loftus (1987) demonstrated that rehearsal of emotional stimuli improved recall but inhibited recognition relative to neutral stimuli, suggesting that conceptual processes may influence the impact of emotionality on memory performance. If this line of reasoning is applied to the false memory situation, it is possible that critical lures come to mind during list presentation and are subjected to some form of rehearsal, which may facilitate false recall of emotional stimuli. It should be noted that the emotional stimuli in the present study were not actually presented but were probably elicited by the semantically related studied items. In addition, other research has demonstrated that the arousal component of emotional stimuli has a detrimental effect on short-term memory performance (Christianson, 1984; Kleinsmith & Kaplan, 1963). Because recall usually takes place on a short-term basis in false memory studies, it is possible that the emotionality of the critical items could interfere with encoding processes that attempt to reduce memory errors, thereby increasing them. This possibility also assumes that the critical item comes to mind during list presentation. Taken together, these studies at least suggest the possibility that the presence of emotionality can increase false memories rather than reduce them.

In summary, the aim of the current study was to investigate the possibility that the word type of critical lures may influence the false memory effect. If emotion words are distinctive, as might be suggested by the results of Pesta et al. (2001), then false memory production should be lowest in the emotion critical lure condition, relative to abstract and concrete critical lures. However, if aspects of emotion words facilitate various memory processes, such as rehearsal or interference, then emotion critical lures might be produced as false memories to a greater extent than concrete and abstract critical lures. Furthermore, the current work was designed to examine effects for positive and negative emotion words because it has been reported that they have different effects on the processing of various types of memory (see Bohn & Berntsen, 2007).

EXPERIMENT

METHOD

Participants and design

Ninety-nine undergraduates from the University at Albany participated for course credit. A 2 (item type: studied, critical) \times 3 (word type: concrete, abstract, emotion) within-groups design was used, and memory performance was assessed in terms of proportion recalled and confidence ratings. It should be noted that the word type labels for the word type variable apply specifically to the critical lures.

Materials

When the current set of materials was generated, critical lures were selected that reflect the profiles for concreteness and imageability found in Altarriba et al. (1999), with the addition of a pleasantness component. The norming database used to generate the critical lures was found in Toglia and Battig (1978), because a measure of all three scales (concreteness, imagery, and pleasantness) was found in that study for each item (Table 1). Associate word lists were then generated for each critical lure using the forward cue to target strength provided by the University of South Florida Free Association Norms (Nelson, McEvoy, & Schreiber, 1998) and were based on the procedures outlined in Roediger and McDermott (1995). A total of 24 lists of 12 items each were constructed (8 for each word type; see the Appendix). For each list, associates were presented in descending order of associative strength, relative to the critical lure, with the strongest item presented first.

Critical lures were defined according to the dimensions of concreteness, imagery, and pleasantness. All three word types differed with regard to concreteness, with concrete words having the highest concreteness score, followed by abstract and then emotion words. For imagery, concrete words were significantly higher than both emotion and abstract words, followed by emotion words and then abstract words. The final dimension was pleasantness, with means of 4.12, 4.15, 4.17, respectively, for concrete, abstract, and emotion words. These mean differences for the pleasantness factor were not significant. However, it should be noted that the mean rating for emotion words contained four items that were positively valenced and four items that were negatively valenced, whereas the other two categories (concrete and abstract) contained items that were close to neutral (the mean for that group). Mean pleasantness ratings for the positively valenced emotion words (M = 5.77) were significantly higher than those for negatively valenced emotion words (M = 2.58), t(6) = 15.15, p < .001.

Within the constraints that the three dimensions used to define word type place on the possible candidate pool for each of the three word types, the number of other factors that can be controlled is limited. However, one factor that seems to be important in producing false memories is associative strength, that is, the probability that a given list item will produce

TABLE 1. Mean associative strength, concreteness, imagery, pleasantness, and emotionality measures for critical items across word types

Word type	Association	Concreteness	Imagery	Pleasantness	Emotionality
Concrete	0.11	5.96	5.84	4.12	2.31
SD	0.03	0.38	0.22	0.14	0.73
Abstract	0.10	3.94	4.07	4.15	2.16
SD	0.03	0.23	0.22	0.28	0.66
Emotion	0.11	3.56	4.68	4.17ª	5.43
SD	0.03	0.35	0.69	1.73	0.64

the critical lure on a free association task. The University of South Florida free association norms database provides such information and was used to match critical lures across the three word types in terms of mean forward cue to target associative strength. Forward strengths are obtained by presenting individual words and asking participants to free associate the first word that comes to mind. The strength is the probability of a given response to a particular cue (Nelson, McEvoy, & Schreiber, 2004). The average associative strength across concrete, abstract, and emotion words was .11, .10, and .11, respectively, and these means did not differ according to a one-way analysis of variance (F < 1). Additionally, the association strengths for the positive emotion word critical lures (M = .41, SD = .10) and the negative emotion word critical lures (M = .42, SD = .11) were not significantly different from each other.

Finally, the order in which the lists were presented was quasirandomly determined, with the stipulation that no more than three lists from a single word type could be presented together. The order was the same for all participants: *coat*, *show*, *pride*, *law*, *doctor*, *city*, *fear*, *love*, *place*, *chair*, *sad*, *anger*, *front*, *happy*, *build*, *feet*, *calm*, *school*, *age*, *hide*, *pain*, *teeth*, *area*, *alcohol*.

Procedure

The procedures were based on Roediger and Mc-Dermott (1995). Participants were tested in groups. After informed consent was obtained, instructions were read informing participants that they would hear several lists of words from a tape recorder and then attempt to recall these words by writing them down in a response booklet that was provided. The response booklet contained a half-sheet of blank paper for each list $(4.25" \times 1")$. List items were presented at a rate of approximately one item every 1.5 s. One practice list composed of items from each word type was given before the experimental lists. For each list, the experimenter played the list on a tape player and then said "recall," at which time the participants began recalling the items from that list. Participants were given 75 s to recall each list. After the recall period, the experimenter instructed participants to rate each response they had provided on a confidence scale ranging from 1 (definitely not sure) to 4 (very sure). Participants were given 30 s to complete the rating task, after which they were prompted to get ready for the next list, and the process was repeated until all lists were presented. Each list was recalled on a clean sheet of paper. After the final list, the participants were thanked and debriefed. It should be noted that the 75-s recall period and the 30-s rating period were adequate because most participants finished each task long before the time period ended.

RESULTS

General analysis

All reported significant results are at the p < .05 level unless otherwise specified. The general analysis includes both the item type and word type variables, and separate item type analyses are considered later in this section. Effect sizes (Cohen's d) are also reported, as appropriate. Results of an analysis of variance (ANOVA) revealed a main effect for item type, such that the proportion recalled for presented items (M = .53)was significantly higher than the proportion recalled for nonpresented critical lures (M = .16; see Table 2 for details), F(1, 98) = 780.70. This main effect was also significant for confidence ratings (scale = 1-4; see Table 2), that is, the mean confidence rating for list items (M = 3.86) was significantly higher than for critical lures (M = 2.96), t(39) = 83.42. Although previous false memory studies have found equivalent levels of veridical and false recall (e.g., Read, 1996; Roediger & McDermott, 1995), this is not always the case (e.g., Smith & Hunt, 1998), and in the current study, this finding could be attributable to the low associative strength between the list items and the critical lures. The mean associative strength used here is similar to the "low" condition used in McEvoy et al. (1999, Experiment 1), and the means reported here are comparable to those results. The item type \times word type interaction was significant, F(2, 196) = 34.33, suggesting that the pattern of means across word types was different for studied items and critical lures. This finding may have implications for activation-based theories of false memory and is discussed in the Discussion section. Although this general analysis included both presented and critical items, they are analyzed separately here.

Presented list items

A one-way ANOVA on the proportion of list items recalled as a function of word type was significant, F(2, 196) = 312.81. Further analysis revealed significant dif-

Item type and word type	Proportion recalled	Confidence rating
Presented list items	.53	3.86
Concrete	.61 (.09)	3.87 (.14)
Abstract	.49 (.09)	3.85 (.16)
Emotion	.49 (.09)	3.85 (.15)
Nonpresented critical lures	.16	2.96
Concrete	.15 (.14)	3.07 (.87)
Abstract	.14 (.13)	2.83 (.89)
Emotion	.19 (.16)	2.98 (.91)

TABLE 2. Mean (*SD*) proportion recalled and mean (*SD*) confidence ratings for presented list items and nonpresented critical lures

ferences between the means for concrete word lists (M = .61) and abstract word lists (M = .49), t(98) = 20.68(Cohen's d = 2.9), and between concrete word lists and emotion word lists (M = .49), t(98) = 21.16 (Cohen's d = 3.0), but not between abstract and emotion word lists, t < 1 (see Table 2). An ANOVA conducted on the confidence ratings was also significant, F(2, 194) = 3.34, and the pattern for mean confidence ratings was similar to the recall data but differed to the extent that the only significant comparison was between confidence ratings for concrete word lists and emotion word lists, t(97) = 3.05 (Cohen's d = 0.4). The other two comparisons were not significant, although the difference between the means for concrete word lists and abstract word lists approached significance, t(97) = 1.7, p = .08(Cohen's d = 0.2).

Nonpresented critical lures

A one-way ANOVA on the proportion of critical lures recalled as a function of word type was significant, F(2, 196) = 4.69. Further analysis revealed that the mean proportion for emotion lures (M = .19) was significantly higher than the proportion for concrete lures (M = .15), t(98) = 2.11, Cohen's d = 0.3, and abstract lures (M = .14), t(98) = 2.85, Cohen's d = 0.4. However, the difference between concrete and abstract lures was not significant, F < 1. In addition, an ANOVA was performed on the confidence rating data for critical items, but this analysis failed to produce a significant result. This could be attributable to the reduced power in these conditions because the statistical analysis included only recalled items, and not all the critical lures were consistently recalled.

Additionally, although the emotion word condition included eight total critical items, it was composed of four positively valenced and four negatively valenced items. An analysis was conducted on the emotion word condition that included item type and valence factors. This analysis resulted in a significant item type × valence interaction, F(1, 98) = 5.72. A follow-up *t* test revealed that the mean for positively valenced critical items (M = .22, SD = .21) was significantly greater than the mean for negatively valenced critical items (M = .16, SD = .19), t(98) = 2.39(Cohen's d = 0.3), an effect not previously reported or investigated in the emotion word literature. The *t* test for studied items was not significant, t < 1.

Additional analyses

The present study examined the false memory effect in terms of the word type of the critical lures. Therefore, the list items of the lures may be abstract, emotion, or concrete word types. However, one may wonder whether the emotion critical lure lists are indeed more emotional than the concrete and abstract critical lure lists. Similarly, one may wonder whether the words in the concrete critical lure lists are more concrete than the words in the abstract and emotion critical lure lists.¹ Unfortunately, the Toglia and Battig (1978) norms that were used to generate the critical lures do not contain all the items used in the present study. Additionally, emotionality ratings were needed

to examine whether the items on the emotion lists are overall more emotional than the items in the abstract and concrete lists. Therefore, a new set of participants was asked to rate the 24 critical lures and all the list items (12 items per list) on concreteness and emotionality scales. The items were randomized and typed into lists. Thirty participants completed each scale. The concreteness scale ranged from 1 (*not at all concrete*) to 7 (*highly concrete*). The emotionality scale ranged from 1 (*not at all emotional*) to 7 (*highly emotional*). These scales are similar to those used by previous researchers (e.g., Altarriba et al., 1999; Campos, 1990; Friendly, Franklin, Hoffman, & Rubin, 1982; Gilhooly & Logie, 1980).

A one-way ANOVA revealed a significant effect for the concreteness scale, F(2, 87) = 32.49, p < .01. Planned comparisons revealed that participants rated the concrete critical lures and list items (M = 5.21, SD = 0.73) as higher in concreteness than both the emotion (M = 3.80, SD = 0.61) and the abstract (M = 4.20, SD = 0.76) items, all ps < .05. The abstract and emotion items were not significantly different from each other in terms of concreteness. As was found for the critical lures, the concrete list items were rated as the most concrete, followed by the abstract and then the emotion list items.

A one-way ANOVA revealed a significant effect for the emotionality scale, F(2, 87) = 67.44, p < .01. Planned comparisons indicated that the emotion critical lures and list items (M = 4.53, SD = 0.98) were significantly more emotional than the concrete (M = 2.25, SD = 0.74) and the abstract (M = 2.49, SD = 0.77) items, all ps < .05. The concrete and abstract items were not significantly different from each other in terms of emotionality. This finding indicates that the items in the emotion lists are indeed overall more emotional than the items in the abstract and concrete lists.

Because the present study investigated whether the type of critical lure had an influence on memory, an analysis was conducted to examine the emotionality of the emotion, concrete, and abstract critical lures (see Table 1 for means and standard deviations across word type lures and Table 3 for the mean emotionality ratings for each critical lure). A one-way ANOVA revealed a significant effect, F(2, 23) = 59.24, p < .01. Planned comparisons revealed that the emotion critical lures (M = 5.43, SD = 0.64) were significantly more emotional than the abstract (M = 2.16, SD = 0.66) and concrete (M = 2.31, SD = 0.73) critical lures, all ps < .05. There were no significant differences between the abstract and the concrete critical lures in terms of emotionality. As can be seen in Table 3, all of the emotion critical lures received a score greater than 4 (often in the 5- to 6-point range) on the emotionality scale, whereas all the concrete and abstract critical lures received scores lower than 4 (often in the 1-2 range). These ratings confirm that

TABLE 3. Mean emotionality ratings for the critical items				
Emotion				
calm	4.23			
pride	5.40			
love	6.53			
happy	5.36			
sad	5.60			
pain	5.13			
anger	5.40			
fear	5.76			
Concrete				
teeth	2.30			
doctor	3.00			
alcohol	2.96			
feet	2.03			
chair	1.33			
coat	1.40			
city	2.20			
school	3.27			
Abstract				
front	1.43			
law	2.40			
age	3.23			
show	2.27			
place	1.43			
build	2.37			
area	1.47			
hide	2.67			

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the lures identified as concrete and abstract are not as emotional as the emotion critical lures.

Taken together, these results indicate that the items in the concrete lists are overall more concrete than the items in the abstract and emotion lists and that the items in the emotion lists are overall more emotional than the items in the abstract and concrete lists. Additionally, the emotion critical lures were rated as higher in emotionality than the abstract and concrete critical lures.

DISCUSSION

The primary finding in the current experiment was that emotion word critical lures were falsely recalled at a significantly higher rate than both concrete and abstract critical lures, which did not differ. Upon further analysis, this emotionality effect seemed to be due to the high level of false recall for the positively valenced emotion critical lures. These results dovetail nicely with those reported by Storbeck and Clore (2008), who found that positive affect promoted associations across the processing of word stimuli and produced greater affective and categorical word priming, whereas negative items did not. Theories of false memory effects that contend that an association mechanism drives participants to falsely recall a highly associated but nonpresented critical lure would argue that items that are more likely to forge a higher degree of association across one another are those that are likely to produce the greatest false memory effects (see Roediger & McDermott, 1995). Although Storbeck and Clore varied mood and investigated its effect on memory, presumably the correlates of possessing a positive mood while processing information would overlap with the same correlates that would be activated by processing positive stimuli. Thus, the quality of positivity appears to affect cognitive processing in a variety of ways. Additionally, Bohn and Berntsen (2007) reported that people who were induced into positive moods produced more vivid memories of flashbulb memory events, but their memories were less accurate than those in negative moods. As applied to false memory effects, to the extent that negative memories are somehow more salient or easier to recollect in a highly accurate manner, it is likely that few false memories will be produced, simply because veridical memory will be quite high,

leaving little room for inaccuracies. Therefore, the current data seem to provide further support for the arguments posed by Storbeck and Clore and Bohn and Bernsten, in a different cognitive paradigm.

Although the current findings appear to support the work of Kensinger and Corkin (2004), they seem to do so only for the negatively valenced critical lures, because the positively valenced lures used here produced high levels of false memory. Kensinger and Corkin reported that younger and older adults were less likely to recognize or recall critical lures that were emotional as compared with those that were neutral. Their words were more aligned with the taboo-type words of Pesta et al. (2001) and colleagues, whereas the current research used emotional stimuli that were not of that variety. Perhaps words that represent these kinds of taboo concepts are processed differently in memory because they are probably of much lower frequency and therefore much more salient than are the more typically used emotion label words. Nonetheless, the current research reports that even within a set of emotional words, degrees of false memory may depend on the valence of the stimuli (see Clore & Huntsinger, 2007, for further discussion of how positive and negative affect differentially influence various cognitive phenomena).

An additional finding in the current work was that for the studied item conditions, recall was significantly highest in the concrete condition, suggesting a form of the concreteness effect, but did not differ between the abstract and emotion word conditions. One possible explanation for the influence of emotive aspects of verbal stimuli on memory processes was suggested by Pesta et al. (2001). They proposed that emotion-laden stimuli are more memorable because they are more distinctive relative to neutral words, and this memorability leads to a decrease in false memories. It should be noted that the stimuli used in that study were selected specifically for their high shock value (e.g., *hell*, *bitch*). The stimuli in the current study were not selected for high shock value but could possibly demonstrate the same effect, which would reduce false memories in the emotion word condition. However, the current results suggest just the opposite, that the positively valenced emotion word critical lures increase the chances of producing false memories. Thus, the distinctiveness hypothesis does not seem to apply to emotion words. However, it should be reiterated that the stimuli were

not the only aspect of the experimental context that differed from those of Pesta et al., so this conclusion is far from definitive.

An alternative explanation is that emotion words seem familiar, and this familiarity underlies the high levels of false memories in this condition. This interpretation is supported in a study conducted by Sharot et al. (2004), who had participants make "remember" and "know" judgments (Tulving, 1985) with regard to emotional or neutral pictures in a recognition procedure. In the remember-know paradigm, "remember" responses are assumed to reflect retrieval that is assisted by actual episodic details, whereas "know" responses are assumed to reflect retrieval without episodic details. Presumably, "know" responses are based on the belief that an item was previously encoded, but the details of the experience are not present at retrieval. They found that participants who viewed the emotional pictures were more likely to report "remember" responses than "know" responses, but this difference was not found in the neutral condition. However, objective accuracy of whether the picture was previously studied did not differ as a function of emotionality. In other words, emotionality enhanced subjective components of memory judgments but not objective components. Thus, they concluded that emotionality increases the subjective sense of remembering but not the objective accuracy of recognition judgments. This study does support the interpretation of the current results in terms of a familiarity-based interpretation with two caveats. First, the stimuli in the Sharot et al. (2004) study were pictures that were actually observed and were presumably designed to induce some level of arousal. However, the emotion word stimuli in the current study were not actually observed by the participants, and it remains to be demonstrated whether such critical items affect arousal levels during encoding or retrieval. Second, the emotional stimuli in that study were negatively valenced, whereas the stimuli in the current study included both positively and negatively valenced stimuli. Furthermore, the effect of emotionality in the present study appears to be attributable to the positively valenced items. However, because arousal levels were not controlled or manipulated directly in the current study, these results can only suggest that this hypothesis might also apply to verbal stimuli and to positively valenced stimuli. Along this same line of reasoning, Levine and Bluck (2004) found that participants who were happy with the O.J. Simpson verdict were more likely to report enhanced clarity of events surrounding the trial, regardless of whether the events actually occurred. Thus, again, emotion seemed to increase the probability that a person would report more details of an event, even if that event did not occur. In other words, emotions seem to produce convincing memory errors. Their results are more consistent with current results in terms of the effect being localized in the positively valenced items, but the same caveat with regard to arousal and context applies here as well. Taken together, these studies support the interpretation that emotional items appear to boost overall familiarity, but given the methodological concerns, more research is needed to support this preliminary conclusion.

One implication of the current findings for explanations of false memory effects in general is that a strictly activation-based approach is not consistent with the data. An activation-based approach explains the false memory effect in terms of the association strength between each studied associate and the critical lure. As each associate is presented, activation accrues to the representation of the critical lure, and after the presentation of all associates for a given list, the highly activated representation of the critical lure is more likely to be erroneously remembered (see Collins & Loftus, 1975; Underwood, 1965). Although it is rather straightforward and somewhat elegant, the current data do not support this explanation. This is not really that surprising, though, because the list items in each condition were matched according to activation strength. Based on this control for associative strength, an activation-based view would predict no differences across the three word types, but differences were actually found. However, it should be noted that in the concrete condition, veridical memory performance was superior to that in the other two conditions, and this could indicate a higher level of activation in this condition. Perhaps the semantic network that underlies concrete items is integrated enough to produce high levels of activation in this condition. If so, then the high levels of false memories in this condition could be the result of increased activation levels. However, even though activation explains some of these findings, it is not

entirely adequate. This has led some researchers to propose that monitoring or strategic processes may also be involved in the false memory effect.

According to the source monitoring view (Johnson, Hashtroudi, & Lindsay, 1993), false memories can result from an inability to correctly determine the source of an item during the test phase. For example, if words are presented auditorily, then the presence of auditory information at test can be used to determine that a test item was probably studied. However, critical lures should not possess such information, and so monitoring processes should successfully distinguish studied items from critical lures. However, if the form of information that is being used as the basis for the monitoring decision is present at high levels in the critical lures, then false memories might be increased. Perhaps emotional information, especially positive emotional information, is more easily imparted to the critical lures than abstract or concrete qualities. In such cases, the probability of producing false memories would increase for emotional stimuli. Thus, the failure to determine the source of an item may lead one to falsely produce that item on a memory test, and perhaps emotion word critical lures appear highly familiar relative to concrete or abstract critical lures. With regard to the proposed familiarity of emotion words, there are two possible explanations. Emotion words may function in more of a contextual capacity than the other word types, making them more universal and applicable to many situations (see Bower, 1981). This interpretation is similar to the context availability hypothesis proposed by Schwanenflugel et al. (1992) to explain concreteness effects. Alternatively, perhaps emotion words, particularly positively valenced emotion words, are represented in memory by episodic (i.e., autobiographical) traces from real experiences, which makes them seem more likely to have occurred (Conway, 1990). Regardless of the exact mechanism, the source monitoring framework assumes that memory and memory errors are the products of a decision or judgment process. This interpretation can be supported by the results of Levine and Bluck (2004) that were discussed earlier. As part of their study, they performed a signal detection analysis to determine whether memorial differences involving emotional stimuli were attributable to discriminability (i.e., memory) or criterion (i.e., bias)

differences. Results supported the interpretation that a positive reaction to an emotional event was accompanied by a more liberal criterion, whereas a negative reaction was accompanied by a more conservative criterion. Discriminability did not seem to differ. These results are also consistent with the finding in the current study that positively valenced critical items were falsely recalled at a higher rate than negatively valenced critical items. However, recall procedures are not as amenable to signal detection analyses as recognition procedures, and so although it is possible that higher false recall in the current study was due at least in part to a judgmental bias (but see Kensinger & Schacter, 2005, for evidence that emotion improves source monitoring judgments), the current study is methodologically limited in the extent to which it can address this issue. However, the current results do seem to be consistent with this interpretation.

In summary, the current study demonstrated that emotion word critical lures, particularly those that are positively valenced, are more likely to be falsely recalled than abstract and concrete critical lures, which suggests that inherent aspects of critical lures may contribute to the false memory effect. Such a finding would have to be accounted for in theories of false memory, although in this specific case it cannot be determined whether the emotionality of critical lures plays a direct or supporting role in false memory processes. It does seem to be inconsistent with a generalized view that emotionality has the effect of improving discriminability between perceived and nonperceived events. However, such a finding does seem to be consistent with the general view that emotionality seems to enhance the subjective aspects of retrieval, which may provide a basis for making convincing memory errors via a bias in judgment. However, more research in this area is necessary to clarify the details of the influence of emotion on the false memory process. Finally, future research could explore the possibility that emotion-laden words (e.g., spider) may produce similar effects to those found in the current study. Such a demonstration might suggest that the emotionality effects that were found here are not necessarily specific to emotion words but are a more general aspect of memory processes.

APPENDIX (See facing page.)

APPENDIX. Twenty-four 12-item lists used in the experiment

The critical lure is italicized at the top of the list. Word type headings occur at the beginning of the section for each particular word type.

Concrete w	vords			place		build	build area
eet	alcohol	doctor	chair	location		construct	construct region
ocks	booze	surgeon	recliner	position		manufacture	manufacture surrounding
andals	bartender	clinic	couch	meeting		contractor	contractor territory
eas	drunk	vet	furniture	market	b	locks	locks surface
nassage	vodka	operation	bench	set	car	penter	penter zone
soak	liquor	prescription	cushion	going	archi	tect	tect rural
mat	rum	anatomy	throne	scene	develo	р	p domain
drag	scotch	cure	comfort	spot	structure	!	neighborhood
tand	intoxicate	hospital	incline	park	make		section
	hoor	injection	wheel	public	create		bay
tocking	sober	treatment	antique	country	engineer		field
odostrian	nuh	therany	hammock	destiny	tools		community
	hattla	vicit	wood				-
		visit	wood	Emotion v	vords		
oat	спу	teetn	school	love	pain		pride
скет	town	dentist	campus	romance	hurt		dignity
ench	suburb	plaque	education	adore	ache		integrity
oak	mayor	jaw	college	lust	cramp		honor
at	state	bite	learning	heart	miserv		confidence
anger	capital	vampire	teacher	wedding	cut		vanity
boc	slum	tongue	student	rose	shock		esteem
eve	skyscraper	gum	book	wife	migraine		calute
/eater	pollution	clench	diploma	truo	sting		valor
it	bus	hygiene	dorm	loval	stross		
ocket	ghetto	chew	lecture	iUyai friand	dicease		eyo
ck	cab	lips	pupil	hushand	disease		success
niform	village	calcium	desk	nuspano	tracture	(
ostract w	vords			spouse	bandage		
			•	sad	anger		calm
ont	law	age	show	depressed	rage		serene
ick	rights	years	display	gloomy	tury		mellow
hind	attorney	wrinkle	television	tears	frustration		relaxed
de	rules	youth	talent	cry	disgust		tranquil
ear	justice	birthday	presentation	sob	aggravate		soothe
head	violation	mature	performance	loss	tantrum		tame
orward	legal	growth	guide	blue	irritate		peaceful
tore	constitution	era	fashion	worry	fight		passive
orch	court	minor	production	die	argument		still
ead	government	wisdom	preview	weep	scold		sedative
entrance	police	old	cast	failure	glare		mild
end	prosecute	ancestor	program	humiliate	yell		casual

NOTES

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