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The Psychological Processes of Mixed Valence Images: Emotional Response, Visual Attention, and Memory

Despite the growing significance of emotional images in advertising, the psychological and physiological responses toward multiple opposite valence images presented simultaneously remains somewhat unexplored. This eye-tracking research examined the relationship between emotional response, visual attention, and recall. The results showed that individuals were more likely to gaze toward the positive images than the negative ones when exposed to both simultaneously. More importantly, longer gaze duration translated into a stronger emotional response toward the images. Together gaze duration and the Empowerment dimension of emotional response significantly predicted the recall of the images. Theoretical and practical implications are discussed.

Taylor Jing Wen, Jon D. Morris, and Mark Sherwood

We are surrounded by visual imagery through television, movies, videos, computers, illustrated texts, and advertisements. The impact of visuals on basic psychological processes is well established. For instance, images are more attention-grabbing than text. Eye-tracking studies have demonstrated that images are the most common entry point into newspaper pages (García, Stark, & Miller, 1991), which points to their amplifying effect on psychological processes. Beyond the effects on attention, images also have a positive influence on memory. The meaning of images is accessed faster than that of text (Barry, 1997). In the realm of memory and learning, the picture superiority effect describes how named images are better recalled than named words due to the concrete imagery they generate (Paivio, 1991). These findings have been extended in the context of advertising and visual communication, where visuals—particularly emotional images—have been shown to be more memorable, leading to better recall of images over text (e.g., Newhagen & Reeves, 1992; Miller & LaPoe, 2016). The use of images in print advertising has received considerable attention with respect to their impact on attitude toward the ad (e.g., Mitchell, 1986), attitude toward the brand (e.g., Miniard, Bhatla, Lord, Dickson, & Unnava, 1991; Rossiter & Percy, 1980), information-processing strategies (e.g., MacInnis & Price, 1987), and inferences (e.g., Smith, 1991).

Print advertisements and news articles routinely employ more than one image. The multiple images in an advertisement or a news article are often of the same valence, either all positive (i.e., an ad for a vacation destination where multiple positive and beautiful sceneries are shown) or all negative (i.e., a social marketing ad for domestic violence, where multiple negative images associated with abusive behaviors are shown). Yet many other advertisements and news employ both positive and negative visuals in the same ad/article. For example, a print advertisement for an antismoking campaign had two images: A negative image showed a black lung resulting from consuming countless cigarettes, while the other positive images showed a clean and healthy lung.

Mixing positive and negative images in a single advertisement is not limited to social marketing, however. "Before and after" ads for cosmetic and skin care products routinely use both positive and negative images in a single advertisement. Likewise, visually supported "happy outcome of use/sad outcome of nonuse" ads are routinely employed in product categories as diverse as motor oil and insurance (Chowdhury, Olsen, & Pracejus, 2008).

In each of these examples, the readers of the advertisements and news articles are concurrently exposed to multiple images. Essentially, they are simultaneously exposed to multiple stimuli capable of eliciting an affective response. A growing body of literature also demonstrates the ability of pictures to convey emotional meaning and evoke an emotional response (e.g., Bradley, Greenwald, Petty, & Lang, 1992; Powell, Boomgaarden, De Swert, & de Vreese, 2015). This research conceptualizes emotional response as a multidimensional construct (Poels & Dewitte, 2006)—namely, Appeal, Engagement, and Empowerment (AEE; Morris, Choi, & Ju, 2016). *Appeal* is the measure of positive or negative reaction. Engagement is used to determine the level of involvement and stimulation. Empowerment is the feeling of control: in control or not in control after exposure to the stimulus. This three-factor theory of emotions is evident in multiple studies that have classified the emotions based on AEE (e.g., Bellman, 2007; Morris, 1995; Morris, Woo, Geason, & Kim, 2002). Especially, the AEE measure has been extensively employed and studied in consumer psychology and advertising research as a concrete theoretical framework of emotional response that measures advertising effectiveness (e.g., Morris, Woo, & Cho, 2003; Morris et al., 2009).

Although it is not uncommon to see a communication stimulus (e.g., an advertisement) that employs more than one picture, limited research has been conducted to examine how the emotional responses generated by pairs of images are integrated into an overall affective response. The advertising literature and communication literature have investigated the impact of visuals in mass communication but have not examined how multiple images of differing valence might be integrated. The psychology literature has more extensively looked at affect integration, yet it has not explicitly investigated the simultaneous presentation that occurs in communication messages. For example, Chowdhury et al. (2008) explored different mechanisms that described people's reactions toward multiple images of the same valence versus different valence. While such empirical evidence underscores the importance of processing multiple images, some questions remain unanswered and offer room for further research. For example, how do images of different valence influence other emotional dimensions, such as Dominance (Empowerment)? How does an individual's visual attention to images of mixed valence influence emotional response? How does such emotional response and visual attention influence recall and memory?

Utilizing eye-tracking technology, the purpose of the current research is to understand individuals' visual attention, emotional response, and recall to mixed valence images. Eye tracking permits a direct measurement of visual gaze and fixation, and thus of visual attention, in nearly real time (Wadlinger & Isaacowitz, 2006). After collecting the eye-gaze data, this study measures the emotional response to images of opposite valence and further examines the attention-emotion effects. In addition, the study postulates that visual attention and emotional response are important predictors of recall.

Literature Review

Three Dimensions of Emotional Response

Several researchers have organized a wide array of emotions by grouping them along the three-dimension theory of emotions originally created by Osgood, Suci, and Tannebaum (1957) and later implemented by Mehrabian and Russell (1974); Lang, Greenwald, Bradley, & Hamm, (1993); and Morris, Woo, & Cho (2003). The dimensions were originally called Evaluation, Activation, and Locus of Control, and then later Pleasure, Arousal, and Dominance (PAD) (Morris, 1995). To better understand the dimensions and applicability in marketing communications, advertising, and other related fields, Morris et al. (2016) relabeled the dimensions Appeal, Engagement, and Empowerment (AEE). In all three cases they are the same three dimensions. All three dimensions are necessary to pinpoint specific feelings. For this study, the dimensions are also labeled Appeal, Engagement, and Empowerment.

Appeal, the valence measure, is a feeling state of positive or negative reaction that constitutes extreme happiness to extreme unhappiness. For instance, sensations of happiness indicate a high positive feeling on the Appeal dimension, whereas feeling of sadness indicates low negative feeling (Morris, 1995). Engagement, the arousal measure, determines the level of stimulation and involvement, which ranges on a physiological continuum indicating some level of physical activity, mental alertness, or frenzied excitement at the arousal end of the continuum, with inactivity, mental dullness, or sleep at the other end. For example, previous studies demonstrated that a feeling of excitement is indicated by high Appeal and high Engagement as being excited triggers a positive feeling and high arousal (Morris et al., 2002). In contrast, feeling pleased is indicated by a sensation of high Appeal and low Engagement because being pleased results in lower stimulation and arousal (Morris, 1995;

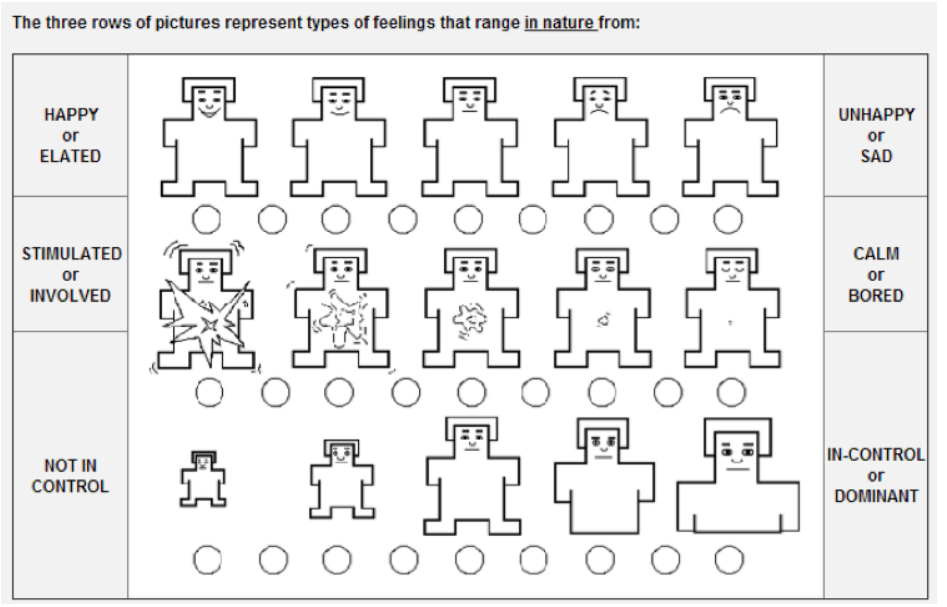


Figure 1 AdSAM® (Attitude Self-Assessment Manikin).

Morris et al., 2002). Finally, Empowerment is a sense of control after being exposed to a stimulus. For example, a particular advertisement may transfer to the respondent a sense of control over a particular situation—say a medication for a disease—whereas another ad may lack the ability to transfer that sense of control or influence that one experienced (Mehrabian & de Wetter, 1987; Morris et al., 2002). A higher level of Empowerment indicates that a person feels more in control and autonomous. For instance, feeling victorious is exhibited by a high level of Empowerment, whereas feeling protected is at a lower level of Empowerment.

Relationship Between Appeal and Empowerment

When Osgood et al. (1957) and later Mehrabian and Russell (1974) conceptualized the three emotional dimensions, they suggested that each of the three dimensions is independent of the other two (Russell & Mehrabian, 1977). However, the three dimensions are essentially uncorrelated, with the exception of Empowerment (Russell, 1978). Empowerment has been correlated at .65 with Appeal; thus, roughly one-third of the variance in Empowerment could be predicted from the Appeal dimension. Similarly, previous work with these three dimensions has consistently shown a moderate correlation of Empowerment with Appeal (Mehrabian & Russell, 1974; Russell & Mehrabian, 1977). Because of the difficulties in empirical studies to establish the independence from Appeal and Engagement, some researchers have lost interest in the dimension of Empowerment and adopted a two-dimensional model instead (i.e., Appeal and Engagement). Moreover, prior research found that Empowerment didn't show a significant main effect but interacted with the other two dimensions to influence behavior (Yani-de-Soriani, Foxall, & Newman, 2013).

However, this research demonstrates that the seemingly high correlation between Appeal and Empowerment does not validate the elimination of Empowerment from the emotional response model. Actually, emotional appeals aimed at establishing feelings of Empowerment appear closely aligned with the intrinsically motivating nature of competence, which is usually highly correlated with positive feelings (i.e., high Appeal) arising from accomplishments or problem-solving situations (Holbrook & O'Shaughnessy, 1984). It is also likely that Empowerment, though correlated to Appeal, may exert its effects on other psychological processes—such as recall—independently. Therefore, this study intends to reexamine the effects of Appeal and Empowerment in the context of mixed valence images.

The current study focuses on positive and negative valence images, following the approach in a previous study (Nummenmaa, Hyönä, & Calvo, 2006), by manipulating the Appeal of the pictorial stimuli. In addition, this study intends to control for the level of Engagement of the positive and negative pictures within the same pair, since Engagement may influence the

allocation of visual attention, as well as recall. As mentioned previously, it is expected that the Appeal dimension will correlate with the Empowerment dimension. Therefore, with Engagement remaining constant, positive pictures should receive higher Appeal and Empowerment scores, whereas negative pictures should score lower on both dimensions.

Measuring Emotional Responses

Early research initially used verbal scales of multiple emotion adjectives and then factor analyzed these to measure emotional response (Mehrabian & Russell, 1974). But this process is cumbersome and lacks cross-cultural application. In the last two decades, researchers have used visual measures, the Self-Assessment Manikin (SAM) scale (Lang, 1980) and AdSAM® (the Attitude Self-Assessment Manikin) (Bashir, Wen, Kim, & Morris, 2018; Morris, 1995; Morris et al., 2002) (See Figure 1). AdSAM® has been used to assess responses to television advertising (Morris, 1994), preproduction versus postproduction advertising (Morris & Waine1993), political messages (Morris, 1995), and brand loyalty (Kim, Morris, & Swait, 2008). AdSAM® has also been used to compare global advertising (Morris, 1994).

AdSAM® captures the three dimensions of emotional response respectively—Appeal, Engagement, and Empowerment (Poels & Dewitte, 2006; Morris, 1995). This research tool employs a database of 196 emotional adjectives, scored with AdSAM®, and then their scores are matched to a current study's response to diagnose the specific feelings without the exposure to those adjectives by the respondents (Ju, Jun, Dodoo & Morris, 2015; Morris, 1995). One major advantage of AdSAM® is that the graphic nature helps eliminate the cognitive processing of words for semantic judgment, an inherent problem in all verbal measures of emotion (Morris, 1995). It is important to point out that AdSAM®, although a self-report technique, is an integral component of physiological research on emotion, particularly in the investigation of physiological responses.

Emotional Response to Mixed Valence Images

As this study investigates individuals' simultaneous emotional response, visual attention, and recall toward multiple images, the literature on Affect Integration explains the combination of multiple affective stimuli within a given message to arrive at an overall affective response to that particular message. When a simultaneous presentation condition, such as print advertising, is considered, the affect integration literature suggests two distinctive mechanisms that individuals use to reach an overall affective reaction toward the stimuli. First, previous research has repeatedly demonstrated that the global affective response to an event/stimulus is particularly impacted by the peak level of affect experienced (i.e., the "peak rule"). In other words, the "peak" will have the predominant impact on the overall affect experienced. A peak mechanism may best describe the integration of simultaneously presented affective images of the same valence (Chowdhury et al., 2008). When advertisement images are all positive or all negative, the most extreme image determines overall emotional response. For instance, when individuals are exposed to a pair of positive images, the more positive image determines the overall response, and a peak-positive effect will be observed.

Second, other research suggests that the overall affective reaction one has to an event/stimulus could simply be a compensatory function (i.e., a mathematical average) of each component experience weighted equally. Particularly in a case where both negatively and positively valenced affective images are present, it is no longer clear what the "peak" is. There is still an absolute peak value (i.e., either the positive image or the negative image will be of higher affective value to an individual). But in this case, it is difficult to determine whether the peak value used will refer to the affective value of the positive image (peak-positive) or the negative image (peak-negative) or the difference in the affect experienced between the positive and negative image (absolute peak). In such a situation, a compensatory process becomes possible, whereby the overall response will be a function of both the positive and negative affective images (Chowdhury et al., 2008). This could be explained by the coping mechanism that individuals may use a positive affect to regulate a negative affect. The presence of positive affect could serve as the emotional buffer that allows individuals to cope with the negative event (Linville & Fischer, 1991; Olsen & Pracejus, 2004).

Overall, if individuals respond to the univalence affective images as a result from the peak affective value, the positive-only images will receive highest Appeal scores, whereas the negative-only images will receive lowest Appeal scores. If individuals respond to the affective images of opposite valence by taking the average of all affective components (i.e., the compensatory mechanism), the mixed-valence images will receive an Appeal score in between the positive-only and negative-only images. Therefore, the following hypothesis is proposed:

H1: Mixed-valence images will receive lower Appeal scores than the positive-only images but higher Appeal scores than the negative-only images.

As the Appeal dimension correlates with the Empowerment dimension, this study expects similar results found for both Appeal and Empowerment. That is, when individuals feel more positive after the exposure to the images, such positive feelings are more likely to signal that they have control over the situations. Formally:

H2: Mixed appeals will receive lower Empowerment scores than the positive-only appeal but higher Empowerment scores than the negative-only appeal.

Visual Attention and Emotional Response

Emotional stimuli generate affective reactions and motivate appetitive or defensive behavior, presumably because such stimuli represent events that have special adaptive importance for preservative or protective functions (Lang, Bradley, & Cuthbert, 1997). Our cognitive systems are also motivationally biased to allocate preferential attention to emotional stimuli in comparison with neutral pictures. Thus, pleasant and unpleasant pictures were more likely to be looked at, and for longer, than neutral pictures as soon as they were presented (Calvo & Lang, 2004). However, limited research has been done in examining emotional stimuli with the same or opposite valence presented simultaneously.

The processes of selective attention and emotion operate together in prioritizing human behavioral responses to visual stimuli. Coordinated behavior thus depends on cooperation and rapid communication between these two processes (Fenske, Raymond, & Kunar, 2004). Indeed, their interaction is supported by neural connections (Amaral & Price, 1984) and shared brain areas (Armony & Dolan, 2002; Bush, Luu, & Posner, 2000). The interactions between attention and emotion are reciprocal. On the one hand, the emotional salience of a stimulus can modulate the speed and efficiency of attentional processes (e.g., Eastwood, Smilek, & Merikle, 2001; Fenske & Eastwood, 2003; Fox, Russo, Bowles, & Dutton, 2001), indicating that emotion can drive attention. On the other hand, prior attentional relevance has ramifications for subsequent emotional evaluation so that images seen previously as distractors were rated as being less cheerful than images seen previously as targets or images not seen before (Fenske et al., 2004; Raymond, Fenske, & Tavassoli 2003). In other words, attention can also drive and modulate subsequent affective emotional responses. The current study is more interested in the latter interaction (i.e., attention-emotion effects), considering that participants would freely view the pair of images first and then reach an overall affective evaluation of the pair. In such a situation, this study emphasizes how the visual attention results in the later emotional response, instead of how the emotional response drives attention when viewing the images.

Based on the attention-emotion effects, focusing on to negative stimuli (such as the distractors) results in a negative response. Similarly, focusing on positive stimuli (such as the targets) drives the emotional response toward the positive end. The current study used the eye tracking technology to better understand individuals' attentional preferences to emotional stimuli of opposite Appeal. Eye tracking allows the measurement of gaze patterns in nearly real time. Although the target of the gaze is not necessarily identical to the target of visual perception, in most cases the two work in concert (Parkhurst, Law & Niebur, 2002). Tracking eye movements has therefore been used to document attentional preferences. Eye tracking has proved to be a valuable tool in unraveling attentional mechanisms (Isaacowitz, Wadlinger, Goren, & Wilson, 2006). Therefore, the following hypotheses are proposed:

H3: Among all the mixed pairs, longer gaze duration on positive images will result in (a) higher Appeal scores and (b) higher Empowerment scores.

H4: Among all the mixed pairs, longer gaze duration on negative images will result in (a) lower Appeal scores and (b) lower Empowerment scores.

Visual Attention, Emotional Response, and Recall

Measuring the effectiveness of visual appeals is a central research interest of both academic and industry researchers. When effectiveness is measured in terms of learning and memory, recall and recognition are common dependent variables (Stewart et al., 1985; Mehta & Purvis, 2006). The fundamental difference in the two measures is that for recall the individual must describe the stimulus, which is not present, whereas for recognition the stimulus, which is shown to the subject, must be identified as having been seen or heard previously (Bettman, 1979; Singh, Rothschild, & Churchill, 1988). Compared to recognition, recall tends to be more stringent and can mask the amount of actual memory utilized (Singh, Rothschild, & Churchill, 1988;

Zielske, 1982). More importantly, considering the complex feature of mixed-valence images, the current study chose to recall a more sensitive and discriminant method as the measure of memory.

During the late 1970s and early 1980s, several researchers hypothesized that because recall was a verbal/left-brain activity and television advertising was largely a right-brained function, recall for television advertising would be penalized by the recall measure (Krugman, 1977; Zielske, 1982). These researchers also suggested and reported that the recall of rational commercials was, on average, higher than the recall of emotional ones. However, historical data and results on recall and emotions did not lend support to Krugman's or Zielske's findings (Du Plessis, 1994; Mehta & Purvis, 2006). Rather, clear evidence gathered over the years shows that emotional advertising is not penalized by recall and that emotional content in well-executed commercials can actually facilitate recall (e.g., Fahmy, Choi, Wanta, & Song, 2006; Newhagen & Reeves, 1992). Most of the prior research on recall and emotions emphasized the comparison between positive, negative, and neutral images, suggesting that people are more likely to recall positive or negative images rather than neutral ones. However, limited research has been conducted regarding the recall of emotional images when opposite valence images are shown simultaneously.

To understand how emotional images work in advertising or how they interact with the recall measure in advertising testing, a basic knowledge of the memory process is useful. Memory is a critical part of consumer behavior and of how advertising influences consumer behavior. Consumers usually do not make brand purchases at the time of advertising exposure. Rather, there is typically a lag between consumers' exposure to advertising and their opportunity to purchase the advertised brand. Given this time delay, advertising effectiveness may depend critically upon consumers' memory performance. The important role of recall stems from the recall that measures some aspect of this memory of the advertising.

New advances in our understanding of how the brain functions have helped clarify the way consumers respond to the deluge of advertising stimuli around them and how memory is built. The process of giving attention is said to govern what stimuli should be utilized, with memory traces being formed or strengthened based on the length and depth of attention given to a particular stimulus. The longer and deeper the attention, the stronger the memory traces. As a result, this study predicts that the gaze duration on positive and negative images will positively relate to their recall on positive and negative images respectively.

In addition, neurologists today are suggesting that the attentioning process is largely out of the conscious control of the individual. For example, emotion rather than cognitive/rational response guides attentioning and recall (Du Plessis, 1998; Mehta & Purvis, 2006). Therefore, the emotional response generated during the attentioning process should thus also influence recall. Overall, this study predicts the following hypothesis:

> H5a: The increase in Appeal and Empowerment scores and the gaze duration on positive images will facilitate the recall of positive images.
>
> H5b: The decrease in Appeal and increase in Empowerment scores and the gaze duration on negative images will facilitate the recall of negative images.

Method

The aim of this study is to investigate the interplay between visual attention, emotional response, and recall toward pairs of images of the same and mixed valence. The researchers conducted a within-subject experimental design, where participants viewed a total of seven pairs of emotional images. There were five pairs of mixed valence, while one pair of positive-only images and one pair of negative-only images served as control groups. Participants were randomly exposed to all seven pairs of images.

Participants

Thirty-five undergraduate students (eight males and 27 females) from a southeastern University were recruited to take part in a lab experiment. As expected of a college student sample, most participants were 18 to 23 years old with a mean age of 21. The majority of the participants were Caucasians (91%).

Stimulus Development and Pretests

Pretest 1: Selection of Stimuli. Stimuli development was preceded by a pretest to determine which images to use for the lab experiment. In total, 20 images of opposite valence were selected and pretested (10 positive and 10 negative). First, a general Google search of images was conducted with several key words used to generate appropriate images needed (e.g., "negative visuals" and "positive visuals"). Since this study

examined individuals' emotional response, visual attention, and recall toward images with opposite valence, the images chosen were based on the criteria that either a positive or negative emotions would be evoked. Next, a pretest was conducted with participants (N = 100) recruited through Amazon Mechanical Turk. Participants were asked to assess the images (15 positive and 15 negative images), after which they reported their emotional response using AdSAM®. The selected images were paired based on the scores of Appeal and Engagement. In particular, the images in the mixed-valence pairs were expected to have significantly different scores in Appeal but similar in Engagement. Results from this pretest led to the selection of seven most positive (Appeal ranging from 8.05 to 7.11) and seven most negative (Appeal ranging from 1.46 to 3.27) images as the final stimulus materials. The level of Engagement for the selected positive and negative images showed insignificant difference in each pair. The pretest showed that individuals spent roughly five seconds on each image; therefore, the researchers decided to allow participants to view each of the pair of two images for 10 seconds. Furthermore, a post hoc t-test showed that all means from the positive images chosen were significantly different from the negative ones (see Table 1 for examples of stimuli).

Pretest 2: Eye Track Lab Experiment Trial. The second pretest, with 10 participants, was conducted as a preliminary trial before the main eye-tracking study. The purpose of this pretest was to gain a better understanding of the overall experimental procedures and to test the environment setting, the appropriate usage of visual stimuli, and the corresponding Area of Interest (AOI). The process was the same as the following procedure in the main study.

Procedure

The main experiment took place in a private research lab with an adjoining waiting area. Once potential participants arrived at the test site, they received a copy of the consent form to read. After agreeing to participate, they were led into the research room (which had dim lighting to focus the subject's gaze) and seated at a private cubicle with a fixed desk and nonrolling chair, facing a computer monitor. The researchers were positioned a few feet behind the participant to facilitate the experiment without disturbing the participant. The participants were then instructed to hold their head still, and the Eye Tribe Tracker (ETT) was calibrated by having them fixate on a series of nine points positioned at various locations around the screen. ETT uses a corneal reflection system to measure the precise location of a person's eye fixations when looking at a visual display—in this case a pair of images—on a computer monitor. The eye-tracking system does not require participants to wear head gear. The system uses a real-time digital image processor to automatically track the center of the pupil and a low-level infrared reflection from the corneal surface. The system collects data at 60 Hz, or about every 16.7 milliseconds, and records the location of fixations, number of fixations, and duration of fixations.

Once calibration was successfully completed, the computer monitor automatically moved to a baseline measurement of the participant's emotional state using AdSAM®. The participants audibly reported which Manikin in each dimension best represented their feelings at that time. Then participants were notified that different pairs of images were about to be shown on the screen. Once the participant was ready, a set of double images was randomly shown for 10 seconds. The images were then automatically replaced by AdSAM®. Participants were instructed to audibly report their overall emotional response to the pair of images they just saw. This procedure was repeated for each pair of dual images until all seven pairs were viewed. When they were finished viewing all the images, participants were given a computer-based survey, where they listed all the images they could still recall and provided demographic information. For each participant, the experiment took about 30 minutes to complete, including technical issues, such as readjusting poor calibration.

Measurement

Emotional Response. Emotional response was measured using the nonverbal three-dimensional approach, called AdSAM®, the attitude self-assessment manikin, which was developed to measure emotional response to marketing communications stimuli and to report those results using a set of visual deliverables of unique charts and graphs as well as standard statistical techniques (Morris & McMullen, 1994) (see Figure 1). AdSAM® visually assesses the three dimensions of emotion with a graphic character arrayed along a continuous 9-point scale. The first row of figures is the Appeal scale, which ranges from a smiling, happy face to a frowning, unhappy face. The second row is the Engagement scale, which ranges from extremely calm with eyes closed to extremely excited with eyes open and elevated eyebrows. The third row, the Empowerment dimension, represents changes in control with changes in the size of AdSAM®: from a large figure indicating maximum control

Table 1 Scores for All Pairs of Images

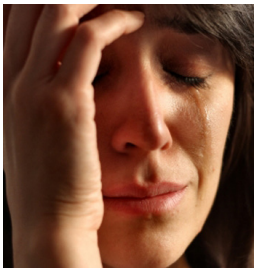
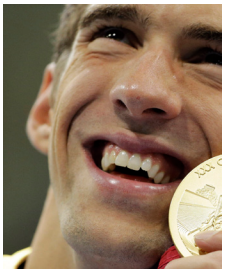
Pair 1


Appeal	Engagement	Empowerment
8.06 (.80)	5.49 (2.50)	6.11 (1.49)

Pair 2

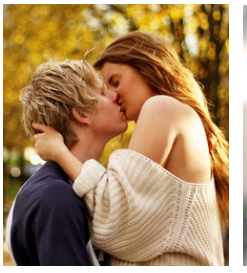
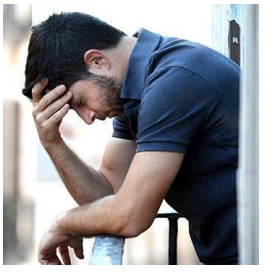

Appeal	Engagement	Empowerment
2.00 (1.46)	6.06 (2.53)	3.00 (2.22)

Pair 3

Appeal	Engagement	Empowerment
5.66 (1.63)	4.91 (1.98)	4.89 (1.32)

Pair 4

Appeal	Engagement	Empowerment
5.63 (1.35)	4.54 (1.98)	4.86 (1.54)

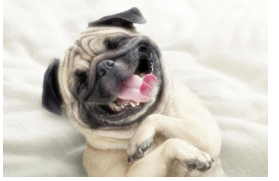
Pair 5


Appeal	Engagement	Empowerment
4.97 (1.62)	5.17 (1.86)	4.51 (1.85)

Pair 6


Appeal	Engagement	Empowerment
3.54 (1.20)	5.37 (1.63)	3.63 (1.70)

Pair 7

Appeal	Engagement	Empowerment
6.26 (1.27)	4.43 (1.99)	4.91 (1.36)

in the situation to a tiny figure, which indicates being under control.

Gaze Duration. Visual attention to the image was recorded by the eye-tracking hardware and software as the Total Gaze Duration (in milliseconds) that participants spent fixating on each of the images in the pair. This study uses raw visual attention scores (in milliseconds) as the measure of Total Gaze Duration. To avoid discarding valid peripheral attention data (see Purucker, Landwehr, Sprott, & Herrmann, 2013), the region coded for the image represented the whole area of the image itself. Therefore, each pair of images resulted in two AOIs. This study was particularly interested in the comparison of total gaze duration on positive and negative images within the mixed-valence pairs. Therefore, the gaze duration scores on the two AOIs in the mixed pairs were labeled as gaze duration on positive image and gaze duration on negative image respectively.

Recall. A free-recall task was administered in which subjects were asked to recall and list as many of the images they remembered seeing as possible. A researcher who was not aware of the research purpose was invited to analyze the recall responses. This researcher was first shown the seven pairs of images and told to code the presence of each of the 14 images individually. The presence in the recall was coded as "1," and the absence was coded as "0." The researchers then used the data to form two indexes, recall of positive images and recall of negative images.

Statistical Analysis

A one-way ANOVA was used to measure differences among mixed-valence images versus positive-only and negative-only images. Multiple regressions were conducted to examine the relationship between total gaze duration on positive and negative images and Appeal and Empowerment respectively. To understand the predictive power of visual attention and emotional response on recall, logistic regressions were used in this study.

Results

Emotional Response

The data were first analyzed using an ANOVA followed by post hoc tests to examine how people responded to the three groups of images (mixed, positive-only and negative-only) along the three emotional dimensions (i.e., Appeal, Engagement, and Empowerment). The results of three F tests were significant on Appeal, $F(2, 244) = 132.229$, $p < .001$; Engagement, $F(2, 244) = 5.128$, $p < .01$; and Empowerment, $F(2, 244) = 29.228$, $p < .001$. In particular, the post hoc tests showed that the mixed pairs received lower Appeal scores ($M = 5.21$, $SD = 1.69$) than the positive-only pair ($M = 8.06$, $SD = .80$) but higher Appeal scores than the negative-only pair ($M = 2.00$, $SD = 1.46$). Therefore, H1 was supported. Similarly, the post hoc tests indicated that mixed pairs received lower Empowerment scores ($M = 4.56$, $SD = 1.62$) than the positive-only pair ($M = 6.11$, $SD = 1.49$) but higher Empowerment scores than the negative-only pair ($M = 3.00$, $SD = 2.22$). Therefore, H2 was supported. In addition, the negative-only pair ($M = 6.06$, $SD = 2.53$) received significantly higher Engagement scores than the mixed pairs ($M = 4.89$, $SD = 1.90$), but the Engagement scores on the positive-only pair ($M = 5.49$, $SD = 2.50$) were not significantly different from the other two.

The current study was interested in identifying how people responded to different pairs of emotional images. There was one pair in each of the positive- and negative-only group (stimulus 1 and 2). There were five pairs in the mixed group (stimulus 3 to 7), which were the major interest in the current study. To further demonstrate these differences, this study conducted three ANOVA tests to compare individuals' responses on Appeal, Engagement, and Empowerment across each of the seven pairs. Overall, the findings from the seven unique pairs reflected consistent results, as the H1 and H2 hypothesized. That is, all of the five mixed pairs reported significantly lower Appeal and Empowerment scores than the positive-only pair but higher Appeal and Empowerment scores than the negative-only pair. Only Pair 2 (negative-only) and Pair 6 (mixed) were not significantly different on Empowerment (See Table 1). In addition, there was no significant difference in the level of Engagement between each of the seven pairs, except that Pair 2 (negative-only) triggered significantly higher Engagement than Pair 7 (mixed). This study successfully controlled for the level of Engagement in the mixed-valence pairs since all of them demonstrated similar levels of Engagement.

Visual Attention

This study aims to link individuals' visual attention with their emotional response toward the presence of multiple images. The mean and standard deviation scores of total duration on positive and negative images in the mixed pairs were displayed in Table 2.

To test H3 and H4, multiple regressions were

Table 2 Gaze Duration for All Pairs of Images

Pair of Images	Gaze Duration on Positive Images	Gaze Duration on Negative Images
3	3501.94 (959.11)	3169.57 (1234.64)
4	3370.00 (1277.87)	2924.57 (1339.91)
5*	3586.71 (1550.84)	2913.91 (1137.44)
6*	2237.40 (1057.17)	3165.49 (1351.55)
7**	3990.57 (1372.64)	2552.54 (1121.63)

Note. Gaze duration is listed as milliseconds. Standard deviations are listed in parentheses.
*$p < .05$; **$p < .001$.

conducted where total duration on positive and negative images were entered as independent variables and Appeal and Empowerment scores were entered as dependent variables respectively. Total duration on positive and negative images together explained a significant proportion of variance in Appeal scores, $R^2 = .27$, $F(2,174) = 6.93$, $p < .001$. Particularly, total duration on positive images significantly predicted Appeal scores, $\beta = .264$, $t(174) = 3.481$, $p < .001$. However, total duration on negative images showed a negative relationship with Appeal scores, but the results were not significant, $\beta = -.030$, $t(174) = -.390$, $p > .05$. Thus, H3a was confirmed, but H4a was not.

Similarly, total duration on positive and negative images together explained a significant proportion of variance in Empowerment scores, $R^2 = .22$, $F(2,174) = 4.32$, $p < .05$. In particular, total duration on positive images significantly predicted Appeal scores, $\beta = .214$, $t(174) = 2.780$, $p < .01$. However, total duration on negative images showed a negative relationship with Appeal scores, but the results were not significant, $\beta = -.017$, $t(174) = -.221$, $p > .05$. Thus, H3b was confirmed, but H4b was not.

Recall

The research consisted of a total of 14 images (seven7 negative and seven positive). On average, participants recalled more than six images. The minimum was 0, and the maximum was 12. Positive images were recalled 60 times, whereas negative images were recalled 51 times. To test H5a and H5b, two logistic regressions were performed to ascertain the effects of Appeal, Empowerment, and the gaze duration on positive or negative images on the likelihood that participants recalled the positive or negative images.

The logistic regression model on the recall of positive images was statistically significant, $x^2(3) = 11.105$, $p < .05$. The model explained 5.9% (Nagelkerke R^2) of the variance in the recall of positive images and correctly classified 59% of cases. Specifically, it seems that increasing Empowerment was associated with an increased likelihood to recall positive images ($B = .197$, $SE = .083$, Wald = 4.592, $p < .05$), and increasing gaze duration on positive images was associated with an increased likelihood to recall positive images ($B = .211$, $SE = .098$, Wald = 4.681, $p < .05$). However, Appeal did not show significant association with the recall of positive images. Therefore, H5a was partially supported.

The logistic regression model on the recall of negative images was statistically significant, $x^2(3) = 11.175$, $p < .05$. The model explained 8.2% (Nagelkerke R^2) of the variance in the recall of negative images and correctly classified 82% of cases. It is likely that increasing Empowerment was associated with an increased likelihood to recall negative images ($B = .262$, $SE = .105$, Wald = 6.196, $p < .05$), and increasing gaze duration on negative images was probably associated with an increased likelihood to recall negative images ($B = .213$, $SE = .105$, Wald = 4.611, $p < .05$). However, Appeal did not show significant association with the recall of negative images. Therefore, H5b was partially supported.

Discussion

The purpose of this study was to determine the relationship between emotional response—in the form of Appeal, Engagement, and Empowerment—and gaze duration in visual imagery. The outcome consisted of recall of the images. Subjects were shown the pair of visuals in three sets: two positive; two negative; and two mixed, one positive and one negative. There were seven sets in all. The objective was to determine, among the five mixed pairs, how Total Gaze Duration was related to Emotional Response in predicting recall.

The overall results of the emotional response measurement of all images showed that individuals evaluated the mixed images lower in Appeal and lower in Empowerment than the positive-only images but higher Appeal and Empowerment than the negative-only images. The negative images had a lasting short-term effect on reducing the pleasing effect of the positive visuals and in making the subjects feel less in control. The scores on the Appeal and Engagement dimensions were correlated with those on the Empowerment dimension. The negative-only pairs of visuals received higher Engagement scores than the mixed pair, indicating that the high negative stimulation was more apparent when absent the mitigating effects of the positive visual.

Next, we compared the emotional response results with the eye tracking variable Total Gaze Duration. We wanted to link the emotional response dimension with the eye behavior. The results on visual attention showed that when exposed to the mixed pairs, individuals were more likely to gaze toward the positive images than the negative images. Although the subject's feelings were affected by the negative images in the mixed set, as illustrated by the lower emotional response scores when compared to the positive-only images, they did attempt to reduce the negative effect by concentrating more on the positive image. This appears to be a defensive measure.

In addition, longer gaze duration on positive images significantly predicted the increase in Appeal and Empowerment scores. However, the relationship between gaze duration on negative images and the decrease in Appeal or Empowerment scores failed to attain significance. The findings suggest that people don't need to pay longer visual attention to a negative image to feel negative about it. Moreover, the lack of predictive power of gaze duration on emotional response to negative images might be because people are less willing to stare at a negative picture.

More importantly, the Empowerment dimension of emotional response coupled with Gaze Duration was a significant predictor of recall. The more the respondents found the image Empowering, and the longer they looked at it, the more this helped to solidify the image in at least their short-term memory. The increase in gaze duration on positive images resulted in an increase in the recall of those positive images. Similarly, the increase in gaze duration on negative images leads to the increase of recall of negative image.

The increases in Empowerment facilitate increases in recall of both positive and negative images. Empowerment, often disregarded in advertising and studies of visual stimuli (Onley, Holbrook, & Batra, 1991), has been shown here to be a significant predictor of recall. Empowerment is important in facilitating recall of advertising images, regardless of the positive or negative Appeal. It appears to be less important that an ad or visual stimulus is positive or negative and more important that it creates a sense of control. Whether a positive image or negative stimulus is used is more important to make the viewer of the visual feel in control. A positive visual should emote more of a victorious feeling (high Empowerment) than a happy one (low Empowerment); if a negative visual is used, the goal should be to generate more anger (high Empowerment) than fear (low Empowerment). Therefore, advertisers and visual designers should do more than simply determine if their ad is liked; they should determine if it makes their target feel more Empowered.

Theoretical Implications

The dimension of Empowerment (i.e., Dominance) has been long been ignored in the emotion literature. The major reason stemmed from the empirical findings by Russell and Pratt (1980), suggesting that Empowerment accounted for only a trivial proportion of variance in the meaning of affect terms but was highly correlated with the measure of Appeal (Russell, 1978). Therefore, they decided to delete the third dimension, Empowerment, to generate a two-dimensional model, which has been widely adopted in marketing and advertising literature (e.g., Gorn, Pham, & Sin, 2001; Shapiro & Maclnnis, 2002).

However, more recent literature suggests that the three-dimensional model (AEE) helps to differentiate between basic emotion categories. It is also clearly more informative as a representation of emotional knowledge than the two-dimensional solution is more informative (Yani-de-Soriano & Foxall, 2006). Empowerment is an important differentiating factor in anger and fear (Wen & Morris, 2015; LeDoux, 1998), as well as in anxiety and depression (Mehrabian, 1996). Empowerment has its own unique role in categorizing fear and anger and approach/avoidance behavior. Although the two-factor model was preferred by Russell (1980), even he acknowledged that unexplained variance was attributable to "control" or "dominance."

The current study might be among the first to investigate the interaction between emotional

response, visual attention, and recall in the setting of mixed emotional images. The eye-tracking data especially suggest that individuals tend to allocate more visual attention on the positive images that induce both high Appeal and high Empowerment when opposite valence images are present simultaneously. The physiological measure of visual attention transfers and represents in the emotional response. More importantly, both the visual attention and empowerment together predict the recall. Therefore, Empowerment seems to have its unique role in physiological response and recall.

Practical Implications

The important role of Empowerment also provides useful practical implications, particularly in terms of message development. Marketers and advertisers need to pay sufficient attention to test the advertising copies and ensure that the copies induce high Empowerment. As the increase of Empowerment facilitates the recall of advertising content, it might help the advertisements and the brands to be more memorable and easier to recall at the time of purchase.

Limitations and Future Studies

As with all research, this study is not without limitations. First, using college students might limit the external validity of the study findings. However, since the primary purpose of the current study is to advance theory, the homogeneity of college students can help strengthen internal validity because there is less extraneous variation associated with them than with the general public (Peterson, 2001). Second, even though the authors tried their best to pair the images with similar content, such as a close-up shot of a sad female face against a smiling male face, the authors acknowledged that the content of two images in each pair might vary in subject matter, which could be a confounding factor to the study results. However, the authors believe that the results have demonstrated a certain level of consistency, which indicates that images with higher Appeal received more visual attention than the lower ones. Therefore, in this exploratory study, the findings provide reliable and interesting insights for visual communication scholars. Future research that examines the mixed valence images can use visuals of the same topic, such as the same news event, to control for potential confounding factors and increase the validity. In addition, the interplay between attention and emotion is reciprocal. While this research only examined the attention-emotion effect, future research is encouraged to investigate how emotional content drives the visual attention. Lastly, this study set the exposure time to 10 seconds for each pair of images. Previous research also suggested a possible causal influence of exposure time on emotional response and memory. Therefore, the effects of exposure time to mixed emotional content warrant future research in visual communication studies.

Conclusions

In conclusion, the current study adds to the growing body of scholarship in consumer psychology that systematically examines the relationship between emotions, visual attention, and memory. The findings reported here suggest several promising directions for future research and the hope that other scholars join us in this journey to explicate these effects in greater detail.

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