Road Kill: The Impact of Aversive Highway Safety Videos on Message Processing

Introduction

The task of persuading individuals to engage in healthy behaviors through public health campaign messages hinges on the effective use of emotional content. The important role emotional processes play in persuasion has been recognized in respected theories of persuasion such as the Elaboration Likelihood Model and Extended Parallel Process Model. Emotional content in messages needs to be designed to motivationally engage targeted individuals in mentally processing and evaluating messages in a way that increases the likelihood of healthy decision making. This view is consistent with recent theorizing in advertising and consumer psychology that human emotion and motivational processes are at the very core of persuasion in general, let alone health persuasion (Du Plessis, 2008.) Health communication campaign messages feature a range of both emotionally pleasant and unpleasant content. However, employing strategic methods when producing and presenting emotional content is likely to positively impact message effectiveness. The manner in which emotional content is produced and presented affects how individuals mentally process and respond to messages, ultimately shaping responses to the message. This study is designed to help health communication professionals by providing insight into how variation in the existence and placement of emotional content presented in traffic safety video ads affects mental processing of the message and emerging message perceptions.

The instant-by-instant flow of attention and emotion during exposure to health messages is the best indicator of how messages are being mentally processed. Psychophysiological measures – indices of mental processes as revealed by physiological activity – have become a well-established part of the media researcher's tool box enabling "real-time" observation of how

media messages are mentally processed (Barthalow & Bolls, 2012; Lang, Potter, & Bolls, 2012, Potter & Bolls, 2012). Specific psychophysiological measures have been validated that index variation in attention and emotion as individuals are exposed to and mentally process media content (Potter & Bolls, 2012). Heart rate is a psychophysiological indicator of attention while skin conductance and facial EMG index the intensity and valence (positive/negative) of emotion respectively. Psychophysiological measures have previously provided insight into how emotional content in anti-drug and anti-tobacco is mentally processed (Leshner, Bolls, & Wise, 2012) The experiment reported here investigates how variation in the presence of negative, graphic content in highway safety video ads affects mental processing of the message and emerging message perceptions. The study includes the use of data obtained from heart rate, skin conductance, and facial EMG along with self-report ratings of message evoked narrative engagement, empathy, sympathy, and perceived message effectiveness to test how variation in negative graphic content within a message affects attention, emotion, and message perceptions. The theoretical and practical importance of this study for addressing the challenge of effectively presenting emotional content in health campaign messages will be discussed in the following paragraphs along with the theoretical model used to generate the hypotheses tested in this experiment.

The Challenge of Designing Effective Emotional Health Messages

Designing effective emotional content in health messages is a challenge. Effective content needs to not only be attention grabbing but also must evoke emotional responses and message perceptions that are likely to increase the likelihood of adopting message recommendations. Unfortunately, those tasked with producing health campaign messages are often also faced with limitations making the process of designing effective messages even more difficult. The organizations that are involved in a majority of health campaign work are often

non-profit or government agencies that typically do not have the large campaign budgets that are behind most commercial product advertising. Advertising research has established that emotional content in product advertising is often highly effective (see Poels and Dewitte 2006 for a recent review.) They typically have the full resources of for-profit advertising agencies backing them and providing extensive support for both message production and media placement. Achieving the desired persuasive objectives of a health campaign arguably means that, in an increasingly cluttered media environment, health messages have to capture attention and achieve similar levels of emotional impact as effective product advertising without the same amount of resources.

A second limitation producers of health campaigns have to overcome is limited access to research that delivers needed insight into designing effective emotional health messages. As mentioned above, such insight is best obtained through psychophysiological data reflecting real time mental processing of messages. The advertising industry has utilized this insight to create effective emotional messages through a research approach known as Neuromarketing. Neuromarketing utilizes psychophysiological data to provide specific insight into optimizing the emotionally persuasive impact of advertising. A growing percentage of television advertisements have been tested and refined using this approach including a large number of recent Super Bowl advertisements. Neuromarketing has not been extensively used to test and develop health campaign messages. This is not surprising given that companies that provide Neuromarketing research services charge a lot for their services leaving the nearly exclusive providers of this kind of research to be conducted by academic health communication researchers working at universities equipped with psychophysiological labs. Potter & Bolls (2012) note that the number of such labs is increasing but this kind of research is still lacking in the published health

communication literature. The majority of health communication research aimed at determining specific strategies for the development of effective messages, has not moved beyond collecting self-reported impressions of attitudes, emotions, memory, and persuasion. Thus, existing research falls short of providing the kind of insight into mental processing of health messages needed to help public health communicators strategically figure out the most effective way to use emotion in public health messages.

The challenges discussed above increase the practical importance of studies such as this. Ideally health communication researchers, working at academic institutions with psychophysiology labs, provide relatively low cost access to Neuromarketing type research to public health organizations. Such was the case with the study reported here that was conducted under contract with the Alaska Injury Prevention Center (www.alaskainjurypreventioncenter.org) in order to generate insights to optimize the emotional impact of highway safety videos targeting males aged 20-30. Cost effective Neuromarketing / Psychophysiological research, that specifically investigates how to design effective health messages – such as this study – have the potential to generate knowledge that can help health communicators maximize the persuasive impact of messages which in turn maximizes the value of campaign budgets, ultimately making health campaigns more cost effective - a desirable objective given the budget limitations discussed above.

The task of creating content that effectively presents the consequences of unhealthy behavior leading the targeted audience to mentally processes messages in a way that is likely to encourage healthier decisions is arguably one of the most challenging aspects of designing effective health messages. Recent research on emotional framing of consequences in health messages demonstrates a mixed range of effects for both positive and negative approaches.

Presentation of consequences of unhealthy behaviors in messages often takes the form of negatively graphic content featuring explicit visual portrayal of physical harm and/or intense emotional displays by characters in the messages. These are the types of emotional content investigated in this experiment. Previous research has investigated this kind of message content under the umbrella of research on fear/threat appeal. That body of research also demonstrates mixed effects of focusing emotional content while graphically presenting health threats in messages.This line of research has shown that the effects of negative graphic content in health messages can vary based on the presence of other message characteristics such as disgust related content (Leshner, Bolls, & Thomas, 20??) and efficacy (Lewis, Watson, & White, 2013). This study builds on that line of work by investigating how varying the overall presence of negative, graphic content depicting the consequences of unsafe driving behaviors affects mental processing of and responses to highway safety video ads. The presence of negative graphic content was manipulated using existing, professionally produced highway safety video ads available online to create three message conditions – low aversive, high aversive and switched aversive messages. The potential for generating insight into how targeted individuals mentally process and perceive health messages that vary in the overall presence of negative, graphic content depicting consequences of unhealthy behavior- a specific area of health communication lacking extensive knowledge- increases the theoretical value of this study. This study maximizes this theoretical value by addressing this topic from a theoretical perspective of emotional / motivational processes engaged by media use that has yet to be extensively applied in related health communication research. We now turn to a discussion of this theoretical perspective and the hypotheses and research question investigated in this experiment.

This study applies several theoretical models. First, it utilizes the limited capacity mediated message model, and second, Bandura's Social Cognitive Theory as it applies to mass communication. Albert Bandura, Social Cognitive Theory of Mass Communication, MediaPsychology, 3, 265-299 (2001) "Most of the models of health behavior are concerned only with predicting health habits. …social cognitive theory offers both predictors and principles on how to inform, enable, guide and motivate people to adapt habits that promote health and reduce those that impair it." P. 146 social cognitive theory posits that human behavior determinants include personal, behavioral and environmental influences. (266) The human capacity to reflect on one's thoughts is a key component to sct. Reflection includes "distinguishing between accurate and faulty thinking." (269) Cues in the personal analysis include comparing one's one thoughts with the perception of what others believe. That perception can come from media versions of reality. (Hawkins, R.P & and Pingree, S. (1982) Television's Influence on social reality. In D. Pearl,L. Bouthilet, & J. Lazar (eds.) Television and behavior: Ten Years of scientific progress and implications for the eighties (Vol. II, pp. 224-247). Rockville, MD: National Institute of Mental Health. Behavioral motivation can come from personal as well as vicarious experiences. Early psychological theories were developed before development of electronic communication. Now, our constructs of what is socially normal is in part derived from exposure to media. Media can provide vicarious behavioral motivation by exposing individuals to outcome expectancies, both positive and negative. "What gives significance to vicarious influence is that observers can acquire lasting attitudes, emotional reactions and behavioral proclivities toward personas, places or things that have been associated with modeled emotional experiences. They learn to fear things that frightened models, to dislike what repulsed them, and to like what gratified them."(281)

Human Emotion and Processing Emotional Health Messages

Bolls, Wise and Bradley (in press), proposed that Embodied Motivated Cognition (EMC) is a useful theoretical framework for studying cognitive and emotional processing engaged during advertising exposure. This is the general theoretical framework used in this study as it provides the means for rigorously conceptualizing both characteristics of emotional message content, as well as the nature of human emotion. First and foremost this model respects the extensive interconnection of emotion and cognition as revealed by recent research in cognitive neuroscience (Duncan and Barrett 2007). Research in cognitive neuroscience demonstrates that both the anatomy and functioning of human emotion and cognition is fundamentally grounded in neuronal connections between areas of the brain believed to be primarily involved in emotion and areas believed to be primarily involved in cognition (Tucker, Derryberry and Luu 2000). The EMC framework reflects this interconnection of emotion and cognition under the concept of motivated cognition.

The motivated cognition perspective expresses the theoretical claim that the amount of attention paid to any stimulus in our environment is modulated by the emotional/motivational significance of perceived information (P. Lang, Bradley and Cuthbert 1997). Mental processes involved in motivated cognition are believed to be completely embodied in the human brain, thus yielding the notion of "embodied" motivated cognition (Berntson and Cacioppo 2008). Viewing processing of emotional health messages through the lens of the EMC framework enables researchers to validly index, in real time, cognitive and emotional processes evoked during exposure to such ads, because mental processes engaged by advertising exposure are believed to be reflected in the moment-by-moment physical functioning of the human brain, which can be

indexed through reliable psychophysiological measures (Potter and Bolls 2012). Doing so, however, requires an understanding of the human emotional system embodied in the brain.

The embodied motivated cognition framework is theoretically grounded in a dimensional conceptualization of human emotion. The dimensional theory of human emotion conceptualizes emotion as consisting of affective experience that is categorized along the dimensions of arousal and valence (Bradley and Lang 2007). Arousal refers to the intensity of emotional experience while valence describes the tone—pleasant and unpleasant—of emotion (P. Lang 1995). The most recent version of the dimensional theory of emotion proposes that the valence of emotional experience emerges from the activity of two independent motivational systems, referred to as the appetitive and aversive systems (P. Lang and Bradley 2008). The aversive system is primarily activated by unpleasant stimuli and ultimately produces affective responses related to defensive withdrawal from environmental stimuli, while the appetitive system is generally activated by pleasant stimuli and is involved in executing approach related responses (Cacioppo and Gardner 1999). Arousal, rather than being conceptualized as an independent dimension of human emotion, has come to be viewed as simply the intensity of input into the appetitive and aversive motivational systems, referred to as motivational activation (P. Lang and Bradley 2008). Under this perspective, emotion and motivation are for all intents and purposes the same concept reflecting the ongoing operation of motivational systems embodied in the brain as we process meaningful stimuli (P. Lang and Bradley 2010). Specific emotions or feelings, such as those proposed under a discrete emotion theory (see Nabi 2010), are proposed to emerge from the appraisal of patterns of motivational activation evoked by relevant stimuli (Bolls 2010). The dimensional theory of emotion has recently been explicitly applied to the study of emotional experience evoked by exposure to television advertising (Morris et al. 2009).

Annie Lang's limited capacity model of motivated mediated message processing (LC4MP) is a specific theoretical model that has emerged from the more general embodied motivated cognition framework (A. Lang, 2009). This model can be used to generate testable hypotheses about how individuals mentally process media messages—such as highway safety video ads like those used in this study. It has recently been applied to the study of mental processing of emotional media messages (Bradley, Angelini and Lee 2007; Leshner, Bolls and Wise 2011; Potter et al. 2006). The LC4MP conceptualizes media content as a stream of sensory experience that varies along the dimensions of appetitive and aversive motivational activation according to the presence and intensity of appetitively (pleasant) and aversively (unpleasant) valent stimuli in the content. It goes on to propose that mental processing of mediated messages consists of embodied activation of the appetitive and aversive emotional/motivational systems in the brain. Thus, the general notions of "appetitive" and "aversive" can be used to conceptualize both dimensions of human emotional experience as well as categories of emotional health message content.This study utilizes the LC4MP to specifically conceptualize variation in the presence and intensity of graphically negative message content in highway safety video ads as reflecting variation in aversive emotional message tone. The validity of conceptualizing emotional media content in this manner has been demonstrated in other experiments incorporating this approach to conceptualizing and manipulating emotional message tone (Lee and Lang 2009; A. Lang et al. 2007; Potter et al. 2006).

The instant-by-instant unfolding of mental processes described by the Embodied Motivated Cognition perspective and Lang's LC4MP model are the mental processes evoked during exposure to emotional health messages that lay the foundation for message outcomes related to perceptions and behavior. It seems likely that the presence and timing of

negative/aversive emotional message content will significantly affect these processes and message responses. Previous research on anti-tobacco messages has demonstrated that when the intensity of aversive motivational activation evoked by emotionally aversive message content gets too high, it can trigger a defensive cascade in the viewer causing them to withdraw cognitive resources from encoding the message (Leshner, Bolls and Thomas 2009; Leshner, Bolls and Wise, 2011). What this means, essentially, is that the viewer stops paying attention to a message that is emotionally too intense. Thus, investigating how aversively graphic health message content engages embodied motivated processing comes down to a consideration of the likelihood of defensive responses being evoked in the targeted audience. The embodied defensive response can be validly observed through psychophysiological measures indexing human nervous system activity connected to mentally processing environmental stimuli, like media messages (Bradley and Lang 2007).

The likelihood that a particular execution of aversively graphic emotional health message content engages defensive responding should theoretically depend on the development of emotional networks in the brains of the targeted audience. This has recently been demonstrated in an experiment on the presence of threatening images in substance abuse video messages in which adolescents were found to engage in significantly more intense embodied motivated processing of substance abuse messages compared to young adults (Bolls, Miles and Zhang 2006). As embodied motivated processing becomes more aversively intense, it becomes increasingly likely that the defensive cascade will begin to unfold, manifested in a gradual withdrawal from an aversive stimulus (Bradley and Lang 2007). The general intensity of emotional experience has been theorized to depend on the development of cortical pathways in the brain involved in the regulation of emotional experience (Goldsmith, Pollack and Davidson

2008). These neural pathways constructed from connections between frontal cortex and the limbic system do not become fully developed until young adulthood (in the twenties) and downregulate the intensity of emotional experience (Perlman and Pelphrey 2011). Emotion regulation embodied in these pathways could make viewing aversively graphic message content a less intense emotional experience. Thus, for individuals with mature neural pathways involved in down-regulating the intensity of emotion, embodied motivated processing of emotional health messages seems less likely to reach a level of intensity that would lead to strong defensive responding to the message. The three executions of aversively graphic health message content manipulated in this experiment were low aversive content, consistently high aversive content, and switched low to high aversive content. Given that the presence of graphic content ought to increase motivational activation, the experience of negative emotional valence and cognitive resources allocated to encoding a message, it is proposed here that messages with consistently high, as well as switched low to high, aversive content will engage higher levels of motivational activation, a stronger experience of negative emotional valence, and increased cognitive resources allocated to encoding compared to low aversive messages. Further, across time processing of aversive message content ought to result in a sharp increase in motivational activation, experience of negative emotional valence, and a significant increase in cognitive resources allocated to encoding part way through the message during exposure to messages in which there is a sudden switch from low to high aversive content.

Motivational activation, as evidenced by arousal can be indexed through galvanic skin conductance level, the embodied experience of negative emotional valence can be recorded through facial EMG indexing activity in the corrugator muscle region, and cognitive resources allocated to encoding can be measured by recording change in heart rate during exposure to

mediated messages (Potter and Bolls 2012). Higher levels of skin conductance recorded during exposure to messages reflects increased motivational activation, or sympathetic arousal, higher levels of corrugator facial EMG activity indicates a stronger experience of negative emotional valence, and greater cardiac deceleration across exposure to a message indicates increased cognitive resources allocated to encoding. This leads to the hypotheses tested in this study:

> H1: There will be a significant aversive message content X time interaction on skin conductance level, such that the consistent presence of aversive message content as well the sudden introduction of aversive content partway through the message, will evoke significantly higher levels of skin conductance across time compared to low aversive message content.
>
> H2: There will be a significant aversive message content X time interaction on corrugator facial EMG activity, such that the consistent presence of aversive message content as well the sudden introduction of aversive content partway through the message, will evoke significantly higher levels of corrugator activity across time compared to low aversive message content.
>
> H3: There will be a significant aversive message content X time interaction on heart rate change from baseline, such that the consistent presence of aversive message content as well the sudden introduction of aversive content partway through the message, will result in significantly greater cardiac deceleration across time compared to low aversive message content.

Incorporating meaningful self-report measures of psychological states emerging from embodied motivated processing of media messages in experimental research significantly

increases knowledge of how the mind processes specific kinds of messages (Potter and Bolls 2012). This is clearly the case in advertising and health communication research where self-report measures are extensively used to index responses believed to be related to persuasion. The second part of the general research question for this study focuses on the relationship between the embodied motivated processing of graphic content in health messages and emerging message perceptions. Thus, several message perceptions theorized to be involved in determining the ultimate effectiveness of health messages are indexed here—felt empathy, sympathy, narrative engagement, and perceived message effectiveness. While there is advertising research that examines each of these message perceptions, there is little theoretically driven research that can be used to guide specific hypotheses related to these message perceptions for this experiment. Thus, in this experiment the impact of the three types of aversive message content studied on these message perceptions is tested, and relationships with embodied motivated processing of these health messages are considered.

Methodology

Participants and experimental design

This study was sponsored by the Alaska Injury Prevention Center, who chose the demographic the study would focus on—males aged 20-30—based on traffic safety statistics indicating this demographic has a particularly high risk for engaging in unsafe driving. Seventy-five participants were recruited from a large Midwestern University community. The experiment employed a 3 (aversive message content: low-aversive, high-aversive, switched low to high-aversive) X 3 (message) X 4 (order) mixed model repeated measures design. Aversive message

content was a within subjects factor and message was a repeated factor representing the three videos included in each type of aversive message content. Participants were randomly assigned to view the nine stimulus videos in one of four orders. The four order conditions were organized randomly without placing videos in the same spot or sequential order more than once.

Independent Variable

Aversive message content was conceptualized as negatively graphic visual scenes depicting the consequences of unsafe driving behaviors. The presence and timing of negatively graphic visual scenes was varied to create the three levels of aversive message content. This was accomplished by pretesting a pool of 23 traffic safety videos obtained online, by having a sample of 34 males, in the same age group as experiment participants, continuously rate the videos along the dimensions of unpleasantness, pleasantness, and arousal. These pretest ratings provided a continuous mapping of the intensity and timing of aversive message content. Based on this mapping, stimulus messages were chosen that featured low levels of aversive content throughout the message, consistently high levels of aversive message content throughout the message, and a switch from low to high levels of aversive content partway through the message.

Dependent Variables

Motivational activation was conceptualized as the intensity of evoked sympathetic arousal during exposure to the messages. This dependent variable was indexed by recording participants' galvanic skin conductance level for a 5 second baseline period prior to the onset of each message, as well as time locked to message exposure. Skin conductance was recorded utilizing a bipolar placement of 8mm AG/AGCL disposable electrodes on the palmer surface of the left hand.

Negative emotional experience was defined as variation in emotional responding in the negative valence dimension of emotion. It was indexed by recording the facial EMG signal obtained from the corrugator facial muscle region. The facial EMG signal was filtered and amplified during recording for a 5 second baseline period prior to the onset of each message, as well as time locked to message exposure. This was done utilizing a bipolar placement of 4mm AG/AGCL disposable electrodes over the corrugator muscle region.

Cognitive resources allocated to encoding were conceptualized as mental effort invested in forming a short term working memory representation of information contained in the videos. This was measured by obtaining an ECG on experiment participants recording heart rate as the length and time between R spikes in the QRS complex of the ECG waveform. Heart rate was recorded for a 5 second baseline period prior to the onset of each message, as well as time locked to message exposure. The signal was obtained by utilizing a Lead I placement of 8mm AG/AGCL disposable electrodes on the left and right forearms and left wrist.

Message perception variables were indexed through existing self-report scales of empathy, sympathy, narrative engagement and perceived message effectiveness. The exact items making up these skills are displayed in Table 1.

Procedure

This experiment was completed in a media psychophysiology lab located at a large Midwestern University. Participants completed the experiment one at a time seated in a comfortable reclining chair positioned approximately 5 feet from an LCD monitor. The researcher welcomed participants and prepped them for the collection of the psychophysiological measures, which involved having participants wash their hands, the researcher wiping down

electrode sites for facial EMG and heart rate with rubbing alcohol, and then gently abrading the sites using an abrasive skin prep pad. After placing all electrodes, the researcher checked the impedance levels of the facial EMG recording cites to note whether or not adequately low levels of electrical impedance were obtained for validly recording muscle activity from the corrugator facial muscle region. Each participant then viewed a two-minute nature clip allowing them to relax and electrode waveforms to be tested for signal clarity. After this clip, participants viewed the nine traffic safety videos, completing the self-report measures in between each video. After completing the self-report measures for the last video, participants received $40 compensation, then were thanked and dismissed.

The physiological data were cleaned for movement artifact, outliers, and non-responders. This resulted in the loss of data from nine participants; therefore statistical analysis was performed on a total of 41 participants. Change scores for each psychophysiological measure were computed by subtracting physiological activity recorded during the last a second of the baseline period for each video from each second of physiological activity recorded during message exposure. The hypotheses for this experiment were tested by submitting the change scores obtained from each of the psychophysiological measures to a 3 (aversive message content) X 3 (message) X 30 (time) repeated measures ANOVA. The videos shown in this experiment were not of equal length. The shortest video was 30 seconds long while the longest was over one minute. Thus the precise time interval for each point in time in the statistical analysis was not equal. Psychophysiological data obtained during exposure to messages longer than 30 seconds, was averaged over longer than one second intervals in order to generate 30 data points across time for each video. The time interval reflected in the 30 data points representing the time factor in this analysis ranged from one to three seconds. This time range should still be

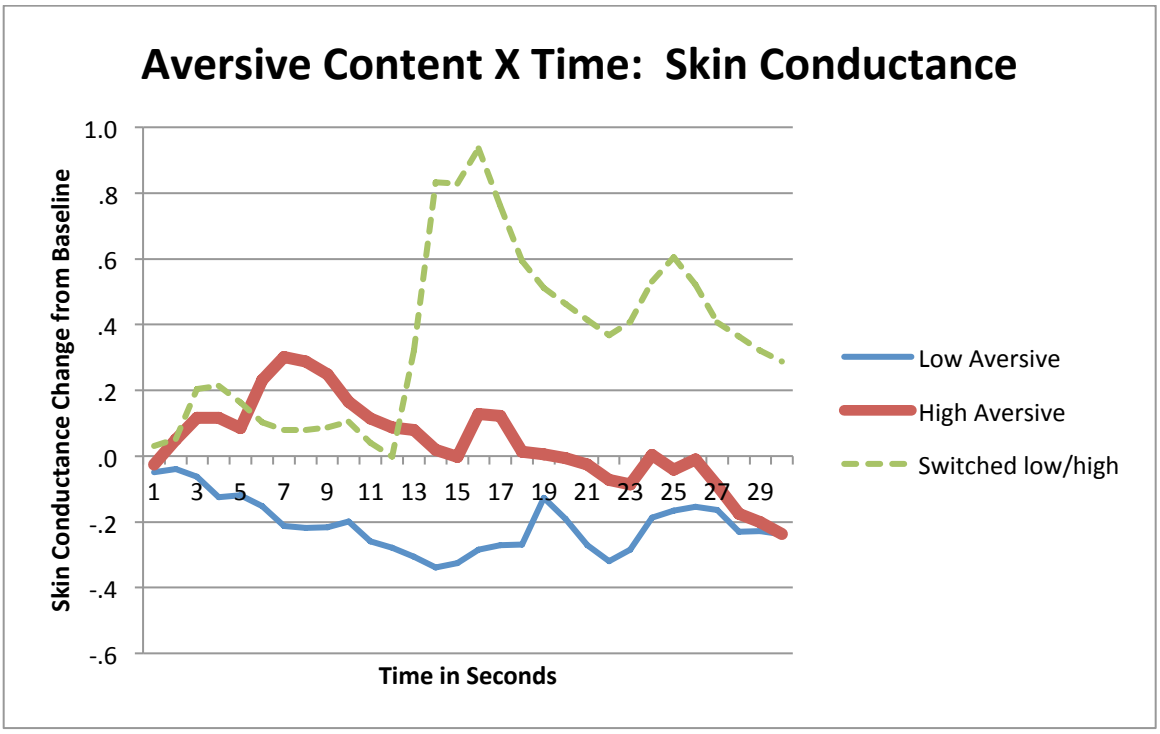
valid for recording meaningful variation across time in embodied motivated processing of the videos in this experiment. Data from the self-report scales completed during this study was submitted to a 3 (aversive message content) X 3 (message) repeated measures ANOVA.

Results

Data Analysis

Hypothesis 1

This hypothesis predicted that there would be a significant aversive message content X time interaction on skin conductance level such that consistently high as well as switched low to high aversive message content in highway safety videos would evoke higher levels of skin conductance across message exposure compared to low aversive message content. There was a significant main effect of aversive message content on skin conductance ($F(1.762, 130,367) = 25.574$, $p=.000$ partial eta-squared = .257). The means for low aversive, high aversive and switched aversive were -.209 (.083), .040 (.079), and .354 (.074), respectively. A pairwise comparison revealed that all means are significantly different than each other ($p<.05$) There was also a significant ad type X time interaction ($F5.436, 402.257) = 17.368$, $p=.000$ partial eta-squared = .190). This interaction is depicted in figure 1 below.

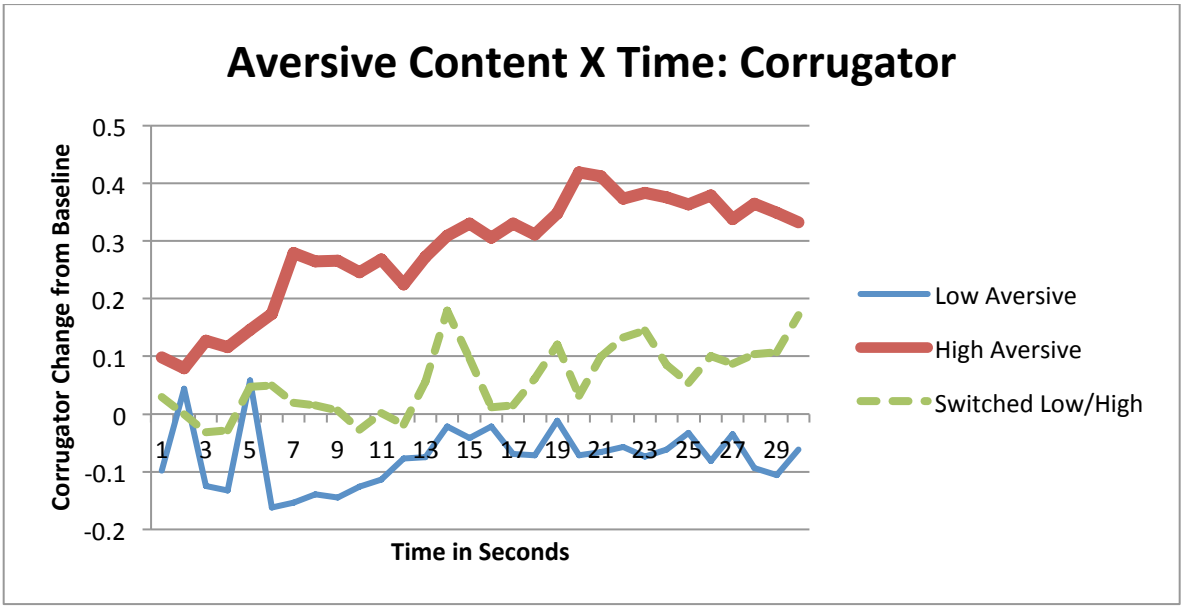


As depicted in figure 1, skin conductance level across time for the majority of message exposure is higher for high aversive and switched aversive message content with a particularly noticeable jump in skin conductance level part way through these switched aversive content messages, as would be expected when a switch in the aversive message content occurs. There is a significant drop in skin conductance level toward the end of exposure to high aversive message content. The psychological meaning of this is something future research will need to explore. Nonetheless the general pattern of results obtained support hypothesis one.

Hypothesis 2

Hypothesis 2 predicted a significant aversive message content X time interaction such that the two kinds of messages used in this experiment containing aversive message content would result in higher levels of corrugator facial muscle activity compared to low aversive

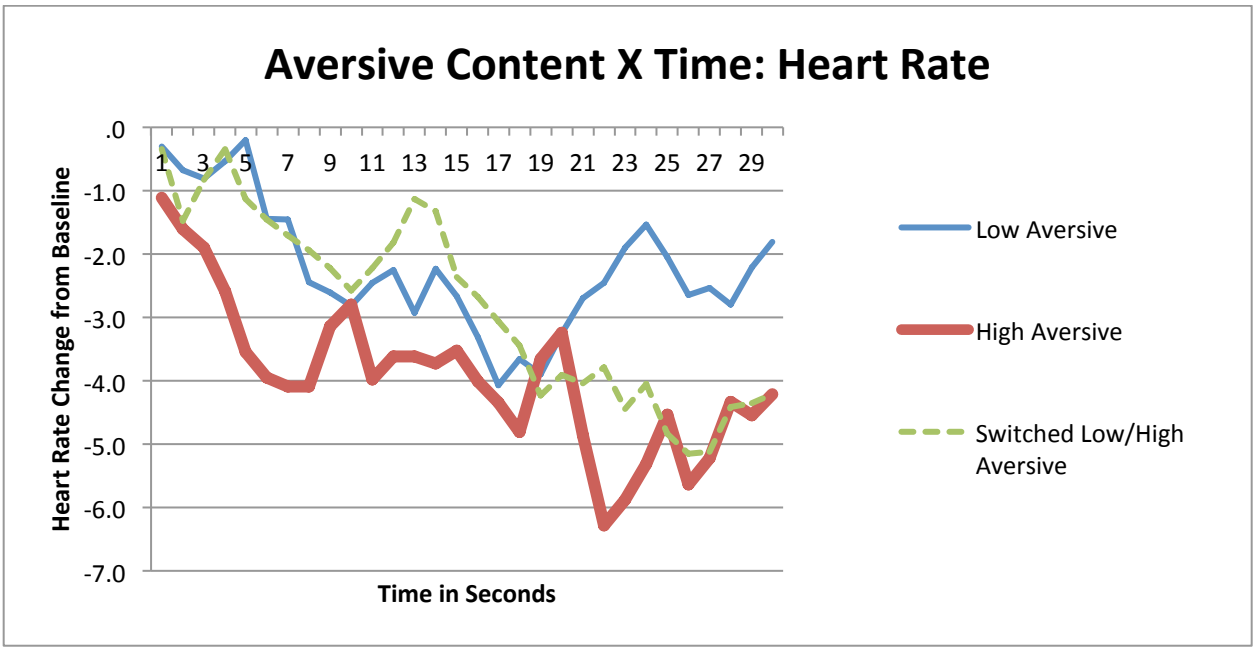
message content. There was a main effect of ad type on corrugator activity (F(1.704,126.100) = 8.407, p=.001 partial eta-squared = .102). The means for low aversive, high aversive, and switched aversive were -.074 (.097), .286 (.072), and .057 (.050), respectively. The difference between low aversive and high aversive message types was calculated to be significant utilizing a pairwise comparison test (p<.05). Switched aversive and the two other message types were not significantly different from each other. The ad type X time interaction approached statistical significance (F(4.966,367.519) = 1.934, p=.088 partial eta-squared = .025). This interaction is displayed below in figure 2.



As figure 2 shows, the highway safety videos featuring aversive content both consistently throughout the message as well as in a switch from low to high aversiveness evoked consistently higher levels of corrugator facial muscle activity across the majority of the message compared to low aversive messages. This pattern of results supports hypothesis two.

Hypothesis 3

The final hypothesis predicted a significant aversive message content X time interaction such that highway safety videos featuring consistently high aversive content and videos featuring switched low to high aversive content would evoke a stronger pattern of cardiac deceleration across message exposure. There was a significant main effect of ad type on heart rate ($F(1.862,128.456) = 4.416$, $p=.016$ partial eta-squared = .060). The means for low aversive, high aversive, and switched aversive were -2.221 (.484), -3.936 (.454), and -2.819 (.505), respectively. Averaged cardiac deceleration for high aversive messages was determined to be significantly greater, by a pairwise comparison, compared to the other two types of aversive message content ($p<.05$). The difference in cardiac deceleration between low and switched aversive content messages was not statistically significant. There was also a significant ad type X time interaction ($F(23.774,1640.422) = 7.212$, $p=.000$ partial eta-squared = .095. This interaction is shown below in figure 3.



As figure 3 depicts, cardiac deceleration across time is generally more consistent during exposure to messages that feature consistently aversive content. There is brief cardiac acceleration during exposure to messages that switch from low to high aversive content followed by a strong pattern of cardiac deceleration. This indicates a possible brief defensive withdrawal of cognitive resources from encoding the message at the point the highly aversive content is introduced. However, this defensive response, as predicted for males aged 20-30, does not appear to lead to a continued withdrawal of cognitive resources from processing the message. This pattern of results offers support for the hypothesis predicting males, aged 20-30, will allocate more cognitive resources to encoding high aversive compared to low aversive message content.

Research Question

The second portion of the research question investigated in this experiment was posed to explore the impact of aversive message content in highway safety videos on message perceptions. Here, statistical analysis of the main effect of aversive message content on each of the message perception variables indexed in this study—empathy, sympathy, narrative engagement, and perceived message effectiveness—is presented. The purpose of proposing this research question was to explore possible relationships between embodied motivated processing of the videos and message perceptions. This portion of analysis of the research question is limited to a theoretical consideration and therefore is reserved for the discussion section of this paper.

Narrative Engagement

There was a main effect of aversive message content on narrative engagement, $F(1.805,133.597) = 220.023$, $p=.000$, explaining 74.8 percent of the variance in this measure. All levels of aversive message content were found to be significantly different from each other, utilizing a pairwise comparison, in terms of evoking narrative engagement ($p<.05$). The means for low aversive, high aversive, and switched aversive were 4.812(.093), 7.085(.106), and 6.775(.123), respectively.

Empathy and Sympathy

There was a main effect of aversive message content on empathy, $F(2,148,000) = 74.366$, $p=.000$, explaining 50.1 percent of the variance in this measure. Low aversive was found, through a pairwise comparison, to be significantly different than all other ad types for empathy ($p<.05$). High aversive and switched aversive were not significantly different from each other. The means for low aversive, high aversive, and switched aversive were 3.496(.167), 5.114(.224) and 5.267(.212), respectively.

There was a main effect of aversive message content on sympathy, $F(1.684,124.584) = 52.764$, $p=.000$, explaining 41.6 percent of the variance in this measure. Low aversive was found, by a pairwise comparison, to be significantly different than all other ad types for sympathy ($p<.05$). High aversive and switched aversive were not significantly different from each other. The means for low aversive, high aversive, and switched aversive were 5.541(.157), 6.770(.142), and 6.800(.152), respectively.

Perceived Effectiveness

Perceived message effectiveness was measured separately for perceived effectiveness for drivers similar to the experiment participants and for drivers perceived to be different than the

participants. There was a main effect of aversive message content on perceived effectiveness for drivers similar to participants, $F(1.791,132.545) = 269.021$, $p=.000$, explaining 78.4 percent of the variance in this measure. Pairwise comparison analysis showed that all message groups were found to be significantly different from each other for this indicator of perceived effectiveness ($p<.05$). The means for low aversive, high aversive, and switched aversive were 4.875(.155), 7.509(.153), and 7,084(.179), respectively.

Discussion

This study was designed to help health communication professionals by providing insight into how variation in the existence and placement of emotional content presented in traffic safety video ads affects mental processing of the message and emerging message perceptions. Three physiological measures: skin conductance, heart rate, and corrugator activity, were used to measure instant-by-instant flow of attention, emotion and arousal during exposure to health messages. These measures were coupled with self-reports of narrative engagement, empathy, sympathy, and perceived effectiveness, They represent a conscious appraisal of psychological states, as reported by the participants after viewing the message. Self-report results add a richness to the physiological data by describing the conscious experience and perception of the effectiveness of the message.

The general hypothesis tested in this study that, highway safety videos featuring consistently high aversive message content and videos featuring a significant switch from low to high aversive content are more motivationally relevant, compared to messages with low aversive content was supported. This is evident in the significant message content X time interactions found for all three psychophysiological measures obtained in this experiment for the highly

aversive message category. It is particularly interesting to note that, as theorized, despite the fact that aversive message content significantly increases motivational activation and a negative emotional experience, it does not appear to begin to push the males studied here into the beginnings of the defensive cascade. To the contrary, aversive message content was found to significantly increase cognitive resources allocated to encoding the message, which could be supportive of further engagement with rather than withdrawal from the message.

It was expected that the switched videos would not have significantly different mean scores from the other two types as they are part high aversive and part low aversive, balancing the mean scores. It is relevant to observe, in the switched videos, that shortly after the switch from low to high aversive content appears, arousal picks up and heart rate drops. This physiological pattern shows an increase in arousal gained by the switch as well as renewed attention and encoding.

The allocation of cognitive resources allocated to encoding the highly aversive and switched aversive videos appears to lead to an emerging message perception of being engaged by a perceived story in the message. Both the high and switched videos scored significantly higher in all self-report measures than the low aversive ones.

An additional interesting relationship between message perceptions and motivated processing of the videos shown in this experiment can be seen by jointly considering the skin conductance and facial EMG results with the self reported effects of aversive message content on empathy and sympathy. The more intense arousal and negative emotional experience evoked during exposure to highly aversive message content, evidenced by skin conductance and corrugator muscle activity data, led to higher levels of both self-reported empathy and sympathy.

It is interesting to note that reported levels of sympathy for this demographic were slightly higher than reported empathy.

Arguably the most practically important relationship is to be found in considering results obtained through the psychophysiological measures along with self-reported perceived message effectiveness. Specifically, for the study participants, the videos featuring consistently high aversive message content and switched content, were more likely to lead to an emerging message perception that the video is effective at persuading drivers like themselves to practice safer driving behaviors.

The results obtained from this study imply that for the advertising context of attempting to persuade males aged 20-30 to practice safer driving behaviors through exposure to video ads, highly aversive content and switched content appear to be effective message designs. On a practical level, the research suggests that message developers targeting this demographic should not hesitate to produce highway safety videos that, in a highly aversive, negatively graphic manner, present the consequences of unsafe driving practices.

As with all studies, certain limitations do exist within this study. To begin with, information on whether or not the participants were able to recall and/or recognize the message was not obtained. Collecting this data would allow scholars to see if the highly aversive content actually does directly impact memory processes as an additional indicator of message effectiveness. This study showed that more resources were allocated to encoding highly aversive messages, but it is undetermined if it is actually encoding the message or other characteristic of the advertisement. The fact that this study was run on a college campus is a second limitation. This skewed the average age of participants to the lower twenties. Therefore, it is possible that

generalizing across the entire 20-30 age-range may not result in a valid assessment, and the results of this study may be more applicable to the younger end of this age demographic. A third limitation includes the degree of graphic content within the ad messages. There are a number of public health ads related to driving safety in existence that are substantially more graphic than the ads chosen for the purposes of this study. An example of this would be the 2009 public safety ad created and released by the Gwent police force in the United Kingdom as part of a new campaign directed at high school students. This ad was widely circulated across the globe due to its highly graphic content, which is considerably more graphic than any of the videos shown in this particular study. It is possible that a defensive cascade could be triggered in ads considerably more graphic than the ones shown here. However, considering the specific demographic and the unique brain development characteristics discussed earlier, it is not believed this would be the case.

Areas for future research emerging from results of this study include examining individual health issues and the role they play in motivated processing and message perceptions. It is possible that for certain health topics graphic images, such as those in the messages of this study, would not be practical for use outside the realm of traffic safety. Further research on the use of graphic images in messages trying to reduce dangerous behaviors, such as drug and alcohol abuse and sexual health and behavior, as opposed to the use of graphic images in preventative and educational health messages, would provide further insight into the use of graphic images as a persuasive technique. Finally, insight could be gained by looking at this topic through different demographics. Age as well as gender could play a crucial role in how graphic images are perceived and encoded.

This study has shown the use of graphic images in traffic safety messages for the demographic of males aged 20-30 is directly related to emotivated processing of the message as well as emerging message perceptions. What this shows is that when developing these messages for this particular demographic, aversive images are effective. The earlier the onset of aversive images and the more aversive those images are in a traffic safety message, the more resources are allocated to encoding that message. This study has theoretical as well as practical implications and gives researchers further insight into the interaction of emotion and brain development when processing persuasive health messages.

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Tables and Figures

Table 1: Items constructing message perception scales

Scale Items (all items placed on nine point scales)

Narrative Engagement Scale
For the following items please indicate the extent to which you agree or disagree with the following statements.
There is a plot in the video
The video tells a story about highway safety
I felt sorry for some of the characters in the video
At points, I had a hard time making sense of what was going on in the video
During the video, my body was in the room but my mind was inside the world created by the video
I had a hard time keeping my mind on the video

Empathy Scale
For the video you just saw, please rate how descriptive each of the following statements is of how you personally reacted to this video.
While watching the video I felt as though I were one of the characters
While watching the video, I experienced many of the same feelings that the characters seemed to feel
While watching the video I experienced feeling as if the events were really happening to me

Sympathy Scale
For the video you just saw, please rate how descriptive each of the following statements is of how you personally reacted to this video.
While watching the video, I tried to understand the events as they occurred
While watching the video, I tried to understand the characters' motivation
Based on what was happening in the video, I understood what the characters were feeling

Perceived Effectiveness
How effective do you think this video is at persuading drivers similar to yourself to practice safe driving behavior?
I think people different from me would find this video persuasive