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Taboo words: The effect of emotion on memory for peripheral information

Rebecca Guillet and Jason Arndt
Middlebury College, Middlebury, Vermont

In three experiments, we examined memory for peripheral information that occurred in the same context as emotion-inducing information. In the first two experiments, participants studied either a sentence (Experiment 1) or a pair of words (Experiments 2A–2C) containing a neutral peripheral word, as well as a neutral, negative-valence, or taboo word, to induce an emotional response. At retrieval, the participants were asked to recall the neutral peripheral word from a sentence fragment or emotion-inducing word cue. In Experiment 3, we presented word pairs at encoding and tested memory with associative recognition. In all three experiments, memory for peripheral words was enhanced when it was encoded in the presence of emotionally arousing taboo words but not when it was encoded in the presence of words that were only negative in valence. These data are consistent with priority-binding theory (MacKay et al., 2004) and inconsistent with the attention-narrowing hypothesis (Easterbrook, 1959), as well as with object-based binding theory (Mather, 2007).

Although some aspects of emotion appear to be universal, others are culture-specific (Elfenbein & Ambady, 2002). Furthermore, one's emotional state is influenced both by current circumstances and by one's disposition (Wood, Maltby, Stewart, Linley, & Joseph, 2008). Given the importance of emotion to the human condition, it is not surprising that emotion plays a key role in our ability to remember events (Buchanan & Adolphs, 2002; Hamann, 2001). Indeed, one's emotional state during encoding can serve as a key retrieval cue for past events, even if those events were not the cause of the emotional state (Bartlett & Santrock, 1979), and events that induce emotional responses, whether arousing or valenced, are remembered better than events that do not induce emotional responses (Kensinger, 2004; Kensinger & Corkin, 2003).

Although there is substantial evidence that emotional events are remembered better than neutral events, applied and theoretical considerations suggest that it is also important to understand how experiencing emotional events impacts memory for other events that occur in the same context. In applied domains, it is often important to understand how affective responses to circumstances such as witnessing a robbery or being in a car accident impact memory for aspects of those events that do not cause an affective response, such as what a perpetrator looked like or the events that preceded a car accident, because those events can be essential in a legal setting. In the theoretical domain, understanding how emotional responses influence memory for events that occurred in close temporal proximity or simultaneously with the emotion-inducing event can be used to test theories of why emotion enhances memory for emotional events. The research reported in this article was designed with the latter purpose in mind.

In order to study the influence of emotional events on memory for other events, it is necessary to operationally distinguish between what constitutes an emotional event and what constitutes nonemotional events that occur in the same context. Prior research has generally divided events into central information and peripheral information. *Central information* is usually defined as the stimulus that produces an emotional response, whereas *peripheral information* is typically defined as the information that is not directly related to the emotion-inducing central stimulus (Kensinger, Garoff-Eaton, & Schacter, 2007). Thus, the definition of *central event* can include events related to the central stimulus, such as the visual details of a stimulus that evokes emotion (Kensinger et al., 2007). For the purposes of the present research, we adopted the operational definitions used by Kensinger, Piguet, Krendl, and Corkin (2005): *Central information* is the portion of an event that produces an emotional reaction, whereas *peripheral information* comprises the elements of an event that are unrelated to the source of arousal. This operationalization of central and peripheral information is attractive because it can be objectively implemented, making it desirable for studying the effects of emotion-inducing stimuli on memory for peripheral events that occur in the same context.

Two primary theories have been used to explain the effects of emotion on memory for peripheral information: the attention-narrowing hypothesis (Easterbrook, 1959) and priority-binding theory (MacKay et al., 2004). Although both theories predict that emotional stimuli will

J. Arndt, jarndt@middlebury.edu

be remembered better than neutral stimuli, they differ in their predictions regarding how experiencing emotional stimuli will affect memory for peripheral information. The attention-narrowing hypothesis (Easterbrook, 1959) suggests that a negative or threatening stimulus causes emotional arousal, which attracts attention to the arousing stimulus. Because attention is limited in capacity, the additional attention given to the arousing stimulus reduces the amount of attentional resources available to process other information present in the same context. As a result, an arousing stimulus is remembered better than a nonarousing stimulus, whereas peripheral information is remembered *worse* in the presence of an arousing stimulus than in the presence of a nonarousing stimulus. Thus, the attention-narrowing hypothesis generally predicts a trade-off between memory for central and for peripheral information.

An alternative to the attention-narrowing hypothesis is priority-binding theory (Hadley & MacKay, 2006; MacKay & Ahmetzanov, 2005; MacKay et al., 2004). This theory suggests that arousing stimuli evoke emotional reactions that give priority to the binding mechanisms that serve to strengthen the association between arousal-inducing stimuli and salient aspects of the context that are directly linked to the arousal-inducing stimuli. As a result, associations between emotional central information and peripheral information tend to be stronger than associations between neutral central information and peripheral information. Thus, if a memory task cues the retrieval of the association between central and peripheral information (Tulving & Thomson, 1973), memory for peripheral information will be better when it is encoded in the context of emotional information. Furthermore, priority-binding theory suggests that there are limitations to binding, such that priority only applies to neutral events or contexts present within a narrow time window around the arousal-inducing event. Thus, priority-binding theory can explain why memory is suppressed for neutral events that precede and follow an emotion-inducing stimulus within that narrow time window (Hadley & MacKay, 2006; MacKay et al., 2004).

Existing research supports both hypotheses. Numerous studies have found a trade-off between memory for central arousing events and memory for peripheral events, supporting the attention-narrowing hypothesis. For example, Loftus, Loftus, and Messo (1987) documented a weapon focus effect, in which participants focused on and remembered a weapon in a scene at the expense of memory for peripheral information, such as the physical features of the perpetrator. In other studies (e.g., Burke, Heuer, & Reisberg, 1992; Christianson & Loftus, 1991), researchers presented a series of pictures depicting a story, with the manipulation of interest being whether or not one slide depicted an emotional event (e.g., a person in surgery) or a nonemotional event (e.g., a person working on a car). It was found in these studies that emotion-inducing slides were remembered better than slides that did not induce emotions, but that events from slides other than the emotion-inducing slides (i.e., peripheral information) were remembered worse in the emotional condition than in the nonemotional condition. In a third approach, using isolated emotional and neutral pictures, researchers (Adolphs, Denburg, & Tranel, 2001; Kensinger et al., 2007; Kensinger et al., 2005) found that memory for peripheral information was impaired in emotional pictures relative to neutral pictures. Thus, substantial evidence exists that, when peripheral events occur in the context of emotional central events, memory for the peripheral events is harmed, which is consistent with the attention-narrowing hypothesis.

However, memory for peripheral information is sometimes enhanced when it occurs in the presence of an emotion-inducing central event—a result that favors priority-binding theory. Although some studies in which pictorial stimuli were used showed enhanced memory for peripheral information experienced in the presence of an arousing central event (Heuer & Reisberg, 1990; Libkuman, Nichols-Whitehead, Griffith, & Thomas, 1999; Libkuman, Stabler, & Otani, 2004), most of the support for priority-binding theory comes from studies using verbal stimuli. In these experiments, negative-valence words were presented, and participants' memory for peripheral information—such as the spatial location of the word, the ink color of the word, or a neutral word in the same sentence as the emotion-inducing word—was measured. In general, such studies have found enhanced memory for peripheral information when the central word produced an emotional response (D'Argembeau & van der Linden, 2004; Doerksen & Shimamura, 2001; Kensinger, Brierley, Medford, Growdon, & Corkin, 2002; Kensinger & Corkin, 2003; MacKay & Ahmetzanov, 2005; MacKay et al., 2004; Medford et al., 2005). These results generally provide support for priority-binding theory, because the source memory tasks used in these studies require the retrieval of associations between emotional central information and presentation characteristics of those emotional stimuli (Johnson, Hashtroudi, & Lindsay, 1993).

Most of the studies favoring priority-binding theory have tested memory for peripheral information that was a presentation feature of the word that induced an emotional response (D'Argembeau & van der Linden, 2004; Doerksen & Shimamura, 2001; Kensinger et al., 2002; Kensinger & Corkin, 2003; MacKay & Ahmetzanov, 2005; MacKay et al., 2004). It is possible to view enhanced memory for presentation features of emotional stimuli as simply due to general enhancement of memory for the emotion-inducing stimulus and not to enhancement of memory for information peripheral to the emotion-inducing stimulus (Kensinger et al., 2007). Indeed, in a recent theory of emotion's effects on central and peripheral information, Mather (2007) suggested that the contradictory patterns reviewed above can be understood by distinguishing between objects that induce arousal and other objects in the same stimulus environment. In this theory, which we refer to as *object-based binding theory*, it is argued that arousal enhances binding of the components of arousal-inducing items to one another (referred to as *within-object binding*) but that arousal-induced binding does not extend to other objects present in the same stimulus environment that do not create arousal (referred to as *between-objects bind-*

ing). Thus, object-based binding theory explains arousal-enhanced memory for features of arousal-inducing stimuli (e.g., color, spatial location) as being due to within-object binding. Furthermore, object-based binding theory suggests that arousing stimuli do not generally facilitate memory for nonarousing objects that occur in the same context as arousing objects (e.g., Christianson & Loftus, 1991; Kensinger et al., 2005), because remembering nonarousing objects can only be enhanced by between-objects binding.

The Present Study

In the first two experiments reported here, we tested these three theories by presenting emotion-inducing words and neutral peripheral words in the same encoding context and testing cued recall. We compared three types of central words: neutral (control) words, negative-valence words, and highly arousing taboo words (MacKay et al., 2004). Taboo words are similar to highly arousing pictures in that they produce physiological arousal as measured by skin-conductance responses (LaBar & Phelps, 1998) and attract attention involuntarily when they are encountered. Thus, taboo words cause greater Stroop interference than neutral words (MacKay et al., 2004; Siegrist, 1995), increase the magnitude of the attentional blink relative to negative-valence or neutral words when they are the initial target in rapid serial visual presentation (RSVP; Anderson, 2005; Mathewson, Arnell, & Mansfield, 2008), and reduce the magnitude of the attentional blink relative to negative-valence or neutral words when they are the second target in RSVP (Mathewson et al., 2008).

In Experiment 1, we presented participants with central words that were taboo, negatively valenced, or that did not induce emotion (neutral words) in a sentence (Medford et al., 2005). In order to assess memory for peripheral words, we chose a neutral word from each sentence and tested the participants' memory for both the central emotion-inducing word and the peripheral neutral word using a sentence-based cued recall task. In Experiment 2, neutral, negative-valence, and taboo words (central words) were randomly paired with neutral words (peripheral words) to create a series of paired associates. At test, the participants were provided with the central word in each pair and were asked to recall the peripheral word that was paired with it during encoding. Thus, in Experiment 1, we sought to examine whether the presence of an emotion-inducing word in a sentence enhanced memory for other words in the sentence, whereas, in Experiment 2, we examined whether encoding emotion-inducing words enhanced the strength of an association between central words and unrelated peripheral words. In Experiment 3, the influence of emotional content on associative recognition of word pairs was examined. Thus, in this final experiment, we also assessed the strength of the association between central words and unrelated words but did so with a recognition memory task instead of a cued recall task.

The three primary theories of emotional arousal's effects on memory for central and peripheral information predict different results for these three experiments. The attention-narrowing hypothesis (Easterbrook, 1959) predicts a trade-off between memory for central words and for peripheral words, such that the more emotionally arousing central words are, the worse memory for peripheral words should be. In contrast, priority-binding theory (MacKay et al., 2004) predicts that memory for peripheral words should increase as emotion-inducing words become more arousing, because arousal helps bind stimuli to elements of their encoding context, such as the peripheral words presented in the same sentence (Experiment 1) or paired associates (Experiments 2 and 3). Thus, to the extent that those associations are accessed at retrieval in order to complete cued recall (Experiments 1 and 2) or associative recognition (Experiment 3), enhanced memory should result when emotional words are encountered during encoding. Finally, object-based binding theory (Mather, 2007) expects binding to occur, but only within the object that produces emotional arousal. Thus, the presence of an emotion-inducing item in Experiment 1 should enhance memory for other words in the same sentence, because the inclusion of an emotion-inducing item affects both the meaning and the arousal characteristics of the entire sentence, allowing the sentence to act as a single object. However, this theory would not predict enhanced memory for word pairs containing an emotionally arousing word in either Experiment 2 or 3, because each word in a paired associate has its own arousal characteristics and semantics, leading each word to function as a separate object. Thus, because paired associates were formed by arbitrarily pairing an emotion-inducing central word with an unrelated neutral peripheral word, enhanced paired-associate learning requires between-objects binding, which object-based binding theory argues is not enhanced by emotional reactions.

EXPERIMENT 1

In Experiment 1, central and peripheral words were presented to participants in the context of sentences (Medford et al., 2005). The participants read sentences containing a central emotion-inducing word and a neutral peripheral word. Prior work has demonstrated enhanced recognition memory for peripheral words from a sentence when another word in the sentence was negatively valenced relative to a neutral word (Medford et al., 2005). In order to examine the effects of highly arousing stimuli on memory for peripheral words, in Experiment 1, we presented the participants with highly arousing (taboo) central words in addition to negative and neutral central words. At test, the participants were presented with studied sentences that had the central and peripheral words deleted and were asked to fill in the missing words. Thus, in Experiment 1, we tested cued recall, rather than recognition (Medford et al., 2005), of central and peripheral information. Finally, in Experiment 1, we examined the generality of the results of two prior studies that tested the recall of neutral information that was encoded as part of emotional sentences (Kensinger et al., 2002; Phelps, LaBar, & Spencer, 1997). Both Kensinger et al. (2002) and Phelps et al. found that, when the participants were asked to generate a sentence that included a neutral word, free recall of the neutral words was

Table 1
Examples of Neutral, Negative-Valence, and Taboo Sentences in Experiment 1

Neutral	Negative Valence	Taboo
She played the part of the *tomboy* in the *production*.	She played the part of the *hostage* in the *production*.	She played the part of the *whore* in the *production*.
The *package* contained a *bowl*.	The *package* contained a *bomb*.	The *package* contained a *dildo*.
My *uncle* is a *golfer*.	My *uncle* is a *pervert*.	My *uncle* is a *faggot*.

Note—Each group of three sentences differed by one word (the central, emotion-inducing word). In the cued recall test, the participants were presented with incomplete sentences in which the italicized words were missing, and were asked to recall the missing words.

enhanced when the generated sentence contained negative emotional connotations. Thus, in Experiment 1, we examined whether self-generation of an emotional sentence was necessary for enhancing recall of neutral words or whether the emotional response produced by a sentence that was read was sufficient to enhance recall of neutral peripheral words.

Method

Participants. The participants were 48 Middlebury College students who participated in order to fulfill a research appreciation requirement, were compensated with $10, or volunteered to participate in this study without compensation. In this and all other experiments reported in this article, only native English speakers were asked to participate, because autonomic reactions to taboo words are different for native and nonnative speakers (Harris, Ayçiçegi, & Gleason, 2003).

Materials and Design. The stimuli used in Experiment 1 came from a variety of sources. The manner in which the stimuli were selected and the design of the study were modeled after the procedure of Medford et al. (2005). Thirty negative-valence words, 30 neutral words, and 30 taboo words were chosen as central stimuli. Negative-valence words were selected from the Affective Norms for English Words (ANEW; Bradley & Lang, 1999) and were high in arousal ($M = 6.88$, $SD = 2.27$) and low in valence ($M = 2.74$, $SD = 1.82$). Neutral words were judged by us to be neutral in valence and arousal because many stimuli that are neutral in valence and arousal do not appear in the ANEW.[1] Taboo words were chosen from Jay (1992) and Kensinger and Corkin (2003).[2] Negative-valence, neutral, and taboo central stimuli were matched for frequency of occurrence using estimates based on the results from an Internet search engine (Blair, Urland, & Ma, 2002).

The 30 negative-valence central words were used to construct 30 sentences, each containing one of the negative-valence central words. Parallel versions of the 30 negative-valence sentences were constructed using neutral and taboo central words, yielding 30 sentence triplets. The sentences within a triplet were identical except for the taboo, negative-valence, or neutral central word inserted in each sentence (see Table 1 for examples and Appendix A for a list of all central words). Finally, in each sentence, 1 word was designated as the peripheral word. It was ensured that peripheral words were linguistically classified as content words (e.g., nouns, verbs, or adjectives), and the words were chosen on the basis of their apparent neutrality in terms of valence and arousal. The same peripheral word was used for all 3 sentences in a triplet, which ensured that the only factor that influenced the ability to recall peripheral words across the different types of sentences was the emotional reaction induced by the presence of a neutral, negative-valence, or taboo central word in the sentence.

The sentences were divided into three sets for counterbalancing purposes. Each set contained 10 neutral sentences, 10 negative-valence sentences, and 10 taboo sentences, and only 1 sentence was chosen from each triplet to serve in each of the three sets of stimuli. A stimulus counterbalancing scheme ensured that each of the sentences within a triplet was shown equally often across participants.

To ensure that each type of sentence differed in measures of arousal and valence, 31 volunteers who were not participants in the three experiments reported here were asked to rate each target word for arousal and valence. The raters were asked to judge how arousing each word was on a scale of 1–7 (1, *no reaction*; 7, *strongest reaction imaginable*; Medford et al., 2005). Similarly, the raters were asked to judge the valence of the words on a scale of 1–7 (1, *negative*; 4, *neutral*; 7, *positive*; Medford et al., 2005). Table 2 presents the mean arousal and valence ratings for neutral, negative, and taboo words (see Appendix A for the arousal and valence characteristics of individual words). Taboo words were rated as significantly more arousing than both negative [$t(30) = 3.98$] and neutral words [$t(30) = 16.09$]. Negative words were also rated as significantly more arousing than neutral [$t(30) = 12.49$] words. In terms of valence, negative words were rated as significantly more negative than both taboo [$t(30) = 7.02$] and neutral words [$t(30) = 19.37$]. Taboo words were also rated as significantly more negative than neutral [$t(30) = 8.33$] words. Nineteen additional volunteers were asked to rate each sentence for arousal and valence, using the same scales. Table 2 also presents the mean arousal and valence ratings for neutral, negative, and taboo sentences. Similar to taboo words, taboo sentences were rated as significantly more arousing than negative sentences [$t(18) = 7.55$] and neutral sentences [$t(18) = 12.62$]. Negative sentences were also rated as significantly more arousing than neutral sentences [$t(18) = 10.40$]. Regarding valence, negative sentences were rated as significantly more negative than neutral sentences [$t(18) = 14.53$], and taboo sentences were rated as significantly more negative than neutral sentences [$t(18) = 6.66$], but there was no significant difference in valence ratings for taboo and negative sentences [$t(18) = 1.14$, $p > .20$].

Table 2
Mean Arousal and Valence Ratings for Taboo, Negative-Valence, and Neutral Words and Sentences in Experiment 1

	Arousal		Valence	
Category	*M*	*SD*	*M*	*SD*
Taboo				
Words	4.76	1.95	3.13	0.65
Sentences	4.08	1.10	3.02	0.65
Negative Valence				
Words	4.03	1.15	2.30	0.48
Sentences	2.98	0.83	2.86	0.37
Neutral				
Words	2.14	0.75	4.14	0.26
Sentences	1.70	0.40	4.00	0.20

Note—Arousal was rated on a scale of 1–7 (1, *no reaction*; 7, *strongest reaction imaginable*). Valence was rated on a scale of 1–7 (1, *negative*; 4, *neutral*; 7, *positive*).

Procedure. Prior to the presentation of the stimuli, the participants were informed that they would encounter a series of sentences that would contain words that are sometimes considered offensive. The participants were told to read each sentence silently, because they would be asked questions about the sentences at the end of the experiment. The participants were not told that there would be a memory test; instead, they were told that the experimenter was interested in studying the cognitive processes involved in sentence comprehension. Presentation of the sentences then began on the computer screen. Each sentence was presented using a masked reading technique (Just, Carpenter, & Woolley, 1982), in which sentences appeared one word at a time. The participants pressed the space bar to control the rate at which the words appeared on the computer screen and were asked to read through the sentences as normally as possible. Following the reading of the final word in each sentence, the lines indicating the words in the next sentence appeared on the computer screen, and the participant was allowed to begin reading that sentence by pressing the space bar. The participants were told to proceed through the sentences at their own rate.

After the presentation of the study sentences was completed, the participants completed math problems during a 5-min retention interval. Following this filler task, the participants were asked to perform a cued recall memory task, in which they were presented with incomplete sentences one at a time. Each incomplete sentence was missing two words: the central word, which was either a neutral, a negative-valence, or a taboo word; and the peripheral word, which was always a neutral word. The participants filled in each blank as best they could by typing their responses into two response boxes on the computer screen and were asked to guess if they could not remember a word. The order of presentation of the sentences in the study list and during the cued recall test was determined randomly for each participant.

Results and Discussion

Two dependent variables were analyzed: the reading times for central and peripheral words during encoding and the number of central and peripheral words correctly recalled in each emotion condition (depicted in Figure 1). The dependent measures were analyzed separately for central and peripheral words using one-way repeated measures ANOVAs. All results were deemed significant at an alpha level of .05.

Reading times. Analyses of mean and median reading times led to the same conclusions. For simplicity, we present only analyses of median reading times. There was a significant difference among the emotion conditions for central words [$F(2,94) = 8.25$, $MS_e = 6{,}529.37$] but not for peripheral words [$F(2,94) = 1.03$, $MS_e = 3{,}872.16$]. Taboo central words were read more slowly ($M = 593$ msec) than were negative central words [$M = 543$ msec, $t(47) = 3.36$] and neutral central words [$M = 529$ msec, $t(47) = 3.53$], which did not differ in reading times [$t(47) = 0.82$].

Recall. Analyses of the number of central and peripheral words recalled indicated that there was a significant difference among the conditions for central words [$F(2,94) = 92.52$, $MS_e = 1.75$] as well as for peripheral words [$F(2,94) = 15.71$, $MS_e = 2.38$]. Bonferroni-adjusted t tests ($\alpha = .008$) were performed to explore the effects of emotion on each word type. For central words, all three pairwise comparisons were significant [smallest $t(47) = 2.75$], indicating that central word recall was lowest for neutral words ($M = 2.38$), intermediate for negative words ($M = 3.04$), and highest for taboo words ($M = 5.81$). Although the same qualitative pattern occurred for peripheral word recall, only the comparisons between the taboo condition ($M = 5.19$) and the negative condition [$M = 3.85$, $t(47) = 4.30$], as well as between the taboo condition and the neutral condition [$M = 3.54$, $t(47) = 4.84$], were significant [$t(47) = 1.13$, $p > .20$ for the comparison between peripheral word recall in neutral and negative sentences].

The results of Experiment 1 showed enhanced memory for neutral peripheral words that occurred in the same sentence as emotional words, which replicates several prior results (Kensinger et al., 2002; Medford et al., 2005; Phelps et al., 1997). Thus, the results of Experiment 1 contradict the attention-narrowing hypothesis, because the high levels of emotional arousal caused by taboo words in a sentence did not impair memory for other words in that sentence. Instead, peripheral words were remembered better when the sentences contained an arousing taboo word, supporting priority-binding theory (MacKay et al., 2004) as well as object-based binding theory (Mather, 2007).

One possible limitation to interpreting the results of this experiment is that reading times for central words differed across stimulus types, such that taboo words took longer to read than negative-valence or neutral words. These reading time differences may partially explain why taboo words were recalled more often than negative-valence and neutral words. More problematic, however, is that recalling the central word in each sentence may have facilitated recall of the peripheral word independent of enhanced binding of the peripheral word to the sentence in which it occurred. Specifically, recalling the central word in a sentence may have made the sentence a better retrieval cue for recalling the peripheral word in that sentence. Thus, it may have been easier to recall a word from a sentence when it was missing a single word than when it was missing two words. Because the participants recalled central words that were taboo more often than they recalled negative-valence and neutral central words, they were likely to have

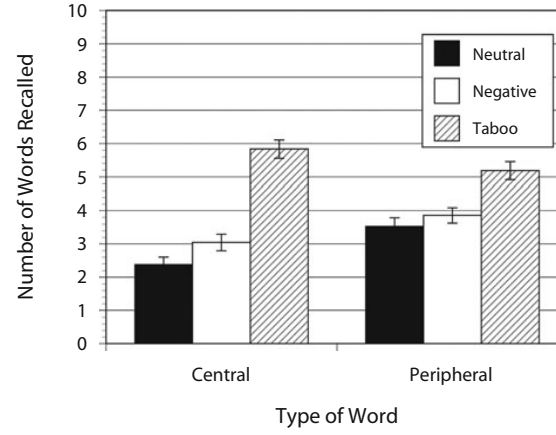

Figure 1. Recall of central and peripheral words in Experiment 1. Error bars represent one standard error of the mean.

had better retrieval cues for peripheral words in sentences that contained taboo words. Consequently, even if the peripheral words were not bound better to the sentences in the taboo condition, recall could have been enhanced simply because of improved recall of central taboo words. In Experiment 2, we created paired associates using one central word and one neutral peripheral word to address this concern, as well as to further test the three candidate theories of emotion and memory.

EXPERIMENTS 2A–2C

In Experiments 2A–2C, participants studied word pairs, created by randomly pairing central words with peripheral words. The memory test was a cued recall task, in which the participants were presented with the first word in each pair (the taboo, negative-valence, or neutral central word) and were asked to recall the second word in each pair (the peripheral word). Thus, this memory task assessed the strength of the association between emotion-inducing words and neutral peripheral words, independent of memory for the emotion-inducing words.

Three versions of the experiment were conducted. In Experiment 2A, the same central and peripheral words from Experiment 1 were used. In both Experiment 1 and Experiment 2A, the selection of stimuli was limited by sentence constraints: Words that fit together in the context of a sentence had to be used, and, as a result, the stimuli were not rigorously controlled for arousal and valence. For example, both taboo and negative-valence words were more arousing and negative in valence than neutral words (albeit not to the same extent). Therefore, for Experiments 2B and 2C, new stimuli were chosen that better controlled the arousal and valence characteristics of central words. Specifically, neutral words were neutral in arousal and valence, negative words were neutral in arousal and negative in valence, and taboo words were high in arousal and negative in valence. Thus, by comparing recall of peripheral words paired with negative central words to recall of peripheral words paired with neutral central words, it was possible to assess the influence of emotional *valence* on the strength of the association between central and peripheral information. Similarly, by comparing recall of peripheral words paired with taboo central words to recall of peripheral words paired with negative central words, it was possible to assess the influence of emotional *arousal* on the strength of the association between central and peripheral information.

In Experiments 2A–2C, we again tested priority-binding theory, object-based binding theory, and the attention-narrowing hypothesis. The attention-narrowing hypothesis suggests that memory for paired associates should decline as emotional content increases, because emotional responses to central words attract attentional resources to central words, producing a decrement in encoding resources available to encode other aspects of the scene in which the emotional stimulus is found. In contrast, priority-binding theory suggests that emotional responses generated by central words should enhance associations between those words and elements of their context. In Experiments 2A–2C, peripheral words that were paired with emotion-inducing central words were a feature of central items' context, such that enhanced binding of emotion-inducing words to their stimulus context should increase memory for peripheral words when recall is cued with central emotional items. In comparison, object-based binding theory suggests that learning paired associates requires between-objects binding, which it argues is not enhanced by the presence of an emotional central item. Between-objects binding is required for enhanced paired-associate learning because central and peripheral words have distinct semantic and arousal properties. Thus, arousing stimuli, such as taboo words, tend to be consolidated in memory as distinct from other objects in their environment (Mather, 2007). Specifically, arousal-inducing stimuli attract focused attention, which improves binding of those objects into a coherent whole, as well as to their presentation features (e.g., font color). However, the focused attention that enhances binding within arousal-inducing objects does not extend to other objects in their stimulus context and may impair binding for those items. For example, when people were asked to generate associates to stimulus words, their memory for the generated associates was poorer when the stimulus terms produced emotional reactions (e.g., Jones, O'Gorman, & Byrne, 1987; but see Parkin, Lewinsohn, & Folkard, 1982). Object-based binding theory explains this result by suggesting that, whereas emotional reactions enhance binding of the emotion-inducing item to its component features, those emotional reactions do not aid—and may hinder—binding of the emotion-inducing item to other objects present in the same encoding context, such as the generated associates (Mather, 2007).

Although words generated from an arousing stimulus term are more poorly remembered than words generated from a nonarousing stimulus term (Jones et al., 1987), when paired associates are read, arousal has been shown to enhance paired-associate recall (e.g., Kleinsmith & Kaplan, 1963, 1964; Kleinsmith, Kaplan, & Tarte, 1963), such that numbers paired with high-arousal words were recalled better than numbers paired with low-arousal words. As detailed above, this result would tend to favor priority-binding theory over object-based binding theory and the attention-narrowing hypothesis. However, whether a word was high arousal or low arousal was determined individually for each participant using galvanic skin responses, which may confound arousal with primacy (Schürer-Necker, 1990). In Experiments 2A–2C, we remedied this problem by using normed stimuli to determine high-arousal, negative-valence, and neutral words. Additionally, neutral words were randomly assigned to emotion conditions in Experiments 2A–2C, whereas associations between neutral and arousing stimuli (Kleinsmith & Kaplan, 1963, 1964; Kleinsmith et al., 1963), as well as self-generated associates and emotional words (Jones et al., 1987), were necessarily correlational in prior work. Experiments 2A–2C, therefore, are the first studies to examine the influence of emotional central words on the strength of associations between arbitrarily related central and peripheral words.

Method

Participants. The participants were a total of 73 Middlebury College students (24 in Experiment 2A, 25 in Experiment 2B, and 24 in Experiment 2C) who participated in order to fulfill a research appreciation requirement or were compensated with $10.

Materials and Design. The stimuli for Experiment 2A were the same 30 neutral words, 30 negative words, and 30 taboo words that were used as central stimuli in Experiment 1 and the same 30 neutral words that had been designated as peripheral words in Experiment 1. However, in Experiment 2A, we did not present the participants with sentences; only the to-be-recalled words from Experiment 1 were used as stimuli. The central stimuli for Experiments 2B and 2C were 10 neutral words, 10 negative words, and 10 taboo words (see Appendix B). Both the neutral and negative words for Experiments 2B and 2C were chosen from the ANEW (Bradley & Lang, 1999). On a scale of 1–9 (1, *not at all arousing*; 9, *highly arousing*), both the neutral words ($M = 4.50$, $SD = 0.21$) and the negative words ($M = 4.54$, $SD = 0.42$) were neutral in arousal. On a scale of 1–9, in which 1 was *negative* and 9 was *positive*, the negative words were strongly negative in valence ($M = 2.04$, $SD = 0.36$), whereas the neutral words were neutral in valence ($M = 5.04$, $SD = 0.71$). Because taboo words do not tend to appear in the ANEW, no direct comparisons among the taboo, negative, and neutral words' valence and arousal properties were possible. However, the taboo words were chosen specifically because they tend to be more arousing than negative words (Kensinger & Corkin, 2003) and were presumed to be negative in valence (see the norming for Experiment 1, as well as Kensinger & Corkin, 2003). The 10 taboo words were selected from MacKay et al. (2004) and Jay (1992) and were considered by us to be the most arousing and offensive of the taboo words used in previous research. The three groups of central words were matched for average frequency using an Internet search engine (Blair et al., 2002). In Experiments 2B and 2C, we also used 30 neutral peripheral words taken from Kensinger and Corkin (2003).

In Experiments 2A–2C, each of the 10 neutral words, 10 negative-valence words, and 10 taboo words that served as central stimuli were paired with one of the 30 peripheral words. The pairing of central and peripheral words was randomly determined for each participant, and word pairs were constructed such that the central word was always shown as the left-hand member of each pair, and the peripheral word was always shown as the right-hand member of each pair. Because there were 30 central words in each emotion category in Experiment 2A (rather than the 10 central words in each emotion category for Experiments 2B and 2C), a stimulus counterbalancing scheme was used to ensure that the taboo, negative, and neutral central words were presented equally often across participants.

Procedure. The procedures for Experiments 2A and 2B were identical. Prior to the presentation of the study list, the participants were informed that they would encounter a list of 30 pairs of words, including taboo words sometimes considered offensive. The participants were told that they should read each word pair silently and try to remember the words as they were paired, because there would be a memory test following the presentation of the word pairs. Intentional memory instructions were used to ensure that the participants attended to the words as pairs rather than as individual entities, thus avoiding floor effects in paired-associate recall performance. As will be shown in the Results and Discussion section, this procedural difference did not alter the effect of the emotional content of the central words on memory for the peripheral words that was found in Experiment 1. The presentation of the stimuli then began on the computer screen. The word pairs were presented in a different random order for each participant at the rate of 3,000 msec per pair.

After the presentation of the study list was completed, the participants were asked to work on a series of simple math problems for 5 min. Following this filler task, the participants were asked to perform a cued recall task, in which they were presented with the left-hand word of each studied word pair (the emotion-inducing central word), one at a time. The participants were then asked to respond with the right-hand word of the word pair (the neutral peripheral word) by typing it into a response box, and to guess if they could not remember a word. Test items were presented in a different random order for each participant.

In Experiment 2C, the stimuli were arbitrarily divided into two study and test lists in an attempt to minimize floor effects. Both study lists were composed of 15 word pairs, each with equivalent numbers of neutral, negatively valenced, and taboo central words. The study presentation and test of the first list proceeded as in Experiments 2A and 2B. Immediately following the test for the first study list, the presentation of the second study list and its corresponding test began.

Results and Discussion

Figures 2A–2C present the number of peripheral words correctly recalled in Experiments 2A (Figure 2A), 2B (Figure 2B), and 2C (Figure 2C) when the participants were presented with the taboo, negative, or neutral central words from each word pair as a recall cue. The conclusion reached from the statistical analysis was the same for all three experiments; thus, we present analyses of Experiments 2A–2C together. A repeated measures ANOVA indicated that there was a difference in recall among the three conditions [smallest $F(2,44) = 11.04$, $MS_e = 1.63$, in Experiment 2A]. Bonferroni-adjusted t tests ($\alpha = .017$) indicated that the recall of peripheral words in the taboo condition was greater than the recall of peripheral words in the negative condition [smallest $t(24) = 3.73$, in Experiment 2B] and the neutral condition [smallest $t(23) = 4.05$, in Experiment 2A]. However, there was no significant difference between the recall in the negative condition and that in the neutral condition in any of the three experiments.

The results of Experiments 2A–2C replicated and extended the results of Experiment 1: Peripheral words studied with taboo words were recalled better than peripheral words that were studied with negative-valence or neutral words. Similarly, there was not a reliable difference in the recall of peripheral words that were studied with negative and neutral central words, even when measures were taken in Experiment 2C to eliminate floor effects. Building on Experiment 1, the results of Experiments 2A–2C showed that enhanced memory for peripheral words associated with taboo central words occurred when the association between central and peripheral words was arbitrarily determined and when the characteristics of the central words were rigorously controlled for arousal and valence.

The results of Experiments 2A–2C reinforce the evidence found in Experiment 1 that the attention-narrowing hypothesis (Easterbrook, 1959) cannot explain the effects of emotion-inducing words on memory for peripheral words. Instead, the results of Experiments 2A–2C suggest that the high arousal properties of taboo words trigger binding mechanisms, which in turn enhance memory for peripheral words by strengthening the association between the representations of peripheral words and taboo words. Thus, the results of Experiments 2A–2C suggest that the enhanced recall of neutral peripheral words that were studied with taboo words was due to between-objects binding (MacKay et al., 2004) rather than to within-object binding (Mather, 2007). In Experiment 3, we explored the

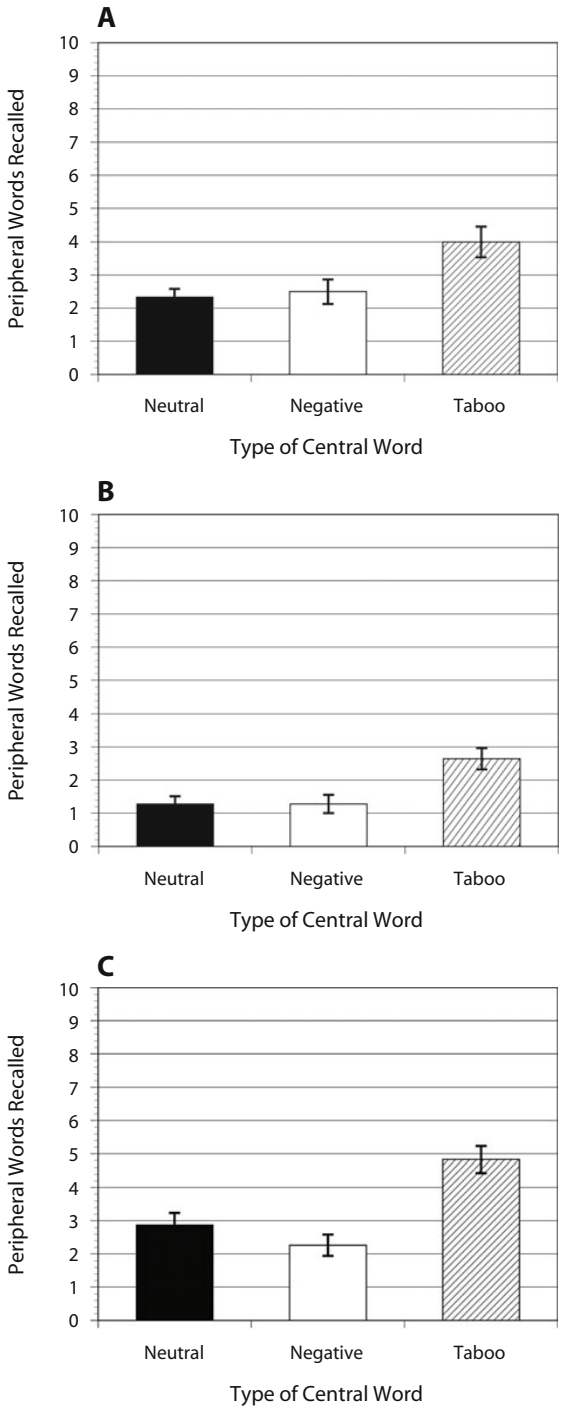

Figure 2. Recall of peripheral words in Experiments 2A (A), 2B (B), and 2C (C). Error bars represent one standard error of the mean.

generality of the results from Experiments 2A–2C with another task that should assess between-objects binding—associative recognition.

EXPERIMENT 3

In Experiment 3, we tested the generality of the results of Experiments 1–2C with an associative recognition task, which has different retrieval demands from cued recall but is also sensitive to the strength of associations between word pairs (Hockley & Cristi, 1996a, 1996b). As in Experiments 2A–2C, participants viewed a list of paired associates and were asked to remember them as best they could. At test, words were presented in their studied (intact) pairs or in rearranged pairs composed of words that were both studied but that were not studied together. In addition to examining the generality of the results of Experiments 1–2C, we again tested the binding hypothesis (MacKay et al., 2004), object-based binding theory (Mather, 2007), and the attention-narrowing hypothesis (Easterbrook, 1959) in Experiment 3. Testing memory with an associative recognition test should directly assess the strength of the association between central and peripheral words without also involving search for and production of a target memory, as was the case with the cued recall tasks used in Experiments 2A–2C. Thus, each theory makes the same predictions for associative recognition as it made for the cued recall of paired associates. Those predictions were detailed in the introduction to Experiment 2A–2C, so we do not repeat them here.

Method

Participants. The participants were 54 Middlebury College students who participated in order to fulfill a research appreciation requirement or were compensated with $10.

Materials and Design. The stimuli for Experiment 3 were identical to the stimuli used in Experiments 2B and 2C, with the addition of 2 neutral, 2 negative, and 2 taboo central words, as well as 6 neutral peripheral words. Thus, there were 12 neutral, 12 negative, and 12 taboo central words and 36 peripheral words (see Appendix C). The relative arousal and valence characteristics of central words were not altered as a result of the additional words. For each participant, study phase paired associates were formed by randomly assigning each of the 36 central words to one of the 36 peripheral words. In the test phase of the experiment, half of the paired associates in each emotional condition were the same word pairs as those presented in the study phase (*intact* pairs), whereas the other half of the paired associates were randomly rearranged, such that each central word was paired with a peripheral word different from that with which it was studied (*rearranged* pairs). Thus, all test pairs were composed of a central and a peripheral word that had been studied, but half of the pairs were composed of central and peripheral words that had not been studied together. Rearrangements occurred within each emotion condition: For example, a taboo central word was repaired with a peripheral word that had originally been studied with a different taboo central word. Constructing rearranged word pairs in this manner allowed us to measure false alarm rates for word pairs within each of the emotion conditions.

Procedure. Experiment 3's study instructions, study list presentation, and the filler task between the study and test lists were the same as those in Experiment 2B, with the exception of the study list length, which was 36 word pairs. Following the filler task, the participants were asked to perform an associative recognition task, in which they were presented with 18 intact pairs of words and 18 rearranged pairs. The participants were asked to distinguish between intact and rearranged pairs by pressing the "O" key for an old, intact pair and the "N" key for a new, rearranged pair. The test word pairs were presented in a different random order for each participant.

Results and Discussion

Figure 3 depicts the proportion of test pairs that the participants judged to be intact. Intact judgments for intact pairs indicate correct responses (hits), whereas intact judgments for rearranged pairs indicate incorrect responses (false alarms). A repeated measures ANOVA for hits indicated a difference among the three conditions [$F(2,106) = 16.25$, $MS_e = .03$]. Bonferroni-adjusted t tests showed more hits for word pairs containing a taboo item than for word pairs containing a neutral item [$t(53) = 4.99$] or for those containing a negative item [$t(53) = 4.40$]. There was not a reliable difference in hits between pairs containing a neutral item and pairs containing a negative item [$t(53) = 0.82$, $p > .40$]. A repeated measures ANOVA for false alarms indicated a near significant difference in incorrect responses among the three conditions [$F(2,106) = 2.72$, $MS_e = .03$, $p > .10$]. This trend reflects a tendency for false alarms to be less for neutral pairs than for taboo or negative-valence word pairs.

Because there was a tendency for the participants to incorrectly label rearranged test pairs *intact* more often if they contained a negative word or a taboo word, we also assessed the participants' ability to differentiate between intact and rearranged pairs with two measures of discriminability: a high threshold correction [(hits − false alarms)/(1 − false alarms)] and d' (Snodgrass & Corwin, 1988). Both analyses led to the same conclusions, so we present the high-threshold analysis for simplicity. A repeated measures ANOVA indicated a significant difference among the three conditions [$F(2,106) = 11.62$, $MS_e = .07$]. Bonferroni-adjusted t tests ($\alpha = .017$) showed greater discriminability for pairs containing taboo items ($M = .85$) than for pairs containing neutral items [$M = .63$, $t(53) = 4.23$] or negative items [$M = .63$, $t(53) = 3.87$] and that negative and neutral pairs did not differ in discriminability [$t(53) = 0.02$].

The results of Experiment 3 again support priority-binding theory over object-based binding theory and the attention-narrowing hypothesis. Furthermore, replicating Experiments 1–2C, these results suggest that arousal—but not valence—triggers binding mechanisms, because word pairs containing negative words that did not induce arousal failed to show a discriminability advantage over word pairs with neutral central words.

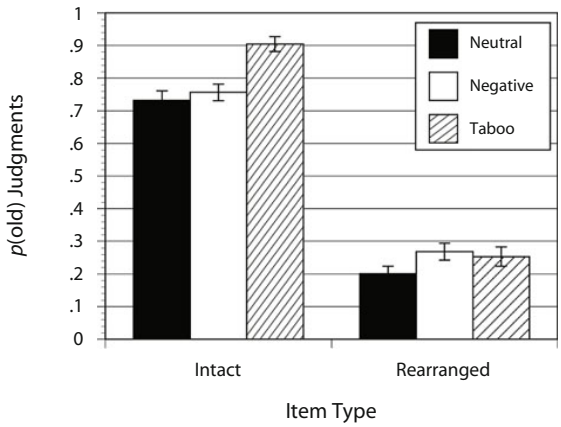

Figure 3. Hits (Intact) and false alarms (Rearranged) for central and peripheral items in Experiment 3 for taboo, negative-valence, and neutral word pairs. Error bars represent one standard error of the mean.

GENERAL DISCUSSION

Two main regularities were observed in the experiments presented here. First, associations between central and peripheral words were enhanced when the central word created arousal, but not when it was negatively valenced. Second, the enhancement of associations between central and peripheral words occurred both when arousing and peripheral words occurred in the same sentence (Experiment 1; Kensinger et al., 2002; Medford et al., 2005; Phelps et al., 1997) and when arousing and peripheral words were arbitrarily paired (Experiments 2A–3). These regularities generally replicate results found in studies using *written* stimuli, in which it has been found that the presence of an emotion-inducing stimulus enhanced memory for peripheral information (e.g., D'Argembeau & van der Linden, 2004; Doerksen & Shimamura, 2001; Kensinger & Corkin, 2003; MacKay & Ahmetzanov, 2005; MacKay et al., 2004; Medford et al., 2005) and are inconsistent with much of the literature using *pictorial* stimuli, in which encountering an emotion-inducing stimulus generally impaired memory for peripheral stimuli (e.g., Adolphs et al., 2001; Burke et al., 1992; Christianson & Loftus, 1991; Kensinger et al., 2007; Kensinger et al., 2005; Loftus et al., 1987).

These results expand our knowledge of the effects of emotion on memory for written stimuli in three ways. First, in the present research, we investigated both recognition and recall, whereas, in most prior studies, only recognition has been investigated using written materials (e.g., D'Argembeau & van der Linden, 2004; Doerksen & Shimamura, 2001; Kensinger & Corkin, 2003; MacKay et al., 2004; Medford et al., 2005; Sharot & Phelps, 2004). This difference in memory retrieval demands did not prove critical to arousal's enhancement of memory for peripheral words—the results reported here found that recall of peripheral words was enhanced when they occurred in the presence of arousing central words, provided that the memory retrieval task cued the association between the central and peripheral words. Second, in this research, we compared memory for peripheral words that occurred in the presence of extremely arousing words, negative-valence words that were not arousing, and neutral words in order to separate the effects that arousal and valence had on memory for peripheral words. Most prior studies have not rigidly defined emotional stimuli such that they are able to separate the influence of arousal and valence on memory for central and peripheral information (see Kensinger & Corkin, 2003, and Libkuman et al., 2004, for exceptions). Distinguishing between the arousal and valence properties of central words proved critical to understanding emotion's influence on memory for peripheral words, because only central words that produced arousal enhanced memory of

peripheral words. Prior research corroborates the finding that valence and arousal have different effects on memory (e.g., Kensinger & Corkin, 2003; Libkuman et al., 2004), consistent with Kensinger's (2004) claim that arousal and valence generally affect memory via distinct mechanisms. Kensinger suggested that the amygdala is responsible for arousal's effects on memory (Phelps, 2004), whereas nonamygdalar networks influence the role that valence plays. Thus, it may be the case that amygdala activation induces binding mechanisms, whereas activation of nonamygdalar networks enhances memory for central stimuli via some mechanism other than contextual binding. Third, in the present research, we examined conditions in which central and peripheral words were arbitrarily paired with one another, whereas most prior studies have examined situations in which emotional stimuli were related to peripheral information by being part of the same story line (Burke et al., 1992), sentence (Kensinger et al., 2002; Medford et al., 2005; Phelps et al., 1997), or scene (Adolphs et al., 2001; Kensinger et al., 2007; Libkuman et al., 2004). Despite arbitrarily pairing central and peripheral words, enhanced memory for the association between central and peripheral words resulted when central words were arousing, suggesting that arousal-induced enhancement of memory occurs in the absence of a meaningful connection between the central and peripheral stimuli.

With regard to the three main theories that explain the effect of emotion-inducing stimuli on memory for peripheral information, the present research supports priority-binding theory over object-based binding theory and the attention-narrowing hypothesis. Although object-based binding theory can explain many aspects of how emotion influences memory for the context of central and peripheral information (Mather, 2007; Mather & Nesmith, 2008), it does not appear to provide a comprehensive account of the binding mechanisms that are enhanced by emotional arousal, such as the between-objects binding that was observed in Experiments 2–3. One reason object-based binding theory may have been designed to prohibit between-objects binding is that most prior research has not used memory tasks that are likely to be sensitive to between-objects binding. Specifically, most prior research has examined situations in which memory for associations between emotional central items and their sources was tested (D'Argembeau & van der Linden, 2004; Doerksen & Shimamura, 2001; Kensinger & Corkin, 2003; MacKay & Ahmetzanov, 2005; MacKay et al., 2004); situations in which memory for central and peripheral stimuli was tested in isolation (Kensinger et al., 2007; Kensinger et al., 2005; Medford et al., 2005); or situations in which memory for the association between central items and their sources, as well as for peripheral items and their sources, was tested (Mather & Nesmith, 2008). These prior studies did not employ memory tasks that are likely to be sensitive to between-objects binding, because memory for the association between arousing central objects and nonarousing peripheral objects was not tested. Thus, an important question for future research will be to determine when and why between-objects binding occurs following emotional arousal, as well as when and why within-object—but not between-objects—binding occurs.

The attention-narrowing hypothesis (Easterbrook, 1959) cannot account for the results of the present research, because it generally proposes a trade-off between memory for central and peripheral information. However, as noted by Reisberg and Hertel (2004), understanding how emotion affects memory for central and peripheral information in part rests on how central and peripheral information are operationally defined. Thus, if the stimuli that we classified as *peripheral information* can be classified as *central information*, it is possible that the attention-narrowing hypothesis can account for the present data by using a different operational definition of central and peripheral information. For example, it has been suggested that the attention-narrowing hypothesis can explain instances in which memory for information semantically linked to an emotionally arousing central stimulus is enhanced (e.g., Libkuman et al., 1999). Even if this operational definition was used, the attention-narrowing hypothesis could only account for the results of Experiment 1, in which central and peripheral information were semantically linked by being in the same sentence. Thus, the attention-narrowing hypothesis would still be unable to account for the results of Experiments 2A–3, which showed that memory for the association between central and peripheral stimuli that were *arbitrarily* paired was nevertheless enhanced when central stimuli were arousing.

A second operational definition of central information comes from Burke et al. (1992), who explored a variety of operational definitions for central and peripheral information in an effort to find what types of memory were enhanced by emotion-inducing stimuli and what types of memory were hindered. Most relevant to the present study are Burke et al.'s results for events that occurred simultaneously in time with emotional information: The presence of an emotion-inducing stimulus enhanced memory for information that was spatially or conceptually linked to the emotion-inducing item, whether that information was detailed visual information or gist information. Furthermore, memory for information that was not linked to central information (i.e., background information that could be changed without altering the story depicted in a series of slides) was harmed by emotional central information. The operational definitions of central and peripheral information used in the present study align with those found by Burke et al. to produce memorial trade-offs between central and peripheral information. Specifically, peripheral information in Experiments 2A–3 was arbitrarily related to the source of emotion and could have been changed (and indeed was changed across participants) without altering the interpretation of the central stimuli. Yet, in contrast to the results of Burke et al., we found enhanced, not decreased, memory for central–peripheral information associations in the present study. Thus, it seems that it is difficult to generate an operational definition of central and peripheral information that would make the results of the present study explicable by the attention-narrowing hypothesis.

One final concern with the present results may be that, in Experiments 2A–3, intentional learning instructions were utilized, whereas, in most prior research on memory for emotional information, incidental learning has been used. Thus, if the participants focused their encoding resources on unitizing word pairs as part of their encoding, it is possible that the attention-narrowing hypothesis and object-based binding theory could explain the results of Experiments 2A–3 by claiming that the paired associates that the participants studied were parts of a single arousing stimulus (attention narrowing) or object (object-based binding). However, remembering paired associates involves the encoding of both item and associative information, such that factors that encourage focus on item information are detrimental to encoding associative information (Hockley & Cristi, 1996a). In the case of the present study, reading times from Experiment 1 suggest that taboo words attracted more attention than did negative-valence or neutral words. Furthermore, prior research examining Stroop interference (MacKay & Ahmetzanov, 2005; MacKay et al., 2004; Siegrist, 1995) and the attentional blink (Anderson, 2005; Mathewson et al., 2008) suggests that taboo words attract attention involuntarily. Thus, any intent to encode associative information should have been disrupted by the presence of a taboo word as one of the terms, resulting in reduced cued recall and associative recognition performance and not the enhanced cued recall and associative recognition observed in Experiments 2A–3.

In summary, the present research makes three main contributions to understanding the effects of emotion-inducing stimuli on memory for peripheral information. First, memory for the association between central and peripheral stimuli was enhanced when the central stimuli created high arousal, but not when central stimuli were only negative in valence. Second, emotional enhancement of memory for the association between central and peripheral information occurred in recall as well as recognition (e.g., D'Argembeau & van der Linden, 2004; Doerksen & Shimamura, 2001; Kensinger & Corkin, 2003; McKay et al., 2004; Sharot & Phelps, 2004). Third, emotional enhancement of memory for the association between central and peripheral information occurred even when there was an arbitrary association between the two stimuli, which required between-objects binding. Taken together, these regularities favor the interpretation that experiencing arousing written stimuli triggers binding mechanisms, which in turn enhance associations between the arousing stimulus and elements of its stimulus context, both within the object and between objects (MacKay et al., 2004).

AUTHOR NOTE

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NOTES

1. A subsequent norming study, described below, indicated that neutral stimuli were less negative and less arousing than the other stimuli.

2. We thank Elizabeth Kensinger for providing the stimulus materials from Kensinger and Corkin (2003).

(*Continued on next page*)

APPENDIX A
Valence and Arousal Ratings of Neutral, Negative-Valence, and Taboo Central Words Used in Experiments 1 and 2A

	Valence		Arousal	
Word	*M*	*SD*	*M*	*SD*
Neutral				
athlete	5.39	1.28	2.48	1.67
bandage	3.97	1.38	1.90	1.49
bowl	3.97	0.41	1.52	1.06
cathedral	4.81	1.11	2.29	1.74
cliffs	3.81	1.01	2.32	1.70
coward	2.39	1.17	3.19	1.58
dance	5.00	1.18	2.84	2.07
daughter	4.87	1.48	2.58	2.17
derelict	3.45	0.85	2.32	1.68
detective	4.16	0.45	1.65	1.14
dock	4.06	0.25	1.29	0.97
fatigue	3.16	1.07	2.32	1.54
girl	4.94	1.15	2.42	1.75
golfer	4.13	0.62	1.65	1.25
habit	4.06	0.51	1.58	1.29
indifference	3.29	1.04	1.81	1.38
lazy	2.81	1.17	2.48	1.71
letter	4.26	0.82	1.32	0.70
polite	5.58	1.26	1.97	1.43
publicity	3.90	0.60	1.94	1.29
relatives	5.45	1.26	3.77	2.29
relax	5.87	1.15	2.81	2.06
seaweed	4.03	1.14	1.90	1.49
sleepy	3.84	1.19	2.35	1.56
soup	4.42	1.18	1.45	1.15
stomach	3.97	0.80	1.55	1.15
subdued	3.84	0.78	1.61	0.95
teenager	3.97	0.66	2.00	1.26
tomboy	3.71	1.19	2.48	1.82
watched	3.26	1.00	2.48	1.36
Negative Valence				
accident	2.48	0.96	3.35	1.52
anger	2.58	0.99	3.16	1.49
assassin	2.16	1.00	3.90	1.85
assault	1.71	0.94	4.35	1.66
bomb	1.87	1.15	4.77	1.87
burn	2.81	0.98	3.48	1.75
chaos	3.00	1.00	3.55	1.52
evil	1.97	1.28	3.97	1.54
fear	2.35	0.98	3.71	1.55
fight	2.71	1.16	3.71	1.57
fire	3.16	1.32	3.13	1.65
gun	2.00	1.18	4.45	1.86
hatred	1.81	0.87	4.55	2.11
hostage	1.81	1.01	4.81	1.78
intruder	2.39	0.92	3.77	1.87
killer	1.55	0.96	4.90	1.40
murderer	1.52	0.77	5.00	1.67
nervous	2.97	1.02	2.97	1.60
obsession	3.00	1.00	3.52	1.75
outrage	2.74	1.21	3.52	1.50
panic	2.52	1.06	4.19	1.60
pervert	1.87	1.20	4.87	1.54
rape	1.03	0.18	6.39	0.99
rejected	2.00	0.89	4.19	1.76
scream	3.06	0.81	3.26	1.53
shark	3.32	1.33	2.84	1.92
slave	1.48	0.72	4.90	1.74
snake	3.35	1.14	2.58	1.46
terrorist	1.52	1.15	5.48	1.69
thief	2.32	1.30	3.55	1.65
Taboo				
ass	3.35	1.33	4.06	1.61
asshole	2.26	0.96	4.32	1.58
bastard	2.06	0.89	4.16	1.51
bitch	1.90	0.83	4.90	1.45
blowjob	4.00	1.91	5.65	1.05
breasts	4.77	1.23	3.87	1.61
clitoris	3.97	1.45	4.90	1.68
cock	2.90	1.19	5.03	1.54
cocktease	2.06	1.24	5.29	1.37
cum	3.00	1.34	5.29	1.49
dick	3.03	1.22	4.42	1.82
dildo	3.26	1.21	4.97	1.47
erection	4.00	1.18	4.97	1.30
faggot	1.48	0.96	5.84	1.44
fuck	2.61	1.31	5.06	1.41
hooker	2.35	1.23	4.65	1.45
lesbian	4.03	1.11	3.94	1.69
masturbate	3.39	1.45	5.06	1.39
nipple	4.42	1.34	4.16	1.59
orgasm	5.84	1.29	5.55	1.26
porn	3.35	1.56	4.48	1.59
prick	2.06	0.81	4.29	1.49
pussy	2.42	1.43	5.55	1.23
sex	5.16	1.19	4.58	1.61
shit	2.52	0.96	3.68	1.68
slut	1.68	1.14	5.06	1.61
stripper	2.77	1.33	4.29	1.68
tits	3.55	1.67	4.97	1.28
vagina	4.00	1.06	4.45	1.82
whore	1.65	0.71	5.26	1.32

APPENDIX B
Neutral, Negative-Valence, and Taboo Central Words Used in Experiments 2B and 2C

Neutral	Negative Valence	Taboo
alley	ache	chink
frog	corpse	cum
garment	defeat	cunt
obey	deformed	dyke
rattle	gloom	faggot
rigid	grief	fuck
scissors	lonely	nigger
stove	scum	orgasm
trunk	stench	pussy
whistle	unhappy	whore

APPENDIX C
Neutral, Negative-Valence, and Taboo Central Words Used in Experiment 3

Neutral	Negative Valence	Taboo
razor	misery	bitch
cliff	hurt	cock
rigid	gloom	nigger
frog	stench	cunt
alley	grief	pussy
obey	unhappy	chink
scissors	corpse	faggot
trunk	lonely	dyke
rattle	defeat	fuck
stove	scum	whore
garment	deformed	orgasm
whistle	ache	cum

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