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# Emotional Fluency and the Discrepancy-Attribution Hypothesis

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**Emotional Fluency and the Discrepancy-Attribution Hypothesis**

**Carissa Zimmerman**

**A departmental honors thesis submitted to the  
Department of Psychology at Trinity University  
in partial fulfillment of the requirements for graduation with departmental honors**

**April 11, 2005**

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**Thesis Advisor**

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**Chair of Department**

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**Associate Vice President  
For Academic Affairs**

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## Abstract

The purpose of this experiment was to investigate emotional fluency within the framework of the discrepancy-attribution hypothesis. A mismatch between expected and actual fluency results in a feeling of surprisingly good fit, which can lead people to misattribute fluency gained from stimulus manipulations to “pastness.” Experiment 1 replicated Whittlesea’s (2002) finding that words completing high constraint sentence stems were judged to have been studied in a previous phase more often than words completing low constraint sentence stems, regardless of whether the words were actually studied or not. Experiment 1 also provided support for the emotional-fluency hypothesis; participants judged emotional words to be old more often than neutral words. In Experiment 2, participants judged whether they actually remembered target words or whether these words merely felt familiar. Participants claimed to remember emotional words more than neutral words, but there was no difference between emotional and neutral words in participants’ familiar responses. This finding suggests that fluency from emotional materials does not merely lead to a vague feeling of familiarity but rather to a strong belief that the item is actually remembered.

## Introduction

Present interpretations can influence perceptions of the past. Indeed, theories advocating attribution of one aspect of an experience to another are prevalent in various domains in both current and past research. For example, Schacter and Singer's (1962) attributional theory of emotion claims that the subjective experience of emotion can be the result of a misattribution of arousal; physical sensations are wrongfully attributed to emotional experiences. These ideas about misattributions can also be applied to memory. In the same way that physical sensations can be wrongly attributed to emotion, so can certain effects of present conditions be mistakenly interpreted as indicators of past experience. Fluency, or the ease with which items come to mind, may be one such effect. Jacoby, Kelley, and Dywan (1989) claim that people are sometimes unable to distinguish between fluency that arises from contextual or situational factors in the present and that due to prior experience. Emotion could be one such situational factor. According to the emotional fluency hypothesis, emotional presentations would themselves give rise to fluency that would then be available to be attributed to prior experience with the emotional materials.

The fluency-attribution hypothesis states that by manipulating either perceptual or conceptual cues, one can influence the perception of "pastness." For example, Whittlesea (1993) demonstrated that lightly visually masked words were more often judged to have been previously presented than more heavily visually masked words, regardless of whether the word had actually been previously seen or not. This is presumably because the lightly masked words were processed more easily; this ease of processing was then misattributed to past experience with the word itself. Another experiment in the same

study generated a similar effect by varying the context in which target words appeared. For example, the word “test” appeared either in the predictive sentence “The anxious student wrote a TEST” or the non-predictive sentence “Later in the afternoon she took a TEST.” Whittlesea found that words in highly predictive contexts were judged old more often than those in less predictive contexts. Whittlesea and Williams (2002) refer to this phenomenon as an “illusion of familiarity.” Predictive contexts led subjects to experience an illusion of familiarity for words presented in these contexts; they believed that they had seen these words previously, even though they had not. This discovery led to the development of the fluency-attribution hypothesis, whereby increased fluency of processing, due in this case to either lighter masking or more specific contexts, was misattributed to the “pastness” of the word. Thus, because subjects were able to process certain words faster but were unaware of the manipulations that caused this faster processing, they assumed that those words must have been previously encountered in a study phase and therefore judged them as old.

When confronted with changes in fluency due either to a perceptual or conceptual manipulation, people implicitly use current context and task demands as they make attributions regarding the source of this fluency; thus, in a memory experiment focusing on judgments of “pastness,” subjects attribute fluency to previous experience with the word in question. However, fluency misattribution occurs not only in the case of judging whether a word is old, but rather can be extended to other decisions, such as those of pleasantness or interestingness (Whittlesea, 1993; Whittlesea & Shimizu, 2003). When confronted with fluency unknowingly gained from contextual or perceptual manipulations, people sometimes incorrectly attribute the fluency to some other aspect of

their experience. To what exactly they decide to attribute it depends upon the framework provided by their knowledge of the experiment or their understanding of the situation.

Subjects' awareness of the perceptual or contextual manipulations is also an important factor in their attribution of fluency, as demonstrated by Jacoby and Whitehouse (1989). When the target word was flashed "subliminally" immediately before its conscious presentation, subjects judged the word as old more often; the fluency caused by the prior flashed presentation that was wrongly attributed to the past. However, when subjects were aware of the first presentation, they could correctly attribute the fluency that they experienced to the flashed presentation of the word rather than misattributing it to prior experience with the word in a study phase.

Although the fluency-attribution hypothesis provides a useful foundation for conceptualizing the role of fluency in memory attributions, later studies have suggested that there is more to these phenomena than fluency alone. Whittlesea and Williams (2000) suggested that fluency misattribution does not occur when the context is completely predictive of the target word to come. One would not expect to see this absence of misattribution if fluency alone were responsible, therefore there must be other processes at work. Whittlesea and Williams (2000) claim that the illusion of familiarity occurs for words that are generally predicted by their contexts, but not for those that are specifically predictable. They give the example, "A rolling stone gathers no MOSS;" in this case they claim one should not expect to see claims of familiarity for the word "moss" because this word is expected as the only logical completion of the given stem. Thus, when this word appears and completes the sentence, subjects are not surprised and thereby experience a feeling of mere congruence, which does not predict familiarity,



rather than discrepancy, which does. If, however, the sentence read, “The garden was messy with weeds and MOSS” one could expect to see claims that the word “moss” was old even if it was not. This is because “moss” is just one of a group of items that could sensibly complete the sentence. Evidence such as this led to the proposal of a modification of the fluency-attribution hypothesis that focused on discrepancy as the determining factor in decisions about “pastness.” Whittlesea (2002) claims that it is actually the mismatch between expected and actual fluency, resulting in an outcome that seems to fit “surprisingly well,” that leads to the claim of familiarity or “pastness.” Thus the perception of discrepancy is dependent upon a general readiness to incorporate something that is consistent with the context without forming a specific expectation as to what that “something” is.

Whittlesea and Williams (2000) provide additional evidence for the role of discrepancy. They created a category of non-words that they refer to as *hensions*. Hensions are derived from natural English words and pronounced in the same way. For example, the hension “barden” was derived from “garden” and is pronounced just like garden is. Participants studied a list made up of hensions, natural words, and irregular non-words (e.g. stofwus) and then, when presented with a new list including both novel and old items, decided whether they had previously studied each item. Whittlesea and Williams found that there were more false alarms for non-word hensions than for natural words or irregular non-words. They claim that it was the discrepancy between participants’ expectations (that non-words should not be fluently processed) and their actual experience (that the non-word hensions were, in fact, fluently processed due to

their similarity to natural words) that led them to attribute the unexpected fluency to the prior presentation of the item in question.

We propose the emotional-fluency hypothesis, which applies the discrepancy-attribution hypothesis to emotional materials. Faced with emotional stimuli, subjects may find that they are processed surprisingly quickly; this unexpected fluency gained from emotion could then, in the context of a memory experiment, be misattributed to “pastness.” Perhaps participants are basing their judgments on a heuristic that quick processing of emotional material signals prior exposure, due to past experience that emotional events are more memorable. It is a well-demonstrated finding that emotional information is recalled more often than neutral information (see Reisberg & Heuer, 2004 for a review). Emotional context can also influence memory for neutral words; Hertel and Parks (2002) demonstrated that neutral nouns paired with emotional descriptors were recalled more than nouns paired with neutral descriptors. Other studies have shown that subjects demonstrate more false alarms for emotional than neutral words (e.g. Windmann & Krüger, 1998, as cited in Edelstein, Alexander, Goodman, & Newton, 2004). We suggest that a plausible explanation of these effects lies within the realm of discrepancy misattribution; instead of attributing surprising emotional fluency to the particular salience of the stimuli, in the context of a memory experiment subjects attribute this fluency to a prior presentation of the word. Thus we propose that emotional events may be processed more fluently than neutral events and that misattribution of this fluency to “pastness” results in an overall increase in claiming emotional materials to be previously encountered.

In attempting to integrate the idea of emotional fluency with the discrepancy attribution hypothesis, it is important to consider the specific source of emotional fluency. In Whittlesea's (2002) context specificity paradigm, in which words completing predictive contexts were judged old more than words completing non-predictive contexts, there are two possible places for emotion to come into play. First, the contexts, in addition to being predictive or not, may also be emotional or neutral. Secondly, the target words themselves could be either emotional or neutral. In one case, emotion is contained in the context; in the other, it is in the target item to be remembered, which is also the potentially discrepant event. These two possibilities may play differential roles in the way emotional fluency is processed and attributed. If emotional fluency is created by the context, then the completing target word would be processed easily because the context has set it up to be processed easily. In other words, the sentence as a whole generates fluency which spills over onto the target word; this fluency is then attributed to prior experience with the target word. In contrast, if the emotional fluency is carried by the target word itself, the word will be processed easily because of its own emotional or distinctive value. Perhaps, compared to the processing of the sentence, processing of the target word is unexpectedly faster or easier; this surprising fact is the source of discrepancy, which eventually ends in misattribution to the past. The purpose of this experiment is to test the emotional-fluency hypothesis within the realm of discrepancy-attribution.

## Experiment 1

### *Method*

#### *Overview*

In this experiment, there were four possible sentence stems. The stems were varied in order to manipulate constraint as well as emotionality. There were also two types of target words: emotional nouns and neutral nouns. Each noun was placed in a high constraint, neutral sentence; a low constraint, neutral sentence; a high constraint, emotional sentence; and a low constraint, emotional sentence. Table 1 gives an example of each sentence type for two target words, one emotional and one neutral. All materials are reproduced in Appendix A. The target nouns were counterbalanced so that, across participants, each noun appeared an equal number of times in each of the four possible sentence structures, or stems.

In the study phase, nouns were presented one at a time on the computer screen. The nouns were presented alone in the study phase; the sentence stems appear only during the test phase. Presence of stems at test only has been demonstrated by Whittlesea (2002) to impair ability to discriminate between old and new words. This serves our purpose in that it blurs the line between old and new words, and thus allows fluency misattributions due to context and valence to play a bigger role in judgments of “pastness.”

During the test phase, the stem was presented and, after a pause, the target word appeared and completed the sentence. Whittlesea (2002) demonstrated that a pause between the sentence and target was necessary in order to create the suspense required for the formation of general expectations that lead to a feeling of familiarity. In sentences

Table 1

*Example Sentences*

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Word and context	Sentence stem
War	
High neutral	The allied countries surprised their mutual enemy by not declaring ...
High emotional	The powerful allies devastated the weak country by waging ...
Low neutral	The active group pleased its loyal supporters by avoiding ...
Low emotional	The maniacal group wrecked the fragile balance by instigating ...
Book	
High neutral	The hard-working student carefully read each page of the ...
High emotional	The illiterate adolescent furiously tore out each page of the ...
Low neutral	The curious girl carefully examined each aspect of the ...
Low emotional	The intolerant mother angrily denounced each declaration of the ...

---

presented without a pause, the word was judged as simply congruent rather than discrepant and thus no effects relating to judgments of “pastness” were found.

During the test phase, participants were instructed to think about the meaning of each sentence as they read it aloud; they were told that one way to do this might be to imagine themselves involved in the sentence. This instruction was included in an effort to heighten the self-relevance of the sentence and thereby possibly direct attention towards emotional aspects. Using a similar imagination procedure, Hertel and Parks (2002) found that ratings of vividness and ease of producing an image were significantly higher for negative word pairs than for neutral word pairs. These results suggest that, following an imagination task, fluency is indeed greater for emotional as compared to neutral stimuli, as demonstrated by higher ease of production ratings.

### *Participants*

Forty undergraduate students (24 women and 16 men) enrolled in introductory psychology classes at Trinity University participated in this experiment for extra credit. Each participant was randomly assigned to an experimental condition, subject to the constraint of equal cell sizes. Due to the use of a manipulation involving negative words and negative sentence stems, students with scores greater than 10 on the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, & Erbaugh, 1961) were excluded; this was done in order to avoid any uncontrolled interaction of dysphoria with the emotional components of the experiment.

### *Materials and Design*

The design consisted of a 2 (novelty: old, new) X 2 (constraint: high, low) X 2 (sentence valence: negative, neutral) X 2 (target valence: negative, neutral) manipulation.

*Nouns.* Both target and filler words were taken from the Affective Norms for English Words (ANEW; Bradley & Lang, 1999). The ANEW provided information about both valence and frequency. The full list of target words was made up of 32 neutral nouns (mean valence = 5.10 on ANEW's scale from 1[very negative] to 9[very positive]) and 32 negative nouns (mean valence = 2.41). Three words that were not rated in the ANEW were also used. (They were never placed in the same set; thus in any given condition, they never completed the same type of sentence stem.) Frequency ratings for the nouns that did not appear in ANEW were taken from Kuçera and Francis (1967). Filler words presented in the study phase were chosen such that the mean valence, frequency, and word length of all fillers was approximately equivalent to these means for the target words. All word information for both targets and fillers is reproduced in Appendix A.

*Pilot studies.* Information related to the materials was gathered in two pilot studies. Participants in these studies were 43 psychology statistics students (Pilot 1) and 32 Trinity University sorority and fraternity members (Pilot 2). Participants in the pilot studies were divided into four groups; each group was given a different sentence (corresponding to either the high neutral, high emotional, low neutral or low emotional stem) for each of the nouns. Each pilot study consisted of two tasks: generation and sentence rating. In the generation task, participants read sentence stems and then completed those stems with the first word that came to mind; if another word also came to mind, participants recorded this second word as well. The dependent variable, percent generation, was defined as the percentage of participants who completed the sentence, in either their first or second response, with the target word with which it was designed to end. For example, if the target word was “morgue” and the participant wrote “cemetery”

for the first word that came to mind and then wrote “morgue” for the second word, this participant’s “morgue” response would be included in the calculation of percent generation for that word. In the rating task, participants read the complete sentences (stem and target word) and then rated that sentence on a scale from 1 (very negative) to 9 (very positive). Participants did not see the same sentences in the generation and ratings tasks; for example, if a participant saw the high neutral version for a given noun in the generation task, they did not see the high neutral version of that same noun in the rating task. The results from these pilot studies provided information about the sentences that was used to remove less apt materials; sentence information was also taken into account when creating lists for the test phase.

*Study lists.* The study phase contained 32 target words and 32 filler words. Filler words are words that appeared in the study phase, essentially as distractors, but never appeared in the test phase. Words in the filler set were the same for all lists; the target set consisted of different words, depending on which words were assigned to be old in a given counterbalancing condition. Word order for the study phase was determined using a randomized block scheme; each block of four words contained two words from each the filler and the target sets. The order of the filler words was the same for all lists whereas the target word order varied based on the words assigned to be old. Two buffer words were placed at each the beginning and the end of the list of study words, to avoid primacy and recency effects.

*Practice list.* After completing the study phase, but before moving on to the test phase, participants completed a practice section. They practiced with eight sentences (one for each cell in the design); these sentences were the same for all participants and are



presented in Appendix A. Practice sentences and their target words were taken from additional materials that were piloted, but excluded from the final experimental set because piloting revealed that they were not optimal for our purposes. For example, some of the sentence stems were completely predictive; for others, the low constraint stems were completed successfully more than the high constraint stems. For reasons such as these, these sentences were only used as practice.

*Test lists.* Eight counterbalancing conditions for the test phase were created to represent the factorial combinations of constraint (high, low), sentence emotionality (negative, neutral), and novelty (old or new target word). The target nouns were divided into eight sets made up of four neutral and four emotional words each. The sets were balanced according to 11 categories: target word valence, target word frequency, target word length, percent generation for each high neutral, high emotional, low neutral, and low emotional sentences, and sentence rating for each high neutral, high emotional, low neutral, and low emotional sentences. These eight sets rotated through the eight cells in the within subjects design. For example, words in Set 1 were novel and paired with their high neutral sentence for one condition, were old and paired with their high neutral sentence in another condition, were novel and paired with their high emotional sentence in yet another condition, and so forth. The complete counterbalancing scheme appears in Appendix A. The test phase consisted of 32 sentences with previously-seen target words and 32 sentences with novel target words. A fixed word order for the test phase was determined by using a randomized block scheme in which each block of eight words contained one word from each of eight sets.

Because there was no delay between the study and test phases, two buffer sentences appeared at the beginning of the test phase. These buffers were included in order to buffer warm up. One buffer sentence was high neutral and was completed with a neutral word while the other was low emotional and was completed with an emotional word; the completing words were both novel.

### *Procedure*

Upon arriving in the lab, participants were told that they would be participating in a memory experiment. They were informed that they would be studying a list of words and that later they would be asked to perform a task involving those words. After instructing the participant, the experimenter moved to the other side of a screen in the testing room and remained there for the duration of the study phase. In the study phase, subjects were exposed to a list of neutral and emotional nouns. The nouns appeared one at a time on the computer screen. The participant read each word aloud and then pressed the spacebar to go on to the next word. After the participant completed the study phase, the experimenter came out from behind the screen. They then read the instructions for the test phase and watched while the participant completed the practice section; at this time, the experimenter corrected any procedural errors that the participant was making and answered any questions that arose. Before the participant began the test phase, the experimenter returned to the opposite side of the room screen. At test, each noun was presented as the terminal word in a sentence stem consisting of one of the four possible contexts: high constraint emotional, low constraint emotional, high constraint neutral, or low constraint neutral. The participants read each sentence stem aloud; they were instructed to think about the meaning of the sentence as they did so. After reading the

sentence stem, participants pressed the space bar; 250 ms after the spacebar was pressed, the target word appeared and completed the sentence. Participants then read the target word aloud and judged whether or not they had seen it in the study phase. They pressed the Y key on the keyboard if they thought they had seen the terminal word in the study phase and pressed the N key if they thought they had not seen that particular word in the previous phase. After completing the test phase, all participants filled out a copy of the BDI. Appendix A contains a full set of instructions.

### *Results*

A repeated measures ANOVA was performed on the proportion of target words judged old with within-subjects factors for novelty, constraint, sentence valence, and target valence. All significance levels were set at .05

#### *Principle findings*

We replicated Whittlesea's results in that the main effect of constraint was significant,  $F(1,24) = 8.25$ ,  $MSE = .047$ ,  $p < .01$ . Participants judged target words that completed high-constraint sentences to be old more often ( $M = .52$ ) than targets that completed low constraint sentences ( $M = .47$ ), regardless of whether those words were previously studied or not. Constraint interacted with gender,  $F(1,24) = 5.177$ ,  $MSE = .047$ ,  $p < .05$ , such that the effect of constraint on the proportion of words judged old was larger for men ( $M = .54$  for high constraint,  $M = .45$  for low constraint) than for women ( $M = .50$  vs.  $.49$ , respectively). The main effect of novelty was also significant,  $F(1,24) = 299.710$ ,  $MSE = .187$ ,  $p < .001$ ; as expected, old words were judged old more often ( $M = .80$ ) than new words ( $M = .19$ ). In regard to our predictions about emotion, we found a

main effect for target word valence,  $F(1,24) = 28.237$ ,  $MSE = .032$ ,  $p < .001$ ); emotional target words were judged old more often ( $M = .53$ ) than neutral target words ( $M = .46$ ).

#### *Interaction with gender*

The main effect of target valence was qualified by a significant four-way gender X novelty X sentence valence X target valence interaction,  $F(1,24) = 5.393$ ,  $MSE = .041$ ,  $p < .05$ . The means for this interaction are presented in Table 2. We followed up on this interaction by examining data from male and female participants separately. For female participants, the simple main effect of novelty was significant,  $F(1,16) = 285.394$ ,  $MSE = .133$ ,  $p < .001$ , as was the simple main effect of target valence  $F(1,16) = 16.936$ ,  $MSE = .560$ ,  $p < .01$ . Female participants judged old words to be old more than new words; they also judged emotional target words to be old more often than neutral. (For all other effects,  $p > .156$ .) For men, the three way interaction of novelty X sentence valence X target valence was significant,  $F(1,8) = 7.031$ ,  $MSE = .031$ ,  $p < .05$ <sup>1</sup>.

To follow up on this three-way interaction for male participants, we next examined the data within the two levels of novelty. Because Whittlesea examined his results in terms of differences between old and new words, we saw this as the most logical step to take due to the nature of the design. Within new words, there was a simple main effect of target valence,  $F(1,15) = 16.304$ ,  $MSE = .019$ ,  $p < .01$ . For old words, there was a significant interaction between sentence valence and target valence,  $F(1,15) = 7.30$ ,  $MSE = .035$ ,  $p < .05$ .

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<sup>1</sup> Also as with women, there were simple main effects of novelty  $F(1,8) = 72.771$ ,  $MSE = .294$ ,  $p < .001$ , and target valence,  $F(1,8) = 12.5$ ,  $MSE = .031$ ,  $p < .01$ ); two other main effects emerged that were not present for women: context,  $F(1,8) = 6.151$ ,  $MSE = .084$ ,  $p < .05$ , and sentence valence,  $F(1,8) = 8.333$ ,  $MSE = .003$ ,  $p < .05$ . Words presented completing high constraint sentences were judged old by men more often than words that completed low constraint sentence stems. Men also judged words that completed emotional sentences as old more often than words that appeared completing neutral sentences.

Table 2

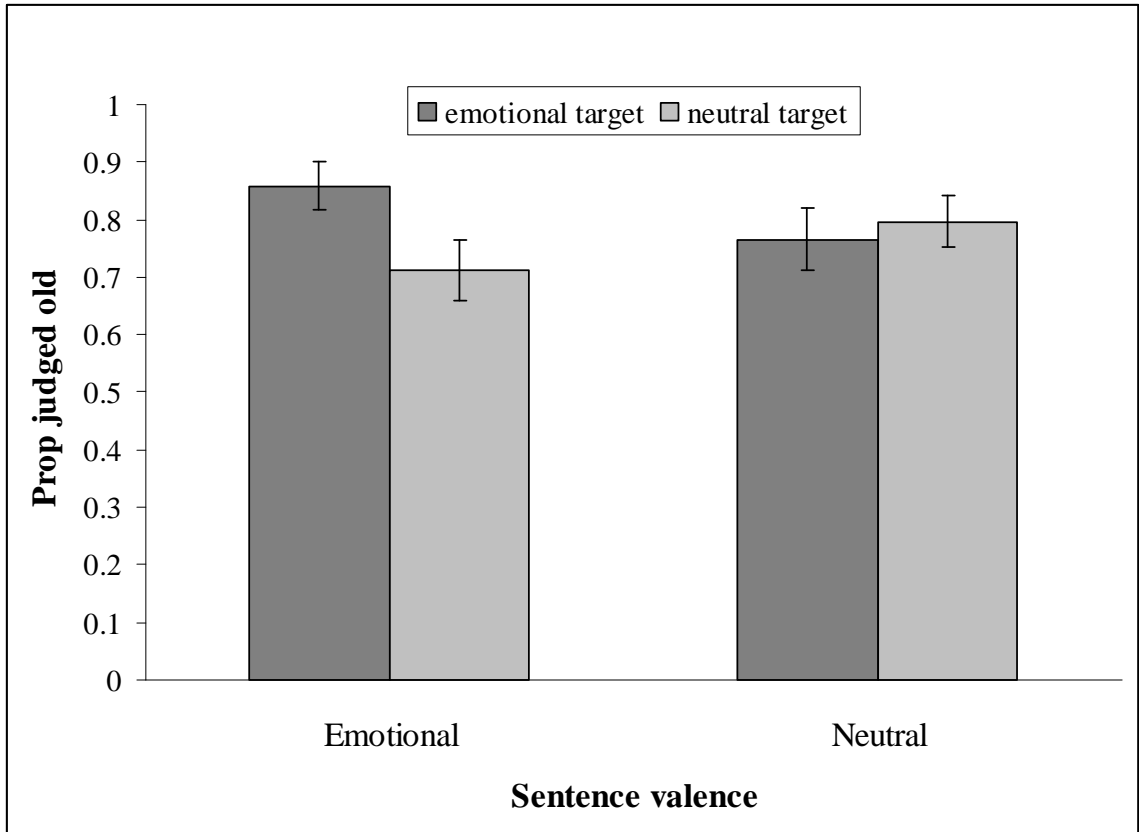
*Means for gender x novelty x sentence valence x target valence interaction*

Sentence valence	Target			
	Old emotional	Old neutral	New emotional	New neutral
Women				
Emotional	.849	.790	.234	.125
Neutral	.844	.766	.215	.156
Men				
Emotional	.859	.711	.219	.148
Neutral	.766	.797	.289	.164

To follow up on the interaction between sentence valence and target valence within old words for men, we examined the means within each level of sentence valence. There were no significant effects for neutral sentence stems (all  $ps > .1$ ). Within emotional sentence stems, there was a significant simple main effect of target valence,  $F(1,15) = 5.997$ ,  $MSE = .059$ ,  $p < .05$ ; men judged old words that completed emotional sentence stems to be old more often when the target words were also emotional as compared to when the target words were neutral (see Figure 1).

### *Discussion*

Experiment 1 found support for Whittlesea's (2002) discrepancy-attribution hypothesis in that it replicated a main effect of sentence constraint; target words that completed high constraint sentences were more likely to be judged old more than targets that completed low constraint sentences. We claim that this effect reflects a misattribution of the fluency generated by the sentence stem to prior presentation of the target word. Reading a high constraint sentence stem causes participants to generate a general expectation of what the completing word will be; when a word fitting with that expectation actually appears and completes the sentence, the mismatch between expected and actual fluency results in a feeling that the word fits "surprisingly well." This surprisingly good fit is then attributed to having seen the target word in the previous study phase. An unexpected finding with regard to this effect was the interaction between gender and constraint. Men judged words completing high constraint sentences to be old more often than those completing low constraint sentences whereas women did not. One explanation is that women are trying to be "better" participants than men. It is possible that women employed some type of strategy or spent slightly more time reading words in



*Figure 1.* Mean percentage of old words judged old by men as a function of sentence valence and target valence.

the study phase. If they thought that they knew they study words better to begin with, there would be less room for fluency due to constraint to play a role.

The design of this experiment allowed for two possible sources of emotional fluency. Sentence stems acted as one potential source of emotional fluency; the target words themselves were another possible source. If the valence of the sentence stem is what gives rise to emotional fluency, then it would appear that target words are processed easily because the sentence context has set them up to be processed easily. The sentence context facilitates processing of the word and any ease created by the valence of the word itself may combine with the ease created by the sentence. Alternatively, a target word may be processed more easily because of its own emotional value. If this is the case, the valence of the sentence would have little impact; the potential for fluency and its misattribution lies within the target word itself. The results from this experiment suggest that emotional fluency from the target word does indeed play a role. Both men and women judged emotional targets to be old more often than neutral targets. This would imply that, at least under some circumstances, fluency due to emotion is indeed gained from the target word rather than from the sentence.

An alternative explanation for this effect of target valence might point to differential frequencies of emotional and neutral words. Although emotional words tended to be less frequent than neutral words, this fact alone cannot account for the main effect of target valence that was found. One might think that, because the emotional targets used in this experiment tended to occur in everyday language less than their neutral counterparts, participants would find these emotional words more salient and therefore easier to remember. To examine this possibility, we calculated average



recognition accuracy (Hits-FAs) for each word, collapsing across sentence type. The average accuracy was approximately equivalent for neutral and emotional targets (10.0 and 10.1, respectively). There was also no significant interaction between novelty and target valence; the effect of target valence did not depend on whether the target word had been previously studied or not. The fact that old emotional targets were not judged to be old significantly more often than old neutral targets suggests that the distinctiveness of previously studied emotional words did not affect judgments of “pastness.” Therefore we can say with confidence that the tendency to claim that emotional targets were old more than neutral targets is not merely due to the differential frequencies of the two target types but rather appears to reflect the attribution of emotional fluency to prior experience.

The four-way interaction between gender, novelty, sentence valence, and target valence revealed that emotional fluency from the sentence stems was only evident when men were judging old target words. When old emotional targets completed emotional sentence stems, men judged them to be old more often than old neutral targets that completed emotional stems. Thus it seems that, for men, a combination of emotion from the sentence stems and the targets words facilitated remembering of previously presented words.

Looking at Experiment 1, some might be inclined to claim that emotion merely gives rise to a vague feeling of familiarity that in turn leads participants to claim that a word is old. However, we think that participants actually convince themselves that they are indeed remembering when making attributions based on surprising fluency. A recent study by Sharot, Delgado, and Phelps (2004) showed that emotional photographs were remembered, but not known, more than neutral photographs. A “remember” response is

defined as recognition that is accompanied by explicit contextual details whereas a “know” response is memory for an item without these specific episodic details. Sharot and his colleagues (2004) demonstrated that the right amygdala showed higher activation for remembered emotional pictures relative to known emotional pictures. A difference between remember and know trials for neutral pictures was found in the right parahippocampal cortex. They conclude that these regions respond differently for remember responses regarding emotional and neutral stimuli and that this difference in neural activity may underlie the tendency to claim to remember emotional materials. Additional evidence supporting the idea that emotional events tend to be remembered rather than known was provided by Ochsner (2000) who also found that emotional (specifically negative) pictures were remembered more than neutral pictures; negative pictures did not, however, differ from neutral pictures in producing “know” responses, which are equated with familiarity.

An experiment by Whittlesea (2002) examined differences between recall and familiarity in the discrepancy-attribution paradigm. Using the constraint manipulation, he found that words completing high constraint stems were remembered more than words completing low constraint stems; in contrast, there was no effect of constraint on claims of familiarity. These results imply that fluency misattribution can lead participants to claim that they actually remember prior experience with a target word. It appears that fluency misattributions manifest themselves in claims of remembering rather than familiarity.

In short, research has shown that emotional materials tend to be remembered rather than “known” to have occurred in the past and that fluency plays a role in claims of

“actually remembering”, but not claims of familiarity. To address these potential emotional fluency differences in remember and familiar responses, we used a variation of the remember/know paradigm in Experiment 2.

## Experiment 2

### *Method*

#### *Participants*

Thirty-two undergraduate students (16 women and 16 men) enrolled in introductory psychology classes at Trinity University participated in the experiment for extra credit. Each participant was randomly assigned to an experimental condition, subject to the constraint of equal cell sizes. As in Experiment 1, students with BDI scores greater than 10 were excluded.

#### *Materials*

In Experiment 1, some target words failed to show false alarms in any of the four possible sentences structures. We interpret this problem as being due to poor materials construction with regard to the sentences for these particular target words. In an attempt to remedy this problem, we revised these materials for Experiment 2. One target word (rabies) was discarded and replaced; for seven target words, all sentence stems were revised. After these revisions were made, a pilot study was conducted with the same group of introductory statistics students that participated in the first pilot in Experiment 1. The procedure for this pilot study was identical to that of Pilot 1 in Experiment 1 and consisted of both generation and rating phases; only sentences for the eight words for which changes had been made were evaluated. The resulting data for both generation and ratings can be found in Appendix B. The filler list was also revised, because some of these words were used in the revised Experiment 1 materials. In order to decrease the number of hits, 16 new filler words were added to the study phase, for a total of 48. The

word information for all fillers, as well as for the one added target word, can be found in Appendix B.

The changes to materials mentioned above resulted in a list of target words made up of 32 neutral nouns (mean valence = 5.02) and 32 negative nouns (mean valence = 2.47). Again, three words that were not rated in the ANEW were used; as in Experiment 1, these words were never placed in the same set and thus in any given condition, these three words never completed the same type of sentence stem. Filler words presented in the study phase were chosen such that the mean valence of all fillers was equal to the mean valence of the target words. Experimental lists for both the study and test phases were created in the same way as those in Experiment 1.

### *Procedure*

The procedure was the same as in Experiment 1, with the exception of the options available to the participants when making their old/new judgment. Whereas in Experiment 1 participants merely judged whether a word was old or new, participants in the current experiment distinguished between two possible types of “old” responses. Participants judged each target word as either “new,” “actually recall,” or “feels familiar.” Participants were given no specific instruction on how to define these categories; they were merely told to press the R key if they actually recalled seeing a word in the previous phase, to press the F key if the word just felt familiar, or to press the N key if they thought the word was new. The complete instructions to participants can be found in Appendix B.

## *Results and Discussion*

A repeated measures ANOVA was performed on the proportion of target words judged old with within-subjects factors for remember/familiar, novelty, constraint, sentence valence, and target valence. All significance levels were set at .05.

### *Principle findings*

As in Experiment 1, the main effect of novelty was significant,  $F(1,16) = 210.818$ ,  $MSE = .056$ ,  $p < .001$ . Participants judged old words to be old more ( $M = .42$ ) than new words ( $M = .21$ ). The main effect of the remember/familiar judgment was also significant,  $F(1,16) = 26.462$ ,  $MSE = .365$ ,  $p < .001$ ; overall, targets were claimed to be remembered ( $M = .41$ ) more than familiar ( $M = .22$ ). The remember/familiar judgment interacted with novelty,  $F(1,16) = 448.821$ ,  $MSE = .053$ ,  $p < .001$ , such that old words were judged to be actually remembered more ( $M = .67$ ) than familiar ( $M = .17$ ) and new words were judged to be familiar ( $M = .26$ ) more than remembered ( $M = .15$ ). Whittlesea (2002) found a similar interaction. He reported that claims of actual recall were higher for old words than for new words, but that claims of familiarity were similar for new and old items. He explained this effect by concluding that subjects experienced actual differences in prior exposure as differences in judgments of recall rather than familiarity; that is, subjects distinguished between old and new words when claiming to actually recall these words, but not when claiming that the words merely felt familiar.

With regard to our predictions about emotion, we found that the main effect of target valence was again significant,  $F(1,16) = 16.012$ ,  $MSE = .021$ ,  $p = .001$ . As in Experiment 1, participants judged emotional words to be old more ( $M = .33$ ) than neutral target words ( $M = .30$ ). However, target valence was also involved in several significant

interactions. The interaction of remember/familiar X target valence was significant,  $F(1,16) = 10.190$ ,  $MSE = .095$ ,  $p < .01$ . Emotional targets were judged to be remembered more than neutral targets; however, emotional targets were not judged to be familiar more than neutral targets (see Figure 2). This demonstrates that emotion does not merely lead to a general feeling of familiarity that then induces people to judge that emotional targets are old. Rather, when faced with emotional fluency from the target, participants misattribute that fluency to “pastness” and claim that they actually remember the target word.

The three-way interaction between remember/familiar, target valence, and constraint was also significant,  $F(1,16) = 5.081$ ,  $MSE = .056$ ,  $p < .05$ . We followed up on this interaction by examining the data within each level of the remember/familiar factor. The target valence X constraint interaction was significant for remember responses,  $F(1,16) = 4.742$ ,  $MSE = .045$ ,  $p < .05$ , but not for familiar responses,  $p = .141$  (see Figure 3). When participants claimed to actually remember the target word, emotional targets were judged to be old more when they completed high constraint stems than when they completed low constraint stems; there was no effect of constraint for neutral target words. This interaction suggests that fluency from the emotion of the target may combine with fluency from high constraint stems to lead to increased claims of remembering for the target.

We again replicated Whittlesea’s results with a significant main effect of constraint,  $F(1,16) = 7.095$ ,  $MSE = .027$ ,  $p < .05$ . As in Experiment 1, targets completing high constraint sentences were judged old more often ( $M = .33$ ) than targets completing

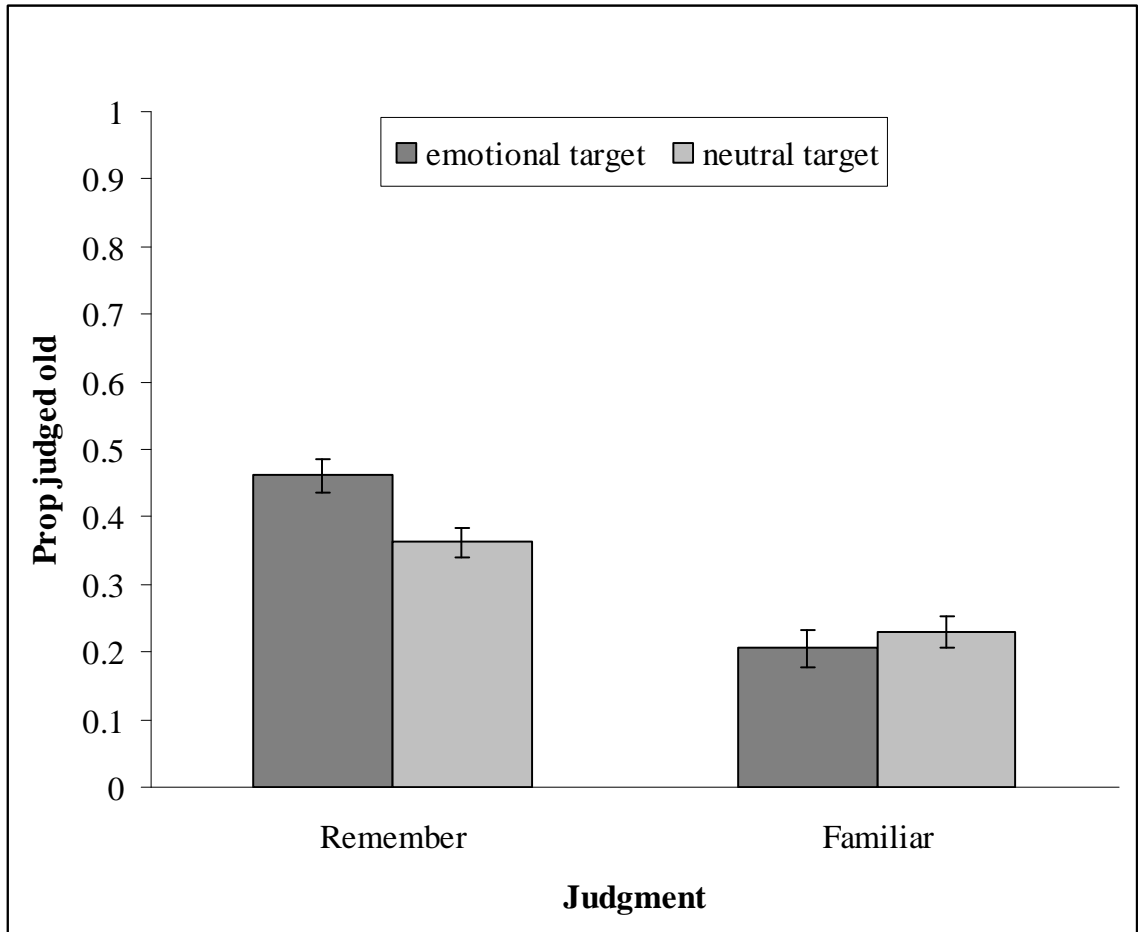
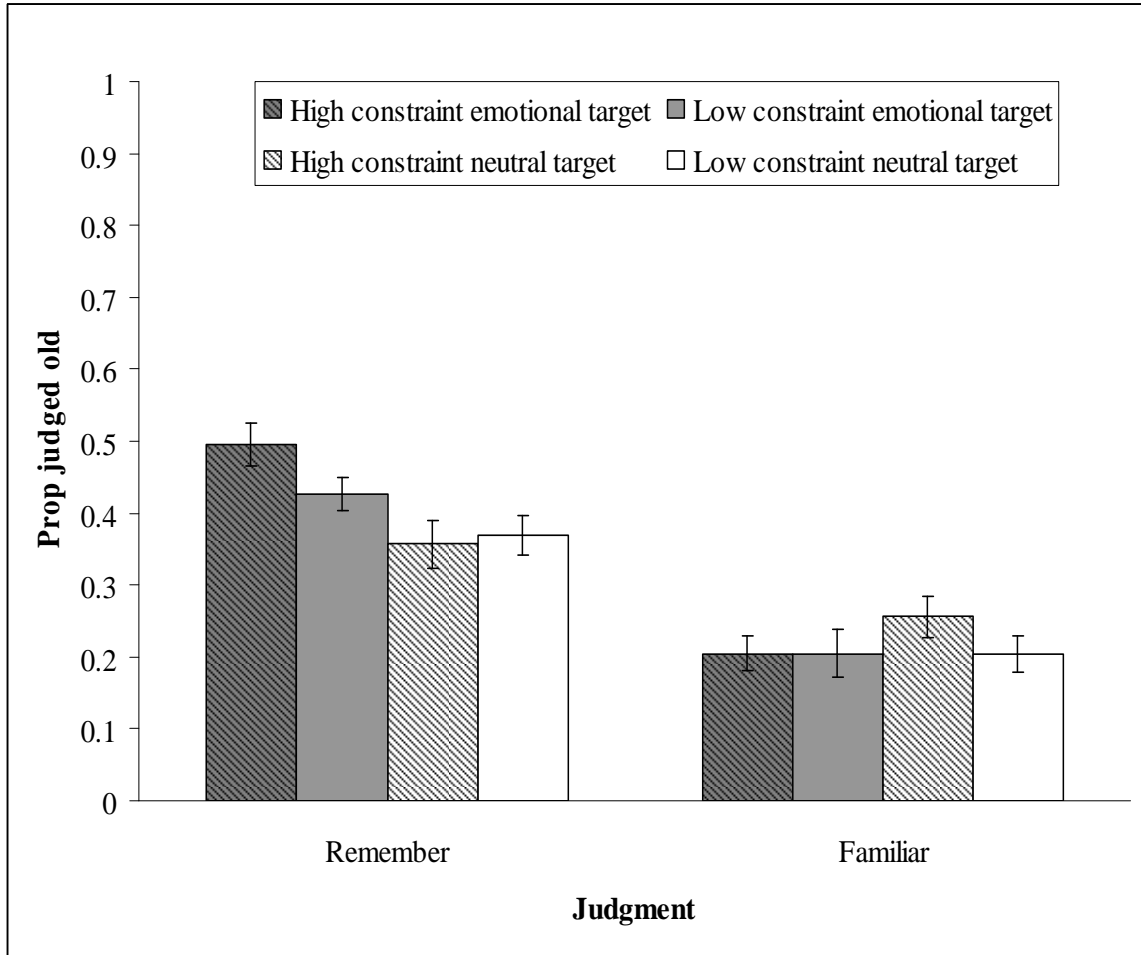


Figure 2. Proportion of words judged old as a function of remember/familiar judgment and target valence.





*Figure 3.* Proportion of words judged old as a function of remember/familiar judgment, constraint, and target valence.

low constraint sentences ( $M = .30$ ). Again, this finding can be conceptualized as reflecting an attribution of the fluency generated by the sentence stem to prior presentation of the target word.

#### *Interactions with gender*

There were a number of interactions involving gender that were not expected and could not be completely understood in the context of the current experiments. Only the interactions involving sentence valence are reported here because the valence of the sentence is central to the motivation for the experiment. We predicted that emotion from sentence stems might generate fluency much in the same way that constraint does, by creating a context that leads the target word to be processed surprisingly easily. Because we made this prediction about the effect of sentence emotionality, it is important to examine here the conditions under which such an effect emerges.

The three-way interaction of gender X constraint X sentence valence reached significance,  $F(1,16) = 8.824$ ,  $MSE = .006$ ,  $p < .01$ . This interaction was qualified by a significant four-way interaction involving gender, constraint, sentence valence, and target valence,  $F(1,16) = 6.164$ ,  $MSE = .009$ ,  $p < .05$ . The three-way gender X constraint X sentence valence interaction was significant only for emotional targets,  $F(1,16) = 15.00$ ,  $MSE = .007$ ,  $p = .001$ . Within emotional targets, the gender X sentence valence interaction was significant for both high constraint stems,  $F(1,16) = 7.049$ ,  $MSE = .010$ ,  $p < .05$ , and low constraint stems,  $F(1,16) = 5.121$ ,  $MSE = .008$ ,  $p < .05$ . For low constraint stems, the simple main effect of sentence valence was significant in judgments of emotional targets made by men,  $F(1,16) = 7.143$ ,  $MSE = .007$ ,  $p < .05$ , but not women,  $p = .511$ . Men judged emotional targets to be old more when they completed low constraint

emotional stems than when they completed low constraint neutral stems. Thus the results from this experiment suggest that gender, target valence, and constraint all play a role in determining when effects from sentence valence arise. For men, emotional fluency from the target apparently combined with that from the sentence to affect judgments of “pastness,” but only for targets completing low constraint sentences. Perhaps, for words completing low constraint stems, the combination of emotion from the target and the sentence generated enough surprising fluency to compensate for the fact that the sentence was low constraint. With high constraint sentences, however, perhaps the fluency from constraint alone was sufficient to lead to misattributions without the emotionality of the sentence coming into play.

## General Discussion

Research in a variety of domains has shown that one aspect of an experience can be mistakenly attributed to another. Within the realm of memory, various experiments have demonstrated that conditions in the present can influence our interpretations of having experienced an event previously. Based on evidence such as this, it is preferable to conceptualize memory as attributional, rather than representational, in nature. People have learned to attribute ease of processing under certain circumstances to prior experience; this attribution is what is referred to as “memory.” In other words, the subjective experience of remembering involves attributing ease of processing in the present to experience in the past.

This pair of experiments replicated findings by Whittlesea (2002) that supported the discrepancy-attribution hypothesis. This hypothesis suggests that the mismatch between expected and actual fluency can lead people to misattribute ease of processing due to current factors to “pastness.” Whittlesea found that words that completed high constraint sentences were more likely to be judged old than words that completed low constraint sentences. In another experiment, when Whittlesea asked participants to distinguish between whether they actually remembered the target word or whether it just felt familiar, he found that participants claimed to remember words that completed high constraint sentences more often than those that completed low constraint sentences; there was no such effect of constraint when participants claimed that the word just felt familiar. We replicated the main effect of constraint in both Experiments 1 and 2. In addition to upholding the discrepancy-attribution hypothesis, we also found support for the

emotional-fluency hypothesis; fluency from emotion, carried by the target word, influenced participants' judgments of "pastness."

Experiment 1 found evidence for fluency due to constraint and emotionality of the target word. Targets completing high constraint stems were judged old more often than those completing low constraint stems, regardless of whether they had been studied previously; also, emotional targets were judged to be old more than neutral targets. The main effect of target valence was qualified by a four-way interaction that revealed, among other patterns, that when old emotional targets completed emotional sentences men judged them as old more than old neutral targets completing emotional sentences. In Experiment 2, we again found evidence of attributions of fluency from emotional targets and constraint to the past. Findings from these experiments support the previously demonstrated findings that fluency from manipulations in the present can influence judgments of "pastness." We have shown that fluency misattributions from these manipulations can be associated with constraint as well as the emotional value of the "remembered" item.

In addition to providing evidence for the emotional-fluency and discrepancy-attribution hypotheses, we found support for the idea that participants actually convince themselves that they are remembering when making attributions based on surprising fluency. Whittlesea (2000) provided evidence of this effect with his sentence constraint manipulation; words completing high constraint sentences were remembered, but not familiar, more than words that completed low constraint sentences. We extended this finding to the realm of emotion and emotional fluency. In Experiment 2, emotional target words were claimed to be actually remembered more than neutral target words; however,

there was no difference in the degree to which the two were judged to be familiar.

Participants claimed to remember being previously exposed to words even when no such exposure occurred. This finding demonstrates that fluency from emotional materials does not merely lead to a vague feeling of familiarity but rather to a strong belief that the item is actually remembered.

The circumstances under which sentence valence appeared to play a role in the attribution of emotional fluency involved gender and varied between the two experiments. In Experiment 1, sentence valence played a role when men made judgments of old emotional targets. In Experiment 2, effects of sentence valence were again found for men, but this time only emerged when emotional targets completed low constraint stems. The fact that the role of sentence valence depended on a variety of other factors and differed between the two experiments leads us to believe that these effects are transitory or that our manipulation was weak. Unexpected gender interactions such as these somewhat reduced the clarity of the overarching effects of constraint and target valence; however, they did not interfere with our overall conclusions. Both men and women judged emotional targets to be old more than neutral targets; they also judged targets completing high constraint stems to be old more often than those completing low constraint stems.

The extent to which we replicated Whittlesea's (2002) findings in terms of levels of performance could be due to differences in materials. Whittlesea used 120 target words in his test phase whereas we only used 64. We also had fewer words in our study phase, which may partially explain why our hits were higher and our false alarms were lower; because participants were exposed to fewer words in our experiment, they were more

able to correctly distinguish between new and old words. Nevertheless we replicated his findings regarding the main effect of constraint and the remember/familiar X novelty interaction. The fact that we obtained significant effects even when participants were better able to distinguish between old and new words demonstrates that fluency misattributions occur even when the boundary between new and old seems more readily apparent.

Research on emotional fluency is particularly relevant to the ongoing false memory debate. Findings of fluency misattributions in general support the idea that memory, or judgments of prior experience, can be influenced by factors in the present. Because many false memories are for emotional events, there exists the potential for emotional fluency to play a large role. For example, in a therapy situation the types of questions a therapist asks or the ideas that he or she proposes may cause an idea to come into one's head surprisingly easily. According to the emotional-fluency hypothesis, when this material is emotional (or the general context itself is emotional), one may misattribute fluency gained from the present situation to the prior occurrence of the ideas generally suggested by the therapist. As demonstrated here, when emotional materials are judged to be old, people claimed that they actually remembered these materials. Convincing themselves that they actually remember would solidify the person's confidence in that memory and perhaps dissuade them from evaluating the accuracy of their memory more carefully. The realm of emotional fluency is important to explore because it has the potential to shed light on a widespread and controversial memory phenomenon.

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## Appendix A

### Materials for Experiment 1

Table A1: Counterbalancing scheme

Counterbalancing condition	Set							
	1	2	3	4	5	6	7	8
A	HNO	HEO	HNN	HEN	LNO	LEO	LNN	LEN
B	HEO	HNN	HEN	LNO	LEO	LNN	LEN	HNO
C	HNN	HEN	LNO	LEO	LNN	LEN	HNO	HEO
D	HEN	LNO	LEO	LNN	LEN	HNO	HEO	HNN
E	LNO	LEO	LNN	LEN	HNO	HEO	HNN	HEN
F	LEO	LNN	LEN	HNO	HEO	HNN	HEN	LNO
G	LNN	LEN	HNO	HEO	HNN	HEN	LNO	LEO
H	LEN	HNO	HEO	HNN	HEN	LNO	LEO	LNN

*Note.* In the first position, H and L designate high and low contexts. In the second position, N and E indicate neutral and emotional contexts. In the third position, N and O refer to new and old target words.

Table A2: Sentence stems

Word and context	Sentence stem
Abuse	
High Neutral	The school was sensitive to issues concerning child sexual ...
High Emotional	The girl was distraught from experiences involving child sexual ...
Low Neutral	The organization was sensitive to issues concerning work related ...
Low Emotional	The girl was distraught by experiences involving family-related ...
Accident	
HN	The shocked drivers stared at the site of the ...
HE	The bloodstained highway remained at the site of the ...
LN	The curious people looked at the remains of the ...
LE	The bloodstained concrete remained at the site of the ...
Alley	
HN	The man collected the trashcans from the narrow back ...
HE	The mugger chased the priest down the dark, narrow ...
LN	The man removed the trash from the crowded unsightly ...
LE	The attacker captured the matron near the crowded shop-filled ...
Anger	
HN	The man aimed his fist at the wall in a state of ...
HE	Following her slap, the man beat his wife because he felt ...
LN	The man turned his face to the wall in a state of ...
LE	Following the insult, the woman wept loudly because she felt ...
Army	
HN	The aspiring young soldier enlisted in the ...
HE	The soldier died overseas while serving in the ...
LN	The ambitious young man joined the ...
LE	The man died overseas while in the ...
Bandage	
HN	The trainer wrapped the sprinter's ankle with a ...
HE	The physician wrapped the bleeding wound with a ...
LN	The teacher wrapped the chair leg with a ...
LE	The teacher wrapped the student's head with a ...
Blister	
HN	The woman's new shoes gave her foot a large ...
HE	The POW's forced march gave his foot a painful ...
LN	The woman's new equipment gave her hand an odd ...
LE	The POW's prison torment gave his hand a painful...
Bomb	
HN	In time, the police experts easily defused the ...
HE	Too late, the ammunition experts suddenly found the ...
LN	In time, the search team easily located the ...
LE	Too late, the search team suddenly found the ...

Word and context	Sentence stem
<b>Book</b>	
HN	The hard-working student carefully read each page of the ...
HE	The illiterate adolescent furiously tore out each page of the ...
LN	The curious girl carefully examined each aspect of the ...
LE	The intolerant mother angrily denounced each declaration of the ...
<b>Bottle</b>	
HN	Warm formula filled the chubby baby's ...
HE	Rancid formula filled the crying baby's ...
LN	Her hand held the chubby baby's ...
LE	Her hand smashed the crying baby's ...
<b>Building</b>	
HN	The architect designed the new ...
HE	He was trapped in the tall, blazing ...
LN	The man worked on the new ...
LE	He was trapped in the new ...
<b>Bullets</b>	
HN	The hunter bought a gun and a box of ...
HE	The mobster's bloated corpse was riddled with many ...
LN	The man bought a weapon and some ...
LE	The fugitive's disgusting face was pierced with many ...
<b>Burn</b>	
HN	Handling the hot appliance, she inadvertently caused a mild ...
HE	Manipulating the smoldering cigarette, he deliberately inflicted a serious ...
LN	Handling the new appliance, she inadvertently caused a slight ...
LE	Activating the steel machine, he deliberately inflicted a serious ...
<b>Bus</b>	
HN	The tired pedestrian gratefully stepped onto the ...
HE	The lonely traveler sadly stepped onto the ...
LN	The tired woman quickly stepped onto the ...
LE	The penniless vagrant sullenly shuffled off the ...
<b>Butter</b>	
HN	The dinner rolls were baked by covering the dough with pats of ...
HE	Her soft hands were scarred from covering popcorn with very hot ...
LN	The pizza pies were baked by covering the dough with spoons of ...
LE	Her soft hands were scarred from covering pizza with very hot ...
<b>Cane</b>	
HN	The old man walked with a ...
HE	The deformed man walked with a ...
LN	The old man used a ...
LE	The deformed man used a ...

Word and context	Sentence stem
Cannon	
HN	The soldier was loading powerful balls into the ...
HE	The soldier was maimed by powerful balls from the ...
LN	The man was loading powerful objects into the ...
LE	The man was disfigured by powerful blows from the ...
Cellar	
HN	The connoisseur stored his wine in the ...
HE	The kidnapper locked her in the dank ...
LN	The collector stored containers in the ...
LE	The kidnapper forced her into the ...
Cemetery	
HN	To earn extra money, the digger worked the nightshift at the ...
HE	To feel close to her husband, the widow walked the grounds of the...
LN	To earn extra money, the watchman worked the nightshift at the ...
LE	To feel close to her husband, the woman walked the grounds of the...
Cliff	
HN	She admired the view from atop the rocky ...
HE	She jumped to her death from atop the rocky ...
LN	She admired the view from atop the high ...
LE	She jumped to her death from atop the high ...
Coast	
HN	The loving couple vacationed at a resort on the Gulf ...
HE	The hazardous wastes amassed on the beaches of the Gulf ...
LN	The loving couple vacationed at a resort on the Mediterranean ...
LE	The stinking garbage amassed in a town by the Mediterranean ...
Cockroach	
HN	When she turned on the kitchen light, across the counter dashed a brown ...
HE	Averse to bugs, she is disgusted by the sickening crunch of stepping on a ...
LN	When she opened the living room door, across the floor scampered a ...
LE	Averse to germs, she is disgusted by the sickening sight of handling a...
Coffee	
HN	The boss asked the secretary for some morning ...
HE	She scorched her tongue with the microwaved cup of ...
LN	The boss asked his assistant for the ...
LE	She scorched herself with the microwaved ...
Coffin	
HN	The embalmed remains were placed in a ...
HE	The mourners sobbed at the sight of the ...
LN	The motionless figure was lying in a ...
LE	The family sobbed at the sight of the ...

Word and context	Sentence stem
<b>Debt</b>	
HN	In the high-income family, her college tuition caused only a modest ...
HE	Due in part to her college tuition, bankruptcy resulted from the incurred ...
LN	In the well adjusted family, her college years caused only a moderate ...
LE	Due in part to her college experience, unhappiness resulted from the incurred ...
<b>Depression</b>	
HN	The counselor attributed the man's sadness to ...
HE	To no avail, the hopeless woman took pills to treat her crushing ...
LN	The counselor attributed the man's emotions to ...
LE	To no avail, the hopeless woman tried to climb out of the steep ...
<b>Discomfort</b>	
HN	The procedure will not cause any pain or ...
HE	The heart attack was the cause of his pain and ...
LN	The procedure will not cause any sensation or ...
LE	The heart attack was the cause of his emotional ...
<b>Divorce</b>	
HN	The next-door neighbor was not surprised that the feuding couple was getting a ...
HE	The neglected child was heartbroken that her feuding parents are getting a ...
LN	The understanding supervisor was not surprised that her best employee was getting a ...
LE	The neglected child was physically ill because her ever-absent father was getting a ...
<b>Doctor</b>	
HN	For his yearly physical, the healthy man was examined by the ...
HE	For his monthly checkup, the cancer patient was examined by the ...
LN	On his last birthday, the healthy man was visited by the ...
LE	In his weakened state, the cancer patient was accompanied by the ...
<b>Dump</b>	
HN	The trash collector disposed of the small load at the city ...
HE	The mugger chased the priest down the dark, narrow ...
LN	The city employee disposed of the paper stack in the nearby ...
LE	The dishonest driver emptied out the rotting cargo into the overflowing ...
<b>Elevator</b>	
HN	The fastest way to the top floor was by ...
HE	She panicked when trapped in the broken ...
LN	The easiest way to the top was by ...
LE	She panicked when stuck in the halted ...

Word and context	Sentence stem
Engine	
HN	A steady hum emanated from the sports car's ...
HE	She was stranded alone due to the breakdown of the car's ...
LN	A constant noise emanated from the loud ...
LE	She was stranded alone due to a problem with the shoddy ...
Fever	
HN	The temporary symptoms of the so-called illness included sweating and mild ...
HE	The intolerable symptoms of the fatal illness included vomiting and high ...
LN	The typical characteristics of the altered state included euphoria and...
LE	The intolerable characteristics of the physical trauma included delusions and ...
Fire	
HN	The campers warmed their hands by the ...
HE	The house was destroyed by the raging ...
LN	The children put their hands near the ...
LE	The house was destroyed by the sudden ...
Funeral	
HN	Family members and friends paid tribute at the solemn state ...
HE	Shocked fans and friends wept openly at the beloved actor's ...
LN	Family members and friends shared stories at the funny man's ...
LE	Upset fans and friends murmured quietly at the young actor's ...
Hospital	
HN	She brought flowers to her good friend in the ...
HE	She brought flowers to her dying friend in the ...
LN	She talked frequently to her good friend at the ...
LE	She worried frequently about her disfigured friend at the ...
Hostage	
HN	That day, the political activists decided to release one ...
HE	Each day, the political insurgents threatened to kill one ...
LN	That day, the peace lovers decided not to take a ...
LE	Each day, the lone madman decided to carve into a ...
Infection	
HN	Antibiotic ointment was used to prevent possible ...
HE	Oozing pus was indicative of advanced bacterial ...
LN	Herbal lotions were used to assuage possible ...
LE	Oozing pus was indicative of advanced venereal ...
Journal	
HN	The young girl wrote all of her deepest secrets in her personal ...
HE	The heartbroken girl recorded her unhappy experiences in her personal ...
LN	The young girl reached under her bed to pull out her ...
LE	The heartbroken girl reached under her bed to pull out her...

Word and context	Sentence stem
Kettle	
HN	She helped herself by boiling water in the tea ...
HE	She scalded herself with boiling water from the tea ...
LN	She helped herself by pouring liquid from the porcelain ...
LE	She scalded herself with hot broth from the porcelain ...
Knife	
HN	The chef minced the vegetables with a ...
HE	The chef sliced his thumb with the ...
LN	The chef mixed the vegetables with a ...
LE	The chef pounded his thumb with the ...
Knot	
HN	With his expert skill, the boy scout could untie the rope's ...
HE	With her hands bound, the captive could not untie the rope's ...
LN	With his mind focused, the boy scout could learn the hardest ...
LE	With her hands chained, the captive could not reach the crucial ...
Lie	
HN	Sure that she would be comforted, he misled her with a little white...
HE	Afraid that he would be punished, he deceived her with a blatant ...
LN	Sure that she would feel better, he comforted her with a harmless ...
LE	Angry that he was rejected, he damaged her with a gruesome ...
Lion	
HN	At the zoo, she saw the mane of the ...
HE	On safari, he was mauled by the ferocious ...
LN	At the zoo, she saw the face of the ...
LE	On safari, he was killed by the large ...
Milk	
HN	She gobbled up her delicious breakfast with a glass of cold ...
HE	She choked down her disgusting breakfast with a glass of rancid ...
LN	She gobbled up her satisfying meal with a cup of warm ...
LE	She choked down her disgusting meal with a serving of spoiled ...
Morgue	
HN	The crime-scene investigator collected results after an autopsy in the...
HE	The incompetent pathologist sliced the liver during an autopsy in the...
LN	The crime-scene investigator collected results after a trip to the ...
LE	The decomposing material obstructed the hallways during a trip to the...
News	
HN	The woman was glad that the letter contained good ...
HE	The officer reluctantly told the widow the horrible ...
LN	The woman was glad that her friend brought delicious ...
LE	The officer crassly told the woman the awful ...
Rabies	
HN	The family pet, back from the vet, was inoculated for ...
HE	The vicious dog, foaming at the mouth, was infected with ...
LN	The domestic animal running through the yard was safe from ...
LE	The vicious dog snarling at the boy was exposed to ...



Word and context	Sentence stem
Razor	
HN	He shaved his face with a sharp ...
HE	She slit her wrists with a disposable ...
LN	He touched his face with a new ...
LE	She marked her belly with a stolen ...
Riot	
HN	A peaceful demonstration occurred instead of a looting ...
HE	The heated protest evolved into a deadly ...
LN	A peaceful gathering occurred in place of a noisy ...
LE	The chaotic situation evolved into a dangerous ...
Scissors	
HN	During school, the child cut out shapes with ...
HE	During school, the child nicked his finger while using ...
LN	Before school, the child bought new, silver ...
LE	During school, the child sliced his finger on the...
Scum	
HN	The pond looked clean without the filmy layer of ...
HE	The pond smelled putrid with its filmy layer of ...
LN	The water smelled fresh when they scooped out the ...
LE	The drink smelled rancid with its thick layer of ...
Ship	
HN	Passengers strolled along the wide decks of the ...
HE	Passengers panicked for their lives and jumped off the sinking ...
LN	People walked across the wooden floor of the ...
LE	People panicked for their lives and jumped off the ...
Slave	
HN	The plantation owner had his work done by his ...
HE	The plantation owner used a whip to punish his ...
LN	The owner had his work done by his ...
LE	The owner severely whipped his ...
Surgery	
HN	The physician removed his appendix during the routine ...
HE	The physicians amputated his leg during the difficult ...
LN	The team fixed his problem during the basic ...
LE	The team ruined his life during the crucial ...
Swamp	
HN	The bullfrog lived in the boggy ...
HE	Malaria infected mosquitoes bred in the boggy ...
LN	The animal lived near the muddy ...
LE	Malaria infected mosquitoes swarm around the large ...
Tobacco	
HN	The cigar company continued to use the finest ...
HE	The wheezing man continued to smoke the harmful ...
LN	The successful company continued to use the finest ...
LE	The dying man continued to chew the bitter ...

Word and context	Sentence stem
Tools	
HN	The handyman bought a metal container for his many ...
HE	The thief picked the door's lock with his specialized ...
LN	The electrician built a wooden shelf for his new ...
LE	The thief broke the glass window with his blunt ...
Torture	
HN	The combat documentary discussed cruel methods of ...
HE	The young captive was subjected to brutal ...
LN	The moving documentary discussed various types of ...
LE	The young man was forced to endure severe ...
Violin	
HN	The musician manipulated the bow while playing the ...
HE	The child smashed the musician's bow and ...
LN	The musician moved her hands while playing the ...
LE	The child destroyed the woman's favorite ...
Volcano	
HN	Smoke billowed out of the erupting ...
HE	They were suffocated by ash from the erupting ...
LN	Smoke billowed from the large ...
LE	They were suffocated by debris from the ...
War	
HN	The allied countries surprised their mutual enemy by not declaring ...
HE	The powerful allies devastated the weak country by waging ...
LN	The active group pleased its loyal supporters by avoiding ...
LE	The maniacal group wrecked the fragile balance by instigating ...
Winter	
HN	The active children often made snowmen during the long ...
HE	The freezing children cried together nightly during the long ...
LN	The active children busily made cookies during the boring ...
LE	The darling children were killed mercilessly during the last...
Wounds	
HN	The kind nurse cleaned his fresh ...
HE	The brusque nurse scrubbed his festering ...
LN	The sympathetic woman inspected his fresh ...
LE	The brusque woman inflamed his sensitive ...

Table A3: Target word information

Word	Valence	Freq	Length
Abuse	1.80	18	5
Accident	2.05	33	8
Alley	4.48	8	5
Anger	2.34	48	5
Army	4.72	132	4
Bandage	4.54	4	7
Blister	2.88	3	7
Bomb	2.10	36	4
Book	5.72	193	4
Bottle	6.15	76	6
Building	5.29	160	8
Bullets	3.29	28	7
Burn	2.73	15	4
Bus	4.51	34	3
Butter	not rated	27	6
Cane	4.00	12	4
Cannon	4.90	7	6
Cellar	4.32	26	6
Cemetery	2.63	15	9
Cliff	4.67	11	5
Coast	5.98	61	5
Cockroach	2.81	2	9
Coffee	not rated	78	6
Coffin	2.56	7	6
Debt	2.22	13	4
Depression	1.85	24	10
Discomfort	2.19	7	10
Divorce	2.22	29	7
Doctor	5.20	100	6
Dump	3.21	4	4
Elevator	5.44	12	8
Engine	5.20	50	6
Fever	2.00	19	5
Fire	3.22	187	4
Funeral	1.39	33	7
Hospital	5.04	110	8
Hostage	2.20	2	7
Infection	1.66	8	9
Journal	5.14	42	7
Kettle	5.22	2	6
Knife	3.62	76	5
Knot	4.64	8	4
Lie	2.79	59	3

Word	Valence	Freq	Length
Lion	5.57	17	4
Milk	5.95	49	4
Morgue	1.92	1	6
News	5.30	102	4
Rabies	1.77	1	6
Razor	4.81	15	5
Riot	2.96	7	4
Scissors	5.05	1	8
Scum	2.43	<1	4
Ship	5.55	83	4
Slave	1.84	30	5
Surgery	2.86	6	7
Swamp	5.14	5	5
Tobacco	3.28	19	7
Tools	5.19	40	4
Torture	1.56	3	7
Violin	5.43	11	6
Volcano	4.84	2	7
War	2.08	464	3
Winter	not rated	83	6
Wounds	2.51	8	6

Table A4: Filler word information

Word	Valence	Freq	Length
Basket	5.45	17	6
Bench	4.61	35	5
Board	4.82	239	5
Cork	5.22	9	4
Coward	2.74	8	6
Danger	2.95	70	6
Errand	4.58	7	6
Fear	2.76	127	4
Glacier	5.5	1	7
Gloom	1.88	14	5
Hat	5.46	56	3
History	5.24	286	7
Industry	5.3	171	8
Insult	2.29	7	6
Lawn	5.24	15	4
Lawsuit	3.37	1	7
Letter	6.61	145	6
Lightning	4.57	1	7
Misery	1.93	15	6
Nightmare	1.91	9	9
Poison	1.98	10	6
Prison	2.05	42	6
Radiator	4.67	4	8
Rage	2.41	16	4
Rock	5.56	75	4
Seasick	2.2	<1	7
Snob	2.75	1	4
Tragedy	1.78	49	7
Traitor	2.22	2	7
Victim	2.44	27	6
Whistle	5.81	4	7
Window	5.91	119	6

Table A5: Practice and buffer stems

Phase and word	CB	Sentence stem
<b>Practice</b>		
Lawsuit	LEO	The reckless corporation bribed him to avoid a public ...
Corridors	HEN	She became hopelessly lost in the building's winding ...
Intruder	LNN	The store clerk was surprised by the late-night ...
Prison	HNO	The students toured the reformatory federal ...
Kerosene	HNN	The old lantern was fueled by ...
Glacier	LNO	The geologist studied the details of the ...
Slum	LEN	The vagrants went to the old, run-down ...
<b>Buffer</b>		
Paint	HNN	The laborer covered the house's exterior with a fresh layer of...
Venom	LEN	The boy's aching, swollen arm was the results of an encounter with ...

Table A6: Pilot generation and rating means by word

Word	gHN	gHE	gLN	gLE	rHN	rHE	rLN	rLE
Abuse	50.00	77.78	0.00	0.00	4.30	2.00	5.20	1.90
Accident	40.00	54.55	25.00	10.00	2.82	1.67	3.00	2.17
Alley	60.00	80.00	30.00	0.00	4.67	3.00	4.70	2.90
Anger	20.00	60.00	0.00	0.00	3.20	1.70	3.90	3.60
Army	63.64	60.00	50.00	16.67	5.11	2.18	6.17	2.40
Bandage	30.00	30.00	11.11	30.00	6.20	3.50	5.10	4.30
Blister	50.00	40.00	0.00	0.00	3.60	2.40	4.00	3.20
Bomb	70.00	30.00	0.00	0.00	6.60	2.70	6.60	2.70
Book	40.00	80.00	0.00	0.00	6.30	3.40	6.90	3.90
Bottle	10.00	50.00	0.00	0.00	7.90	3.30	6.40	2.30
Building	50.00	80.00	0.00	0.00	5.80	2.40	5.80	3.60
Bullets	50.00	30.00	40.00	0.00	5.00	3.30	4.50	1.90
Burn	90.00	50.00	0.00	0.00	3.80	3.30	3.70	2.90
Bus	50.00	18.18	8.33	0.00	6.55	3.00	5.40	3.36
Butter	50.00	50.00	10.00	0.00	7.50	3.60	5.90	3.00
Cane	75.00	50.00	60.00	45.45	4.70	2.67	4.82	2.78
Cannon	80.00	60.00	0.00	0.00	3.10	2.20	4.00	1.90
Cellar	70.00	25.00	9.09	0.00	5.58	2.10	5.56	2.18
Cemetery	33.33	70.00	0.00	66.67	4.70	5.00	6.00	4.40
Cliff	40.00	63.64	0.00	0.00	8.00	2.00	7.80	1.67
Coast	20.00	22.22	10.00	0.00	7.60	2.80	7.90	3.00
Cockroach	20.00	80.00	11.11	0.00	3.90	2.30	4.70	2.20
Coffee	66.67	70.00	10.00	0.00	5.70	3.70	5.40	3.10
Coffin	30.00	30.00	0.00	0.00	3.70	2.00	4.00	2.70
Debt	10.00	70.00	0.00	0.00	5.90	2.80	5.50	4.20
Depression	80.00	20.00	10.00	0.00	4.30	2.40	3.70	3.30
Discomfort	50.00	0.00	10.00	0.00	6.10	2.60	6.00	2.80
Divorce	80.00	90.00	0.00	20.00	4.50	2.70	4.10	2.90
Doctor	70.00	70.00	20.00	10.00	6.10	4.70	5.80	3.60
Dream	100.00	20.00	10.00	8.33	6.78	3.64	6.33	3.90
Dump	80.00	60.00	0.00	10.00	5.30	1.80	4.70	2.80
Engine	81.82	70.00	10.00	0.00	6.56	3.00	4.33	2.60
Fever	30.00	80.00	0.00	0.00	4.50	2.50	5.10	2.70
Fire	72.73	50.00	40.00	8.33	6.67	1.91	4.67	1.70
Funeral	40.00	20.00	40.00	0.00	4.00	2.80	6.00	2.90
Hospital	90.00	80.00	0.00	66.67	5.40	4.20	6.60	3.30
Hostage	0.00	20.00	0.00	0.00	5.70	2.30	6.30	1.50
Infection	70.00	80.00	10.00	70.00	5.70	3.30	4.70	2.80
Journal	50.00	30.00	0.00	10.00	5.90	4.00	5.20	4.10
Kettle	44.44	10.00	0.00	0.00	5.80	3.30	6.90	3.30
Knife	60.00	100.00	0.00	0.00	5.60	2.90	6.60	3.10
Knot	80.00	90.00	10.00	0.00	7.20	3.90	6.70	2.20

Word	gHN	gHE	gLN	gLE	rHN	rHE	rLN	rLE
Lie	80.00	90.00	0.00	0.00	3.90	4.10	3.30	3.70
Lion	58.33	50.00	10.00	36.36	6.20	1.42	6.18	2.11
Milk	80.00	70.00	30.00	40.00	7.10	2.10	7.50	2.30
Morgue	60.00	60.00	30.00	10.00	3.40	3.00	3.40	3.10
News	80.00	60.00	0.00	40.00	7.30	2.50	7.30	3.00
Rabies	75.00	100.00	0.00	30.00	5.40	3.10	6.40	2.80
Razor	70.00	80.00	0.00	0.00	5.30	1.40	5.10	2.70
Riot	60.00	20.00	0.00	10.00	6.80	2.90	6.90	3.20
Scissors	81.82	70.00	10.00	41.67	5.89	3.91	6.17	2.60
Scum	30.00	40.00	0.00	10.00	6.40	3.20	4.60	2.60
Ship	60.00	72.73	0.00	10.00	6.91	1.89	5.30	2.08
Slave	75.00	90.00	10.00	45.45	3.20	1.67	3.00	1.44
Surgery	60.00	30.00	0.00	0.00	5.80	2.20	6.20	2.30
Swamp	63.64	70.00	20.00	8.33	5.33	2.91	5.33	2.70
Tobacco	70.00	20.00	0.00	0.00	5.70	2.30	5.30	3.00
Tools	80.00	90.00	40.00	0.00	6.80	4.00	6.10	3.50
Torture	58.33	30.00	0.00	18.18	2.50	1.75	2.71	1.44
Violin	75.00	80.00	0.00	0.00	7.00	3.42	6.00	2.44
Volcano	50.00	91.67	0.00	20.00	4.75	1.80	4.56	1.64
War	100.00	90.00	10.00	0.00	6.90	3.70	6.70	2.30
Winter	70.00	33.33	0.00	0.00	7.20	1.80	5.90	2.00
Wounds	70.00	60.00	70.00	0.00	6.40	2.70	4.60	3.20

*Note.* In the first position, g and r refer to generation and rating, respectively. In the second position, H and L refer to high and low constraint stems. In the third position, E and N refer to emotional and neutral constraint stems.



Table A7: Set means

Set	Valence	Freq	Length	gHN	gHE	gLN	gLE	rHN	rHE	rLN	rLE
Emotional											
1	2.06	9.63	6.25	57.50	57.50	5.00	21.36	5.28	2.64	5.00	2.41
2	2.10	21.00	7.25	55.00	53.64	26.25	2.50	4.51	2.32	4.10	2.84
3	2.26	18.00	6.75	50.00	45.00	10.00	5.00	3.95	2.48	4.53	2.93
4	2.63	67.75	6.25	53.18	55.00	22.50	19.58	5.14	2.55	4.44	2.50
5	2.58	6.25	4.5	52.5	52.5	7.50	7.50	5.35	2.63	5.13	3.33
6	2.41	124.0	5.75	55.83	57.50	2.50	16.67	5.28	3.58	5.68	2.78
7	2.64	22.75	5.75	57.50	57.50	2.78	0.00	5.05	2.83	5.20	2.73
8	2.57	29.00	6.00	59.58	56.94	0.00	4.55	4.53	2.24	4.95	2.36
Mean	2.41	37.30	6.06	55.14	54.45	9.57	9.65	4.89	2.66	4.88	2.74
Neutral											
1	5.14	88.75	4.75	59.62	59.55	7.08	0.00	6.28	3.28	5.51	3.24
2	5.03	9.25	5.75	63.61	57.50	4.77	7.50	5.91	2.80	6.01	2.82
3	5.19	31.50	5.50	60.00	57.50	17.50	12.50	6.29	3.18	5.83	3.08
4	4.66	25.50	5.50	64.66	61.25	20.00	18.45	5.50	2.30	5.15	2.28
5	5.09	92.25	6.00	62.50	61.93	7.27	5.00	6.10	2.77	5.62	2.87
6	4.99	32.00	5.50	56.25	58.41	2.78	17.50	7.13	2.86	6.55	2.85
7	5.24	58.50	5.25	61.36	60.56	27.50	14.28	6.35	3.22	6.59	2.88
8	5.42	52.50	6.00	59.58	60.00	2.50	25.76	5.65	2.78	5.80	2.40
Mean	5.10	48.78	5.53	60.95	59.59	11.18	12.62	6.15	2.90	5.88	2.80
Total											
1	3.60	49.19	5.50	58.56	58.52	6.04	10.68	5.78	2.96	5.25	2.83
2	3.57	15.13	6.50	59.31	55.57	15.51	5.00	5.21	2.56	5.05	2.83
3	3.73	24.75	6.13	55.00	51.25	13.75	8.75	5.12	2.83	5.18	3.00
4	3.64	46.63	5.88	58.92	58.13	21.25	19.02	5.32	2.42	4.80	2.39
5	3.83	49.25	5.25	57.50	57.22	7.39	6.25	5.72	2.70	5.37	3.10
6	3.70	78.00	5.63	56.04	57.95	2.64	17.08	6.20	3.20	6.11	2.81
7	3.94	42.13	5.50	59.43	59.03	15.14	7.29	5.70	3.02	5.89	2.80
8	3.99	40.75	6.00	59.58	58.47	1.25	15.15	5.09	2.51	5.37	4.76
Mean	3.75	43.23	5.80	58.04	50.77	10.37	11.15	5.52	2.78	5.38	3.07

## Instructions to Participants

### Study phase

In this first phase, you will study words in preparation for a memory task in the next phase. The words will be presented one at a time on the computer screen. Please read each word aloud at your own pace. Press the space bar when you are finished with a word to receive the next word. I'll be sitting on the other side of the screen while you do this task, but I'll be working on something else. Please do everything just as you would if I were not in the room. Don't worry about whether you're correctly pronouncing the word or not, just read it as you would if you were alone. I'll come back over when you've finished the study phase. Do you have any questions? Feel free to begin whenever you are ready.

### Test phase

Okay, now in this task you will be judging whether or not you studied certain words in the previous phase. On each trial, a sentence in which the final word is missing will appear on the screen. You should read the sentence aloud and concentrate on the meaning of the sentence; one way to do this might be to imagine yourself involved in the sentence. Concentrating on the meaning will be important for a later task. After you have finished reading the sentence, press the spacebar. The end word will appear and complete the sentence. You must read the completing word out loud and then judge whether you previously studied that word or not. Press Y if you did see that word in the study phase; press N if you did not study that word. There will be a short break in the middle during which you can relax your eyes. Do you have any questions?

Alright, let's try some practice. Remember that you will read the sentence aloud, think about its meaning as fully as you can while you read it, press the space bar, read the completing word out loud, and then judge if you saw the completing word in the study phase. Press the spacebar to begin.

Good, now let's start the main trials. I'll be on the other side of the screen again for this portion of the experiment. Remember to focus on the meaning of the sentence as you read it aloud. When the message "XXX" appears, let me know then sit back and rest for a minute. Press the spacebar when you are ready to begin.

### At the rest point:

Take a brief rest; let me know when you are ready to continue. Remember to be sure you're really attempting to think about the meaning of the sentence as you read it aloud. Press the spacebar when you are ready to begin the last block.

### After the last block:

Alright, well, it's running a little late, so we're going to go ahead and skip the meaning task. There's just one more task to complete. Please fill out this questionnaire. When you are finished, place it in the envelope and seal it. Your answers will be completely anonymous. Only Dr. Hertel, who will not know your name, will see your responses. I am going to leave the room while you fill out the questionnaire. When you are done and have sealed it in the envelope, knock on the door. Any questions?

## Appendix B

### Materials for Experiment 2

Table B1: Added and revised sentence stems

Word and context	Sentence stem
<b>Army</b>	
HN	The young man was eager after enlisting in the ...
HE	The brave soldier was shot while deployed with the ...
LN	The young man was restless after working in the ...
LE	The paraplegic man was injured while employed by the ...
<b>Blister</b>	
HN	During a pleasant day of back packing, the woman's heel developed a small ...
HE	After a long day of hard labor, the prisoner's hand developed a festering ...
LN	After a pleasant day of productive effort, the diligent man noticed a small ...
LE	After a long day of hard labor, the orphaned child cried about her ...
<b>Bullets</b>	
HN	The target shooter's gun was loaded with blank ...
HE	The shooting victim's body was riddled with discharged ...
LN	The team member's case was supplied with blank ...
LE	The strangler's calling card was a box of jagged ...
<b>Cane</b>	
HN	To walk like an old man the young actor leaned on a ...
HE	To escape from the danger the deformed man hobbled with a ...
LN	To dance like a showman the young actor needed a ...
LE	To escape from the danger the deformed man depended on a ...
<b>Flood</b>	
HN	The large dam was built to protect the quaint town from a possible ...
HE	The decrepit dam failed to save the innocent citizens from the sudden ...
LN	The large structure was built to prevent unnecessary damage from the impending ...
LE	The mayor's precautions failed to protect the innocent people from the wild ...
<b>Lion</b>	
HN	Spectators at the zoo admired the gorgeous mane of the sleeping ...
HE	Children at the zoo fled from the ferocious roar of the escaped ...
LN	Spectators at the park gathered around the new habitat for the exotic...
LE	Children on the trip fled from the terrible sight of the wounded ...

Word and context	Sentence stem
Milk	
HN	The healthy toddlers felt full from drinking the nourishing ...
HE	The malnourished children felt nauseous from drinking the sour ...
LN	The busy woman was satisfied after drinking the fresh ...
LE	The sickly woman was vomiting after ingesting the spoiled ...
Morgue	
HN	The medical examiner's exciting career started in a city ...
HE	The crime scene's mangled corpses were transported to the ...
LN	The chief investigator's exciting career started in a local ...
LE	The terrorists' mangled bodies were scattered around the ...

Table B2: Word information for added fillers and target

Word	Valence	Freq	Length
Fillers			
Alimony	3.95	2	7
Basket	5.45	17	6
Bench	4.61	35	5
Blackmail	2.95	2	9
Board	4.82	239	5
Cabinet	5.05	17	7
Cork	5.22	9	4
Corner	4.36	115	6
Coward	2.74	8	6
Crisis	2.74	82	6
Errand	4.58	7	6
Fabric	5.3	15	6
Failure	1.7	89	7
Fear	2.76	127	4
Fraud	2.67	8	5
Glacier	5.5	1	7
Gloom	1.88	14	5
Gossip	3.48	13	6
Grief	1.69	10	5
Hat	5.46	56	3
Hatred	1.98	20	6
Industry	5.3	171	8
Ink	5.05	7	3
Lawn	5.24	15	4
Lawsuit	3.37	1	7
Lightning	4.57	14	9
Misery	1.93	15	6
Museum	5.54	32	6
Nightmare	1.91	9	9
Pest	3.13	4	4
Poison	1.98	10	6
Prison	2.05	42	6
Rabies	1.77	1	6
Radiator	4.67	4	8
Rage	2.41	16	4
Rock	5.56	75	4
Salad	5.74	9	5
Seasick	2.2	<1	7
Square	4.74	143	6
Stench	2.19	1	6
Stress	2.09	107	6
Table	5.22	198	5

Word	Valence	Freq	Length
Tower	5.46	13	5
Tragedy	1.78	49	7
Traitor	2.22	2	7
Umbrella	5.16	8	8
Whistle	5.81	4	7
Window	5.91	119	6
Target			
Flood	3.75	19	5

Table B3: Pilot generation and rating means for revised materials

Word	gHN	gHE	gLN	gLE	rHN	rHE	rLN	rLE
Army	90.9	50.0	0.0	30.0	6.3	3.0	4.5	2.8
Blister	70.0	20.0	0.0	0.0	5.1	4.0	5.1	3.0
Bullets	70.0	54.5	0.0	0.0	4.6	1.3	5.4	2.2
Cane	80.0	81.8	40.0	10.0	4.9	2.5	6.4	2.3
Flood	100.0	50.0	20.0	0.0	6.2	1.3	4.7	2.6
Lion	60.0	80.0	0.0	0.0	8.1	1.9	6.0	2.7
Milk	90.0	100.0	0.0	50.0	7.5	3.1	6.9	2.7
Morgue	36.3	90.0	0.0	0.0	5.2	1.7	4.4	2.7

## Instructions to participants

### Study phase

In this first phase, you will read words in preparation for a memory task in the next phase. The words will be presented one at a time on the computer screen. Please read each word aloud at your own pace. Press the space bar when you are finished with a word to receive the next word. I'll be sitting on the other side of the screen while you do this task, but I'll be working on something else. Please do everything just as you would if I were not in the room. Don't worry about whether you're correctly pronouncing the word or not, just read it as you would if you were alone. I'll come back over when you've finished the study phase. There will be 80 words in this first part. Please do not attempt to memorize them, just read each one aloud. Do you have any questions? Feel free to begin whenever you are ready.

### Test phase

Okay, now in this task you will be judging whether or not you studied certain words in the previous phase. On each trial, a sentence in which the final word is missing will appear on the screen. You should read the sentence aloud and concentrate on the meaning of the sentence; one way to do this might be to imagine yourself involved in the sentence. Concentrating on the meaning will be relevant for a later task. After you have finished reading the sentence, press the spacebar. The end word will appear and complete the sentence. You must read the completing word out loud and make a judgment regarding that word. If you actually recall seeing the word in the first phase, press the key with the sticker marked "R"; if the completing word just feels familiar, press the key labeled "F"; if you think the word is totally new, press the key labeled "N". There will be a short break in the middle during which you can relax your eyes. Do you have any questions?

Alright, let's try some practice. Remember that you will read the sentence aloud, think about it's meaning as fully as you can while you read it, press the space bar, read the completing word out loud, and then make your judgment about the completing word ("actually recall", "feels familiar", or "new"). Press the spacebar to begin.

Good, now we'll start the main trials. I'll be on the other side of the screen again for this portion of the experiment. Remember to focus on the meaning of the sentence as you read it aloud. When the message "XXX" appears, let me know then sit back and rest for a minute. Press the spacebar when you are ready to begin.

### At the rest point:

You can take a brief rest now. Remember to be sure you're really attempting to think about the meaning of the sentence as you read it aloud. Press the spacebar when you are ready to begin the last block.

### After the last block:

Alright, well, it's running a little late, so we're going to have to move ahead and skip the meaning task. There's just one more task to complete. Please fill out this questionnaire. When you are finished, place it in the envelope and seal it. Your answers will be completely anonymous. Only Dr. Hertel, who will not know your name, will see your



responses. I am going to leave the room while you fill out the questionnaire. When you are done and have sealed it in the envelope, knock on the door. Any questions?