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Affective Image Recognition in Valanced Contexts

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AFFECTIVE IMAGE RECOGNITION IN VALANCED CONTEXTS

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This thesis is submitted in partial fulfillment of

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ABSTRACT

This study examined the effect of emotional image presentation context on recognition of target emotional images. Standardized valance ratings of images in the IAPS image database were used to divide 192 IAPS images into positive, negative, and neutral categories with 64 images each. Six streams of 8 positive, negative, or neutral context images were presented to participants at a rate of 250ms per picture. Four target images of positive or negative valance were embedded within each 8-image stream. Thirty seconds after each presentation stream, participants identified target images from among 8 novel distracter images of the same valance as the target images. Results indicated a significant effect of presentation context on both speed and accuracy. Images presented in negative contexts were significantly more accurately and more quickly recognized than images presented in positive contexts, regardless of target image valance. Negative images presented in negative contexts were significantly more accurately identified than negative images presented in positive contexts.

AFFECTIVE IMAGE RECOGNITION IN VALANCED CONTEXTS

INTRODUCTION

The impact of emotion on memory has been a subject of debate for many in the fields of psychology, communication, law, and neuroscience. Comparisons of memory for emotional and non-emotional stimuli, using a range of stimuli, tasks, measures, exposure rates, recall mechanisms, and retention paradigms, have helped define some of the areas in which emotion may help or hinder memory. With some exceptions, researchers tend to find that people have a better memory for emotional stimuli over neutral stimuli. There has been relatively little research, however, examining the effect of serial presentation of emotional stimuli, such as images, on recall of target stimuli. Does the serial presentation of emotional images act as a context? Does context valance, or emotional tone, have an effect on recall of target images?

The idea that visual stimuli provoke emotional and physiological responses in people, and these responses can be measured along a theoretical two-dimensional model of emotion, has been established by previous research. The exact mechanisms by which affective and arousing stimuli affect memory processes are still being determined. The primary investigation concerns differing predictions made by two major memory theories: the modal model (Atkinson & Shiffrin, 1968) and the network model (Collins & Loftus, 1975).

Research based on the modal model suggests that emotional images may have a greater emotional effect when presented sequentially, thereby creating a sort of emotional

emotional context of sustained affect. However, research based in this model offers no solid predictions of the effect of contextual valance on recognition of target images. Instead, this research suggests that emotional images with a negative emotional valance are remembered more accurately and more quickly than images with either positive or neutral valance, thereby suggesting a primary effect for valance but not context. In contrast, research based in the network model (with some notable exceptions) strongly suggests a contextual effect, indicating that recall for affective images will be enhanced by surrounding target images with congruently valanced context.

The present study was undertaken in order to clarify conflicting predictions from existing memory research in regards to emotional images and their context presentation, and furthermore, to investigate the impact of emotional context on image recognition.

Emotion

Wundt (1916) first characterized emotion as varying along two principal axes; valance, or the degree of pleasantness, and arousal, the intensity of the emotion. Although more recent researchers have developed multiple theories of emotion, these two factors remain a parsimonious model for defining emotion. Numerous studies support a two-factor model: for example, Osgood, Suci, and Tannenbaum (1957) used the semantic differential to demonstrate that pleasantness (valance) and intensity (arousal) accounted for much of the variability in judgments of emotional text. Russell (1980) proposed that these two dimensions may be thought of as defining a circumplex of emotion, with four quadrants placed 45° apart: Pleasantness, Excitement, Activation, and Distress. The two main dimensions remained Pleasantness (valance) and Activation (arousal). Watson and Tellegen (1985) extended Russell's circumplex model into a two-factor model of mood, consisting of positive and negative affect (valance) with either high or low activation (arousal). Whissel et al. (1986) conceived of a two-dimensional space defined by Evaluation of Pleasantness (valance) and Activation (arousal) as the best-fit model for emotional word ratings. In addition, Mandler (1992), conceived of emotions as possessing a cognitive or evaluative aspect (i.e, the degree to which something is good or bad) as well as a visceral gut reaction (the intensity of the felt emotion).

Although historical studies used in developing the two-factor model of emotion focused on mood state or language, Lang et al (1993) found strong support for the two-factor model of emotion when analyzing physiological reactions to images. Pleasantness ratings, heart rate, and facial muscles loaded on one factor, considered to correspond to the valance dimension, and arousal ratings, skin conductance, and cortical slow-wave electroencephalograph (EEG) ratings loaded on a second factor, considered to be the arousal dimension (Lang, Greenwald, Bradley, & Hamm, 1993). A large database of images, the International Affective Picture System (IAPS), has developed from this work (Lang, Bradley, & Cuthbert, 1999). The IAPS is a standardized image set with images gathered from a variety of sources and depicting a wide range of content and affective variability (for example images, see Appendix A). IAPS images have been rated on affective valance and arousal by thousands of participants; the results are plotted on a two-dimensional emotional space in figure 1.

Valance and Arousal. Although valance and arousal are generally considered two components of a larger category of emotion, it is worth investigating differential effects of the two factors. The main concern for the present study is examining how valance and arousal may be related, and how that relationship may affect memory. When valance and arousal ratings of IAPS images are plotted on a Cartesian plane, a boomerang shape appears (see figure 1), with two arms that reach towards the high-arousal, extreme valance areas of the quadrant. Similarly skewed results occur when plotting self-report data of mood states (Watson, Weise, Vaidya, & Tellegen, 1999), physiological reaction to emotional stimuli (Bradley, Codispoti, Cuthebert, & Lang, 2001), words in the English language (Russell, 1980), and the emotional meaning of stories (Smith & Ellsworth, 1985).

These studies results indicate a bipolar model of the pleasantness and arousal dimensions, in which opposite ends of both spectra are correlated -1.00, and valance and affect are orthogonal factors. This may not be the most parsimonious explanation. Tellegen, Watson, and Clark (1999) postulated that underlying an overall "Happiness vs. Sadness" conceptualization of emotion, there exist dimensions characterized by independent structures of positive and negative affect. Positive affect and negative affect are dimensions of mood state that include an arousal factor. Positive affect, for example, may be measured by items such as "excited" "alert", "joyful", "amazed", and negative affect by items such as "ashamed", "downhearted", and "discouraged"(Tellegen, Watson, & Clark, 1999). Conceptualizing emotion research in this way supports theoretical supposition that valance and arousal are not two separate, bimodal dimensions, but that they are inexorably intertwined. As viewed in the graph of the IAPS images, images evoking high PA and NA would be in the highly clustered upper right and upper left corners of the distribution, and images evoking low PA and NA would be clustered around the midpoint of both the arousal (4.83) and valance (5.00) scales.

This distribution pattern may have an evolutionary explanation. Lang et al. (1998) postulate that the affective and arousal evaluations participants give stimuli are based in our evolutionary history (Lang et al., 1998; Bradley, Codispoti, Cuthebert, and Lang, 2001). Stimuli which depict events that are threatening to survival, such as attack or disease images, and stimuli which are related to procreation or sustenance, such as erotic or food images, should produce higher arousal ratings than those images which are not directly tied to motivational states. As Lang (1998), and Bradley et al. (2001) theorize, physiological systems involved in attentional allocation, specifically cardiac orienting, electrodermal responding, and the visual system do show greater activity when people view pictures engaging appetitive or approach (erotica) and aversive or avoidant (threat) situations than neutral situations (Bradley, 2001; Bradley et al. 2003).

Watson, Weise, Vaidya, and Tellegen (1999) also support this approach-avoidance model of affective systems, however, rather than dividing their focus along valance and arousal dimensions, they examine mood states among their independent dimensions of positive affect (PA) and negative affect (NA). In their model, images could either evoke high positive affect (alert, active, excited) or low positive affect (sleepy, tired, sluggish), high negative affect (scared, nervous, jittery) or low negative affect (rested, calm, relaxed), depending on the image used. However, as images have not yet been rated using PA and NA, and regardless of the model used, images falling to the left and right of the median score for valance (5.00) and arousal (4.83) would still evoke separate systems and therefore separate cognitive processes, the two-factor model will be utilized in the current project with the awareness that other, discrete emotional states remain to be investigated in future work.

Due to the interrelated nature of arousal and affect, separating the two systems can be difficult in an experimental setting. Stimuli that evoke strong valance ratings, most often erotic images or threat scenes, also tend to provoke strong arousal reactions (Revelle & Loftus, 1992). Bradely, Greenwald, Petry, & Lang (1992) analyzed arousal and valance main effects on rating, free recall, and recognition memory in short- and long-term memory conditions. Arousal and valance both had significant effects on memory in short-term free-recall and recognition conditions. Analyzing each component separately, valance continued to have a small but significant main effect on recall, with pleasant and unpleasant slides recalled proportionately more often than neutral slides even in low-arousal conditions. In high-arousal conditions, valance was a less significant indicator of recall than arousal. At set periods after the initial testing, participants were contacted in a free-recall paradigm and asked which images they recalled. High-arousal images had better recall than low-arousal images for up to one year after testing (Bradley, Greenwald, Petry, & Lang, 1992).

Similarly, Kensinger and Corkin (2003) postulate that memory for arousing vs. neutral stimuli is driven by separate processes. Kensinger and Corkin propose that enhanced memory for arousing stimuli (words) is driven by a stress-hormone effect on the limbic system which activates the amygdala to modulate the hippocampus. In a study examining recall of affective words, Kensinger and Corkin (2003) found that with undivided attention (during a low-engagement, concurrent task) negative arousing and non-arousing words were recalled at similar rates when compared to neutral words. However, when attentional resources were divided during a high-engagement task, negatively valanced non-arousing words were recalled at a rate no different than the neutral words, while the negative arousing words continued to be recalled at a higher rate (Kensinger and Corkin, 2003).

Due to these studies demonstrating the effect of arousal on memory for valanced stimuli, Bradley et al. (2001) propose that much of the past research on affective memory may have been confounded by unintended arousal variations in stimuli. (see Bradley et al., 2001 for review; or Revelle and Loftus, 1992, for more on arousal and memory). Only by testing each component of stimuli separately can we hope to attain an accurate picture of memory processes.

Despite Bradley et al.'s concern, some researchers have been able to account for arousal confounds in their research, and examine valance as a unique distinguishing factor in image recognition. For example, Kensinger and Corkin (2003) examined the effect of negative and neutral stimuli on working memory performance, and found an inhibitory effect of negative stimuli on reaction time. This effect increased with the context of the cues: negative cues placed back-to-back inhibited reaction times significantly when compared to neutral cues. This suggests that negative images, specifically, will have a unique effect on reaction times independent of contextual factors. In addition to recall data, neuroimaging data collected during this experiment showed activation in the pre-frontal cortex for valanced words compared to neutral words. Therefore, Kensinger and Corkin (2003) postulate that non-arousing negative words enhance memory independent of arousal levels. Additionally, Bradley, Codispotti, Cuthbert, and Lang (2001) found greatest physiological response patterns for aversive images (i.e. high negative valance and high arousal) compared to appetitive images (high positive valance, high arousal), although both sets of emotional images were more arousing than neutral images.

Taking into account the concern for separating arousal and affect, the question still remains: do serially presented images have a contextual effect? That is, do images presented form a set based on image valance? As the definition of context is dependent on memory, and because two models of memory suggest quite different contextual effects, in order to discuss the potential of emotional images to form a sort of recognizable context a greater understanding of the modal model and the network model of memory is required.

Memory

Modal Model. The *modal model*, or the stage theory, was developed by Waugh and Norman (1965) and later expanded by Atkinson and Shiffrin (1968). The modal model is characterized by discrete periods during which information is recognized, encoded, and stored for later retrieval. According to the modal model, the process of memory can be organized (in order of occurrence) into sensory memory, which is a brief recognition and categorization of stimuli, short-term memory, where stimuli are processed and retained for cognition, and long-term memory, where stimuli are retained and stored for long-term use.

Sensory memory is the primitive, brief memory of an item the second it hits our senses. Sensory memory is very short, and occurs in the first 500ms of stimulus exposure for visual input (Jiang, Olson, & Chun, 2000). In regards to image recognition, sensory memory may be referred to as visual short-term memory (VSTM). VSTM was defined by Potter (1975) who demonstrated that images viewed for as brief a time period as 125ms could be accurately recognized using a cued recall paradigm when the cued recall occurred within 0-30s of initial exposure. VSTM has a limited storage capacity of about four objects or six spatial locations (Jiang, Olson, & Chung, 2000). Typically, studies in VSTM research include contrast, distinguishing features, orientation, hue, and spatial location as distinguishing characteristics of stimuli.

Recent studies indicate that emotional intensity may also qualify as a VSTM cue. For example, using a rapid serial visual presentation (RSVP) technique, in which images are presented on screen for brief intervals with no inter-stimulus-interval, Maljkovic and Martini (2005) determined that specific short-term memory encoding was different for emotional versus neutral pictures. Maljkovic and Martini (2005) further state that different results for valance, independent of arousal, are specifically related to VSTM processes. Memory for negative images had an increasing hazard rate (the probability that a previously viewed image will be correctly recalled if seen for an extra increment of time), whereas neutral and positive images had a constant hazard rate. Maljkovic and Martini (2005) suggest that negative images therefore are processed more intelligently than neutral or positive images. This difference is greatest in the first 500ms of exposure.

In the modal model, after an image passes out of sensory memory, sensory input is quickly analyzed and moves to short-term memory (STM). Once moved to short term memory, the brain works on the information to categorize and analyze it. Research investigating the emotional impact of images on short term memory has been mixed. Controversy centers on the timing of the amygdalar modulation on the hippocampus. Bianchin, Mello e Souza, Medina, and Izquierdo, (1999) found the influence of the amygdala occurs specifically in long term memory and not short term memory. Taylor, Liberzon, Fig, Decker, & Minoshima (1998) found the amygdala was indeed active while participants viewed stimuli with strong negative emotionality, although increased activation in the amygdala did not lead to increased stimuli recall. These results corroborated research by Hamann et al (1999) indicating that the amygdalar activation during viewing an emotional image had no impact on short-term recall. Therefore, an *encoding* and *consolidation* theory of emotional memory gained attention: the amygdala was implicated solely in the encoding period of emotional memory, and not the consolidation period (Hamann et al, 1999).

Further studies have shown that the amygdala is active in enhancing both encoding and consolidation of emotional stimuli, even during a short time frame. Kensinger and Corkin (2003) found that activation in the amygdala resulted in modulation of the hippocampal function, as well as increased recall of emotional as compared to neutral stimuli, within a short-term paradigm. In addition, Hamann and Mao (2001) found increased recall for emotional words versus neutral words in a short (<15 min) term paradigm. Therefore, the consolidation theory of emotional memory is currently being revised. Regardless of the exact neuronal mechanisms responsible, it does seem as though emotional stimuli have a unique effect on STM when compared to neutral stimuli.

Although the present study focuses on sensory memory rather than short term memory, three factors of STM that may be relevant for this study include the *attentional blink effect, order effects,* such as *primacy* and *recency effects,* and *rumination effects.*

The attentional blink effect is seen in RSVP studies in which stimuli are presented at a rapid rate with an inter-stimulus onset asynchrony rate between 100 and 500ms. The attentional blink occurs when presentation of an initial target (T1) has an effect on the recall of a second target presented subsequently (T2) (Anderson & Phelps, 2001). However, valance may mitigate the effect of the attentional blink; Anderson and Phelps (2001) found no effect of the attentional blink when presenting negative words in an RSVP task. Although Maljkovic and Martini (2005) also found no evidence of attentional blink in their study of affective images, in order to address any potential attentional blink issues they recommend presenting images for 250ms or longer during RSVP tasks.

Order effects originate in the idea that VSTM and STM are limited in the amount they can hold, and therefore presentation order effects can be observed. Participants asked to recall lists of items utilizing STM are most likely to remember the first few items on a list, known as the *primacy effect*, and the last few items on the list, known as the *recency effect* (Baddeley & Hitch, 1977). Testing for order effects in VSTM, however, Maljkovic and Martini (2005) found no evidence of serial position effects when using affective images in an RSVP procedure. To accommodate potential order effects, random presentation orders of stimuli within each image stream are required in order to determine order-independent effects. In addition, target images may neither be placed in the first or last position of the image stream.

It has been proposed that memory for emotional images could be enhanced due to rumination effects in STM rather than the emotional intensity of the image. In order to test rumination effects on short term memory for emotional images, Harris and Pashler (2005) conducted a series of studies. The researchers had participants sit at a computer and complete a series of difficult mathematical problems. Without warning, in the midst of the mathematical presentation, blocks of 10 neutral images and 1 emotional image would appear on the screen. Immediately after image presentation the mathematical operations resumed, thereby mitigating rehearsal possibilities. Controlling for presentation rate and order effects, emotional images were recalled significantly more accurately than neutral images in a free-recall task. Based on these results, Harris and Pashler theorize that emotional images are stored differently than neutral images, regardless of rumination effects. Therefore, rumination effects will not be analyzed in this study.

In conclusion, differential encoding and retrieval for emotional images in the modal theory of memory has been shown to occur in VSTM or STM, and seems to occur, with sufficient controls enacted, despite potential confounds of attentional blink, repetition and order effects.

Context and the Modal Model. The modal model does not indicate the importance of surrounding images, or context images, in the retention of emotional images in short term memory. However, supporting the idea that affective images can constitute an emotional context, the cumulative physiological effect of affective pictures presented in blocks is greater than the effect of one alone. Smith, Bradley, and Lang (2005) examined participants' startle reflex with a loud sound while participants viewed blocks of positive, negative, and neutral images. Participants' startle reflex was positively correlated with increased numbers of negatively valanced images presented. In addition, corrugator EMG activity (frown muscles) increased as more unpleasant images were presented, and zygomatic EMG activity (smile muscles) increased as more pleasant images were shown.

Such work would suggest that there is a measurable short term effect of emotional eligible state induction which carries over from one picture to the next. However, the research conducted in line with this model does not indicate the potential effects of this induction, beyond suggesting a differential pattern of response for emotional images versus neutral images, and specifically, a faster pattern of response for negative images versus positive and neutral images. Therefore, this model predicts the reaction times (RT) for negative images will be faster than those for positive and neutral images, regardless of presentation context. This pattern of results would indicate that target valance, not context valance, is the primary indicator of recognition. The modal model, however, is not the sole memory model with implications for context effects.

The Associative Network Model. The associative network model (Collins & Loftus, 1975) may help explain contextual memory effects better than the modal model. The network model suggests that information in memory is stored in the form of networks of connections, or nodes. The activation of a particular node spreads to semantically related nodes, thereby facilitating the processing of and recall for semantically related stimuli. This model suggests that the more connections to a single node; the more likely it is to be remembered. This allows for a discussion of semantic priming effects, or the effects that semantically related stimuli may have on the recognition of target stimuli.

Semantic priming effects describe the finding that participants are faster at responding to meaningful target words when the words are presented with a semantically relevant prime (e.g. *bird-beak*) than an unrelated prime (e.g. *bird-car*). This reasoning can be applied to affective stimuli, in that the activation of a particular node (e.g. *pleasant*) may facilitate processing of similar nodes. For example, response to positive images may be facilitated by including the target image only after several images of the same valance. However, there may also be an interference effect, in that activation of a particular node may negatively impact activation of an unrelated node (e.g. *pleasant-unpleasant, pleasant-neutral*), thereby decreasing reaction times for images places in semantically different contexts.

Further supporting the supposition that presentation context has an impact on recognition, Gawronski, Deutsch, and Seidel (2005) found that context primes (preceding subliminal primes of either similar or dissimilar valances) had the greatest effect on evaluation of target stimuli when dissimilarly valanced (i.e. primary image was positive, secondary image was negative, and the target image was either positive or negative) Participants were quickest to respond to affective words when the secondary prime and target were of the same valance, and the primary was different. This suggests that although responses to affective primes may be instinctual and automatic, they may still be influenced by surrounding affective material. In addition, congruence of affective prime and target has been shown to have a distinct EEG pattern. Smith and Gevins (2004) found that EEG activity was greatest for commercials with a high component of emotionally evocative stimuli in conjunction with anomalous (i.e. differentially valanced) content.

Based in the network model, but contrasting the suggestions of semantic priming, Zajonc's *affective primacy hypothesis* (1980) postulates an automatic, primary processing pathway for *preferenda*, or the qualities of stimuli that trigger affective reactions, and a secondary conscious deliberative pathway for *discriminanda*, the qualities used to discriminate objects from each other. Therefore affect would not qualify as a discriminating factor between stimuli. Recent affective priming studies utilizing evaluative methodology (i.e. "*rate the following as pleasant or unpleasant*") have supported this hypothesis (e.g. Duckworth, Bargh, Garcia, & Chaiken, 2002). This hypothesis asserts that affective response comes prior to semantic identification and categorization, and suggests that there would not be any effect on evaluation of emotional stimuli of imbedding negative or positive cues within disparate contexts. This study, however, utilized a categorization paradigm rather than a recognition test, and is therefore of limited applicability to the current study.

The network model suggests a different pattern of results than the modal model for embedding emotional images within emotional contexts. The network model suggests that congruence of context with target image valance, rather than context valance alone, will have the most significant effect on target image recognition. Therefore, the results would show the fastest and most accurate recognition rates for congruent presentations (i.e. positive images within positive contexts and negative images within negative contexts), and slower results for incongruent presentations (i.e. negative images in positive contexts, positive images in negative contexts). However, also based in network theory, Zajonc's affective primacy hypothesis suggests that an inconsistent pattern of results will emerge as emotional valance is not used as a distinguishing cue for set discrimination.

The Present Study

There is an extensive existing body of work examining the recognition and retention of affectively valanced images. Previous work has examined the recall of affectively valanced images presented at varying speeds, at long and short term inter-stimulus intervals, with differing presentation procedures, and during positive and negative induced mood states. Psychophysiological responses, brain activation, recognition speed and accuracy, and free recall have been used singly or in combination with each other as dependent measures in these studies. However, apart from priming studies, which focus on directly preceding primes, very little work has examined contextual effects of emotional images on the recognition of affectively valanced images. This is despite evidence that suggests images presented in serial presentation formats may have a sustained emotional effect greater than that of individual images, or that negative and positively valanced context would have differential effects on recall of target images. Although there is some attempt to address contextual effects in advertising and media literature, especially in regards to advertising and program context, these studies may not adequately control for arousal effects to examine valance as an independent variable. In addition, different patterns of results may be expected depending on which memory model is utilized.

Therefore, the present study was developed in order to examine the effect of presentation context as an independent factor in the recall of differentially valanced images. In order to control for arousal effects for the present study, only low-arousal images were used, and arousal differences minimized by selection of similarly-rated images. Context was operationally defined to be the majority of the images in a given presentation stream. Prior to viewing target images, participants viewed at least two images of the assigned context valance. For example, if the context valance was negative, participants saw at least two negative images preceding a target image of positive or negative valance. If the context valance was positive, participants saw at least two positive images before a target image. In this way, we hoped to determine if context valance can be considered an independent variable with a predictable effect on the recognition speed and accuracy of emotional images. Our primary hypothesis, therefore, predicted that this type of presentation context would have an effect on recognition speed and accuracy of target images.

In order to test context effects, two contrasting predictions were developed. First, based in the modal model of memory, was that the valance of images would be the determining factor in different reaction times. Specifically, based in this theory we predicted that negative images would have a faster and more accurate response rate overall than positive images or neutral images, regardless of context presentation. The second, contrasting prediction, based in the network association model, stated that context valance congruence or incongruence with target images would be the primary indicator of reaction time and accuracy in target image recall. A third prediction, based in Zajonc's affective primacy model, predicted inconsistent results with no discernable pattern for emotional vs. neutral images. In addition, due to the use of emotional stimuli, mood state pre- and post- test will be assessed in order to account for mood-state changes during the course of the experiment.

METHOD

Participants

Seventy-eight William and Mary undergraduates participated in this study for course credit. Students were predominantly right-handed (n = 67) and all indicated 20/20 vision or corrective lenses. Six participants were dropped from the final analysis (4 data collection errors due to computer error, 2 participants not following directions) leaving a final sample of 72 (23 male and 49 female, M_{age}=18.8). All participants were at least 18 years of age and were treated in accordance with the ethical guidelines established by the American Psychological Association (see Appendix B for consent form).

Stimuli

Images selected from the International Affective Picture System (IAPS) set were used as affective stimuli. Only low arousal images (images averaging less than 4.83 on a 9-point scale) were considered (see figure 2). Images used were randomly selected from the three categories and target and context images were randomly selected from within these constraints (see figure 3). Images were randomly assigned to target, distracter, or context images. All image valance and arousal means and standard deviations, listed by IAPS identification number, condition, and assignation are displayed in Appendix B. Target affective categories differed significantly on valance ($F(2, 47) = 970.63, p < .01$), but did not differ significantly on arousal ($F(2, 47) = 3.05, p > .05$). Target images for all conditions are included for reference (see Appendix A).

Measures

The Positive and Negative Affect Scale (PANAS) (Watson, 1988) is a 20-item scale measuring current felt positive and negative affect (see Appendix D for scale). Participants rate 10 adjectives indicating the presence of positive affect (e.g. interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, active) and 10 items indicating the presence of negative affect (e.g. distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, afraid) on a 1 (not at all) to 5 (extremely) Likert-type scale responding to the prompt: "Indicate to what extent you feel this way right now, that is, at the present moment."

Apparatus

Images were presented in bitmap format in an 8 x 10 aspect ratio surrounded by a white background on a Hewlett-Packard computer monitor with a refresh rate of 60 hz. Participants entered their responses on the computer keyboard. The presentation instructions and procedures were programmed in house using SuperLab Pro.

Procedure

Participants were seated at a computer station with the monitor turned off while they completed the consent form. After the completion of the scale, the monitor was turned on and the task began. All further instructions were displayed on the computer screen. The task consisted of eight self-paced trials during which the participant viewed the entire stimulus set, preceded by one practice trial which was not included in this analysis. As displayed in figure 4, during each trial, participants were shown a 12-image stream, during which each image appeared for 250 ms, followed after a 30s delay by the test phase. During the exposure stream, positive and negative target images were arranged in positive, negative, and neutral contexts, constructed by at least two images of the designated context valance appearing before a target image. During the test phase, 12 images were shown singly, 4 from the initial stream and 8 new images of the same valance as the target image. Images remained on screen until the participant indicated a response. All exposure and test streams were bracketed by low-arousal, neutral-valanced images. See figures 4 and 5 for illustration of trial procedure. Context order presentation was counterbalanced across 8 orders, and target and distracter images appeared based on a randomization algorithm included in the SuperLab software. After completion of all trials, participants completed a second PANAS, were debriefed (see Appendix E for debriefing form), and received course credit.

RESULTS

Reaction Time. Descriptive statistics and error rates for all target and distracter images and are reported in Table 1. Outliers more than 2.5 standard deviations from the mean were excluded from analysis. Although median analysis is generally recommended for reaction time data due to the presence of outliers, the performed data correction resulted in satisfactorily standard distributions for statistical analysis. Composite variables for each condition were created by summing mean reaction times for all images in each condition by participant, thereby giving an average condition response time for each participant (e.g. Cameron & Frieske, 1994) Means and standard deviations for conditions are reported in Table 2.

A repeated-measures ANOVA examining the effect of the within-subjects manipulation of target valance (positive or negative) x context valance (positive, negative, neutral) with a between-subject factor of order (8) indicated a significant main effect for context, $F(2, 142) = 3.53, p < .05$. Target images presented in negative contexts received significantly faster reaction times than those presented in positive or neutral contexts, $F(2, 142) = 5.05, p < .05$. Negative images overall had faster reaction times than positive images, ($M_{pos} = 1057.53$ms, $M_{neg} = 1022.44$ms).

Accuracy. Response errors for each target image were summed by condition, and then divided by 100, thereby creating a percentage correct score for each condition. Means and standard deviations are reported in Table 2. A similar procedure was performed for distracter images in order to determine selection bias. Means and standard deviations are reported in Table 3.

A repeated-measures ANOVA examining the effect of the within-subjects manipulation of target valance (positive or negative) x context valance (positive or negative) x target (target or distracter) with a between-subject factor of order (8). Results indicated a significant main effect for context, with pictures presented in negative contexts more accurately identified than pictures in positive or neutral contexts, $F(2, 142) = 3.81$, $p<.05$. There was also a significant effect for target, with distracter pictures more often correctly rejected than target pictures were correctly identified $F(1, 142) = 132.06$, $p<.01$. An interaction effect between target pictures in positive and negative contexts was also significant, with negative target images presented in congruent (negative) contexts significantly more accurately recognized than negative images presented in incongruent (positive) contexts $F(1, 142) = 4.75$, $p<.05$. There was no similar effect for positive images.

Mood-state. Positive and negative affect scores were created using the standardized procedure for scoring the PANAS (Watson, 1985). See Table 4 for pre- and post-test means. All scores were used in analysis. A repeated-measures ANOVA was conducted between pre- and post- test measures. There was no significant effect for time, $F(1, 64) = 0.00$, $p = .99$. Overall image reaction times were examined and grouped as composite positive, negative, and neutral times and accuracy rates by participant in order to compare reaction times with PANAS scores. Pearson correlations run between positive and negative affect scores on the PANAS, reaction times, and accuracy showed no significant correlations.

DISCUSSION

The first hypothesis, that presenting images in emotional contexts will have an effect on target image recognition accuracy and speed, was supported. These results indicate that valance may be considered a distinguishing contextual cue such as orientation, hue, and intensity when utilized in a VSTM memory task. This contrasts research suggesting that emotion has no effect on VSTM or STM (Hamann, 1999; Bianchin et al, 2001), and supports research suggesting that humans may distinguish emotional effects even when stimulus cues are presented for very short periods of time (Kensinger and Corkin, 2003; Hamann and Mao, 2001). Furthermore, these results suggest that valance may be considered a distinguishing cue independent of arousal, which had been suggested by previous work (Malkovic and Martini, 2006) but not fully investigated until this point. Future research would extend this line of research, attempting to isolate the necessary components of contextual construction; i.e. how many images are required in order to constitute "context", how great of a difference is required between target and context image valance in order to observe an effect, and how would the inclusion of non-valanced images as target or context affect target recognition? Attempting to answer these questions would allow for a greater investigation into affective image effects.

The predictions of the modal model were partially born out. Images presented in negative contexts were responded to more quickly and more accurately than images presented in positive or neutral contexts, indicating a significant effect of image valance on recognition and speed of response. More importantly, this effect was observed when controlling for arousal effects, thereby corroborating research indicating that valance has a contextual effect separate from arousal. This extends previous studies of sustained exposure to affective images, and indicates areas of research into establishing and maintaining emotional context effects. In addition, these results suggest that valance of the context, rather than semantic similarity or dissimilarity, is a more important cue for recognition tasks presented in RSVP procedures, thereby discounting both the affective primacy hypothesis as well as the semantic congruence hypothesis. If semantic similarity or dissimilarity made a difference, semantic congruence or incongruence would have been a stronger indicator of reaction time than valance context. However, the results indicate that context, rather than congruence, was the distinguishing factor between groups, thereby discounting semantic activation of emotional nodes as a compelling argument for these result patterns.

Congruence did, however, indicate one pattern of results in a very specific fashion. Negative images presented in congruent contexts were more accurately recalled than negative images presented in incongruent contexts. This may be explained by the semantic priming hypothesis: there was significant congruence between negative context and negative target images. However, again as no similar effect was observed for positive images in positive contexts, these results may indicate a separate response pattern for negatively valanced images rather than a semantic priming effect. This interpretation supports the previous analysis suggesting that valance, rather than congruence, is the primary discriminating factor.

Separate result patterns for positive and negatively valanced images have been found in previous work (e.g. Reeves and Nass, 1996), indicating that separate processes might be at work when recognizing and remembering negative and positive images. In addition, the evolutionary model of emotion suggests that images with a direct connection to threat (e.g. mutilation, attack) may cause faster orienting response to negatively valanced stimuli, as a quick response would be demanded of the organism for survival purposes (Lang et all 1998). The current study may suggest that low-arousal, negatively valanced images induce the same reaction as high-arousal images, at least to the extent that they are recognized more quickly than positive images. Although arousal levels should have been low, perhaps the presentation of serial negative images induced higher arousal levels than one alone (see Bradley et al, 1998 for discussion).

There was no mood induction effect, indicating support for the notion that mood state induced by images is a fleeting induction if it occurs (Bradley, Codispotti, and Lang, 2001). In the future, physiological measures such as facial EMG, heart-rate monitors, and skin conductance measures could be employed along with different assessments of mood-state in order to identify rapid mood change during the course of the experiment. In addition, the PANAS measures positive and negative affect by utilizing words that also have positive and negative arousal components (e.g. excited, distressed). Utilizing a mood-state measure which is independent of arousal may give a clearer picture of the role existing mood-state plays in recognizing affective images.

Limitations

Several limitations of this study should be acknowledged. First, there is a limited number of low-arousal, high-emotion images to choose from. That considerably limited the pool of potential stimuli. In addition, in order to control for arousal, true random selection of target and distracter images from this limited pool was hampered by the need to keep mean arousal levels within acceptable norms. Although 6 groups of 20 pictures were able to be constructed with no repetition and minimal tweaking, there was considerable frustration with the limited database. As discussed by Bradley et al (2001) this may be due to evolutionary selection rather than a faulty database of images; humans are not predisposed to judge many images as highly emotional but non-arousing.

The main limitation of this study was the failure to include a condition with neutral images in valanced contexts. As this study was initially conceived to test the predictions of existing memory models on the contextual effect of emotional images, the neutral image, positive or negative context conditions were not prioritized. This is unfortunate, but does open wide avenues for future research into emotional contextual effects.

Conclusion

Despite limitations, this study indicated a contextual effect of emotional valance, independent of arousal, on the recognition of target images in a rapid serial visual presentation procedure. These results suggest that recognition of emotional images presented in contexts of positive, negative, or neutral affective valance is affected by both target image emotional valance as well as the emotional valance of the surrounding images. These results partially support both the modal model and the network association models of memory. Contrary to previous work, congruence between target and context was not found to be a significant factor in recognition speed and accuracy when compared to valance. This study extends previous work on emotional image recognition as well as opens new areas of exploration into the effects of affective valance on memory. In addition, broad applications of this theory may extend into media campaigns as well as visual design applications. Although this is a small part of a much larger body of work on emotion and recognition, consideration of context valance may prove to be a much-needed addition in the literature when considering future affective memory research.

TABLE 1

REACTION TIME AND ACCURACY

Condition, Image, IAPS Number	Reaction Time (ms)		Accuracy (% correct)	
	Mean	SD	Mean	SD
Condition PP				
Target				
Mountain 5814	1131.42	488.21	71	0.46
Boys 2224	982.76	326.35	81	0.40
Nature 5760	1096.89	580.34	61	0.49
Girls 2091	957.83	353.19	75	0.44
Distracter				
Kitten 1460	927.80	289.53	99	0.12
Father 2165	974.96	282.11	100	-
Neuter Baby 2260	1009.33	341.19	93	0.26
Family 2395	993.59	326.59	99	0.12
Couple 2530	921.83	252.00	97	0.17
Couple 2550	932.41	248.77	99	0.12
Flowers 5200	1069.72	388.93	82	0.39
Clouds 5551	1138.00	453.27	42[a]	0.50[a]
Condition PN				
Target				
Flower 5010	926.36	307.98	74	0.44
Seagulls 5831	1105.97	524.60	78	0.42
Desert 7580	994.28	378.11	72	0.45
Sky 5982	979.39	339.21	62	0.49
Distracter				
Seal 1440	839.99	215.12	99	0.12
Horse 1590	896.01	266.10	100	-
Rabbit 1610	853.27	205.77	100	-
Babies 2080	886.39	200.32	100	-
Chef 2331	911.70	269.76	100	-
Family 2360	1083.69	343.04	90	0.30

TABLE 1 CONTINUED

Condition, Image, IAPS Number	Reaction Time (ms) Mean	SD	Accuracy (% correct) Mean	SD
Flowers 5811	1077.72	409.79	92	0.28
Condition PU				
Target				
Wines 7280	1096.64	494.75	78	0.42
Family 2598	1236.58	527.02	64	0.48
Mother 2540	974.65	263.76	79	0.41
Nature 5780	1076.14	447.86	53	0.50
Distracter				
Cat 1540	857.86	243.01	99	0.12
Horse 1600	928.17	289.79	99	0.12
Mickey 1999	868.53	229.37	100	-
Baby 2070	1356.55	746.01	82	0.39
Family 2299	1068.62	364.86	99	0.12
Three Men 2370	916.38	259.25	100	-
Baby 2660	968.48	263.53	100	-
Beach 5836	1305.79	663.67	87	0.33
Condition NN				
Target				
Soldiers 9404	1000.66	352.49	72	0.45
Cocaine 9101	948.72	249.47	75	0.44
Fisher 9171	940.94	242.71	92	0.28
Burnt Building 9471	1084.90	400.23	74	0.44
Distracter				
Roach 1270	891.01	232.04	99	0.12
Mother 2312	1142.49	409.68	96	0.20
Drug Addict 2718	1345.28	631.88	92	0.28
Alcoholic 2752	1088.83	357.51	100	-
Gun 6241	1025.54	276.44	96	0.20
Cemetery 9001	1048.12	423.87	94	0.23
Exhaust 9090	1002.13	333.93	100	-

TABLE 1 CONTINUED

Condition, Image, IAPS Number	Reaction Time (ms) Mean	SD	Accuracy (% correct) Mean	SD
Man 2490	1050.07	476.51	79	0.41
Garbage 9290	1140.88	448.66	47	0.50
Smoke 9280	1011.19	311.96	60	0.49
Refugees 2695	1005.49	497.49	82	0.39
Distracter				
Angry Face 2110	887.55	245.43	100	-
Girl 2276	1047.40	295.50	96	0.20
Police 2682	888.87	269.04	100	-
Smoking 2715	958.65	304.84	100	-
Disabled Child 3300	974.00	323.19	100	-
Attack 6314	1031.87	391.01	100	-
Scared Child 9041	1026.57	357.68	100	-
Homeless Man 9331	1044.00	395.54	96	0.20
Condition NU				
Target				
Needle 9008	981.74	383.20	93	0.26
Alcoholic 2753	1054.59	351.43	82	0.39
Cemetery 9220	1049.86	441.11	15	0.36
Woman 2399	943.01	374.20	76	0.43
Distracter				
Fingerprint 2206	954.46	183.30	100	-
Elderly Man 2520	892.81	192.73	97	0.17
Jail 6010	1038.47	316.92	99	0.12
Native Fem 9045	1547.36	1011.71	100	0.00
Family 9046	1105.37	367.33	99	0.12
Pollution 9341	993.78	304.23	97	0.17
Dishes 9390	1112.26	346.86	99	0.12
Sick Kitty 9561	1233.24	589.57	100	-

Note. PP = positive images within positive context; PN = positive images within negative context; PU= positive images within neutral context; NN = negative images within negative context; NP = negative images within positive context; NU = negative images within neutral context.

TABLE 2

REACTION TIMES AND ACCURACY BY CONDITION

Condition	Reaction Time (ms)		Accuracy (% correct)	
	Mean	SD	Mean	SD
Condition PP				
Target	1057.09	322.35	72	0.28
Distracter	1001.19	194.85	99	0.01
Condition PN				
Target	1002.88	234.99	71	0.25
Distracter	952.75	189.92	99	0.01
Condition PU				
Target	1113.46	296.58	68	0.28
Distracter	1039.23	252.97	99	0.01
Condition NN				
Target	997.09	217.64	78	0.26
Distracter	1089.69	281.17	99	0.01
Condition NP				
Target	1063.04	276.32	67	0.28
Distracter	989.11	216.06	99	0.01
Condition NU				
Target	1007.21	258.76	67	0.20
Distracter	1121.45	298.93	99	0.01

Note. PP = positive images within positive context; PN = positive images within negative context; PU= positive images within neutral context; NN = negative images within negative context; NP = negative images within positive context; NU = negative images within neutral context.

TABLE 3

DESCRIPTIVE STATISICS AND RELIABILITY FOR PRE- AND POST-TEST

POSITIVE AND NEGATIVE AFFECT

Variable	Mean	SD .	Min	Max	Internal Consistency
Positive Affect					
Time 1	23.16	5.59	1.92	3.20	0.81
Time 2	25.25	7.28	1.94	3.26	0.88
Negative Affect					
Time 1	13.17	3.40	1.08	1.65	0.78
Time 2	13.25	3.76	1.08	1.66	0.80

Note. N = 72.

FIGURE 1

DISTRIBUTION OF VALANCE AND AROUSAL RATINGS FOR

INTERNATIONAL AFFECTIVE PICTURE SET

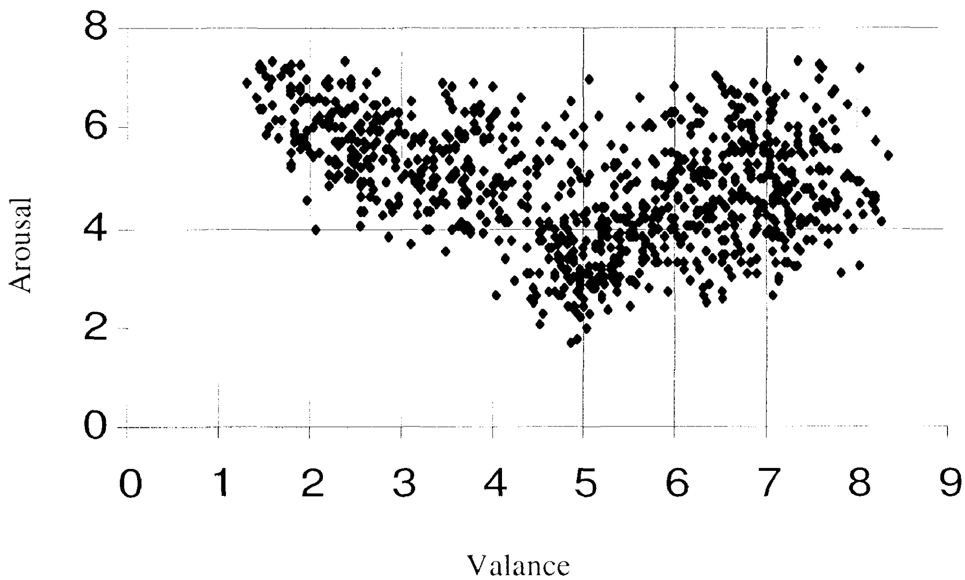


FIGURE 2

DISTRIBUTION OF VALANCE AND AROUSAL RATINGS FOR

LOW-AROUSAL IMAGES

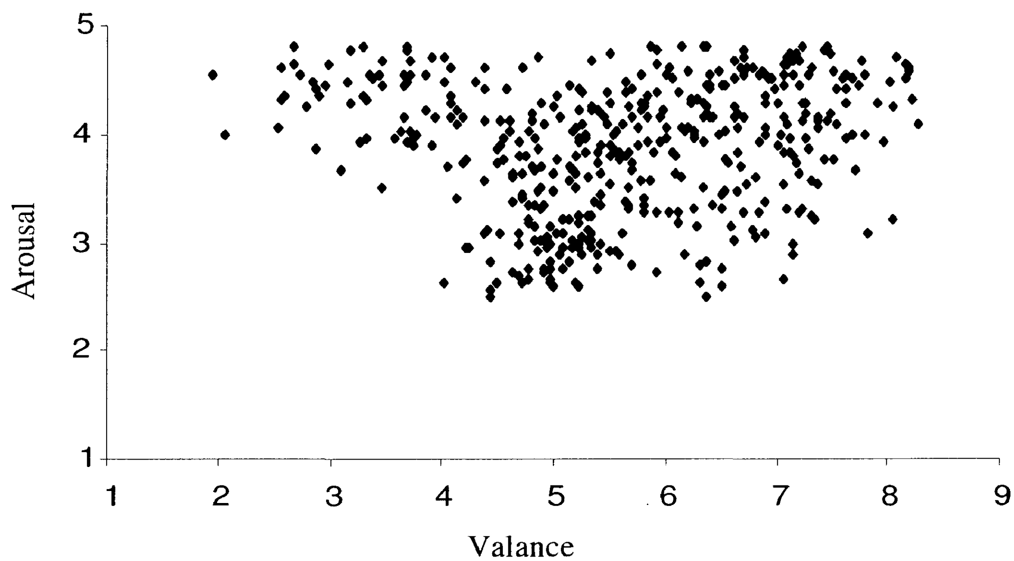


FIGURE 3.

DISTRIBUTION OF VALANCE AND AROUSAL RATINGS FOR STIMULI SET

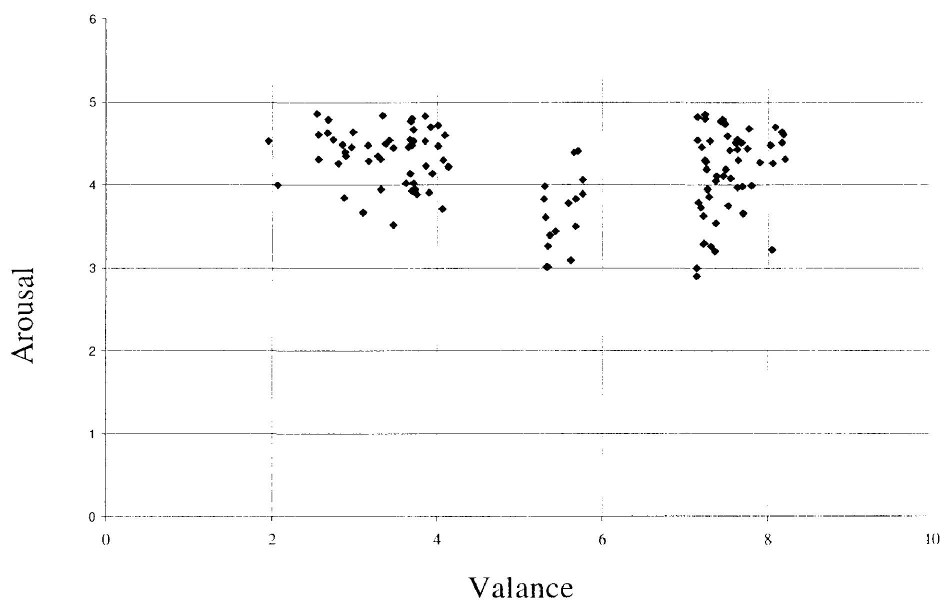
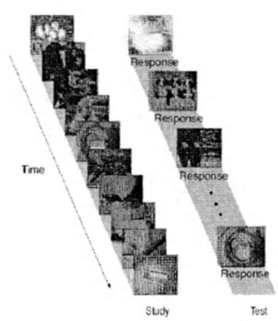


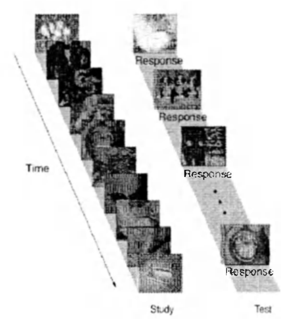
FIGURE 4

ILLUSTRATION OF RAPID SERIAL VISUAL PRESENTATION TASK

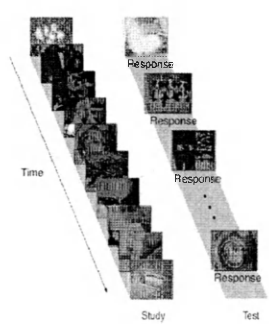
Positive pictures in positive context



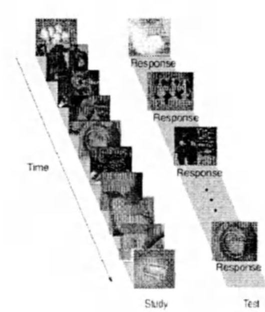
Positive pictures in negative context



Negative pictures in negative context



Negative pictures in positive context



APPENDIX A

TARGET AFFECTIVE IMAGES BY CONDITION

Positive Images Within Positive Context


Mountain 5814


Boys 2224


Nature 5760


Girls 2091

Positive Images Within Negative Context


Flower 5010


Seagulls 5831


Desert 7580


Sky 5982

Positive Images within Neutral Context


Wines 7280

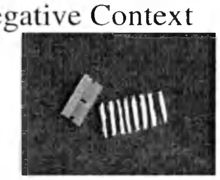

Family 2598


Mother 2540


Nature 5780

Negative Images Within Negative Context


Soldiers 9404


Cocaine 9101


Fisher 9171


Burnt Building 9471

Negative Images Within Positive Context


Man 2490


Garbage 9290


Smoke 9280


Refugees 2695

Negative Images Within Neutral Context


Needle 9008


Alcoholic 2753


Cemetery 9220


Woman 2399

APPENDIX B

VALANCE AND AROUSAL RATINGS FOR IAPS IMAGES BY CONDITION

Condition IAPS	Valance Mean	Valance SD	Arousal Mean	Arousal SD
Condition PP				
Target				
Mountain 5814	7.15	1.54	4.82	2.40
Boys 2224	7.24	1.58	4.85	2.11
Nature 5760	8.05	1.23	3.22	2.39
Girls 2091	7.68	1.43	4.51	2.28
Context				
Sunflower 5001	7.16	1.56	3.79	2.34
Mountains 5631	7.29	1.34	3.86	2.64
Family 2154	8.03	1.13	4.48	2.31
Children 2341	7.38	1.59	4.11	2.31
Clouds 5891	7.22	1.46	3.29	2.57
Porpoise1920	7.90	1.48	4.27	2.53
Carnival Ride 8497	7.26	1.44	4.19	2.41
Springbok 1620	7.37	1.56	3.54	2.34
Distracter				
Kitten 1460	8.21	1.21	4.31	2.63
Father 2165	7.63	1.48	4.55	2.55
Neuter Baby 2260	8.06	1.42	4.26	2.44
Family 2395	7.49	1.69	4.19	2.40
Couple 2530	7.80	1.55	3.99	2.11
Couple 2550	7.77	1.43	4.68	2.43
Flowers 5200	7.36	1.52	3.20	2.16
Clouds 5551	7.31	1.63	3.26	2.47
Condition PN				
Target				
Flower 5010	7.14	1.50	3.00	2.25
Seagulls 5831	7.63	1.15	4.43	2.49
Desert 7580	7.51	1.60	4.59	2.72
Sky 5982	7.61	1.48	4.51	2.85
Context				
Skulls 9440	3.67	1.86	4.55	2.02
Sad Girls 2455	2.96	1.79	4.46	2.12
Jail 2722	3.47	1.65	3.52	2.05

APPENDIX B CONTINUED

Condition IAPS	Valance		Arousal	
	Mean	SD	Mean	SD
Flood 9926	3.85	1.59	4.83	1.95
Hospital 2205	1.95	1.58	4.53	2.23
Pollution 9342	2.85	1.41	4.49	1.88
Cigarettes 9830	2.54	1.75	4.86	2.63
Distracter				
Seal 1440	8.19	1.53	4.61	2.54
Horse 1590	7.24	1.45	4.80	2.10
Rabbit 1610	7.69	1.34	3.98	2.40
Babies 2080	8.09	1.47	4.70	2.59
Chef 2331	7.24	1.72	4.30	2.38
Family 2360	7.70	1.76	3.66	2.32
Boat 2398	7.48	1.32	4.74	2.11
Flowers 5811	7.23	1.60	3.30	2.33
Condition PU				
Target				
Wines 7280	7.20	1.80	4.46	2.38
Family 2598	7.19	1.30	3.73	1.84
Mother 2540	7.63	1.51	3.97	2.33
Nature 5780	7.52	1.45	3.75	2.54
Context				
Tomatoes 7285	5.67	1.60	3.83	2.11
Woman 2506	5.67	1.23	3.50	1.94
Bed 7710	5.42	1.58	3.44	2.21
Medical Worker 2394	5.76	1.74	3.89	2.26
Dice 7058	5.29	1.38	3.98	2.17
Attractive Fem 4275	5.70	2.01	4.41	2.45
Coffee Cup 7057	5.35	1.37	3.39	2.01
Rowing 8241	5.76	1.31	4.06	1.96
Distracter				
Cat 1540	7.15	1.96	4.54	2.35
Horse 1600	7.37	1.56	4.05	2.37
Mickey 1999	7.43	1.47	4.77	2.40
Baby 2070	8.17	1.46	4.51	2.74
Family 2299	7.27	1.53	3.95	2.22
Three Men 2370	7.14	1.46	2.90	2.14

APPENDIX B CONTINUED

Condition IAPS	Valance		Arousal	
	Mean	SD	Mean	SD
Baby 2660	7.75	1.48	4.44	2.41
Beach 5836	7.25	1.39	4.28	2.41
Condition NN				
Target				
Soldiers 9404	3.71	1.67	4.67	2.26
Cocaine 9101	3.62	1.96	4.02	2.33
Fisher 9171	4.01	1.94	4.72	2.17
Burnt Building 9471	3.16	1.35	4.48	2.02
Context				
Heroin 9102	3.34	1.76	4.84	2.50
Woman 9190	3.90	1.44	3.91	1.73
Angry Face 2100	3.85	1.99	4.53	2.57
Boy 2795	3.92	1.77	4.70	2.00
Crying Boy 2900.1	2.56	1.41	4.61	2.07
Prostitute 4635	3.86	1.85	4.23	2.35
Bum 2750	2.56	1.32	4.31	1.81
Garbage 9330	2.89	1.74	4.35	2.07
Distracter				
Roach 1270	3.68	1.85	4.77	2.44
Mother 2312	3.71	1.64	4.02	1.66
Drug Addict 2718	3.65	1.58	4.46	2.03
Alcoholic 2752	4.07	1.84	4.30	1.94
Gun 6241	3.42	1.52	4.54	2.35
Cemetery 9001	3.10	2.02	3.67	2.30
Exhaust 9090	3.69	1.92	4.80	2.23
Condition NP				
Target				
Man 2490	3.32	1.82	3.95	2.00
Garbage 9290	2.88	1.52	4.40	2.11
Smoke 9280	2.80	1.54	4.26	2.44
Refugees 2695	4.01	1.58	4.47	1.92
Context				
Lion 1721	7.30	1.39	4.53	2.21
Mother 2170	7.55	1.42	4.08	2.48
Romance 4622	7.46	1.61	4.11	2.30

APPENDIX B CONTINUED

Condition IAPS	Valance		Arousal	
	Mean	SD	Mean	SD
Kittens 1463	7.45	1.76	4.79	2.19
Girl 2304	7.22	1.31	3.63	2.15
Baby 2040	8.17	1.60	4.64	2.54
Family 2332	7.64	1.60	4.30	2.29
Mother 2311	7.54	1.37	4.42	2.28
Distracter				
Angry Face 2110	3.71	1.82	4.53	2.25
Girl 2276	2.67	1.66	4.63	1.93
Police 2682	3.69	1.65	4.48	2.10
Smoking 2715	3.28	1.95	4.35	2.27
Disabled Child 3300	2.74	1.56	4.55	2.06
Attack 6314	4.09	1.51	4.60	2.31
Scared Child 9041	2.98	1.58	4.64	2.26
Homeless Man 9331	2.87	1.28	3.85	2.00
Condition NU				
Target				
Needle 9008	3.47	1.85	4.45	2.10
Alcoholic 2753	3.17	1.75	4.29	2.22
Cemetery 9220	2.06	1.54	4.00	2.09
Woman 2399	3.69	1.40	3.93	2.01
Context				
Farmer 2191	5.30	1.62	3.61	2.14
Frog 1313	5.65	1.47	4.39	2.03
Food Basket 2980	5.61	1.50	3.09	1.91
Building 7242	5.28	1.45	3.83	2.06
Clothespins 7052	5.33	1.32	3.01	2.02
Teenager 2870	5.31	1.41	3.01	1.72
Checkerboard 7183	5.58	1.39	3.78	2.19
Building 7500	5.33	1.44	3.26	2.18
Distracter				
Fingerprint 2206	4.06	1.4	3.71	2.03
Elderly Man 2520	4.13	1.9	4.22	1.69
Jail 6010	3.73	1.98	3.95	1.87
Native Fem 9045	3.75	1.67	3.89	2.16
Family 9046	3.32	1.49	4.31	1.99
Pollution 9341	3.38	1.89	4.5	2.1

APPENDIX B CONTINUED

	Valance		Arousal	
Condition IAPS	Mean	SD	Mean	SD
Dishes 9390	3.67	1.58	4.14	2.52
Sick Kitty 9561	2.68	1.92	4.79	2.29

Note. PP = positive images within positive context; PN = positive images within negative context; PU= positive images within neutral context; NN = negative images within negative context; NP = negative images within positive context; NU = negative images within neutral context.

APPENDIX C

RESEARCH PARTICIPATION CONSENT FORM

Psychology Department
College of William & Mary

Title of Project: Visual Perception
Researcher(s): Allison Eden, Dr. J.A. Stevens

This is to certify that I, ____ have been given the following information with respect to my participation in this study.

1. Purpose of the research: To examine cognitive responses to presented pictures.

2. Procedure to be followed:
As a participant in this study, you will first fill out a short questionnaire. You will then complete two tasks, described in more detail below. These tasks will involve the presentation of different pictures on a computer screen, and will be repeated for the duration of the experiment.

Task 1. Picture viewing task.
You will view a short series of pictures presented on a computer screen.

Task 2. Picture response task.
In this task you will view another short series of pictures. You will be asked to respond, indicating whether or not you recognize the picture from the preceding group.

You will receive more specific instructions once you are placed in front of the computer station.

3. You will be asked to complete a second short questionnaire.

4. Discomforts and risks: There are no known discomforts or risks associated with the response tasks in this experiment. It is possible that you will experience minor mental fatigue during or after the experiment. If you do experience fatigue during the experiment, please alert the experimenter and a break will begin as soon as possible.

5. Time duration of participation: Your participation will last approximately 15 minutes, including consent procedures, instructions, experiment, and debriefing.

6. Statement of confidentiality: All participation will be held confidential. All data collected will be identified through a coding system; only the primary investigators

(Allison Eden and Dr. Stevens) will have access to the code, which will be kept under lock and key.

7. Voluntary participation: Participation is voluntary. You are free to withdraw at any time without penalty or prejudice.

8. Incentive for participation : research credit. Research credit will be given for participation in this study, 1 credit per hour of study. We anticipate the experiment to last about 30 minutes, resulting in .5 research credits.

9. Potential benefits: There are no known physical benefits of participating in the study.

10. Termination of participation: Participation may be terminated by the experimenter if it is deemed that the participant is unable to perform the tasks presented. If participation is terminated, full research credit (.5 credit) will be given to the individual.

11. Questions or concerns regarding participation in this research should be directed to: Allison Eden, aleden@wm.edu, or Dr. J. Stevens, 757-221-3862, in the WM Cognitive Neuroscience Lab, 757-221-3876

I agree to participate in this study and have read all the information provided on this form.

I am aware that I may report dissatisfactions with any aspect of this study to Michael Deschenes, Ph.D., the Chair of the Protection of Human Subjects Committee by telephone (757-221-2778) or e-mail (mrdesc@wm.edu). I am aware that I must be at least 18 years of age to participate in this project. Any questions that I have regarding this study have been answered to my satisfaction. My signature below confirms that my participation in this project is voluntary, and that I have received a copy of this consent form.

Name (Please Print) : ____
Signature : ______________________________
Date : ______________________

THIS PROJECT WAS APPROVED BY THE COLLEGE OF WILLIAM AND MARY PROTECTION OF HUMAN SUBJECTS COMMITTEE (Phone 757-221-3966) ON 2006-01-23 AND EXPIRES ON 2006-06-15

APPENDIX D

POSITIVE AND NEGATIVE AFFECT SCALE

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers.

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

_ interested	_ irritable
_ distressed	_ alert
_ excited	_ ashamed
_ upset	_ inspired
_ strong	_ nervous
_ guilty	_ determined
_ scared	_ attentive
_ hostile	_ jittery
_ enthusiastic	_ active
_ proud	_ afraid

What is your gender? (Circle one) male female

How old are you? _______

Which is your dominant hand? (Circle one) right left

APPENDIX E

DEBRIEFING

Visual Perception: Debriefing

Thank you for participating in this study. The purpose of this study was to find out how emotional context affects picture recall. The reason we asked for you to fill out the questionnaire was to see what your mood was like before and after the experiment. The pictures you saw in the experimental phase had different emotional ratings, and we were interested to see which you were able to remember when you saw them again during the trial phase. All your information will remain confidential; however we may use your results in future research. If you would like a copy of the results of this study, or have any questions about the nature of this research, please email Allison Eden (aleden@wm.edu).

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VITA

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Allison Eden was born in Omaha, NE on June 26, 1977. She graduated with Dean's Honors from the Friends School of Baltimore in May, 1995, and *summa cum laude* from the Corporate Communication program at the University of Baltimore in Baltimore, MD in June 2004. In August 2004, the author entered the College of William and Mary as a graduate student and teaching assistant in the Department of Psychology. She defended her thesis in July of 2006. Allison is currently enrolled in the Communication doctoral program at Michigan State University in East Lansing, MI.