2008

An Item-Specific and Relational Processing Account of Emotional Memory Enhancement

Carissa Ann Zimmerman

FLORIDA STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

AN ITEM-SPECIFIC AND RELATIONAL PROCESSING ACCOUNT OF EMOTIONAL MEMORY ENHANCEMENT

By

CARISSA ANN ZIMMERMAN

A Thesis submitted to the
Department of Psychology
in partial fulfillment of the
requirements for the degree of
Master of Science

Degree Awarded:
Summer Semester, 2008

The members of the Committee approve the thesis of Carissa A. Zimmerman defended on April 30, 2008.

Colleen M. Kelley
Professor Directing Thesis

Michael Kaschak
Committee Member

E. Ashby Plant
Committee Member

The Office of Graduate Studies has verified and approved the above named committee members.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my advisor, Dr. Colleen Kelley. She has helped me through every step of my graduate career by offering not only encouragement, guidance, and intellectual stimulation, but also a certain independence. Colleen is a kind person who cares not only about the academic success of her students, but also their general wellbeing; without her, I could not have achieved many of the acccomplishments that I have today. I would like to thank my committee members, Ashby Plant and Michael Kaschak, for their thoughtful feedback on this project. To Paula Hertel, my undergraduate research advisor, I am grateful for her tough love, which helped me carve out the path that I am on today.

I would like to acknowledge and thank the many student research assistants who assisted me in running these experiments: Nicholas Karr, Becki Kielaszek, Richard Molina, Iraida Neira, Haley Flenniken, Jessica Brinkerhoff, Faun Yordon, and Angela Ugolini. Their hours of dedication and thoughtful comments are greatly appreciated.

Thank you, also, to my many friends for their help in maintaining my sanity throughout my graduate student training. My lab mates, Edward Cokely and Ainsley Mitchum, were instrumental in helping me adapt to the graduate student lifestyle. They were not only friends, but also great colleagues; their willingness to engage in challenging academic discussion and to continually act as a sounding board for ideas created a supportive and exciting lab environment that has doubtlessly contributed to my success. I would like to thank my fellow Saucy Tarts, Ainsley Mitchum, Lisa Glover, and Ryan Yordon, with whom I have formed a rapidly solidifying bond; thank you for lending your ears to my complaints and for helping me to unwind when the stresses of student life seemed almost unbearable. Thank you, also, to my other fellow cognitive graduate students, Mark Fox, Katy Nandagopal, and Mine Misirlisoy for forming an important part of my social support network. Lastly, to my non-graduate-student friends, Amy Ostrander, Mariah Espinosa, Suzy Green, and Adrienne and Peter Haik, thank you for being my oasis from the academic world and for helping me recharge when I needed an escape from the pressures of the lab.

Finally, I would like to thank those who are, perhaps, the most imporant influence in my life: my family. Their constant encouragement has played a vital role in helping me to succeed in all aspects of my life. From an early age, they instilled in me the belief that I could achieve anything I set my mind to. They have supported me in every venture that I have undertaken and for that I am eternally grateful. Last, but by no means least, I would like to thank Nick Espinosa for his unwavering patience, support, and encouragement; having him by my side gives me the stength to face whatever challenges come my way.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Two experiments tested the competing item-specific and semantic cohesion hypotheses of emotional memory enhancement. The item-specific hypothesis predicts that emotional words receive more item-specific and less relational processing than neutral words, whereas the semantic cohesion hypothesis posits more relational processing of emotional words. In both experiments, emotional words were better remembered than neutral words. However, Experiment 1 found no support for either hypothesis; emotional and neutral words did not differ in the amount of either item-specific or relational processing, as measured by item gains and losses across repeated tests. Experiment 2 found that the memory advantage of emotional over neutral words did not differ as a function of the type of orienting task in which participants engaged. Several methodological explanations for the absence of the hypothesized findings are dicussed along with future directions for research.

INTRODUCTION

Emotional materials, including words, pictures, film clips, and narrated slide shows, are generall recalled and recognized better than their neutral counterparts (Bradley, Greenwald, Petry, & Lang, 1992; Buchanan, Denburg, Tranel, & Adolphs, 2001; Cahill, et al., 1996; Doerksen & Shimamura, 2001; Harris & Pashler, 2005; Hertel & Parks, 2002; Kensinger, et al., 2002; Kensinger & Corkin, 2003; Nagae & Moscovitch, 2002; Ochsner, 2000; Rubin & Friendly, 1986). In addition to objective measures of memory, such as free recall, the subjective experience of remembering is also affected by emotionality. Kensinger and Corkin found that, in a remember-know paradigm, participants gave significantly more "remember" responses to emotional words compared to neutral words; Oschner reports a similar finding using emotional and neutral pictures.

However, there are also instances in which emotion appears to hurt, rather than benefit, memory. One such case involves the linking of emotional materials. Although binding of emotional materials to contextual elements such as location may be enhanced (D'Argembeau & Linden, 2005; Doerksen & Shimamura, 2001; Mather & Nesmith, 2008, but see Mitchell, Mather, Johnson, Raye, & Greene, 2006), binding of emotional stimuli to one another is often impaired relative to neutral materials (Mather, 2007). Indeed, Levinger and Clark (1961) found that memory for self-generated word associates was worse for words associated with large galvanic skin responses and emotional ratings. Additionally, Mather (as cited in Mather, 2007) found no evidence of enhanced binding of emotional pictures to neutral "bystander" pictures presented simultaneously, although location memory was superior for individual emotional pictures. Mather (2007) discusses these, and other, findings in terms of differential effects of within-object and between-object binding. She claims that the pull of attention to emotional objects enhances binding of within-object features, such as color or location, at the expense of between-object associations. I propose, however, that a broader conceptualization framed in terms of differences in item-specific and relational processing will ultimately prove more useful in thinking about how memory for emotional and neutral materials will differ.

Item-specific processing involves the encoding of individual items in a distinctive fashion, focusing on the differences among items that make them unique. In contrast, relational processing emphasizes the relationships among items; it involves processing items in terms of their similarities rather than differences. The amounts of item-specific and relational processing

engaged in during encoding can be measured empirically in a variety of ways. In traditional study-test paradigms, recognition performance is one common measure of item-specific processing, whereas clustering in free recall is often used to measure the extent of relational processing (Engelkamp, Biegelmann, & McDaniel, 1998; Hodge & Otani, 1996; Hunt & Einstein, 1981). In hypermnesia paradigms, which utilize a study-test-test procedure, item-specific and relational information may also be measured by item gains and item losses, respectively. Item-specific information contributes to distinctiveness and thus facilitates the initial retrieval of items (Klein, Loftus, Kihlstrom, & Aseron, 1989); to the extent that memory is not exhausted during the first recall phase, item information will continue to facilitate retrieval of new items, thus resulting in item gains across tests. Relational information, however, serves to organize items within a retrieval scheme and thus increases the likelihood that an item will not be forgotten once it is recalled, insuring against item losses across tests.

Research investigating the roles of item-specific and relational processing in memory has traditionally examined the interaction between the processing induced by orienting tasks and that induced spontaneously by factors related to the materials themselves, such as list structure. Einstein and Hunt (1980; Hunt & Einstein, 1981) argue that lists of unrelated words generally induce item-specific processing spontaneously, whereas related lists induce relational processing. They demonstrate that recall performance is best when both item-specific and relational information are encoded, when the orienting task complements the processing elicited by the materials rather than duplicates it. Thus item-specific orienting tasks, such as rating pleasantness, benefit related lists more than unrelated lists; unrelated lists already engage item-specific processing spontaneously, so further item-specific processing from the orienting task does not contribute any unique information to the encoding. Relational orienting tasks, such as category sorting, however, best benefit unrelated lists, which spontaneously elicit item-specific processing. Additionally, engaging in both relational and item-specific orienting tasks enhances recall relative to either task alone for both related and unrelated lists. Differences in item-specific and relational processing have been called upon to explain a wide variety of memory phenomena (see Hunt & McDaniel, 1993 for a review) including hypermnesia, the generation effect, proactive interference, prose recall, and self-referent encoding. I propose that research on memory and emotion will also benefit by thinking about emotional memory from the perspective of differences in item-specific and relational processing.

Indeed, recent research suggests that emotional materials may receive more item-specific processing than neutral materials. Zimmerman and Kelley (2008) found enhanced recall for emotional compared to neutral words in a free recall task, but failed to find any emotional memory enhancement in a cued recall paradigm. Our results suggested that this difference between free and cued recall performance may be due to differential item-specific encoding of emotional and neutral materials. We argued that emotional words received more item-specific processing than neutral words, which aids memoy in free recall; item-specific information alone, however, is not sufficient for success on a cued recall task, which necessitates binding two individual items together with relational processing. Results from both free and cued recall experiments suggested that there was little spontaneous relational processing for either emotional or neutral words. Analyses of categorical clustering (Roenker, Thompson, & Brown, 1971) by valence in free recall revealed no evidence of relational processing with regard to emotional and neutral categories. Additionally, emotional words were at a disadvantage relative to neutral words in the cued recall task; emotional word pairs were recalled worse than neutral word pairs and participants committed more commission errors in their recall of emotional words. However, further analyses of item-level recall showed that individual emotional words were recalled better than neutral words, although emotional targets were less often paired with their correct cue; this finding suggests that emotional materials receive more item-specific processing at the expense of relational processing.

Conversely, some researchers claim that emotional items induce more relational processing spontaneously because emotionality represents a salient semantic category. They argue that it is this relational processing or semantic cohesion rather than any aspect of emotion per se that acounts for the memory advantage of emotional words in free recall (Buchanan, Etzel, Adolphs, & Tranel, 2006; Maratos, Allan, & Rugg, 2000; Talmi & Moscovitch, 2004); for example, Talmi and Moscovitch found that memory for a list of emotional words was equivalent to memory for a list of related neutral words. However, these studies rely on subjective ratings to classify their materials. Such a posteriori relations, which capture the extent to which words presented together appear to be related, affect predictions about memory, but not necessarily memory performance itself (Koriat & Bjork, 2005, 2006a, 2006b; Zimmerman & Kelley, 2008). Additionally, the semantic clustering results discussed previously suggest that little relational processing at the level of emotional and neutral categories takes place spontaneously. If the

semantic cohesion argument were correct, participants should cluster emotional and neutral words together in their free recall output; this, however, is not the case. The current experiments further test the semantic cohesion hypothesis by measuring the amount of spontaneous relational processing for both emotional and neutral words.

I propose that emotional materials induce item-specific processing automatically, at the expense of relational processing. I argue that, due to their emotional nature, the pleasantness of emotional items may be assessed obligatorily (Franks, Bilbrey, Lien, & McNamara, 2000). Pleasantness rating has been found to selectively increase measures of item-specific processing, such as items per category recalled and recognition; indeed, it is often used as an orienting task to induce item-specific processing (Burns, 1993; Einstein & Hunt, 1980; Hunt & Einstein, 1981; Klein, et al., 1989). Thus, any obligatory processing of pleasantness may essentially be seen as the equivalent of an item-specific processing task. The current experiments test the item-specific hypothesis that emotional words receive more spontaneous item-specific processing, and less relational processing, than their neutral counterparts.

EXPERIMENT 1

Experiment 1 employed a hypermnesia paradigm to examine differential item-specific and relational processing of emotional and neutral words. In a basic hypermnesia experiment, participants study a list of words and then successively recall the list multiple times. As previously discussed, item-specific processing results in more item gains across recall tests whereas relational processing prevents item losses across tests (Burns, 1993; Klein, et al., 1989). I used measures of item gains and losses to assess item-specific and relational processing for emotional compared to neutral items. I predicted that emotional words would automatically induce item-specific processing and thus would show more item gains than neutral words. Additionally, emotional words may suffer more item losses because automatic item-specific processing would prevent what little relational processing may occur.

Method

Participants

Fifty-eight undergraduates enrolled in an introductory psychology course at Florida State University participated in exchange for partial course credit. All participants were tested individually.

Materials

Forty-four nouns were chosen from the Affective Norms for English Words (ANEW; Bradley & Lang, 1999); half of the words were neutral (M = 5.17 on ANEW's scale from 1 [unpleasant] to 9 [pleasant]) and half were negative (M = 2.45). Negative and neutral words were equated for frequency (Kuçera & Francis, 1967; M = 2.79 for negative, M = 30.3 for neutral), length (M = 5.8 for negative, M = 5.4 for neutral), concreteness (Nelson, McEvoy, & Schreiber, 1998; Friendly, Franklin, & Rubin, 1982; M = 5.1 for both), familiarity (Wilson, 1988; M = 530.7 for negative, M = 519.2 for neutral), and imageability (Wilson; M = 543.1 for negative, M = 521.8 for neutral), all $F < 1$. A matrix latent semantic analysis (LSA; Landauer, Foltz, & Laham, 1998) on the individual words insured that negative words were no more related than neutral words, $F < 1$; the average similarity scores was .08 for both emotional and neutral word sets. Words were also examined using free association norms (Nelson, et al., 1998); only seven words had associates on the list. The mean probability of producing any word in response to another was .02 for emotional words and .08 for neutral words, $F < 1$. The complete list of materials can be found in Appendix A.

Procedure

In the study phase, each of the 44 words was presented individually on a computer screen for 5 s. Participants were instructed to study each word so that they would be able to recall it on their own later. After the study phase, participants were instructed to recall as many of the studied words as possibly by typing their responses into the compute. The first recall phase lasted for 5 min; participants were instructed to use the entire 5 min for their recall. Immediately following the first recall phase, participants were told that they would recall the same list a second time and that they should try to improve their recall performance from the first test. Before beginning the second recall test, participants were given 3 min to think back to the study list and prepare to recall the words a second time (Klein, et al, 1989). The second recall phase lasted for 4 min; again, participants were reminded to use the entire time for their recall.

Results and Discussion

Recall

A 2 (test: 1, 2) X 2 (valence: emotional, neutral) repeated-measures ANOVA on the percentage of words recalled revealed a main effect of test, F (1, 57) = 46.57, MSE = 197.04, $p <$ .01, η^2 = .14; participants recalled more words on the first test compared to the second (see Figure 1). Additionally, more emotional words were recalled than neutral words across both tests, F (1, 57) = 46.57, MSE = 197.04, $p <$ .001, η^2 = .45. There was a marginal interaction such that the difference in memory for emotional and neutral words was smaller on the second test than the first, F (1, 57) = 2.26, MSE = 14.20, p = .138, η^2 = .04.

Item Gains and Losses

Because there were different levels of recall for emotional and neutral words, I calculated the gain and loss measures as a proportion relative to the number of items of each type recalled on test 1 (Burns, 1993). A 2 (type: gain, loss) X 2 (valence: emotional, neutral) repeated-measures ANOVA performaned on the proportion of items gained or lost on test 2 resulted in a marginally significant main effect of type, F (1, 57) = 3.62, MSE = .016, p = .062, η^2 = .06. Overall, there was a higher proportion of items lost than items gained on test 2, as can be seen in Figure 2. Contrary to predictions, there was no main effect of valence, F (1, 57) = .028, MSE = .01, p = .868, η^2 = .0004, nor did the interaction reach significance, F (1, 57) = 1.32, MSE = .019, p = .26, η^2 = .02. The fact that there were not more item gains for emotional items fails to support the item-specific hypothesis. However, these findings also do not support the semantic

cohesion explanation of emotional memory enhancement; emotional items did not receive more relational processing than neutral items, as reflected by the item loss measure.

It is possible that significant differences in gains and losses between emotional and neutral words failed to emerge because the measures were not sensitive enough to detect these differences. The item gains measure, for example, is only effective if memory is not exhausted in the first recall phase (Klein, et al., 1989). Because many emotional items were retrieved initially, there may not have been room for emotional item gains. In other words, perhaps because emotional words were highly accessible on the first recall test, item gains did not emerge in the second recall test.

Semantic Clustering by Valence

Semantic clustering is often used as a measure of relational processing (Einstein & Hunt, 1980; Klein, et al., 1989). I calculated an Adjusted Ratio of Clustering (ARC; Roenker, Thompson, & Brown, 1971) score for each subject using the categories "emotional" and "neutral." The ARC score reflects a measure of categorical cohesion; specifically, it is the proportion of actual category repetitions above chance to the total possibly category repetitions above chance. ARC scores were not significantly different from zero on the first test, t (57) = .74, p = .47, d = .1. This finding converges with the results from the item loss analysis presented above; participants were not engaged in significant relational processing during encoding, thus their recall was not clustered into the categories of "emotional" and "neutral." These results further argue against the semantic cohesion explanation of emotional memory enhancement.

EXPERIMENT 2

In my second experiment, I manipulated whether participants engaged in relational or item-specific processing and examined the effects on memory for emotional and neutral words. Previous research has found an interaction between orienting instructions and materials (related vs. unrelated items) such that recall is enhanced when the two complement each other compared to when they are redundant (Einstein & Hunt, 1980; Hunt & Einstein, 1981). In other words, recall is best when participants engage in both item-specific and relational processing. To the extent that one type of processing is automatically encouraged by the items themselves, recall will be best when the orienting task directs attention to the opposite type of information. Following this line of reasoning, I made three specific predictions. First, I predicted that the recall difference between emotional and neutral materials would be larger in the control condition compared to the rate condition. In the rate condition, the orienting task would be redundant with the item-specific processing automatically induced by emotional materials and so memory for emotional words should be the same in the control and rate conditions; neutral items, however, may benefit from the rating task, resulting in better memory for neutral words in the rate compared to control condition. Second, I predicted that the difference between memory for emotional and neutral words would be larger in the sort condition compared to the rate condition. In the sort condition, emotional words should receive both spontaneous item-specific processing and relational processing induced by the orienting task whereas neutral items would receive only relational processing. Thus, there should be a memory advantage for emotional words in the sort condition, but not the rate condition. Finally, I predicted that the memory difference between emotional and neutral words would be smaller in the both condition compared to the sort condition. In the both condition, emotional and neutral words would receive both item-specific and relational processing and therefore memory should be equivalent for emotional and neutral words.

Method

Participants and Design

One hundred twenty undergraduates enrolled in an introductory psychology course at Florida State University participated in exchange for partial course credit. All participants were tested individually. The current experiment employed a 4 (orienting task: rate, sort, both, control) X 2 (valence: emotional, neutral) mixed measures design. Participants were randomly assigned

to one of four between-subjects conditions. Valence was manipulated within-subjects; all participants were presented with both emotional and neutral words.

Materials

A full list of materials can be found in Appendix B.

Practice. Six nouns were selected from the ANEW (Bradley & Lang, 1999) to be used in the practice phase; three were neutral and three were negative. Additionally, each word was chosen from a different one of the six ad-hoc categories described below.

Words. Forty-four nouns were chosen from the ANEW (Bradley & Lang, 1999); half were neutral (M = 5.19 on ANEW's scale from 1 [unpleasant] to 9 [pleasant]) and half were negative (M = 2.45). Negative and neutral word sets were equated for frequency (Kuçera & Francis, 1967; M = 24.95 for negative, M = 31.7 for neutral), length (M = 5.6 for negative, M = 5.8 for neutral), and concreteness (Nelson, et all, 1998; Friendly, et al., 1982; M = 5.0 for both).

For the sorting task, these target words were placed into six ad-hoc categories. These categories were: things that contain people or items, things that affect relationships, things you find in a medical textbook, things that can make noise, things in nature, and things related to a trip to a store. Four of the categories were made up of eight items each and the two remaining categories contained six items each. All categories contained an equal number of emotional and neutral words.

Study list. Words were organized into a pseudorandomized blocked list such that two members of the same category were never adjacent. Additionally, no more than two words of the same valence appeared next to each other. This list order was held constant for all participants in all orienting conditions.

Procedure

After receiving the instructions, but before beginning the experimental trials, each participant completed six practice trials to familiarize them with their assigned orienting task. Once the practice trials were complete and any questions had been addressed, participants began the experimental trials.

Orienting phase. Participants first completed one of four orienting tasks, depending on the condition to which they were assigned. In the rate condition, each word appeared on the screen for 6 s; participants were instructed to rate the words for pleasantness on a scale from 1 (unpleasant) to 5 (pleasant). Participants in the sort condition were instructed to sort each word

into one of six categories. They were told that some words could fit into more than one category, but that they should assign the words to the category that they thought fit best. The six categories were displayed below the target word on the screen, along with the corresponding response for that category (1 for containters, 2 for relationships, and so on). Each word was displayed for 6 s, during which time the participants pressed a number key to designate the category to which they wished to assign the word. Participants in the both condition completed both the rating and the sorting tasks for each word. They first rated the word for pleasantness; then, the same word appeared again and they sorted it into the appropriate category before moving on to the next word. They had a total of 6 s to complete both of the tasks, 3 s for the pleasantness rating and 3 s for the category sorting. Lastly, participants in the control condition studied each word such that they would later be able to recall it on their own; each word was presented for 6 s.

Test phase. After the orienting phase, participants completed a free recall memory test. They were told to type in as many of the words as they could remember from the orienting phase. They were given as much time as they needed to do so.

Results and Discussion

Semantic Clustering by Category

I again calculated ARC scores (Roenker, et al., 1971) as a measure of relational processing. For each participant in the sort and both conditions, I calculated ARC scores using the category information from their orienting task; each participant's individual sorting was the criteria used to judge their categorical clustering. The clustering of participants in the control and rate conditions was calculated based on the "ideal" category membership listed in Appendix B; because they never engaged in the sorting task, they had no individual sorting of the items against which to score their clustering. Overall, there were in fact differencecs among the four conditions in the amount of categorical clustering, F (1, 116) = 4.48, MSE = .076, $p < .01$, η^2 = .10. Follow up tests revealed that, as expected, clustering was higher in the sort condition than in either the control, F (1, 58) = 7.14, MSE = .09, $p < .05$, η^2 = .11, or rate, F (1, 58) = 3.01, MSE = .072, p = .088, η^2 = .05, conditions; clustering in the both condition was also higher than that in the control, F (1, 58) = 9.68, MSE = .08, $p < .01$, η^2 = .14, and rate, F (1, 58) = 4.74, MSE = .06, $p < .05$, η^2 = .08, conditions. Additionally, ARC scores were significantly different from zero only in the sort, t (29) = 3.34, $p < .01$, d = .59, and both, t (29) = 4.13, $p < .001$, d = .75,

conditions. These findings suggest that the orienting tasks that were designed to induce relational processing did, in fact, do so.

Recall

For each participant, I calculated the percentage of emotional and neutral words recalled. The mean recall levels in all conditions can be found in Figure 3. I analyzed the recall scores as a series of planned two-way interactions, based on my predictions that emotional words would receive item-specific processing automatically, regardless of orienting task. A 2 (condition: control, rate) X 2 (valence: emotional, neutral) mixed measures ANOVA revealed a significant main effect of valence, F (1, 58) = 60.81, MSE = 61.18, $p < .001$, $\eta^2 = .51$; across conditions, emotional words were recalled better than neutral words (see Figure 4). There was also a marginal effect of condition, F (1, 58) = 2.67, MSE = 181.20, $p = .108$, $\eta^2 = .04$, such that participants in the control condition recalled more words overall than participants in the rate condition. The predicted interaction between valence and condition did not reach significance, $F < 1$. One possibility for this null finding is that rating the pleasantness of emotional and neutral items is easier than rating the pleasantness of neutral items alone. If rating pleasantness of a mixed list of emotional and neutral words does not require participants to think deeply about each item, it may not be an effective item-specific orienting task under those conditions. I will address this possibility further in the General Discussion.

A 2 (condition: rate, sort) X 2 (valence: emotional, neutral) mixed measures ANOVA revealed a main effect of valence, F (1, 58) = 22.61, MSE = 88.81, $p < .001$, $\eta^2 = .28$. Figure 5 illustrates that emotional words were better recalled than neutral words in both the rate and sort conditions. There was also a main effect of condition, F (1, 58) = 5.22, MSE = 171.02, $p < .05$, $\eta^2 = .08$, such that participants in the sort condition recalled more words overall than those in the rate condition. This main effect of condition appeared to be driven by neutral words; however, the two-way interaction was not significant, F (1, 58) = 1.74, MSE = 88.81, $p = .192$, $\eta^2 = .03$.

Lastly, a 2 (condition: sort, both) X 2 (valence: emotional, neutral) mixed measures ANOVA revealed only a main effect of valence, F (1, 58) = 20.24, MSE = 73.55, $p < .001$, $\eta^2 = .26$; as in all other conditions, emotional words were better recalled than neutral words (see Figure 6). Neither the main effect of condition, F (1, 58) = 1.55, MSE = 206.26, $p = .219$, $\eta^2 = .03$, nor the interaction, $F < 1$, reached significance. Again, it is possible that this lack of an effect is due to the ineffectiveness of the pleasantness rating component in the both condition.

GENERAL DISCUSSION

Experiment 1 found no support for the semantic cohesion hypothesis that emotional words receive more spontaneous relational processing than neutral words; however, there was also no support for the item-specific hypothesis. There were no significant differences between emotional and neutral words in either item-specific processing, as measured by item gains across multiple tests, or relational processing, as measured by item losses across tests. Additionally, Experiment 1 revealed no significant clustering by valence, as would have been expected if emotional and neutral words were perceived as independent categories. These findings replicate Zimmerman and Kelley's (2008) findings of no enhanced relational processing of emotional items, as indexed by both cued recall and ARC scores. However, the failure to find differences in item gains and losses may be at least in part due to limitations in the gain and loss measures themselves. For example, according to Burns (2006), item losses may not accurately index relational processing when the variables assumed to affect relational processing (in this case, valence) are manipulated within-subjects, although it remains unclear exactly why this is the case.

In Experiment 2, the three predicted interactions between valence and orienting condition did not emerge. One issue that may help explain these null findings involves the timing in the both condition. It is possible that participants in this condition were unable to engage in effective item-specific and relational processing because they had only 3 s for each task, compared to the 6 s for participants in the individual rate and sort conditions. To test whether the pattern of results would be different if participants in the both condition had more time, I extended the task time to 12 s total for all conditions, thereby giving participants in the both condition 6 s to complete each task. Data from 14 participants revealed that, indeed, when participants had 12 s to make their rate and sort responses, memory in the both condition was better overall than memory in all other conditions, as would be expected. However, the predicted interactions between valence and orienting condition were still not significant, possibly due to low power. However, as before, there was a main effect of valence such that emotional words were better recalled than neutral words across all conditions.

Another potential explanation for why the predicted interactions failed to reach significance involves the rating task; it is possible that the pleasantness rating did not induce the level of item-specific processing necessary for differences between emotional and neutral words

to be observed. In past experiments manipulating item-specific and relational processing, pleasantness rating has often been used to induce item-specific processing (Burns, 1993; Einstein & Hunt, 2980; Hunt & Einstein, 1981; Klein, et al., 1989). In a list of neutral words, because no word is obviously pleasant or unpleasant, pleasantness rating requires particpants to think about each item carefully in order to make their ratings. I thought it plausible that pleasantness rating would be an effective item-specific task in a mixed list of emotional and neutral words because, on one level, assessing the pleasantness of negative items relative to one another may require quite fine distinctions. Indeed, according to the ANEW (Bradley & Lang, 1999), the range of pleasantness ratings was larger for the set of negative words in Experiment 2 (range = 2.25 on a 9-point scale) than for neutral words (range = 1.48), suggesting that there was more room for variability in the rate responses for negative words. However, ratings from participants in the rate and both conditions had a smaller range for negative (range = 2.77) than for neutral (range = 3.5) words. Thus, based on the results from Experiment 2, it seems that there was less variability in the ratings of negative words; participants were limited to the lower end of the scale and so were able to make pleasantness judgments without considering finer distinctions. Therefore, pleasantness rating may not be a valid task to induce item-specific processing with mixed lists of emotionally valenced materials.

To futher examine the effectiveness of the rating task, I compared recognition memory, a measure of item-specific processing (Burns, 2006; Burns, 1993; Engelkamp, Biegelmann, & McDaniel, 1998; Hodge & Otani, 1996; Hunt & Einstein, 1981), for a separate set of 24 participants run in the four orienting task conditions. As I predicted, participants who took a recognition test rather than a recall test did not have better corrected recognition memory (proportion of hits minus false alarms) in the rate condition (M = .36) compared to the sort condition (M = .42); this finding would seem to indicate that the pleasantness rating condition was not effective at inducing item-specific processing. One promising finding that emerged, however, was higher recognition memory for emotional words (M = .36) compared to neutral words (M = .33) in the control condition. This seems to suggest that emotional words may in fact receive more spontaneous item-specific processing than neutral words, as originally hypothesized.

The purpose of the current experiments was to explore two possible explanations of emotional memory enhancement. Although many researchers have documented this effect, few

have offered detailed demonstrations of how or why it occurs. The current experiments tested the item-specific hypothesis that emotional items induce item-specific processing automatically and receive little relational processing, as well as the semantic cohesion hypothesis that emotional words receive more spontaneous relational processing than neutral words. Although I found no evidence of enhanced item-specific processing for emotional materials, I also did not find evidence of more relational processing of emotional materials. One possible conclusion from these findings is that differential item-specific and relational processing do not account for the observed memory advantage of emotional over neutral materials. It is entirely possible that researchers should turn to other memory constructs in order to account for emotional memory enhancement.

One potential candidate is survival processing (Nairne, Thompson, & Pandeirada, 2007). Perhaps emotional words elicit thoughts about survival relevance, which Nairne and colleagues have shown enhances memory relative to other encoding tasks suchs as pleasantness rating and self-referential encoding. This evolutionary explanation that nature has "tuned" the memory system to remember survival relevant information may be one tool that proves useful in exploring the mechanisms behind emotional memory enhancement. However, the precise mechanism by which memory for survival-related information is enhanced is not specified.

In spite of the lack of evidence for the item-specific hypothesis in the two experiments presented here, I believe that enhanced item-specific processing is still a viable explanation for emotional memory enhancement. This explanation fits with previous data from my lab showing enhanced item recall and impaired cued recall (Zimmerman & Kelley, 2008), as well as with other findings showing enhanced recognition for emotional compared to neutral materials (Ochsner, 2000). The item-specific hypothesis is also consistent with a pilot study conducted in our lab in which three participants gave think-aloud protocols while encoding emotional and neutral word pairs; a task analysis of the encoding strategies revealed that participants engaged in significantly less relational processing for emotional versus neutral pairs. Finally, the idea that emotional words spontaneously evoke item-specific processing is also consistent with the item-order account recently proposed by McDaniel & Bugg (2008). These authors suggest that "unusual" items (self-generated, bizarre, or low frequency words) induce substantially more item elaboration, or item-specific processing, than "common" items, but disrupt people's encoding of serial order, which represents one type of relational processing, in a free recall paradigm. This

idea closely parallels the item-specific account of emotional memory enhancement in which emotional items are presumed to elicit spontaneous item-specific processing to the detriment of relational processing and fits with the idea that emotional items draw attention at the expense of relational information (Mather, 2007).

The methodological limitations of the current studies, such as the inefficiency of the pleasantness rating task in Experiment 2, make drawing definitive conclusions about the validity of the item-specific hypothesis difficult. One line of future research will use cumulative recall scores (Bousfield & Sedgewick, 1944) to further examine the possibility of differential item-specific and relational processing of emotional and neutral words. The shape of cumulative recall scores has been shown to differ depending on whether items are encoded in item-specific or relational orienting tasks (Burns & Hebert, 2004; Burns & Schoff, 1998). Specifically, cumulative recall curves for words that receive item-specific processing show lower initial recall and approach asymptote more slowly compared to curves for words that receive relational processing. If the item-specific hypothesis is correct and emotional words do in fact induce item-specific processing automatically, then cumulative recall curves for emotional words should approach asymptote more slowly than those for related neutral words, which spontaneously elicit relational processing.

Additionally, future research will compare memory for emotional and neutral words in mixed versus pure lists. McDaniel and Bugg's (2008) item-order account, which closely relates to the item-specific hypothesis, makes specific predictions about memory for unusual materials in pure compared to mixed lists. Specifically, in mixed lists of unusual and common words, unusual words may benefit from greater item-specific processing, but will disrupt serial order information thay normally aids memory for neutral words. In pure lists, however, unusual words show enhanced item-specific processing, but common words show enhanced relational processing that allows serial order to be used in recall; the balance of the two effects can lead to roughly comparable memory in pure unusual compared to pure common lists. Future research will extend this approach to examine memory for emotional and neutral words in mixed and pure lists; additionally, because word valence will be manipulated between-subjects, this paradigm will also allow for the accurate measurement of item gains and losses for emotional and neutral words. In fact, the item-order hypothesis may account for why I did not find fewer losses for neutral words compared to emotional words in Experiment 1. The relational processing of the

neutral words may have been disrupted by the intermixed emotional words to the same extent that the spontaneous item-specific processing of the emotional words precluded relational procsesing of these words; thus there was a similar lack of relational information (reflected in equivalent item losses) for both emotional and neutral items.

In conclusion, although the current experiments did not provide support for the item-specific hypothesis of emotional memory enhancement, there are a number of potentially promising avenues of research to be explored before this approach should be abandoned. In general, research in the domain of memory and emotion is particularly important because it has implications for episodic and autobiographical memory. Common experience shows us that emotional events make up a significant portion of our life memories. Indeed, the relationship between memory and emotion is so ubiquitous that it is an integral part of people's naïve theories about memory (Magnussen, et al., 2006). In addition to being an essential element of basic memory research, the impact of emotion on memory also has many applied facets; for example, an important issue for the area of eyewitness testimony is how arousal or emotion impacts witness' memory for crimes. More specifically, studies such as those discussed herein address the processes underlying emotional memory enhancement. Research has demonstrated that a memory benefit exists for emotional compared to neutral materials, but a unified explanation as to why this effect occurs remains elusive. Indeed, it will be impossible to fully understand the effects of emotion on memory without understanding why such effects occur, which is ultimately the goal of current and future research on the item-specific hypothesis.

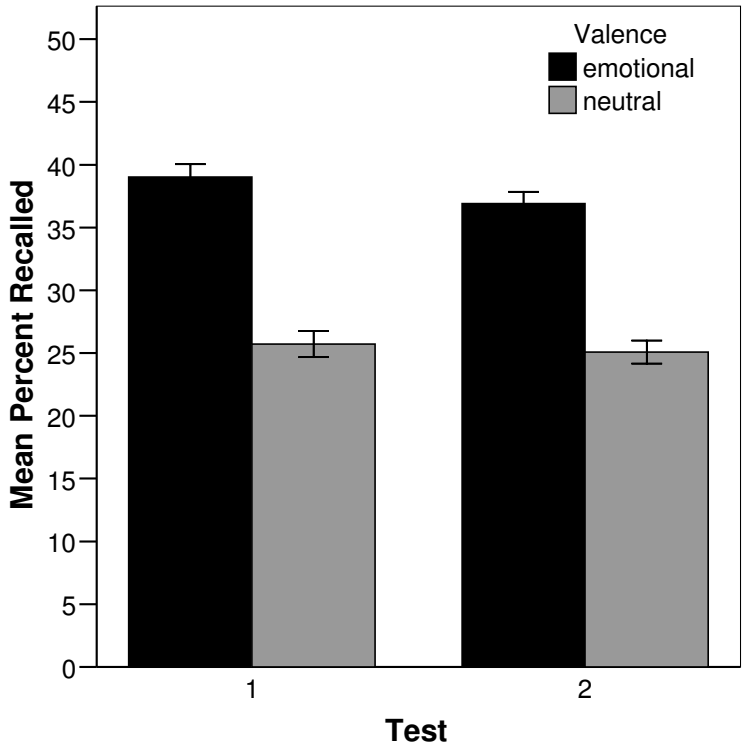

Figure 1. *Graph of recall in Experiment 1. Mean percentage of words recalled as a function of word valence and test.*

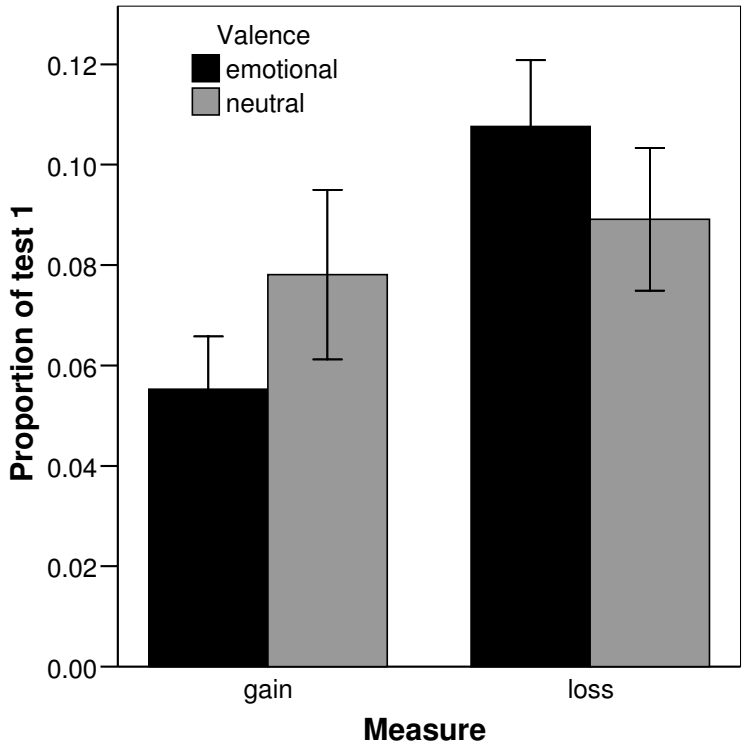

Figure 2. *Graph of item gains and losses in Experiment 1. Mean gains and losses as a proportion of recall on test 1 for emotional and neutral words.*

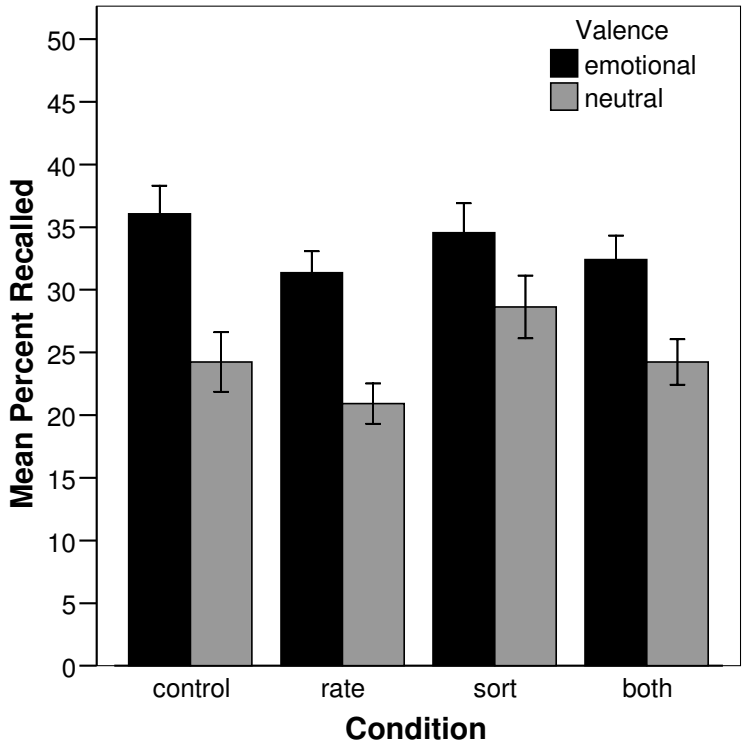

Figure 3. *Graph of overall recall in Experiment 2. Mean percentage of words recalled as a function of word valence and condition.*

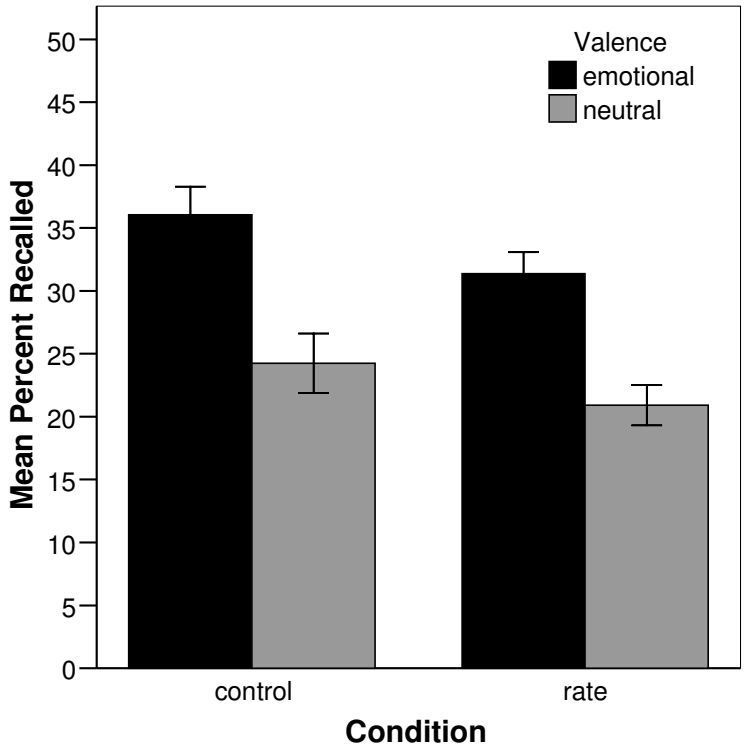

Figure 4. *Graph of recall in the control and rate conditions in Experiment 2. Mean percentage of words recalled as a function of condition and word valence.*

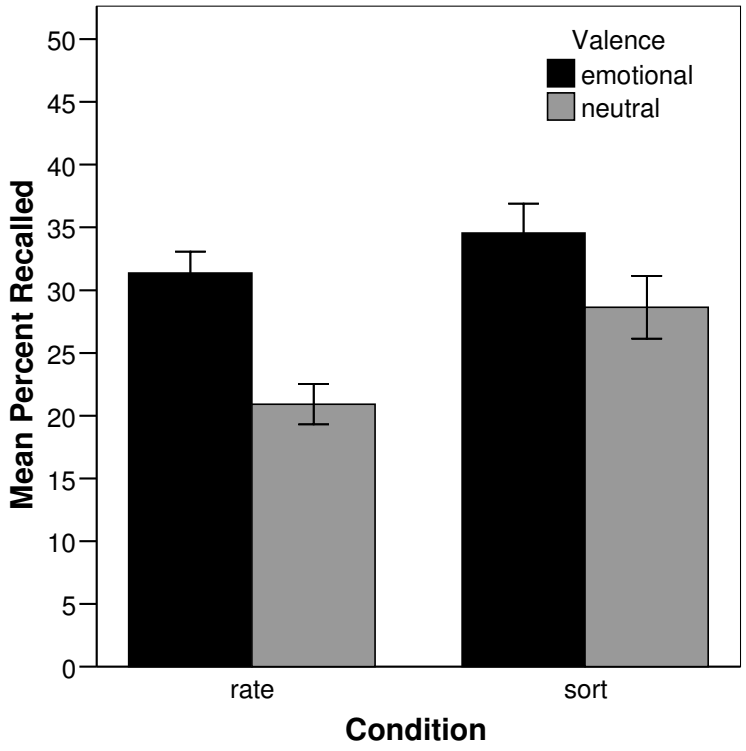

Figure 5. *Graph of recall in the rate and sort conditions in Experiment 2. Mean percentage of words recalled as a function of condition and word valence.*

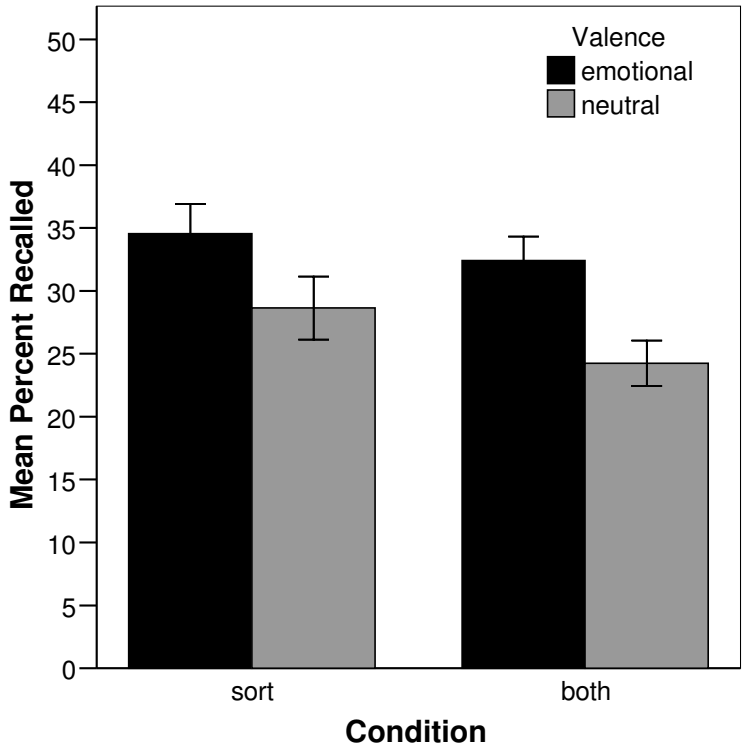

Figure 6. *Graph of recall in the sort and both conditions in Experiment 2. Mean percentage of words recalled as a function of condition and word valence.*

APPENDIX A: EXPERIMENT 1 MATERIALS

Table 1: Experiment 1 Materials.

Valence	Word
Emotional	Abuse
Emotional	Accident
Emotional	Ache
Emotional	Bees
Emotional	Bomb
Emotional	Bullets
Emotional	Burn
Emotional	Cancer
Emotional	Coffin
Emotional	Debt
Emotional	Disaster
Emotional	Divorce
Emotional	Flood
Emotional	Fungus
Emotional	Infection
Emotional	Knife
Emotional	Lie
Emotional	Poison
Emotional	Poverty
Emotional	Prison
Emotional	Stress
Emotional	Tobacco
Neutral	Basket
Neutral	Butter
Neutral	Cannon
Neutral	Cliff
Neutral	Coast
Neutral	Context
Neutral	Cork
Neutral	Detail
Neutral	Errand
Neutral	Excucse
Neutral	Gender
Neutral	Kettle
Neutral	Key
Neutral	Knot
Neutral	Lawn
Neutral	Paint
Neutral	Passage
Neutral	Shadow
Neutral	Theory
Neutral	Tools

Table 1, continued.

Valence	Word
Neutral	Trunk
Neutral	Violin

APPENDIX B: EXPERIMENT 2 MATERIALS

Table 2: Experiment 2 Materials.

Phase	Category	Valence	Word
Practice	Containers	Neutral	Cellar
Practice	Relationships	Emotional	Quarrel
Practice	Medical textbook	Emotional	Germs
Practice	Noise	Neutral	Rattle
Practice	Nature	Emotional	Spider
Practice	Trip to store	Neutral	Umbrella
Experiment	Containers	Emotional	Coffin
Experiment	Containers	Emotional	Dump
Experiment	Containers	Emotional	Prison
Experiment	Containers	Neutral	Basket
Experiment	Containers	Neutral	Cabinet
Experiment	Containers	Neutral	Trunk
Experiment	Relationships	Emotional	Abuse
Experiment	Relationships	Emotional	Divorce
Experiment	Relationships	Emotional	Poverty
Experiment	Relationships	Emotional	Stress
Experiment	Relationships	Neutral	Context
Experiment	Relationships	Neutral	Excuse
Experiment	Relationships	Neutral	Gender
Experiment	Relationships	Neutral	Privacy
Experiment	Medical textbook	Emotional	Ache
Experiment	Medical textbook	Emotional	Burn
Experiment	Medical textbook	Emotional	Cancer
Experiment	Medical textbook	Emotional	Poison
Experiment	Medical textbook	Neutral	Detail
Experiment	Medical textbook	Neutral	Passage
Experiment	Medical textbook	Neutral	Patient
Experiment	Medical textbook	Neutral	Theory
Experiment	Noise	Emotional	Accident
Experiment	Noise	Emotional	Bomb
Experiment	Noise	Emotional	Bullets
Experiment	Noise	Neutral	Cannon
Experiment	Noise	Neutral	Kettle
Experiment	Noise	Neutral	Violin
Experiment	Nature	Emotional	Bees
Experiment	Nature	Emotional	Disaster
Experiment	Nature	Emotional	Flood
Experiment	Nature	Emotional	Fungus
Experiment	Nature	Neutral	Cliff

Table 2, continued.

Phase	Category	Valence	Word
Experiment	Nature	Neutral	Coast
Experiment	Nature	Neutral	Lawn
Experiment	Nature	Neutral	Shadow
Experiment	Trip to store	Emotional	Cigar
Experiment	Trip to store	Emotional	Debt
Experiment	Trip to store	Emotional	Knife
Experiment	Trip to store	Emotional	Thief
Experiment	Trip to store	Neutral	Errand
Experiment	Trip to store	Neutral	Milk
Experiment	Trip to store	Neutral	Paint
Experiment	Trip to store	Neutral	Tools

APPENDIX C: IRB APPROVAL LETTER

Office of the Vice President For Research
Human Subjects Committee
Tallahasse, Florida 32306-2742
(850) 644-8673 . FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 9/27/2007

To: Carissa Zimmerman

Dept.: PSYCHOLOGY DEPARTMENT

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
Memory and Emotion

The application that you submitted to this office in regard to the use of human subjects in the research proposal referenced above has been reviewed by the Human Subjects Committee at its meeting on 9/12/2007 2:00:00 PM. Your project was approved by the Committee.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 9/10/2008 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted fot approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems of adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving

human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Colleen Kelley, Advisor
HSC No. 2007.657

APPENDIX D: INFORMED CONSENT FORM

INFORMED CONSENT FORM: MEMORY AND EMOTION

I freely and voluntarily consent to be a participant in the research project entitled "Memory and emotion." I have been informed that Dr. Colleen Kelley, an Associate Professor in the Department of Psychology at Florida State University, and Carissa Zimmerman, a graduate student in the Department of Psychology, have requested my participation in a research study at Florida State University.

The purpose of this research is to understand how emotion influences people's memory. My participation will involve studying either words or pictures, followed by a test of my memory for the material I have studied. The experiment will last between 30 minutes and 1 hour. My performance on the memory test will be confidential to the extent allowed by law. No individual results of the experiments will ever be reported.

I understand that some of the pictures I will see may be found disturbing or offensive by some people; I am free to end my participation at any time without prejudice, penalty, or loss of benefits to which I am otherwise entitled. That is, my grade in the course will not be affected if I choose to withdraw from the experiment, nor will I receive an experiment credit penalty. I will receive credit for the time I have participated.
If I am upset by these pictures, I understand that I may contact the University Counseling Center by phone at 850-644-2003 or online at http://counseling.fsu.edu/..

I may contact Dr. Kelley (644-3816) or Cari Zimmerman (zimmerman@psy.fsu.edu) if I have questions about this project. If I have any questions about my rights as a participant in this research, or if I feel I have been placed at risk, I can contact the Chair of the Human Subjects Committee, Institutional Review Board, through the Vice President for the Office of Research at 644-8633.

I have read and understand this consent form.

_____ _____

(participant) (date)

FSU Human Subjects Committee approved 9/12/2007. Void after 9/10/2008.
HSC#2007.738.

REFERENCES

Bousfield, W. A., & Sedgewick, C. H. W. (1944). An analysis of restricted associative responses. *Journal of General Psychology,* 30, 149-165.

Bradley, M. M., Greenwald, M. K., Petry, M. C., & Lang, P. J. (1992). Remembering pictures: Pleasure and arousal in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18*(2), 379-390.

Bradley, M. M., & Lang, P. J. (1999). *Affective norms for English words (ANEW): Instruction manual and affective ratings.* Technical Report C-1, The Center for Research in Psychophysiology, University of Florida.

Buchanan, T. W., Denburg, N. L., Tranel, D., & Adolphs, R. (2001). Verbal and nonverbal emotional memory following unilateral amygdala damage. *Learning and Memory, 8*, 326-335.

Burns, D. J. (1993). Item gains and losses during hypermnesic recall: Implications for the item-specific-relational information distinction. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19*(1), 163-173.

Burns, D. J. (2006). Assessing distinctiveness: Measures of item-specific and relational processing. In R. R. Hunt, & J. B. Worthen (Eds.), *Distinctiveness and memory* (pp. 109-130). New York: Oxford University Press.

Burns, D. J., & Hebert, T. (2005). Using cumulative-recall curves to assess the extend of relational and item-specific processing. *Memory, 13*(2), 189-199.

Burns, D. J., & Schoff, K. M. Slow and steady often ties the race: Effects of item-specific and relational processing on cumulative recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24*(4), 1041-1051.

Cahill, L., Haier, R. J., Fallon, J., Alkire, M. T., Tang, C., Keator, D., Wu, J., & McGaugh, J. L. (1996). Amygdala activation at encoding correlated with long-term free recall of emotional information. *Proceedings of the National Academy of Sciences of the United States of America, 93*(15), 8016-8021.

D'Argembeau, A., & Van Der Linden, M. (2005). Influence of emotion on memory for temporal information. *Emotion, 5*(4), 503-507.

Doerksen, S., & Shimamura, A. P. (2001). Source memory enhancement for emotional words. *Emotion, 1*(1), 5-11.

Einstein, G. O., & Hunt, R. R. (1980). Levels of processing and organization: Additive effects of individual-item and relational processing. *Journal of Experimental Psychology: Human Learning and Memory, 6*(5), 588-598.

Engelkamp, J., Biegelmann, U., & McDaniel, M. A. (1998). Relational and item-specific information: Trade-off and redundancy. *Memory, 6*(3), 307-333.

Franks, J. J., Bilbrey, C. W., Lien, K. G., & McNamara, T. P. (2000). Transfer-appropriate processing (TAP) and repetition priming. *Memory and Cognition, 28*(7), 1140-1151.

Friendly, M., Franklin, P. E., & Rubin, D. C. (1982). The Toronto Word Pool: Norms for imagery, concreteness, orthographic variables, and grammatical usage for 1080 words. *Behavior Research Methods and Instrumentation, 14*(4), 375-399.

Harris, C. R., & Pashler, H. (2005). Enhanced memory for negatively emotionally charged pictures without selective rumination. *Emotion, 5*(2), 191-199.

Hertel, P. T., & Parks, C. (2002). Emotional episodes facilitate word recall. *Cognition and Emotion, 16*(5), 685-694.

Hodge, M. H., & Otani, H. (1996). Beyond category sorting and pleasantness rating: Inducing relational and item-specific processing. *Memory and Cognition, 24*(1), 110-115.

Hunt, R. R., & Einstein, G. O. (1981). Relational and item-specific information in memory. *Journal of Verbal Learning and Behavior, 20*, 497-514.

Hunt, R. R., & McDaniel, M. A. (1993). The enigma of organization and distinctiveness. *Journal of Memory and Language, 32*, 421-445.

Kensinger, E. A., Brierley, B., Medford, N., Growdon, J. H., & Corkin, S. (2002). Effects of normal aging and Alzheimer's disease on emotional memory. *Emotion, 2*(2), 118-134.

Kensinger, E. A., & Corkin, S. (2003). Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words? *Memory and Cognition, 31*(8), 1169-1180.

Klein, S. B., Loftus, J., Kihlstrom, J. F., & Aseron, R. (1989). Effects of item-specific and relational processing on hypermnesic recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15*(6), 1192-1197.

Koriat, A., & Bjork, R. (2005). Illusions of competence in monitoring one's knowledge during study. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31*(2), 187-194.

Koriat, A., & Bjork, R. (2006a). Illusions of competence during study can be remedied by manipulations that enhance learners' sensitivity to retrieval conditions at test. *Memory and Cognition, 34*(5), 959-972.

Koriat, A., & Bjork, R. (2006b). Mending metacognitive illusions: A comparison of mnemonic-based and theory-based procedures. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 32*(5), 1133-1145.

Kuçera, H., & Francis, W. H. (1967). Computational analysis of present-day American English. Providence, RI: Brown University.

Landauer, T. K., Foltz, P. W., & Laham, D. (1998). Introduction to Latent Semantic Analysis. *Discourse Processes, 25*, 259-284.

Levinger, G., & Clark, J. (1961). Emotional factors in the forgetting of word associations. *Journal of Abnormal and Social Psychology, 62*(1), 99-105.

Magnussen, S., Andersson, J., Cornoldi, C., De Beni, R., Endestad, T., Goodman, G. S., Helstrup, T., Koriat, A., Larsson, M., Melinder, A., Nilsson, L., Rönnberg, J., & Zimmer, H. (2006). What people believe about memory. *Memory, 14*(5), 595-613.

Maratos, E. J., Allan, K., & Rugg, M. D. (2000). Recognition memory for emotionally negative and neutral words: An ERP study. *Neuropsychologia, 38*, 1452-1465.

Mather, M. (2007). Emotional arousal and memory binding: An object-based framework. *Perspectives in Psychological Science, 2*(1), 33-52.

Mather, M., & Nesmith, K. (2008). Arousal-enhanced location memory for pictures. *Journal of Memory and Language, 58*(2), 449-464.

McDaniel, M. A., & Bugg, J. M. (2008). Instability in memory phenomena: A common puzzle and a unifying explanation. *Psychonomic Bulletin and Review, 15*(2), 237-255.

Mitchell, K. J., Mather, M., Johnson, M. K., Raye, C. L., & Greene, E. J. (2006). A functional magnetic resonance imaging investigation of short-term source and item memory for negative pictures. *Neuroreport, 17*(14), 1543-1547.

Nagae, S., & Moscovitch, M. (2002). Cerebral hemispheric differences in memory of emotional and non-emotional words in normal individuals. *Neuropsychologia, 40*, 1601-1607.

Nairne, J. S., Thompson, S. R., & Pandeirada, J. N. S. (2007). Adaptive memory: Survival processing enhances retention. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33*(2), 263-273.

Nelson, D. L., McEvoy, C. L., & Schreiber, T. A. (1998). The University of South Florida word association, rhyme, and word fragment norms. http://www.usf.edu/FreeAssociation/.

Ochsner, K. N. (2000). Are affective experiences richly recollected or simply familiar? The experience and process of recognizing feelings past. *Journal of Experimental Psychology: General, 129*(2), 242-261.

Roenker, D. L., Thompson, C. P., & Brown, S. C. (1971). Comparison of measures for the estimation of clustering in free recall. *Psychological Bulletin, 76*(1), 45-48.

Rubin, D. C., & Friendly, M. (1986). Predicting which words get recalled: Measures of free recall, availability, goodness, emotionality, and pronounceability for 925 nouns. *Memory and Cognition, 14*(1), 79-94.

Talmi, D., Luk, B. T. K., McGarry, L. M., & Moscovitch, M. (2007). The contributions of relatedness and distinctiveness to emotionally-enhanced memory. *Journal of Memory and Language, 56*, 555-574.

Talmi, D., & Moscovitch, M. (2004). Can semantic relatedneses explain the enhancement of memory for emotional words? *Memory and Cognition, 32*(5), 742-751.

Wilson, M. D. (1988). The MRC psycholinguistic database: Machine readable directory version 2. *Behavioral Research Methods, Instruments and Computers, 20*, 6-11.

Zimmerman, C. A., & Kelley, C. M. (2008). When metacognition meets emotion: Monitoring memory for emotional events. Manuscript submitted for publication.

BIOGRAPHICAL SKETCH

Carissa Ann Zimmerman was born in Houston, Texas on September 28, 1982. She attended Trinity University, where she worked with Dr. Paula Hertel on an undergraduate thesis investigating the effects of emotional fluency on memory. At Trinity, she belonged to a number of academic honor societies, was a founding member of the Prowlers dance team, and served as the university mascot. In the spring of 2004, Carissa studied abroad in Granada, Spain where she immersed herself in the Andalusian language and culture. Carissa graduated Summa Cum Laude with her Bachelor of Arts in Psychology, with honors, and Spanish in 2005. The following fall, she relocated to Tallahassee, Florida to pursue her Ph.D. in Cognitive Psychology under the mentorship of Dr. Colleen Kelley. Her main research interests include metacognition and the effects of emotion on memory.

In her free time, Carissa enjoys reading novels, listening to Spanish music, traveling, and learning languages. Carissa also volunteers for a variety of organizations, including the Tallahassee-Leon community animal shelter; she is also a volunteer translator for both the International Children's Digital Library and the Brain Injury Association of Minnesota.