# THE IMPACT OF WEBPAGE COMPLEXITY AND PHOTO INTENSITY ON PROCESSING OF ONLINE NEWS

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

THE IMPACT OF WEBPAGE COMPLEXITY AND PHOTO INTENSITY ON PROCESSING OF ONLINE NEWS

presented by Jennah Sontag,

a candidate for the degree of Master of Arts,

and hereby certify that, in their opinion, it is worthy of acceptance.

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# DEDICATION

To my parents,

Thank you for your encouragement, support, high expectations, and most of all your daily prayers and spiritual guidance. Thanks for always pointing me to the One who has all the answers and who gave me the peace I needed during times of stress and doubt.

To my friends,

Thank you for your friendship and love, and thank you for all the good times that pulled me through the rough times. I cherish our memories and time together.

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# THE IMPACT OF WEBPAGE COMPLEXITY AND PHOTO INTENSITY ON PROCESSING OF ONLINE NEWS

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## ABSTRACT

This study investigates the impact of webpage complexity and negative emotional intensity of photographs used with online news stories on reader engagement and processing of online news. A 2 x 2 within-subjects experiment measured attention, emotion, arousal, and memory of story content using heart rate, skin conductance, facial EMG of the corrugator, a recognition test, and self-reports of perceived arousal and emotion. The study was grounded on Lang's (2009) limited capacity model of motivated mediated message processing that people are information processors but are limited in what they can process and encode during exposure to media. This study also tested Berlyne's aesthetic theory, which assumes that increased complexity results in increased pleasure, and assessed the impact of the manipulations on additional psychophysiological processes. It was hypothesized that high webpage complexity (3 photos) and high negative emotional intensity of photos would increase attention, negative emotion, and skin conductance and that participants viewing websites with high intensity photos and low complexity (1 photo) would have better memory. Self-reports found that participants reported greater negative emotion after viewing webpages with high complexity and high negative emotional intensity. Results also found that participants who viewed webpages with only one photo had better memory of the new story content.

# 1. Introduction

The purpose of this study was to examine how visual elements on news websites influence reader engagement and mental processing of online news stories. Acknowledging only the existence of visuals with text ignores the complexity of variations within webpage designs that may have a stronger, more specific impact on readers. Photo editors and webpage designers must decide the most effective way to communicate news stories by taking into consideration how the interaction of visual elements may influence readers.

While multiple studies have assessed the effect of visuals on media message processing (Brosius & Donsbach, 1996; Cross, 2011; Edwardson & Kent, 1992; Edwardson, Kent, & McConnell, 1985; Fox, Lang, Chung, Lee, Schwartz, & Potter, 2004), assessing the specific features of photos used in news stories is understudied. Research findings demonstrate that the presence of images in media messages influences how those messages are processed. Studying the various features of those images will help designers further determine how the design style and content of the images affect how the message is processed and remembered by audience members.

As photo editors, photojournalists, and designers become more knowledgeable about the role of visual elements in reader memory and attention, they may use this information to determine how to select images and design webpages in a way that facilitates communication more effectively.

This study focuses on the impact of two specific features of visual content by determining how the emotional intensity of images, at low and high levels, and website

complexity, through the use of single or multiple images, impacted reader engagement and processing of online news content. Additionally, this study assessed the interaction between emotional intensity of images and webpage complexity on the processing of online news.

This study was built upon prior psychophysiological research that assessed how media messages are processed, by exploring the cognitive and emotional processes that interact in the minds of individuals during exposure to media. Professionals in the areas of visual communication may find the results useful when deciding upon the emotional intensity of photos and the visual complexity used in the design layout of webpages so that the combination of features that will not only grab their readers' attention but also improve the level of comprehension and memory of news content.

To address the main research question, individuals participated in an experiment in which they viewed news stories from mock news webpages. The news stories included images that supplement the story and vary in emotional intensity at two levels (low, high) and in complexity (1 or 3 images).

In order to measure attention, or the cognitive resources allocated to process and encode the media messages, participants' heart rate was recorded. Measurement of participants' skin conductance levels indicates the participants' level of arousal. Facial EMG activity was recorded as an indication of emotional response, as well as self-report measures of arousal and valence. Lastly, the participants' memory of information from the news stories was measured through a recognition test.

## 2. Literature Review

### Visual Complexity

Photo editors and designers of news websites make decisions on a daily basis as to which visual elements will capture the attention of their readers. Images are selected with intentions to enhance comprehension of news stories in order to achieve effective communication with the audience.

Scholars have assessed whether the complexity of media messages influences mental processing of those messages and have found mixed results. Tuch, Bargas-Avila, Opwis, & Wilhelm (2009) investigated the effects of visual complexity in website design on cognitive and emotional processing. Participants viewed 36 website screenshots of varying complexities, operationalized by their JPEG file size, which increased as the number of visual elements on the website increased. Participants' psychophysiological responses were assessed and results indicated that visual complexity features had an impact on individuals' emotional responses: valence, arousal, heart rate, facial electromyography (EMG) and recognition memory. Less arousing, low complexity websites were found to be more pleasurable, produced less corrugator muscle activation, resulted in less heart rate deceleration, and were better remembered on recognition tasks. Complexity and heart rate deceleration were found to have a positive correlation; as complexity increased, greater heart rate deceleration occurred, indicating more resources were allocated to encoding the message. Additionally, high complexity websites were found to be less positive, more negative, and not remembered as well as low complexity websites.

Other scholars have assessed similar situations of message complexity, outside the realm of visual messages, and produced opposite results. Potter (2009) considered audio complexity when he conducted a study to determine the impact of clutter in radio commercial breaks on listeners. One group of participants listened to five, 60-second commercials, while another listened to 10, 30-second commercials. Heart rate results suggested that participants that listened to only five commercials allocated more cognitive resources than the group that listened to 10 commercials. Potter concluded that participants who listened to 10 commercials became cognitively disengaged, as their heart rates decelerated less than those who had listened to only five, suggesting that clutter reduces resource allocation to message encoding. While Potter's study investigated the impact of audio complexity, the current study investigated the impact of visual complexity on viewer engagement. Visual stimuli differed in complexity through the use of 1 photo and 3 photos presented in news websites in order to determine how this variation influences mental processing of news stories accompanying the photos.

## Berlyne's Aesthetic Theory

To assess the impact of webpage complexity, this study tested Berlyne's aesthetic theory (1974), which predicts that viewer's pleasure in response to an object will increase with increased complexity to an optimal level. As webpage designs become increasingly complex through the use of photos, links, text, graphics, and other visual elements, the optimal level of complexity becomes more challenging to determine. It is important that designers determine a complexity level that increases, yet maintains, viewer pleasure.

Berlyne (1960) defined complexity as the amount of variety or diversity in a stimulus pattern. One way to increase complexity relevant to the current study is to increase the quantity of distinguishable elements, which is why an increased number of photos were used to produce greater website complexity.

More recent research (Tuch et al., 2009) that tested Berlyne's aesthetic theory, is similar to the current study in that it investigated the effects of visual complexity in website design on cognitive and emotional processing. As mentioned previously, participants viewed website screenshots of varying complexities, differing in JPEG file size, which increased as the number of visual elements on the website increased. Participants' psychophysiological responses were assessed and results indicated that low complexity websites, compared to high complexity websites, were found to be more pleasurable, less arousing, better remembered on recognition tasks, produced less corrugator muscle activation, and resulted in lower heart rate deceleration. These results, therefore, did not support Berlyne's aesthetic theory.

The current study also worked under the assumption of Berlyne's aesthetic theory and sought to determine if website complexity produced similar results of viewers' emotional responses as found by Tuch et al. Berlyne's theory assumes that more complexity is more pleasurable, while Tuch et al. found that less complexity was more pleasurable and better remembered. The current study determined which website presentation produced better recognition of information from the news story.

Sundar (2000) tested how text, text-picture, and video presentations of news affected memory of online news stories. Results support what is known as the cue-summation theory, which states that when textual information is presented with images it

provides additional learning cues that enhance memory of the text. As pictures presented with news stories in Sundar's study were found to enhance memory of the story content, the current study further assessed how the quantity of pictures used with news stories influenced memory of story content.

Pieters, Wedel, and Batra (2010) conducted a study on the effects of design complexity and feature complexity of advertisements on attention to the ads. In their study, feature complexity refers to levels of visual color, luminance, and edges, known as "clutter" in the ads. Similar to the current study, design complexity refers to the quantity of visuals in the ads. Low complexity ads contained one visual element, whereas high complexity ads contained four or more, including text, which is why the current study will be using three images with text as the high complexity presentation.

Results from the Pieters et al. study indicated that advertisements with more design complexity, operationalized by having a greater quantity of visual elements (Berlyne, 1960), had a positive effect on attention to the textual message in the advertisement. While the study did not measure how attention to the message affected memory, Tuch et al. (2009), who shared the same definition of complexity as Berlyne and Pieters et al., found the same results regarding greater attention given to more complex websites, but also found that websites of greater complexity resulted in lower recognition. Therefore, it was hypothesized that websites containing more images will elicit greater heart rate deceleration, as more resources will be allocated to message encoding, but that viewer recognition of the information from the news message will be lower.

## Emotional Intensity

Another element in visual communication that designers need to consider during their photo selection process is the emotional intensity of the photos.

Several scholars have conducted research that assessed the impact of emotionally intense messages in a variety of media platforms on the processing of those messages. Lang, Greenwald, Bradley and Hamm (1993) conducted a study on varying degrees of valence and arousal of pictures. Results indicated that as rated pleasantness or unpleasantness increased, arousal also increased. For this study, arousal was measured at different levels (low and high) of negative emotional intensity of the images used in the news stories.

Bolls, Lang, and Potter (2001) conducted a study in which they assessed the effects of valence and arousal of radio ads on attention and memory. Participants listened to 10 60-second radio ads, then completed memory tests for recognition and recall. Facial EMG and heart rate were recorded. Results indicated that negative messages received more attention than positive messages and that arousal was a strong predictor of memory. Similarly, Bolls and Adi (2007) assessed how valence of multimedia messages impacted comprehension. They found that negative information in multimedia messages was better remembered than positive. The current study also explored the effect of negative emotional intensity of images on cognition and emotion.

## LC4MP

To assess the impact of emotional intensity on processing online news stories, this study tested Lang's (2000) LC4MP theory. The cognitive and emotional processes that

interact in the human mind during exposure to media messages can be explained by Lang's (2000) limited capacity model of motivated mediated message processing (LC4MP). Many psychophysiological studies are grounded in this model when assessing how the content and structure of media messages are mentally processed. This model, constructed by a mixture of information processing models developed over several decades, is used to determine which parts and how much of those messages are remembered. It recognizes that people are information processors and in that process exists three subprocesses — encoding, storage, and retrieval, which occur simultaneously, while an individual processes media messages.

During the process of encoding, the message engages the sensory receptors, and the visual message only has about 300msec until is it lost. The piece of information that is selected and held in the working (short-term) memory is a representation. If it is linked with prior knowledge (or memories) then it is stored into long-term memory. An individual's goals, knowledge, and environment determine which pieces of those representations are transferred into long-term storage. The last subprocess, retrieval, occurs when a stored mental representation is reactivated into working memory. This process is continuous as information in a message is being received, understood, and stored. More prior knowledge, or stored memory, makes the process of storage and retrieval of new information easier.

The LC4MP works under several major assumptions (Lang, 2006). One assumption, most relevant to the current study, is that humans are limited in their capacity to mentally process media messages. An individual is limited in his or her ability to allocate multiple resources needed for encoding multiple messages simultaneously,

whether visual, audio, or written, without letting go of previous thought. The LC4MP assumes that processing messages that are highly emotional cause greater resource allocation to encoding, which will result in a greater ability to remember the messages. However, processing too many messages at once will result in mental overload, thus reducing the ability to remember the messages. Therefore, the current study tested whether the interaction of emotional intensity and complexity resulted in processing overload.

Another assumption is that media stimuli activate the appetitive and aversive motivational systems, only to the extent that media are motivational. These motivational systems contribute to an individual's approach or avoidance response during media exposure. In this study, for example, photos of highly negative emotional intensity were expected to activate an individual's aversive motivational system if they feel the stimuli are unpleasant, initially increasing resource allocation. Another assumption is that human behavior is always changing as the audio/visual message changes over time. Lastly, communication is the interaction between the media message and the information processing systems that process the message.

The purpose of this study, therefore, was to determine how the negative emotional content of images, and the interaction between negative emotional content and webpage complexity, influence memory of news story content. It was hypothesized that more cognitive resources will be allocated to process websites containing multiple, highly emotional images and that arousal and negative emotion would also be greater for this website presentation. However, as cognitive overload can occur with processing too much information at once, it was hypothesized that the website presentation containing

only one photo of high intensity would enable participants to better remember information from the news stories during the encoding process.

## Emotional and Cognitive Processing of Media Messages

### Attention

Attention, as a process, involves the allocation of cognitive resources used during the encoding process. A deceleration of the heart rate indicates an increase in resource allocation. Lang (2009) describes people as being information processors whose personal interests and goals influence how resources are allocated during media message processing. Shoemaker (1996) further proposes that people allocate more cognitive resources to encode negative messages in the media such as natural disasters, violence, or other topics that threaten survival.

Bradley et al. (2003) studied how images that produced arousal in 18 male participants affected attention. Based on their findings, they suggest that the pictures with greater emotional intensity caused extensive cortical (visual) activation, facilitating greater attention, and that such stimuli were processed at a deeper level. Similarly, this study assessed how emotionally intense images influenced attention, but in the context of webpages. Bradley's team of researchers used black and white survival-relevant emotionally intense stimuli. This study used all color pictures, which are more commonly used in news webpages, and measured responses of a greater number of participants, both male and female.

The Tuch et al. (2009) study, which investigated the effects of visual complexity in website design on cognitive and emotional processing, found that websites with high

visual complexity resulted in greater heart rate deceleration. Based on the results from previous studies, the following hypotheses were developed:

H1a-Main Effect: Participants will experience more heart rate deceleration while viewing webpages containing multiple photographs than webpages containing a single photograph.

H1b-Main Effect: Participants will experience more heart rate deceleration while viewing webpages containing photographs of high emotional intensity than photographs of low emotional intensity.

H1c-Interaction Effect: Participants will experience greater heart rate deceleration while viewing webpages containing multiple photographs of high emotional intensity.

## Emotion

Some researchers who study how individuals mentally process emotional messages work from the dimensional theoretical perspective (Osgood, Suci, & Tannenbaum, 1957), through which variations in arousal and valence are assessed during media exposure (Lang et al., 2009). Lang et al. (1999) predicts that feelings of arousal elicited by media interaction create measureable activity of the nervous system and that emotional-eliciting messages are better remembered because they increase attention as more cognitive resources are allocated during encoding.

One method for measuring emotion is through the facial muscles that produce electrical signals during muscle activity when an individual experiences negative or positive emotion. Research has found that when individuals experience unpleasant emotion, their corrugator supercilii muscles are activated, which can sometimes be seen

as a participant's eyebrows furrow. (Cacioppo, Petty, Losh, & Kim, 1986). Similarly, Bolls, Miles, & Zhang (2006) conducted a study comparing how televised anti-drug messages are emotionally processed between young adults and adolescents. In measuring emotional response, results indicated that corrugator muscle activity corresponded with negative emotional response. While assessing the impact of website complexity on emotional and cognitive processing, Tuch et al. (2009) found that websites of low complexity produced less corrugator muscle activation. The following hypotheses were developed based on previous findings:

H2a-Main Effect: Participants will experience greater corrugator muscle activation while viewing webpages containing multiple photographs than webpages with one photo.

H2b-Main Effect: Participants will experience greater corrugator muscle activation while viewing webpages containing photographs of high emotional intensity.

H2c-Interaction Effect: Participants will experience greater corrugator muscle activation while viewing webpages containing multiple photographs of high emotional intensity.

## Arousal

As mentioned above, arousal is another dimension of emotion, in addition to valence, and is assessed by measuring skin conductance level cites. According to multiple studies, appetitive and aversive motivational systems activate in accordance with arousal, which is activated by media messages containing both positive and negative emotional tone. Arousal is measured to determine emotional processing and works under the

directional view of arousal, which states that participants may vary in other physiological measures, such as heart rate, when their arousal increases. However, arousal always leads to increased skin conductance.

Codispoti, Surcinelli, & Baldaro (2008) studied how emotional films evoked changes in skin conductance and found that when viewing unpleasant films, skin conductance increased and heart rate decreased. They interpreted their results as indicators of aversive response activation and increased attentional processing.

Researchers Bradley, Greenwald, Petry, & Lang (1992) conducted a similar study but also assessed the affect of pleasantness and arousal on memory. Participants viewed pictures at varying levels of pleasantness and arousal and later completed a speed recognition test. Results indicated that the level of intensity of a picture determines how it is encoded, as highly arousing pictures that were previously encoded produced faster reaction times than pictures that elicited low arousal response. While participants' memory improved for pictures that were highly arousing, memory of pictures of varying emotional valence produced no significant results.

Referring, again, to the Tuch et al. (1993) study on the effects of visual complexity in website design on cognitive and emotional processing, it was found that websites of low complexity elicited low arousal. The following hypotheses were formed:

H3a-Main Effect: Participants will experience lower skin conductance levels while viewing webpages containing only one photo than webpages with multiple photos.

H3b-Main Effect: Participants will experience greater skin conductance levels while viewing webpages containing high emotionally intense photos.

H3c-Interaction Effect: Participants will experience greater skin conductance levels while viewing webpages containing multiple photographs of high emotional intensity.

## Memory

Researchers that use psychophysiological measurements to determine how information is processed (Zechmeister & Nyberg, 1982; Lang 2009) work under the assumption that during cognitive processing, information is transformed into a memory representation. Memory is not one broad concept that occurs in a specific place in the brain, but consists of subprocesses of encoding, retrieval, and storage. The news images used in this study varied in negative emotional intensity and may have impacted aversive processing systems, which are activated by unpleasant images. System activation may have impacted how the participant processed the information in memory during encoding, retrieval, or storage.

A study conducted by Lang, Newhagen and Reeves (1996) found that participants were able to better remember negative information because processing such information increased attention. Schimmack's (2005) study, however, produced different results. The purpose of the study was to assess the degree to which emotional pictures interfered with attention. It was predicted that negative pictures interfere with attention, regardless of their negative intensity, which is grounded in the categorical negativity theory. Results supported the assumption that negative pictures interfere with attention. Tuch et al. (2009) found that websites with low visual complexity resulted in better performance on

recognition tasks. Based on results from previous studies, the following hypotheses were developed:

H4a-Main Effect: Recognition tests for story content will be better for the single photo presentation than for the multiple photo presentation.

H4b-Main Effect: Recognition tests for story content will be better for the high emotionally intense photo presentation.

H4c-Interaction Effect: Recognition tests for story content will be better for the single photo of high emotional intensity webpage presentation.

The twelve hypotheses presented in the Table 1. were tested during an experiment in which participants' physiological responses and self-reports were measured while they interacted with media messages.

Table 1. *Hypotheses Summary*

| H# | Hypothesis | Concept | DV |
|---|---|---|---|
| 1a | Participants will experience more heart rate deceleration while viewing webpages containing multiple photographs than webpages containing a single photograph. | Attention: Main Effect | Heart rate |
| 1b | Participants will experience more heart rate deceleration while viewing webpages containing photographs of high emotional intensity than photographs of low emotional intensity. | Attention: Main Effect | Heart rate |
| 1c | Participants will experience greater heart rate deceleration while viewing webpages containing multiple photographs of high emotional intensity. | Attention: Interaction Effect | Heart rate |
| 2a | Participants will experience greater corrugator muscle activation while viewing webpages containing multiple photographs than webpages with one photo. | Negative Emotional Response: Main Effect | Facial EMG |

| | | | |
|---|---|---|---|
| 2b | Participants will experience greater corrugator muscle activation while viewing webpages containing photographs of high emotional intensity. | Negative Emotional Response: Main Effect | Facial EMG |
| 2c | Participants will experience greater corrugator muscle activation while viewing webpages containing multiple photographs of high emotional intensity. | Negative Emotional Response: Interaction Effect | Facial EMG |
| 3a | Participants will experience lower skin conductance levels while viewing webpages containing only one photo than webpages with multiple photos. | Arousal: Main Effect | Skin conductance |
| 3b | Participants will experience greater skin conductance levels while viewing webpages containing high emotionally intense photos. | Arousal: Main Effect | Skin conductance |
| 3c | Participants will experience greater skin conductance levels while viewing webpages containing multiple photographs of high emotional intensity. | Arousal: Interaction Effect | Skin conductance |
| 4a | Recognition tests for story content will be better for the single photo presentation than for the multiple photo presentation. | Memory: Main Effect | Story content recognition |
| 4b | Recognition tests for story content will be better for the high emotionally intense photo presentation. | Memory: Main Effect | Story content recognition |
| 4c | Recognition tests for story content will be better for the single photo of high emotional intensity webpage presentation. | Memory: Interaction Effect | Story content recognition |

# 3. Methodology

Based on the literature regarding the mental processing of emotional and complex stimuli, the following research question was formed: How does the interaction of webpage complexity and emotional intensity of negative images on news websites affect cognitive and emotional processing of news stories? An experiment was used to determine if there was a significant relationship between the manipulations and the dependent variables by addressing the following hypotheses:

H1a-Main Effect: Participants will experience more heart rate deceleration while viewing webpages containing multiple photographs than webpages containing a single photograph.

H1b-Main Effect: Participants will experience more heart rate deceleration while viewing webpages containing photographs of high emotional intensity than photographs of low emotional intensity.

H1c-Interaction Effect: Participants will experience greater heart rate deceleration while viewing webpages containing multiple photographs of high emotional intensity.

H2a-Main Effect: Participants will experience greater corrugator muscle activation while viewing webpages containing multiple photographs than webpages with one photo.

H2b-Main Effect: Participants will experience greater corrugator muscle activation while viewing webpages containing photographs of high emotional intensity.

H2c-Interaction Effect: Participants will experience greater corrugator muscle activation while viewing webpages containing multiple photographs of high emotional intensity.

H3a-Main Effect: Participants will experience lower skin conductance levels while viewing webpages containing only one photo than webpages with multiple photos.

H3b-Main Effect: Participants will experience greater skin conductance levels while viewing webpages containing high emotionally intense photos.

H3c-Interaction Effect: Participants will experience greater skin conductance levels while viewing webpages containing multiple photographs of high emotional intensity.

H4a-Main Effect: Recognition tests for story content will be better for the single photo presentation than for the multiple photo presentation.

H4b-Main Effect: Recognition tests for story content will be better for the high emotionally intense photo presentation.

H4c-Interaction Effect: Recognition tests for story content will be better for the single photo of high emotional intensity webpage presentation.

The experiment was a 2 (negative emotional intensity of images: low, high) x 2 (image complexity: 1 or 3 images), within-subjects design. Participants viewed four mock news webpages, each containing a different news story and one or three corresponding images. Participants viewed the webpages at a randomized order.

## Independent Variables

Webpage complexity and image emotional intensity were the independent variables used in this study. Webpage complexity was manipulated by the use of a single photo or three photos of the same emotional intensity that corresponded with an online news story.

The negative emotional intensity of the images was manipulated at two levels: low and high. The emotional intensity of the images was determined using the International Affective Picture System (IAPS).

## Dependent Variables

Attention: Attention refers to the amount of resources allocated in order to encode a message. Heart rate was used to measure attention while participants interacted with the news websites. A standard Ag/AgCl floating electrode to record heart rate was filled with electrode gel, then placed on the right and left forearms of each participant. Before placement, participants' arms were cleaned with alcohol pads. A ground electrode was placed on the participant's left forearm. Heart rate was collected in milliseconds, measured during participant interaction with the websites, and averaged in beats per minute across one minute and 20 seconds, as this allowed participants enough time to read the news story and view images on each webpage. A decrease in heart rate, accompanied by better recognition, indicated increased attention.

Emotion: Emotion is the level of valence, pleasantness or unpleasantness, a stimulus elicits during interaction with media messages. Emotional response has been shown to be associated with one's ability to encode messages (Lang et al., 2009). This study measured emotion in two ways: self-report and facial EMG of the corrugator muscle, which only measures unpleasantness. After viewing each mock news webpage, participants rated their level of unpleasantness on a 9-point scale, one being not unpleasant, and nine being very unpleasant. They also rated their level of pleasantness on a 9-point scale, one being not very pleasant, and nine being very pleasant.

To measure facial EMG of the corrugator muscle, the area directly above the participant's inner left brow was cleaned with an alcohol swab, then exfoliated with a scrub to remove oil and dirt. Two standard Ag/AgCl electrodes filled with electrode gel were placed over the area of the muscle. As studies have shown, electrical signals produced by the corrugator muscle have been shown to be associated with negative emotional response (Bolls, Miles, & Zhang, 2006). Negative emotional response indicated when participants experienced negative emotion while interacting with each of the four presentations, which reflect the level of unpleasantness they experienced for each presentation.

Arousal*:* Arousal refers to the emotional state that ranges from calm to excited. It was measured in two ways: self-report and skin conductance levels. After viewing each mock news webpage, participants rated their level of arousal on a 9-point scale, one being calm, and nine being excited.

Skin conductance levels were also measured to determine participants' arousal while interacting with the media. Skin conductance indicates the level of activation of the sympathetic nervous system, specifically, the eccrine sweat gland, which has been shown to be associated with psychological sweating (Potter & Bolls, 2012). Participants were instructed to wash their hands with soap and water and dry them with a paper towel before electrode placement. Two Ag/AgCl electrodes, filled with skin conductance gel, were placed on the palm of the participants' dominant hand. Data was measured during participant interaction with the websites and averaged over a period of time. Increased arousal indicated when a participant experienced calmness or excitement while interacting with media, and has been shown to be associated with one's ability to encode messages (Lang et al. 1999).

Memory*:* Memory refers to one's ability to encode, retrieve and store information obtained from media messages. This study assessed how memorable news messages were when presented with the manipulations of this study. A multiple-choice recognition test was used to determine how well participants encoded information from the stories. Before completing the recognition test, participants viewed a short, unrelated distraction video in order to clear the contents from short-term memory (Potter & Bolls, 2012). Participants responded to 20 multiple-choice questions after viewing all four webpages. Conditions resulting in the greatest amount of correct responses indicated the message that was encoded the best.

## Procedure

This experiment took place at the PRIME (psychological research on information and media effects) Lab at the University of Missouri. Psychophysiological data was collected using the lab's equipment. Fifty-seven participants from university classes were recruited for the study. Before skin preparation, participants signed a consent form, washed their hands with soap and water, then sat in a lounge chair.

Participants remained in the chair for the duration of the study and were given a mouse and keyboard. MediaLab was used to present the media messages that were displayed on a television screen. Prior to each stimulus, baseline data for each physiological measure was collected for five seconds. This served as an indicator of the participant's heart rate, corrugator, and skin conductance level at a relaxed state, then was compared with the other data points in order to measure where significant changes in physiological responses took place. Participants were prompted to spend one minute and 20 seconds viewing each of four mock webpages and to read the news story. Each message contained a different news story and imagery, representing the following four conditions: one image of low emotional intensity, one image of high emotional intensity, three images of low emotional intensity, three images of high emotional intensity. Each image presentation was presented with one of the four news stories and webpages were presented in a randomized order. After each news story, participants used the keyboard and mouse to complete the arousal and valence self-reports using 9-point scales. After reading all four stories, participants viewed a distraction video, then answered 20 multiple-choice questions. After completing the recognition test, participants were debriefed, thanked, then dismissed.

In order to determine which images represented low or high emotional intensity to be used in the mock webpages, images were selected from the IAPS. These images, rated for arousal and pleasantness, were chosen to represent low and high negative intensity based on moderate arousal ratings and low pleasantness ratings.

# 4. Results

Using SPSS, a 2 (low vs. high intensity level) x 2 (1 vs. 3 photos) x 80 (seconds) repeated measures ANOVA was run to analyze the physiological data. A 2 (low vs. high intensity level) x 2 (1 vs. 3 photos) repeated measures ANOVA was run to analyze the self-report data. To clean the data, data points that were more or less than 10 units from the previous data point were changed to match the previous data point or averaged between the preceding and following data point. Outlier data were cleaned similarly. Fifty-seven people participated in this study and were used in the physiological data analysis. Change scores of the physiological data were analyzed. These scores were calculated by finding the difference between the data point and the fifth baseline score. These changes scores represented where an actual physiological change took place. These same participants also provided data via self-reports in order to analyze valence and arousal.

## Hypothesis 1a

Hypothesis 1a predicted a main effect for webpage complexity that participants would experience more heart rate deceleration while viewing webpages containing multiple photographs than webpages containing a single photograph. The mean heart rate of participants who viewed webpages with one photo was compared to the mean heart rate of participants who viewed webpages with three photos. No significant difference was found ($F(1,56)=.291$, $p=.591$, partial $\eta^2=.005$). Heart rate levels of participants who viewed webpages with one photo did not differ significantly from heart rate levels of

participants who viewed webpages with three photos. Participants who viewed webpages with one photo had a mean heart rate level of -0.28 (*sd*=6.24). Participants who viewed webpages with three photos had a mean heart rate level of 0.01 (*sd*=6.61). Therefore, this hypothesis was not supported.

Hypothesis 1b

Hypothesis 1b predicted a main effect for photo intensity that participants would experience more heart rate deceleration while viewing webpages containing photographs of high emotional intensity than photos of low emotional intensity. The mean heart rate of participants who viewed webpages with low emotional intensity photos was compared to the mean heart rate of participants who viewed webpages with high emotional intensity photos. No significant difference was found ($F(1,56)=1.497$, $p=.226$, partial $\eta^2=.026$). Heart rate levels of participants who viewed webpages with low intensity photos did not differ significantly from heart rate levels of participants who viewed webpages with high intensity photos. Participants who viewed webpages with low intensity photos had a mean heart rate level of 0.21 (*sd=6.35*). Participants who viewed webpages with high intensity photos had a mean heart rate level of -0.47 (*sd*=6.59). This hypothesis was also not supported.

Hypothesis 1c

Hypothesis 1c predicted an interaction for webpage complexity and photo intensity that participants would experience greater heart rate deceleration while viewing webpages containing multiple photographs of high emotional intensity. The mean heart

rate of participants was compared among the four webpage conditions: one low intensity photo, three low intensity photos, one high intensity photo, three high intensity photos. No significant interaction was found ($F(1,56)=.380$, $p=.540$, partial $\eta^2=.007$). Participants who viewed webpages with one low intensity photo had a mean heart rate level of -0.17 (*sd*=6.59). Participants who viewed webpages with one high intensity photo had a mean heart rate level of -0.38 (*sd*=6.06). Participants who viewed webpages with three low intensity photos had a mean heart rate level of 0.59 (*sd*=6.10). Participants who viewed webpages with three high intensity photos had a mean heart rate level of -0.56 (*sd*=7.12). This hypothesis was not supported.

Table 2. *Mean Heart Rate of Participants by Webpage Complexity, Photo Intensity, and the Interaction of Both (with Standard Deviations in Parentheses)*

| | Heart Rate | | |
|---|---|---|---|
| Webpage Complexity | | Photo Intensity | |
| 1 photo | -0.28 (6.24) | Low | 0.21 (6.35) |
| 3 photos | 0.01 (6.61) | High | -0.47 (6.59) |

Interaction

| Webpage Complexity | Photo Intensity | |
|---|---|---|
| | Low | High |
| 1 photo | -0.17 (6.59) | -0.38 (6.06) |
| 3 photos | 0.59 (6.10) | -0.56 (7.12) |

Self-report data for unpleasant emotion was used to determine whether Hypotheses 2a, 2b, and 2c were supported. Problems with measuring corrugator activation occurred during the data collection process; therefore, results of these data will not be discussed. A 2 (low vs. high intensity level) x 2 (1 vs. 3 photos) repeated measures ANOVA was run to test for significance for the unpleasant and pleasant valence self-reports.

Hypothesis 2a

Hypothesis 2a predicted a main effect for webpage complexity that participants would experience greater unpleasant emotion while viewing webpages containing multiple photographs than webpages with one photo. Unpleasant valence of participants who viewed webpages with one photo was compared to the unpleasant valence of participants who viewed webpages with three photos. A significant difference in unpleasant valence was found ($F(1,56)=5.88$, $p=.02$, partial $\eta^2=.10$). Participants who viewed webpages with three photos reported experiencing greater unpleasant emotion. Participants who viewed webpages with one photo had a mean unpleasant valence of 5.53 (*sd*=2.23). Participants who viewed webpages with three photos had a mean unpleasant valence of 6.06 (*sd*=2.13). Therefore, stories with three photos were rated more unpleasant than stories with one photo, which supports this hypothesis.

Results from the pleasant valence self-reports indicated the reverse. Pleasant valence of participants who viewed webpages with one photo was compared to the pleasant valence of participants who viewed webpages with three photos. A significant difference in pleasant valence was found ($F(1,56)=7.03$, $p=.01$, partial $\eta^2=.11$).

Participants who viewed webpages with one photo reported experiencing greater pleasant emotion. Participants who viewed webpages with one photo had a mean pleasant valence of 4.24 (*sd*=2.23). Participants who viewed webpages with three photos had a mean pleasant valence of 3.67 (*sd*=2.23). This result provides indirect support for this hypothesis.

Hypothesis 2b

Hypothesis 2b predicted a main effect for photo intensity that participants would experience greater unpleasant emotion while viewing webpages containing photographs of high emotional intensity. Unpleasant valence of participants who viewed webpages with low intensity photos was compared to the unpleasant valence of participants who viewed webpages with high intensity photos. A significant difference in unpleasant valence was found ($F(1,56)=4.24$, $p=.04$ partial $\eta^2=.07$). Participants who viewed webpages with high intensity photos reported experiencing greater unpleasant emotion. Participants who viewed webpages with low intensity photos had a mean unpleasant valence of 5.59 (*sd*=2.17). Participants who viewed websites with high intensity photos had a mean unpleasant valence of 6.0 (*sd*=2.17). This hypothesis was supported.

Results from the pleasant valence self-reports provide no support for this hypothesis. Pleasant valence of participants who viewed webpages with low intensity photos was compared to the pleasant valence of participants who viewed webpages with high intensity photos. No significant difference in pleasant valence was found ($F(1,56)=.31$, $p=.58$, partial $\eta^2=.01$). Participants who viewed webpages with low

intensity photos had a mean pleasant valence of 4.01 (*sd*=2.17). Participants who viewed websites with high intensity photos had a mean pleasant valence of 3.89 (*sd*=2.30).

Hypothesis 2c

Hypothesis 2c predicted an interaction for webpage complexity and photo intensity that participants would experience greater unpleasant emotion while viewing webpages containing multiple photos of high emotional intensity. No significance in unpleasant valence was found in the interaction of photo intensity and webpage complexity ($F(1,56)= .66$, $p=.42$ partial $\eta^2=.012$). Participants who viewed webpages with one low intensity photo had a mean unpleasant valence of 5.49 (*sd*=2.17). Participants who viewed webpages with one high intensity photo had a mean unpleasant valence of 5.56 (*sd*=2.26). Participants who viewed webpages with three low intensity photos had a mean unpleasant valence of 5.68 (*sd*=2.16). Participants who viewed webpages with three high intensity photos had a mean unpleasant valence of 6.44 (*sd*=2.09). This hypothesis was not supported.

Results from the pleasant valence self-reports indicate no significance in pleasant valence was found in the interaction of photo intensity and webpage complexity ($F(1,56)= .53$, $p=.47$, partial $\eta^2=.009$). Participants who viewed webpages with one low intensity photo had a mean pleasant valence of 4.12 (*sd*=2.10). Participants who viewed webpages with one high intensity photo had a mean pleasant valence of 4.35 (*sd*=2.37). Participants who viewed webpages with three low intensity photos had a mean pleasant valence of 3.89 (*sd*=2.23). Participants who viewed webpages with three high intensity photos had a mean pleasant valence of 3.44 (*sd*=2.23).

Table 3. *Mean Self-reported Unpleasant Valence of Participants by Webpage Complexity, Photo Intensity, and the Interaction of Both (with Standard Deviations in Parentheses)*

| | Unpleasant Valence | | |
|---|---|---|---|
| Webpage Complexity | | Photo Intensity | |
| 1 photo | *5.53 (2.23) | Low | *5.59 (2.17) |
| 3 photos | *6.06 (2.13) | High | *6.00 (2.17) |

| | Interaction | |
|---|---|---|
| Webpage Complexity | Photo Intensity | |
| | Low | High |
| 1 photo | 5.49 (2.17) | 5.56 (2.26) |
| 3 photos | 5.68 (2.16) | 6.44 (2.09) |

*Significant at 0.05 level within each main effect

Table 4. *Mean Self-reported Pleasant Valence of Participants by Webpage Complexity, Photo Intensity, and the Interaction of Both (with Standard Deviations in Parentheses)*

| | Pleasant Valence | | |
|---|---|---|---|
| Webpage Complexity | | Photo Intensity | |
| 1 photo | *4.24 (2.23) | Low | 4.01 (2,17) |
| 3 photos | *3.67 (2.23) | High | 3.89 (2.30) |

| | Interaction | |
|---|---|---|
| Webpage Complexity | Photo Intensity | |
| | Low | High |
| 1 photo | 4.12 (2.10) | 4.35 (2.37) |
| 3 photos | 3.89 (2.23) | 3.44 (2.23) |

*Significant at 0.05 level within the main effect

Hypothesis 3a

Hypothesis 3a predicted a main effect for webpage complexity that participants would experience lower skin conductance levels while viewing webpages containing one photograph than webpages containing a multiple photographs. The mean skin conductance level of participants who viewed webpages with one photo was compared to the mean skin conductance level of participants who viewed webpages with three photos. No significant difference was found ($F(1,56)=.003$, $p=.955$, partial $\eta^2=.000$). Skin

conductance levels of participants who viewed webpages with one photo did not differ significantly from skin conductance levels of participants who viewed webpages with three photos. Participants who viewed webpages with one photo had a mean skin conductance level of 0.01 (*sd*=0.12). Participants who viewed webpages with three photos had a mean skin conductance level of 0.02 (*sd*=0.15). The hypothesis was not supported.

The arousal self-report data were also analyzed for this main effect of webpage complexity. The mean arousal level of participants who viewed webpages with one photo was compared to the mean arousal level of participants who viewed webpages with three photos. No significant difference was found ($F(1,56)= .52$, $p= .47$, partial $\eta^2=.01$). Arousal levels of participants who viewed webpages with one photo did not differ significantly from arousal levels of participants who viewed websites with three photos. Participants who viewed webpages with one photo had a mean arousal level of 4.60 (*sd*=1.74). Participants who viewed webpages with three photos had a mean arousal level of 4.72 (*sd*=1.91). The hypothesis was not supported.

Hypothesis 3b

Hypothesis 3b predicted a main effect for photo intensity that participants would experience greater skin conductance levels while viewing webpages containing high emotionally intense photos than webpages containing low emotionally intense photos. The mean skin conductance level of participants who viewed webpages with high emotionally intense photos was compared to the skin conductance level of participants who viewed webpages with low emotionally intense photos. No significant difference

was found (F(1,56)=1.581, p=.214, partial $\eta^2$=.027). Skin conductance levels of participants who viewed webpages with low emotionally intense photos did not differ significantly from skin conductance levels of participants who viewed webpages with high emotionally intense photos. Participants who viewed webpages with low emotionally intense photos had a mean skin conductance level of 0.02 (*sd*=0.14). Participants who viewed webpages with high emotionally intense photos had a mean skin conductance level of 0.01 (*sd*=0.13). The hypothesis was not supported.

The arousal self-report data was also analyzed for this main effect of photo intensity. The mean arousal level of participants who viewed webpages with low intensity photos was compared to the mean arousal level of participants who viewed webpages with high intensity photos. No significant difference was found (F(1,56)= 1.52, p= .22, partial $\eta^2$=.03). Arousal levels of participants who viewed webpages with low intensity photos did not differ significantly from arousal levels of participants who viewed websites with high intensity photos. Participants who viewed webpages with low intensity photos had a mean arousal level of 4.57 (*sd*=1.76). Participants who viewed webpages with high intensity photos had a mean arousal level of 4.75 (*sd*=1.89). The hypothesis was not supported.

Hypothesis 3c

Hypothesis 3c predicted an interaction effect for webpage complexity and photo intensity that participants would experience greater skin conductance levels while viewing webpages containing multiple photographs of high emotional intensity. Mean skin conductance levels of participants were compared among the four webpage

conditions: one low intensity photo, three low intensity photos, one high intensity photo, three high intensity photos. No significant difference was found ($F(1,56)=.136$, $p=.714$, partial $\eta^2=.002$). Participants who viewed webpages with one low intensity photo had a mean skin conductance level of 0.02 (*sd*=0.12). Participants who viewed webpages with one high intensity photo had a mean skin conductance level of 0.01 (*sd*=0.12). Participants who viewed webpages with three low intensity photos had a mean skin conductance level of 0.03 (*sd*=0.16). Participants who viewed webpages with three high intensity photos had a mean skin conductance level of 0.01 (*sd*=0.13). The hypothesis was not supported.

The arousal self-report data was also analyzed for this interaction effect of photo intensity and webpage complexity. The mean arousal level of participants were compared among the four webpage conditions: one low intensity photo, three low intensity photos, one high intensity photo, three high intensity photos. No significant difference was found ($F(1,56)= .020$, $p=.89$ partial $\eta^2=.000$). Participants who viewed webpages with one low intensity photo had a mean arousal level of 4.49 (*sd*=1.79). Participants who viewed webpages with one high intensity photo had a mean arousal level of 4.70 (*sd*=1.68). Participants who viewed webpages with three low intensity photos had a mean arousal level of 4.65 (*sd*=1.72). Participants who viewed webpages with three high intensity photos had a mean arousal level of 4.79 (*sd*=2.09). Therefore, the hypothesis was not supported according.

Table 5. *Mean Skin Conductance of Participants by Webpage Complexity, Photo Intensity, and the Interaction of Both (with Standard Deviations in Parentheses)*

| | Skin Conductance | | |
|---|---|---|---|
| Webpage Complexity | Photo Intensity | | |
| 1 photo | 0.02 (0.12) | Low | 0.02 (0.14) |
| 3 photos | 0.02 (0.15) | High | 0.01 (0.12) |

| Interaction | | |
|---|---|---|
| Webpage Complexity | Photo Intensity | |
| | Low | High |
| 1 photo | 0.02 (0.12) | 0.01 (0.12) |
| 3 photos | 0.03 (0.16) | 0.01 (0.13) |

Table 6. *Mean Self-reported Arousal of Participants by Webpage Complexity, Photo Intensity, and the Interaction of Both (with Standard Deviations in Parentheses)*

| | Arousal | | |
|---|---|---|---|
| Webpage Complexity | | Photo Intensity | |
| 1 photo | 4.60 (1.74) | Low | 4.57 (1.76) |
| 3 photos | 4.72 (1.91) | High | 4.75 (1.89) |

| Interaction | | |
|---|---|---|
| Webpage Complexity | Photo Intensity | |
| | Low | High |
| 1 photo | 4.49 (1.79) | 4.70 (1.68) |
| 3 photos | 4.65 (1.72) | 4.79 (2.09) |

Hypothesis 4a

Hypothesis 4a predicted a main effect for recognition tests that participants would score better for the single photo presentation than for the multiple photo presentation. The mean recognition score of participants who viewed webpages with one photo was compared to the mean recognition score of participants who viewed webpages with three photos. A significant difference was found ($F(1,56)=8.115$, $p= .006$, partial $\eta^2=.127$). Recognition of participants who viewed webpages with one photo was significantly better than the recognition of participants who viewed webpages with three photos. Participants who viewed webpages with one photo had a mean recognition score of 3.33

(*sd*=1.18). Participants who viewed webpages with three photos had a mean recognition score of 2.97 (*sd*=1.13). The hypothesis was supported.

Hypothesis 4b

Hypothesis 4b predicted a main effect for recognition tests that participants would score better on recognition tests for story content from webpages with high emotionally intense photos than on recognition tests for story content from webpages with low emotionally intense photos. The mean recognition score of participants who viewed webpages with high intensity photos was compared to the mean recognition score of participants who viewed webpages with low intensity photos. No significant difference was found ($F(1,56)=1.438$, $p=.236$, partial $\eta^2=.025$). Participants who viewed webpages with high intensity photos had a mean recognition score of 3.07 (*sd*=1.15). Participants who viewed webpages with low intensity photos had a mean recognition score of 3.23 (*sd*=1.16). The hypothesis was not supported.

Hypothesis 4c

Hypothesis 4c predicted an interaction effect for webpage complexity and photo intensity that recognition tests for story content would be better for the single photo of high emotional intensity webpage presentation. Mean recognition scores of participants were compared among the four webpage conditions: one low intensity photo, three low intensity photos, one high intensity photo, three high intensity photos. No significant difference was found ($F(1,56)=.003$, $p=.955$, partial $\eta^2=.000$). Participants who viewed webpages with one low intensity photo had a mean recognition score of 3.40 (*sd*=1.13).

Participants who viewed webpages with one high intensity photo had a mean recognition score of 3.25 (*sd*=1.23). Participants who viewed webpages with three low intensity photos had a mean recognition score of 3.05 (*sd*=1.19). Participants who viewed webpages with three high intensity photos had a mean recognition score of 2.88 (*sd*=1.07). The hypothesis was not supported.

Table 7. *Mean Recognition Score of Participants by Webpage Complexity, Photo Intensity, and the Interaction of Both (with Standard Deviations in Parentheses)*

| | Recognition | | |
|---|---|---|---|
| Webpage Complexity | Photo Intensity | | |
| 1 photo | *3.33 (1.18) | Low | 3.23 (1.16) |
| 3 photos | *2.97 (1.13) | High | 3.07 (1.15) |

| Interaction | | |
|---|---|---|
| Webpage Complexity | Photo Intensity | |
| | Low | High |
| 1 photo | 3.40 (1.13) | 3.25 (1.23) |
| 3 photos | 3.05 (1.19) | 2.88 (1.07) |

*Significant at 0.05 level within the main effect

# 5. Discussion

## Overview

The main purpose of this study was to examine the effects of webpage complexity and emotional intensity of photos on attention, arousal, emotion, and memory. It was hypothesized that attention, negative emotional response, and arousal would be the greatest for participants who viewed webpages with multiple photos and webpages containing high negative emotional intensity. Memory, however, was hypothesized to be better for participants who viewed webpages with only one photo and webpages with the high emotionally intense photo presentation because of cognitive overload. Results of the hypotheses tests are summarized in Table 8 below.

No significant effects were found among the physiological data. The significant effects found among the self-report data were: main effects of webpage complexity on unpleasant emotion; main effects of photo complexity on unpleasant emotion; and a main effect of webpage complexity on memory of story content.

Media industry professionals aim to produce media messages effective in grabbing the attention of their readers and maintaining that attention to influence whether readers read a news story in its entirety and how much of that story they remember.

Table 8. *Results Summary*

| H# | Hypothesis | Concept | DV | Finding | Supported |
|---|---|---|---|---|---|
| 1a | Participants will experience more heart rate deceleration while viewing webpages with multiple photographs than webpages containing a single photograph. | Attention: Main Effect | Heart rate | No significant results. | No |
| 1b | Participants will experience more heart rate deceleration while viewing webpages containing photographs of high emotional intensity than photographs of low emotional intensity. | Attention: Main Effect | Heart rate | No significant results. | No |
| 1c | Participants will experience greater heart rate deceleration while viewing webpages containing multiple photographs of high emotional intensity. | Attention: Interaction Effect | Heart rate | No significant results. | No |
| 2a | Participants will experience greater negative emotion while viewing webpages containing multiple photographs than webpages with one photo. | Negative Emotional Response: Main Effect | Facial EMG | Unpleasant emotional response was greater for websites containing multiple photos. | Yes |
| 2b | Participants will experience greater negative emotion while viewing webpages containing photographs of high emotional intensity. | Negative Emotional Response: Main Effect | Facial EMG | Unpleasant emotional response was greater for websites containing high | Yes |

| | | | | | |
|---|---|---|---|---|---|
| | | | | intensity photos. | |
| 2c | Participants will experience greater negative emotion while viewing webpages containing multiple photographs of high emotional intensity. | Negative Emotional Response: Interaction Effect | Facial EMG | No significant results. | No |
| 3a | Participants will experience lower skin conductance levels while viewing webpages containing only one photo than webpages with multiple photos. | Arousal: Main Effect | Skin conductance | No significant results. | No |
| 3b | Participants will experience greater skin conductance levels while viewing webpages containing high emotionally intense photos. | Arousal: Main Effect | Skin conductance | No significant results. | No |
| 3c | Participants will experience greater skin conductance levels while viewing webpages containing multiple photographs of high emotional intensity. | Arousal: Interaction Effect | Skin conductance | No significant results. | No |
| 4a | Recognition tests for story content will be better for the single photo presentation than for the multiple photo presentation. | Memory: Main Effect | Story content recognition | Memory of story content was higher for websites containing one photo. | Yes |
| 4b | Recognition tests for story content will be better for the high emotionally intense photo presentation. | Memory: Main Effect | Story content recognition | No significant results. | No |

| | | | | | |
|---|---|---|---|---|---|
| 4c | Recognition tests for story content will be better for the single photo of high emotional intensity webpage presentation. | Memory: Interaction Effect | Story content recognition | No significant results. | No |

Attention

Heart rate was used to measure resources allocated to encoding (attention) in order to determine whether participants' attention increased or decreased during exposure to the webpages. This measure occurs moment-by-moment so that it captures the participant's heart rate at the same time they are interacting with the media message. This is important because message processing is impacted by prior events, interactions, and by anticipated events and interactions. The mental processes and psychological states are constantly changing; therefore, psychophysiological measures should be taken constantly during media exposure. Heart rate acceleration indicates a decrease in attention, whereas heart rate deceleration indicates an increase in attention. It was predicted that attention would increase, indicated by a heart rate deceleration, for participants viewing webpages with multiple photos of high negative emotional intensity. Previous studies (Tuch et al., 2009) have shown that visual complexity resulted in greater heart rate deceleration and also that heart rate decelerates more when processing negative messages (Shoemaker, 1996). However, the results of the current study indicate that neither of these variables (webpage complexity and negative intensity) caused a significant increase in heart rate deceleration.

Emotion

Unpleasant and pleasant self-report data were used to measure emotional response, as corrugator data collection contained errors. An increase in unpleasant valence indicates an increase in perceived negative emotional response, as an increase in pleasant valence indicates an increase in perceived positive emotional response.

Participants rated their level of positive and negative emotional response (valence) after viewing each of the four webpages by using a 9-point scale for each, with one being very negative and nine being not at all negative; and one being not at all positive and nine being very positive. This measure occurred only after the participants' interaction with the media message. This is important because had they been prompted to respond to a self-report measure during the message, their cognitive processes would have been interrupted in order to answer the question and, therefore, may not reflect their purest psychophysiological state used for processing the message. Unlike psychophysiological data, however, self-reports of valence reflect the participants' perception of the feelings and thoughts they had at the time of message exposure. Negative emotion may have changed during the minute and 20 seconds that the participants viewed the webpages, in addition to the possibility that participants may not have accurately remembered their initial emotional response to the stimuli, as the self-report is a post-hoc appraisal.

It was predicted that unpleasant emotional response would be greater for participants who viewed webpages containing multiple photos and photos with high negative emotional intensity. A significant main effect of webpage complexity on unpleasant emotion indicated that participants who viewed webpages with three photos

experienced greatest unpleasant emotion, while those who viewed webpages with one photo experienced the reverse, greatest pleasant emotion. Therefore, participants perceived themselves as having greater pleasant emotion when viewing less complex websites. These results are similar to those from the study conducted by Tuch et al. (2009), which also found that websites with less complexity were more pleasurable.

A significant main effect of photo intensity indicated that participants experienced greater unpleasant emotion when viewing webpages with high intensity photos. While results revealed a significant main effect for both webpage complexity and photo intensity, there was not a significant interaction effect.

## Arousal

Skin conductance levels and self-report data were used to measure arousal. An increase in skin conductance levels and frequency indicates an increase in arousal. Similar to the heart rate measure, skin conductance was measured while the participants viewed the webpages so that significant changes in arousal were captured at the time of their occurrence. Participants rated their arousal level via self-report after viewing each of the four webpages by using a 9-point scale, with one being calm and nine being excited. Similar to the self-report for valence, participants were prompted to report their perception and memory of how calm or excited they after they had been exposed to the stimuli.

It was predicted that skin conductance levels would be greater for participants who viewed webpages containing multiple photos of high emotional intensity. Results

produced no significant differences in skin conductance among participants from the four conditions.

Results from the self-reports also did not indicate a significant main or interaction effect of photo intensity and webpage complexity on arousal. This means participants did not perceive a significant difference in arousal when viewing webpages from each of the four conditions.

## Memory

To measure memory, participants answered 20 multiple-choice recognition questions, five questions from each website, all of which pertained to the news story content. Participants were prompted to answer the questions after viewing all four websites and a distractor video so that stored information from the stories was measured, instead of short-term memory. A high percentage correct indicates greater memory of the news story content. It was predicted that memory would be better for participants who viewed websites containing a single photo and high intensity photos. A significant main effect was found of the memory of participants who viewed webpages containing a single photo. Participants who viewed webpages with only one photo performed better on the recognition test than participants who viewed webpages with multiple photos of either high or low emotional intensity. This implies that story content on webpages containing one photo will be better remembered than story content from webpages containing multiple supplemental.

Tuch et al. (2009) found that websites with less complexity were more pleasurable and better remembered, which did not support Berlyne's aesthetic theory. As

the current study also found that webpages with low complexity were more pleasurable and better remembered, the results also do not support Berlyne's theory.

Working under the LC4MP, it was assumed that photos of highly negative emotional intensity would activate participants' aversive motivational system, thus increasing resource allocation (attention) in processing the news story and increasing memory of the story content. However, there was no significant main effect for memory of participants who viewed webpages with high emotionally intense photos. The fact that the results found significance in memory for webpages containing only one image fits under the model's assumption that if too much information is processed at once, participants will experience mental overload, thus reducing memory. Therefore, this study supports the LC4MP, as participants experienced processing overload while viewing webpages with multiple highly emotional photos.

## Industry Implications

A primary goal of the on-line news industry is to effectively communicate news stories using text, photographs, audio, or a combination of these through the use of multimedia presentations. Professionals need to have an understanding behind the mental and emotional processes that play a role in how the message is perceived and how it is remembered in order to understand how to make a story most effective and memorable for the reader.

When photo editors and webpage designers in a newsroom decide upon what photographs to include with text, they should base their decisions upon their desired goal. Since the results of this study produced a significant main effect of webpage complexity

(number of photos used) on memory of the story content, it is suggested that professionals consider using only a single image, verses multiple images, to supplement a news story. Based on the significant main effects on unpleasant emotion, it is suggested that if the desired outcome is for readers to experience pleasant emotion, professionals should consider using one low negative intensity photo.

## Limitations

As this experiment took place in a lab, participants were not in a context in which they would ordinarily read on-line news; therefore, this factor may contribute to a loss of external validity. Participants may not have read news stories completely if they had not been prompted to do so as they were in this experiment. These factors may have produced different results for the dependent variables had participants been in their own environments. Internal validity, however, was strengthened in a lab setting, as the variables and environment was controlled and consistent among participants.

Another limitation was the realistic level of the stimuli presentations. The independent variables of this study were the number of photos used and the negative emotional intensity of those photos. Typical websites include multiple links, graphics, and advertisements. If these visuals had been added to the webpages to make them appear more realistic, those would serve as additional variables, which this study did not aim to assess.

Lastly, the images chosen to represent low and high levels of negative emotional intensity were chosen from the International Affective Picture System (IAPS), which provides a set of normative emotional visual stimuli that are outdated and, therefore, do

not accurately represent how the age group of the participants in this study might have rated them for negative emotion. The level of negative emotional intensity of the IAPS photos may not have been significant. In addition, limitations due to the possibility of unreliable physiological measures may have influenced the lack of significant results. Unreliability of these measures might be due to improper placement of the electrodes or signal noise due to surrounding electronic equipment.

## Future Research

To continue contributing to the knowledge of the field of journalism and psychophysiology research, further research can answer additional questions related to this study. For example, how does the interaction of photos, the emotional intensity of those photos, and advertisements influence the way in which an on-line message, whether in news or entertainment, is mentally and emotionally processed? How do these interactions influence memory?

Study of these elements as main effects and their interactions can be conducted in any media context, across multiple platforms, in order to determine the most effective approach and design for each platform and message. Also, conducting these studies among different age groups would also provide useful information for professionals when determining how to communicate most effectively with a particular age group.

Another type of manipulation related to the current study that future research could examine is the news content itself. Researchers could follow the same experimental design as the current study but manipulate the story content to soft news, hard news, local news, national news, or international news, for example. As readers of online news are

attentive to news that pertains to them personally, further research could examine how the news content influences cognitive and emotional processing of that news.

## Conclusion

While research has been conducted to assess how visual elements affect memory and comprehension of a news story, this study adds to the body of knowledge by assessing how a specific number of photos, the negative emotional intensity level of those photos, and the interactions of these variables influence message processing and memory, specifically for on-line news.

This study opens the door to many additional research questions that pertain to how visuals can be most effectively used with media messages. It also illustrates how visuals that are assumed to have a significant impact on message processing may not significantly impact how a message is processed and remembered.

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# APPENDIX

## Stimuli

| | 1 Photo | |
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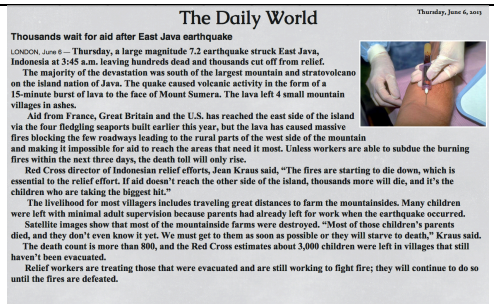
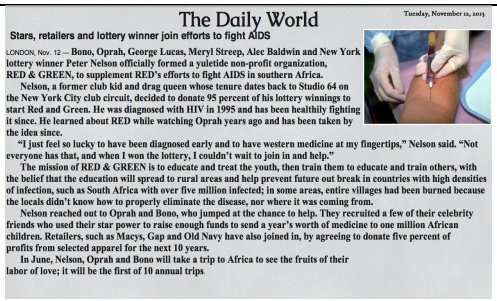
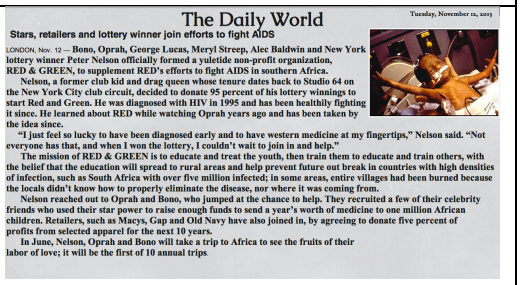
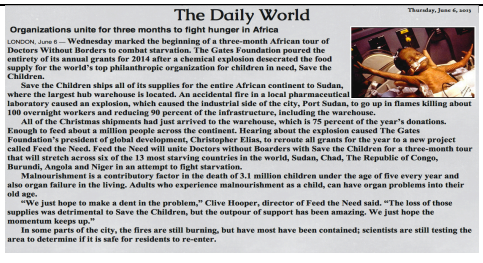
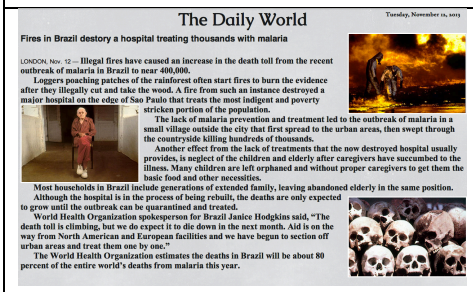
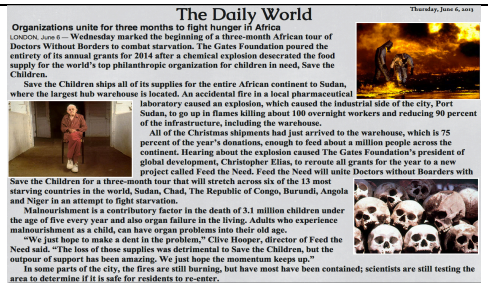
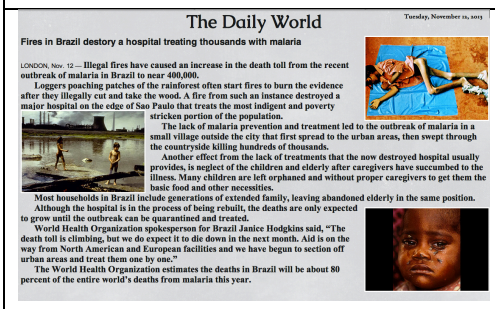
| Low Intensity |  |  |
| |  |  |
| High Intensity |  |  |
| |  |  |

| | 3 Photos | |
|---|---|---|
| Low Intensity |  |  |
| |  |  |
| High Intensity |  |  |
| |  |  |